REPORT

Reclamation and Closure Plan

Coffee Gold Mine

Submitted By:

Goldcorp Kaminak Ltd.
201-166 Titanium Way
Whitehorse, YT Y1A 0G1

November 24, 2025

REVISION TRACKING LOG

Revision Tracking Log			
Version	**Date**	**Section Updated**	**Description of Update**
0	November 2023	-	First submission of the Reclamation and Closure Plan
1	April 2024	General	Updated with responses to Type A WUL IR4; minor editorial corrections
2	November 2025	Various	Updated with responses to QML IR1 and Type A WUL IR9; updated cost basis (Closure Costs v6)

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS XIII

LIST OF SYMBOLS AND UNITS OF MEASURE XVI

1.0 INTRODUCTION 1

1.1 Project Summary 2

1.1.1 Project Schedule 6

1.1.2 Regulatory Context 8

1.2 Mine Closure Philosophy and RCP Guiding Principles 8

1.2.1 Newmont Internal Standards 11

1.2.2 Coffee Gold Mine Guiding Principles and Closure Philosophy 12

2.0 RECLAMATION AND CLOSURE PLANNING 13

2.1 Consultation and Engagement Activities 13

2.2 Sequences and Phases of Reclamation and Closure Planning 14

2.3 Designing and Operating for Closure 14

2.3.1 Reclamation Research 15

2.3.2 Progressive Reclamation 25

2.3.3 Minimizing Project Effects 26

2.3.4 Alternatives Assessment Overview 26

3.0 CLOSURE OBJECTIVES AND DESIGN CRITERIA 33

3.1 Reclamation and Closure Planning Approach 33

3.1.1 Post-mine Vision 33

3.1.2 Closure Principles 34

3.1.3 Project-specific Closure Objectives 36

3.1.4 Component-specific Closure Objectives 38

3.1.5 Water Quality Objectives 41

3.2 End Land Use Planning 43

3.3 Design Criteria 43

3.3.1 Project Component Design Criteria 44

3.3.2 Socio-economic Criteria 44

3.3.3 Quality Management 44

4.0 ENVIRONMENT AND SOCIOECONOMIC DESCRIPTIONS 47

4.1 Physical Environment 47

4.1.1 Weather and Climate 47

4.1.2 Seismic Conditions 59

4.1.3 Air Quality 61

4.1.4 Noise 62

4.1.5 Surficial Geology, Terrain, Soils, and Permafrost 62
4.1.6 Watercourses and Surface Hydrology 71
4.1.7 Surface Water Quality 76
4.1.8 Groundwater 92
4.2 Biophysical Environment 103
4.2.1 Aquatic Environment 103
4.2.2 Vegetation 105
4.2.3 Wildlife 109
4.2.4 Birds 112
4.3 Socio-economic Conditions 114
4.3.1 Demographics 114
4.3.2 Economic Conditions 117
4.3.3 Social Economy 119
4.3.4 Infrastructure and Services 120
4.3.5 Education Services 122
4.3.6 Land and Resource Use 122
4.3.7 Community Health and Well-Being 126
4.3.8 Heritage 128

5.0 PROJECT DESCRIPTION 129
5.1 Coffee Property History 129
5.2 Project Schedule 129
5.3 Project and Ancillary Components 133
5.3.1 Open Pits and Mining Activities 136
5.3.2 Alpha Waste Rock Storage Facility 145
5.3.3 Stockpiles 146
5.3.4 Ore Crushing Facilities 147
5.3.5 Heap Leach Facility 150
5.3.6 Plant Site 158
5.3.7 Camp Site 164
5.3.8 Camp Facilities 164
5.3.9 Bulk Explosive Storage Area 165
5.3.10 Land Treatment Facility 168
5.3.11 Mine Site and Haul Roads 168
5.3.12 Site Water Management Infrastructure 168
5.3.13 Ancillary Infrastructure 173
5.4 Current Conditions (Year -5) 178
5.5 Conditions Two-years Forward (Year -1) 178
5.5.1 Mine-Related Land Disturbance Two-Years Forward 182
5.6 End-of-mine Conditions (End of Year 9) 183

5.6.1 Mine-Related Land Disturbance at End of Mine (Year 9) 185
5.7 Monitoring Activities 186
5.7.1 Monitoring and Inspections of Mine Site and Supporting Infrastructure 186
5.7.2 Monitoring of Physical and Biophysical Environments 187
5.7.3 Monitoring of Socio-economic Conditions 187
5.8 Risk Assessment, Contingency Planning and Adaptive Management 187
5.8.1 Risk Assessment 187
5.8.2 Contingency Planning and Adaptive Management Approach 188

6.0 TEMPORARY CLOSURE 189

6.1 Temporary Closure Scenario Description 189
6.2 Personnel and Consumable Requirements 192
6.2.1 Personnel Requirements 192
6.2.2 Consumable Requirements 193
6.3 Site Security, Monitoring and Maintenance 194
6.3.1 Site Access Restrictions and Maintenance Requirements 194
6.3.2 Open Pit Access Restriction 195
6.3.3 Facility and Infrastructure Security and Hazardous Goods Storage 195
6.3.4 Vehicle and Equipment Use and Storage 196
6.4 Ensuring Geochemical and Physical Stability 196
6.4.1 Heap Leach Facility and ROM Stockpile 196
6.4.2 Alpha WRSF 197
6.4.3 Open Pits 197
6.4.4 Water Management Structures – Diversion Ditches, Alpha and Facility Pond 198
6.4.5 Organic and Frozen Soil Stockpiles 198
6.5 Interim Water and Solution Management 198
6.5.1 Open Pits 199
6.5.2 Heap Leach Facility 199
6.5.3 Facility and Alpha Ponds 200
6.6 Reporting and Monitoring Requirements 201
6.7 Socio-Economic and Community Engagement Aspects of Temporary Closure 205
6.7.1 Management of Socio-economic Aspects of Temporary Closure 205
6.7.2 Managing Community Perceptions through Engagement Focused on Temporary Closure Period 209
6.7.3 Community Commitments, Partnerships and Agreements 211
6.7.4 Community Investments 211
6.7.5 Community Partnerships and Agreements 211
6.7.6 Socio-economic Monitoring and Evaluation During Temporary Closure Period 211

7.0 FINAL RECLAMATION AND CLOSURE MEASURES 212
7.1 Open Pits 217
7.1.1 Pit Lakes and Water Quality Predictions 217
7.1.2 Surface Discharge from Pit Lakes 220
7.1.3 Groundwater Leakage from Pit Lakes 238
7.1.4 Closure Measures 239
7.1.5 Reclamation Activities 239
7.1.6 Remaining Issues and Investigations 239
7.2 Waste Rock Storage Facilities and Stockpiles 241
7.2.1 Alpha WRSF – Closure Measures 242
7.2.2 Stockpile Pads – General Closure Measures 244
7.2.3 Reclamation Activities 244
7.2.4 Remaining Issues and Investigations 244
7.3 Heap Leach Facility and Process Ponds 244
7.3.1 Heap Leach Pad Closure Measures 244
7.3.2 Heap Leach Facility Pond Closure Measures 247
7.3.3 Reclamation Activities 247
7.3.4 Remaining Issues and Investigations 248
7.4 Ore Crushing Facilities 250
7.4.1 Crusher System and Crushed Ore Stockpile Area Closure Measures 251
7.4.2 ROM Stockpile Area Closure Measures 251
7.4.3 Reclamation Activities 251
7.4.4 Remaining Issues and Investigations 251
7.5 Plant Site Closure Measures 252
7.5.1 Bulk Fuel and LNG Storage Areas 253
7.5.2 Reclamation Activities 253
7.5.3 Remaining Issues and Investigations 253
7.6 Camp Site Closure Measures 254
7.6.1 Reclamation Activities 254
7.6.2 Remaining Issues and Investigations 254
7.7 Site Water Management Infrastructure 254
7.7.1 Reclamation Activities 255
7.7.2 Remaining Issues and Investigations 255
7.8 Mine Site Roads and Other Components 256
7.8.1 Haul Roads and Mine Site Roads 256
7.8.2 NAR and On-site Access Road 256
7.8.3 Project Airstrip 262
7.8.4 Laydown Areas 262
7.8.5 Bulk Explosive Storage Area 262
7.9 Environmental Management 262

7.9.1 Air Quality and Dust 262
7.9.2 Spill Management 262
7.9.3 Hazardous Materials Management 263
7.9.4 Erosion and Sediment Control 263
7.9.5 Revegetation 264
7.9.6 Soil Salvage 264
7.10 Material Balance 264
7.10.1 Required Materials 265
7.10.2 Borrow Material and Locations 265
7.11 Maintenance, Monitoring and Reporting Activities 267
7.11.1 Meteorological Monitoring 269
7.11.2 Aquatic Conditions Monitoring 272
7.11.3 Wildlife Monitoring 284
7.11.4 Vegetation Monitoring 286
7.11.5 Fish and Aquatic Life Monitoring 290
7.11.6 Physical Inspections 303
7.11.7 Reporting 305
7.12 Socio-Economic Aspects of Permanent Closure 305
7.12.1 Education and Training Measures 305
7.12.2 Local Employment, Procurement, and Economic Measures 308
7.12.3 Community Infrastructure and Services Measures 313
7.12.4 Traditional Knowledge and Lands and Resource Use Measures 316
7.12.5 Community Health and Well-Being Measures 318
7.12.6 Heritage Resources 320
7.13 Performance Uncertainty and Risk Management 321

8.0 RECLAMATION AND CLOSURE SCHEDULE AND EXECUTION STRATEGY 322

8.1 Schedule Overview 322
8.2 Reclamation Execution Strategy 324
8.3 Equipment Fleet 325
8.4 Site Access and Haul Roads 326
8.5 Site Security 327
8.6 Site Infrastructure 327
8.6.1 Site Camp 327
8.6.2 Site Offices and Labs 327
8.6.3 Emergency Response Team Building 327
8.6.4 Bulk Fuel Storage 327
8.6.5 Waste Management 328
8.6.6 Maintenance Areas and Laydowns 328
8.6.7 Power Generation 328

8.7 Labour Requirements 328

9.0 RECLAMATION AND CLOSURE LIABILITY 330

9.1 Basis of Estimate 330

9.2 SRCE Model 330

9.3 Two Years Forward Liability Estimate 331

9.4 Life of Mine Liability Estimate 332

10.0 REFERENCES 334

LIST OF TABLES (WITHIN TEXT)

Table 1-1 Newmont Global Standards 11

Table 2-1 Summary of Closure Alternatives Evaluation 31

Table 3-1 Closure Principles 35

Table 3-2 Project-Specific Closure Objectives 36

Table 3-3 Component-Specific Closure Objectives and Closure Measures 39

Table 3-4 Summary of Proposed WQO for Halfway Creek, Latte Creek, and YT-24 42

Table 4-1 Summary of Measured Precipitation Data for the Km 11 Climate Station (July 2012 – June 2019) 52

Table 4-2 Summary of Measured Precipitation Data for the Kona Climate Station (October 2018 – October 2021) 54

Table 4-3 Estimated Summer Rainfall Depths at 1,300 m Elevation for Various Intervals and Return Periods based on Historical Conditions 55

Table 4-4 Estimated Maximum Snow Pack (Snow Water Equivalent, or SWE) at 1,300 m Elevation for Various Return Periods 56

Table 4-5 Potential Evaporation Estimates for the Coffee Gold Project based on Data Collected at the Km 11 and Kona Climate Stations 57

Table 4-6 Summary of Probabilistic Seismic Hazard Results 61

Table 4-7 Ambient Particulate Matter Concentrations Based on Monitoring in 2015 (µg/m^3) 61

Table 4-8 Summary of Soil Nutrient Characteristics from Coffee Proposed Heap Leach Facility Area 70

Table 4-9 Annual Precipitation and Average Annual Runoff Recurrence Interval Estimates 73

Table 4-10 Instantaneous Peak Yield Recurrence Interval Estimates for Project Basins Derived from Regional Analysis (L/s/km^2) 74

Table 4-11 June – September Minimum 7-day Low Flow Recurrence Interval Estimates for Regional Stations. Values are Unit Yields (L/s/km^2) 75

Table 4-12 Summary of Monthly Mean Values for Water Quality in Latte Creek 79

Table 4-13 Summary of Mean Monthly Values for Water Quality in Coffee Creek 82

Table 4-14 Summary of Monthly Mean Values for Water Quality in Halfway Creek 85

Table 4-15 Summary of Monthly Mean Values for Water Quality in Yukon Tributary (YT-24) 87

Table 4-16 Summary of Mean Monthly Values for Water Quality in Independence Creek 89

Table 4-17 Summary of Mean Monthly Values for Water Quality in Yukon River 91
Table 4-18 Ranges of Selected Dissolved Metals of Concern Measured in Groundwater Screening Overburden, Breccia, and Schist 101
Table 4-19 Ranges of Selected Dissolved Metals of Concern Measured in Groundwater Screening Granite and Gneiss 102
Table 4-20 Summary of Local Populations, 2021 115
Table 4-21 Summary of First Nation Registered Members 116
Table 4-22 Summary of Average Income Among Local Populations 118
Table 4-23 Traditional Land and Resource Use Activities 124
Table 5-1 Closure and Monitoring Activities Planned during the Operation, Closure, and Post-closure Phases 132
Table 5-2 Open Pit Dimensions and Life of Mine Quantities of Contained Mineralized Material and Waste Rock 136
Table 5-3 Summary of LOM Production Schedule by Year 137
Table 5-4 Estimated Annual Waste Allocations by Destination 145
Table 5-5 Heap Leach Facility Key Operating Parameters 152
Table 5-6 HLP Stacking Metrics by Stage 153
Table 5-7 Early and Late Phase HLF Solution Chemistry Estimates 156
Table 5-8 Summary of Key Activities and Infrastructure in Place in Year -1 181
Table 5-9 Mine-Related Land Disturbance Two-Years Forward (Year -1) 182
Table 5-10 Mine-Related Disturbance Areas at End of Mine Life (Year 9) 185
Table 6-1 Personnel Required for Temporary Closure Period 193
Table 6-2 Estimated Annual Power and Fuel Requirements 194
Table 6-3 Temporary Closure Monitoring and Surveillance Activity Details by Mine Component 203
Table 6-4 Management of Socio-economic Aspects of Temporary Closure 206
Table 6-5 Engagement to Disseminate Temporary Closure Information 210
Table 7-1 Water Volume Capacity, Spill Elevation, and Predicted Spill Date for Pits Post-Mining 220
Table 7-2 Latte East Pit Lake Surface Discharge Rates (L/s) 222
Table 7-3 SU1 and SU1W Pit Lake Surface Discharge Rates (L/s) 224
Table 7-4 SU2W Pit Surface Discharge Rates (L/s) 226
Table 7-5 SU3W and SU3 Pit Lake Surface Discharge Rates (L/s) 229
Table 7-6 SU4E and SU4W Pit Lake Surface Discharge Rates (L/s) 232
Table 7-7 SU5 Pit Lake Surface Discharge Rates (L/s) 234
Table 7-8 Backfilled Double Double Pit Surface Discharge Rates (L/s) 236
Table 7-9 Backfilled Kona Pit Surface Discharge Rates (L/s) 237
Table 7-10 Predicted Groundwater Leakage Rates from Pit Lakes to Receiving Catchments 238
Table 7-11 Alpha Waste Rock Storage Facility Basal Seepage Rates (L/s) 243
Table 7-12 Comparison of Upper Case Late Phase HLF Solution Prediction to Back-Calculated Allowable Concentration in PTS Discharge 248

Table 7-13 Reclamation Material Volume by Location and Type 266
Table 7-14 Meteorological Monitoring Station Locations 270
Table 7-15 Summary of Mine Site and Receiving Environment Surface Water Hydrology and Quality Monitoring Stations, Monitoring Parameters, and Frequency 274
Table 7-16 Analytical Parameter List and Reportable Detection Limits 278
Table 7-17 Groundwater Monitoring Well, Thermistor and Vibrating Wire Stations and Monitoring Frequency 282
Table 7-18 Overview of Wildlife Observation Monitoring Program 285
Table 7-19 Overview of Project-related Wildlife Mortality Monitoring Program 285
Table 7-20 Overview of Habitat Loss/Habitat Reclaimed Monitoring Program 286
Table 7-21 Overview of Invasive Plant Monitoring 288
Table 7-22: Overview of Fish Community, Condition and Habitat Monitoring 291
Table 7-23 Fish and Fish Habitat Monitoring Stations and Sampling Frequency 292
Table 7-24 Overview of Benthic Invertebrate Monitoring 295
Table 7-25 Benthic Invertebrate Monitoring Areas and Frequency 296
Table 7-26 Overview of Periphyton Monitoring 299
Table 7-27: Periphyton Monitoring Areas and Frequency 300
Table 7-28 Overview of Sediment Monitoring 302
Table 7-29 Sediment Quality Monitoring Areas and Frequencies 303
Table 7-30 Closure Physical Inspection Program 304
Table 7-31 Education and Training Measures Associated with Closure 307
Table 7-32 Local Employment, Procurement, and Economic Measures Associated with Closure 309
Table 7-33 Community Infrastructure and Services Measures Associated with Closure 314
Table 7-34 Traditional Knowledge and Lands and Resource Use Measures Associated with Closure 317
Table 7-35 Community Health and Well-Being Measures Associated with Closure 319
Table 8-1 Major Mining, Support, and Ancillary Equipment Count by Year (Start, Peak, LOM) 325
Table 8-2 Personnel Required for Closure Phase 329
Table 9-1 Two Years Forward Closure - Undiscounted Costs 331
Table 9-2 Life of Mine Closure - Undiscounted Costs 333

LIST OF FIGURES (WITHIN TEXT)

Figure 1-1 Coffee Project Location and Northern Access Route 4
Figure 1-2 Mine Site General Arrangement 5
Figure 1-3 Coffee Project Schedule Overview 7
Figure 1-4 Continuous Closure Planning Concept (ICMM 2008) 10
Figure 2-1 Estimated Implementation Schedule for Reclamation Research Activities 24
Figure 4-1 Site Climate Monitoring Network 48

Figure 4-2 Mean Monthly Minimum (top panel), Mean (middle panel) and Maximum (bottom panel) Air Temperature Records for the Km 11 and Kona Climate Stations 50
Figure 4-3 Comparison of the Measured Monthly Precipitation Signature for the Coffee Gold Km 11 and Kona Climate Stations to nearest Regional Stations (n = 21) with Long-Term Records 51
Figure 4-4 Continuous Snow Depth Record Measured at the Kona Climate Station (October 2018 to June 2021) 56
Figure 4-5 Historical Seismic Activity in the Yukon 60
Figure 4-6 Coffee Mine Hydrogeological Monitoring Network 64
Figure 4-7 Overburden Drill Core Locations with Acid Base Accounting (ABA) Samples 65
Figure 4-8 Permafrost and Related Geohazards 68
Figure 4-9 Location of Key Catchments in the Mine Site Area 72
Figure 4-10 Surface Water Quality Monitoring Station Locations 77
Figure 4-11 Groundwater Instrumentation at the Coffee Project 93
Figure 4-12 Bedrock Hydraulic Conductivity versus Depth 95
Figure 4-13 Groundwater Head Contours at the Coffee Mine Site 98
Figure 4-14 Piper Plot of Coffee Groundwater Quality Data (2014 - 2019) 99
Figure 4-15 Local and Regional Areas Referred to for Vegetation, Birds, and Wildlife Descriptions 106
Figure 4-16 YBS 2022 – Population by Age Group and Sex, Yukon, December 31, 2011, and December 31, 2021 117
Figure 5-1 Schedule of Key Activities by Project Phase and Year 131
Figure 5-2 Layout of Existing Site Components 135
Figure 5-3 Ore and Waste Rock Mining Schedule by Pit Parameters 139
Figure 5-4 Location of Open Pit Lakes Post-Closure 140
Figure 5-5 Open Pit Dewatering Schedule and Predicted Years to Spillover Elevation 141
Figure 5-6 Schematic of Predicted Open Pit Drainage Pattern – End of Operation Phase 142
Figure 5-7 Schematic of Predicted Open Pit Drainage Pattern – Post-closure Phase 143
Figure 5-8 Process Flow Diagram for Ore Crushing, Leaching, Processing, and Refining 149
Figure 5-9 General Layout of Heap Leach Facility 151
Figure 5-10 Plant Site General Arrangement 159
Figure 5-11 Process Plant General Arrangement 161
Figure 5-12 Bulk Fuel Storage Area Plan and Sections 163
Figure 5-13 Layout of the Bulk Explosive Storage Area 167
Figure 5-14 Water Management Infrastructure - Operation Phase Activities 171
Figure 5-15 Water Management Infrastructure – End of Closure Phase (Year 21) 172
Figure 5-16 General Arrangement of Coffee Exploration Camp 174
Figure 5-17 Project Airstrip General Arrangement 177
Figure 5-18 Mine Site Layout — Two-Years Forward (Year -1) 180
Figure 5-19 Mine Site Layout — End of Operation Phase (Year 9) 184
Figure 6-1 Mine Site General Arrangement at End of Year 1 191

Figure 7-1 Mine General Arrangement at beginning of Closure Phase (Year 10) 215
Figure 7-2 Mine General Arrangement at End of Closure Phase (Year 21) 216
Figure 7-3 Pit Lake Schematic for Post-closure Phase 218
Figure 7-4 Open Pit Dewatering Schedule and Predicted Years to Spillover Elevation 219
Figure 7-5 Latte East and Latte West Pit Lake Volumes 221
Figure 7-6 Latte East Pit Lake Surface Discharge Rates 222
Figure 7-7 SU1 (top) and SU1W (bottom) Pit Lake Volumes 223
Figure 7-8 SU1 (top) and SU1W (bottom) Pit Lake Surface Discharge Rates 225
Figure 7-9 SU2 Pit Lake Volume 226
Figure 7-10 SU2W Pit Surface Discharge Rates 227
Figure 7-11 SU3W (top) and SU3 (bottom) Pit Lake Volumes 228
Figure 7-12 SU3W (top) and SU3 (bottom) Pit Lake Surface Discharge Rates 230
Figure 7-13 SU4E (top) and SU4W (bottom) Pit Lake Volumes 231
Figure 7-14 SU4E (top) and SU4W (bottom) Pit Lake Surface Discharge Rates 233
Figure 7-15 SU5 Pit Lake Volumes 234
Figure 7-16 SU5 Pit Lake Surface Discharge Rates 235
Figure 7-17 Backfilled Double Double Pit Water Volumes 235
Figure 7-18 Backfilled Double Double Pit Surface Discharge Rates Backfilled Kona Pit 236
Figure 7-19 Backfilled Kona Pit Water Volumes 237
Figure 7-20 Backfilled Kona Pit Surface Discharge Rates 238
Figure 7-21 Time Series of Predicted Kona Pit Water Quality. Passive Spilling of the Backfill Pit Water is projected to Occur in Year 27 240
Figure 7-22 Time series of Predicted Double Double Pit Water Quality. Passive Spilling of the Backfill Pit Water is Projected to Occur in Year 24 240
Figure 7-23 Time Series of Predicted As Concentrations in Halfway Creek at Attainment Location HC-1.0 241
Figure 7-24 Alpha Waste Rock Storage Facility Basal Seepage Rates 243
Figure 7-25 Plan View of HLF and Cover System 246
Figure 7-26 Time-series of NO_3 and As Water Quality Predictions at HC-1.0 for all Mine Phases and into Post-Closure Relative to Use Protection Objectives 249
Figure 7-27 NAR Section for Reclamation 258
Figure 7-28 Base Case Cover System Material Requirements 265
Figure 7-29 Meteorological Monitoring Locations 271
Figure 7-30 Hydrological and Surface Water Quality Monitoring Stations 276
Figure 7-31 Groundwater Monitoring Network 283
Figure 7-32 Invasive Plant Monitoring Areas 289
Figure 7-33 Fish and Habitat Monitoring Locations 293
Figure 7-34 Benthic Invertebrate, Periphyton and Stream Quality Monitoring Areas 297
Figure 8-1 Key Closure Activities Estimated Time Period 323

APPENDICES

Appendix 1-A	Reclamation and Closure Plan YWB and EMR Table of Concordance
Appendix 1-B	Reclamation and Closure Plan Decision Document and Proponent Commitments Table of Concordance
Appendix 2-A	Summary of Consultation and Engagement Activities Related to Reclamation and Closure
Appendix 2-B	Coffee Gold Mine – Revegetation Reclamation Research and Monitoring Report
Appendix 2-C	2021 Revegetation Research at Minto Mine – Year 1 Progress Report
Appendix 2-D	Coffee Project Water Treatment: From Feasibility Studies to a Conceptual System Design
Appendix 2-E	Work Plan to Demonstrate Feasibility of Passive Bioremediation Treatment of Heap Leach Rinse Solutions at Closure
Appendix 2-F	Laboratory Scale Study of Nitrate and Arsenic Removal via Permeable Reactive Barrier under Cold Conditions
Appendix 2-G	Column Test Results for the Evaluation of Semi-Passive Zero Valent Iron Bioreactor Treatment Systems (Lorax)
Appendix 2-H	Fall 2017 Testpitting Program, Coffee Mine Site
Appendix 2-I	Fall 2018 Testpitting Program Date Report, Coffee Gold Project
Appendix 2-J	Initial Ecohydrological Modelling in support of Coffee Gold Reclamation
Appendix 2-K	Closure Alternatives Assessment Report
Appendix 2-L	2018 Preliminary Project Failure Modes and Effects Analysis
Appendix 2-M	2022 Coffee Mine FMEA Summary Report
Appendix 3-A	Component Specific Objectives Table
Appendix 4-A	2015 Climate Change Projections for Coffee Creek Region Yukon
Appendix 4-B	Ground Temperature Monitoring Update, Coffee Mine Project, YT
Appendix 5-A	2023 Feasibility Pit Slope Stability Update
Appendix 5-B	Preliminary Slope Stability Analysis, Waste Rock Storage Facilities and Overburden Stockpiles
Appendix 5-C	Coffee Mine Conceptual Water Treatment Design for Permitting
Appendix 7-A	2023 Geochemical Source Term Report
Appendix 7-B	Coffee Mine Heap Leach Facility Cover Design Summary Report
Appendix 7-C	Material Balance Report – Coffee Project
Appendix 9-A	Cost Model Summary

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
ABA	Acid Base Accounting
ACG	Access Consulting Group
AMP	Adaptive Management Plan
ARO	Asset Retirement Obligation
As	arsenic
ASTM	American Society for Testing and Materials
ATVs	all-terrain vehicles
BACI	Before-After-Control-Impact
BC-MOE	British Columbia Ministry of Environment
BR	biological reactors
CCME	Canadian Council of Ministers of the Environment
CEC	cation exchange capacity
CFP	Chance Find Procedure
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	catch per unit effort
DCRs	Design Change Requests
DOC	dissolved organic carbon
EBR	Electrochemical Bioreactor
EDI	EDI Environmental Dynamics Inc.
EEM	Environmental Effects Monitoring
EMAMP	Environmental Monitoring and Adaptive Management Plan
EMR	Yukon Department of Energy, Mines and Resources
EQS	Effluent quality standards
ET	Evapotranspiration
ESR	Event Storage Requirement
FA	Financial Assurance
FALMP	Fish and Aquatic Life Monitoring Plan
Fe^{2+}	iron
FFG	Functional feeding group
FMEA	Failure Modes and Effects Analysis
FNNND	First Nation Na-cho Nyäk Dun
FoS	Factors of Safety
FRMP	Forest Resources Management Plan
FSSA	Frozen Soil Storage Area

Acronym / Abbreviation	Definition
GCL	Geosynthetic Clay Liner
GDP	Gross domestic product
Green alder	Alnus viridis subsp. crispa
HC	Halfway Creek
HDPE	high density polyethylene
HRIA	Heritage Resources Impact Assessment
HROA	Heritage Resources Overview Assessment
HLF	Heap Leach Facility
HPG	Habit preference group
HRT	Hydraulic Retention Time
ICMM	International Council on Mining & Metals
ICs	Intermediate Components
KGC	Kaminak Gold Corp.
LCT	Latte Creek Tributary
LLDPE	linear low-density, polyethylene
LNG	liquid natural gas
LOM	Life of Mine
LSA	Local Study Area
LT	Latte Creek
Mn^{2+}	manganese
MAP	Mean annual precipitation
MCI	Multiple Control-Impact Approach
MDMER	Metal and Diamond Mine Effluent Regulations
MSE	Mechanically stabilized earth
NAR	Northern Access Route
NBCC	National Building Code of Canada
NCRs	Non-Conformance Reporting
Newmont	Goldcorp Kaminak Ltd., a wholly owned subsidiary of Newmont Corporation
NH_3	ammonia
NP	neutralization potential
NO_3	nitrate
NO_{2-}	nitrite
non-ML	non-metals leaching
NSERC	Natural Sciences and Engineering Research Council of Canada
ODF	overliner drain fill
PEL	Probable Effects Level
PGA	Peak ground acceleration

Acronym / Abbreviation	Definition
PM2.5	Particulate matter of 2.5 microns or less
POPCs	Parameters of potential concern
PRB	Permeable reactive barrier
PSD	Particle size distribution
PTS	Passive treatment systems
QA/QC	Quality Assurance/Quality Control
QML	Quartz Mine Licence
RCP or Plan	Reclamation and Closure Plan
RFIs	Request for Information
ROM	Run-of-Mine
RSA	Regional Study Area
SARA	*Species at Risk Act*
SEMP	Socio-economic Monitoring Plan
SER	Sustainability and External Relations
SFN	Selkirk First Nation
soapberry	*Shepherdia canadensis*
smooth-leaf mountain avens	*Dryas integrifolia*
SRCE	Standard Reclamation Cost Estimator
S^{2-}	sulfide
SWE	Snow Water Equivalent
SSWQO	Site-specific water quality objectives
TDS	Total Dissolved Solids
TH	Tr'ondëk Hwëch'in
TSP	Total suspended particulate matter
TSS	Total Suspended Solids
U	uranium
VCs	Valued Components
VWP	vibrating wire piezometer
WAD	Weak acid dissociable
WB/WQM	Water balance and water quality model
WQM	Water Quality Model
WQO	Water quality objectives
WRFN	White River First Nation
WROMP	Waste Rock and Overburden Management Plan
WRSF	Waste Rock Storage Facility
WTP	Water Treatment Plant
WUL	Water Use License

Acronym / Abbreviation	Definition
YBS	Yukon Bureau of Statistics
Yukon CDC	Yukon Conservation Data Centre
YDA	Dawson City Airport
YESAA	Yukon *Environmental and Socio-economic Assessment Act*
YESAB	Yukon Environmental and Socio-economic Assessment Board
YMRC	Yukon Mining Research Consortium
YWB	Yukon Water Board
YXY	Erik Nielsen Whitehorse Airport
ZVI	zero valent iron

LIST OF SYMBOLS AND UNITS OF MEASURE

Symbol / Unit of Measure	Definition
dBA	decibels
ha	Hectares
kg	Kilogram
km	kilometre
Km^2	Square kilometre
kW/m^2	Kilowatt per square metre
kWh/yr	kilowatt hours per year
L/s	Litres per Second
L/yr	in litres per year
$L/s/km^2$	Liters per second per square kilometer
Masl	Metres above sea level
mg	milligrams
$mg/dm^2/day$	milligrams per square decimeters per day
m/s	meters per second
Mt	Million tonnes
MW	megawatts
rpm	revolutions per minute
t/d	tonnes per day
µg/L	Micrograms per liter
v	volts

1.0 INTRODUCTION

The proposed Coffee Gold Mine (the Project) is an open-pit gold mine owned by Goldcorp Kaminak Ltd, a subsidiary of Newmont. The site is located on the south side of the Yukon River in the White Gold District of west-central Yukon, approximately 130 km south of the City of Dawson, 140 km west of Pelly Crossing, 95 km north-east of Beaver Creek, 160 km west-northwest of Carmacks, and 340 km northwest of Whitehorse. In 2017, the Project was submitted for assessment under the YESAA, SC 2003, c.7 for consideration by the YESAB Executive Committee. This Reclamation and Closure Plan (RCP or Plan) has been written to meet the guidance provided in the *Reclamation and Closure Planning for Quartz Mining Projects* (YWB and EMR 2013) and incorporates comments that were received throughout the YESAB screening and assessment process.

The primary objectives of this RCP are to:

- Provide the proposed approach to decommission mine features and reclaim landforms and disturbed areas.
- Outline a monitoring program to be conducted until mitigation and reclamation measures have achieved Project-specific and component-specific closure objectives.
- Provide estimated costs for liabilities associated with three scenarios: current conditions; conditions two-years forward, and conditions at the end of mine life.

This RCP is provided in conjunction with several other plans to meet the requirements for quartz mine applications for a Quartz Mining License and a Water Use Licence under the *Quartz Mining Act* and *Waters Act*, respectively. This RCP has been informed by input and feedback received from Project partners, stakeholders, and First Nations, and developed to provide the level of detail necessary for the licensing stage of the Project. It has been developed in accordance with current industry best practices, corporate standards, and guidance documents. Appendix 1-A provides a Table of Concordance for reclamation and closure plan requirements and closure costing information outlined in Annex 1 of YWB and EMR (2013) – Annotated Outline for Reclamation and Closure Plans.

The general structure of this Plan and a brief description of section content are as follows:

- **Section 1.0 Introduction** – Provides an overview of the proposed Project including the Project schedule, regulatory context, and closure philosophy and guiding principles incorporated into reclamation and closure planning.
- **Section 2.0 Reclamation and Closure Planning** – Describes the key aspects of reclamation and closure planning, including consultation and engagement activities, reclamation research activities, and mine design and operating strategies, and presents the outcomes of the closure alternatives evaluation process.
- **Section 3.0 Closure Objectives and Design Criteria** – Outlines the vision for Project closure and Project-specific closure objectives and summarizes the design criteria for mine components that will remain as part of the landscape post-closure.
- **Section 4.0 Environment and Socioeconomic Descriptions** – Describes the existing physical and biophysical conditions for the Project and surrounding areas, as well as local and regional socio-economic conditions.

- **Section 5.0 Project Description** – Describes the history of the Coffee Property, the proposed Project schedule, and the design/construction and operation of Project components and facilities; characterizes current conditions and anticipated conditions two-years forward and at the end-of-mine; and outlines proposed monitoring and surveillance activities, and the approach to managing potential risks.
- **Section 6.0 Temporary Closure** – For a hypothetical period of temporary closure commencing in Year 1 of mine operation, presents key objectives, socio-economic aspects, and expected site security, monitoring, maintenance, and management activities.
- **Section 7.0 Final Reclamation and Closure Measures** – Presents the measures and monitoring requirements for the decommissioning and closure of mine facilities and infrastructure, as well as socio-economic aspects of closure, to allow for the vision and objectives of the Project closure to be met.
- **Section 8.0 Reclamation and Closure Schedule and Execution Strategy** – Describes the preliminary schedule and strategy for executing the reclamation and closure activities.
- **Section 9.0 Reclamation and Closure Liability** – Presents the cost estimate methodology and liability estimates for current conditions, for conditions two-years forward immediately following construction, and for decommissioning and reclaiming the Project site at the end of the mine life.
- **Section 10.0 References** – Lists all sources of information that have informed the content of this document. Sources of information of greatest relevance are appended.

Newmont retained Ensero Solutions Canada, Inc. and JDS Energy and Mining to lead the development of this RCP.

1.1 Project Summary

The proposed Coffee Gold Mine (the Project) is an open-pit gold mine owned by Goldcorp Kaminak Ltd., a wholly owned subsidiary of Newmont Corporation (Newmont), located on the south side of the Yukon River in the White Gold District of west-central Yukon. The Project site is approximately 130 km south of the City of Dawson, 140 km west of Pelly Crossing, 95 km north-east of Beaver Creek, 160 km west-northwest of Carmacks, and 340 km northwest of Whitehorse. The Project is located wholly within the traditional territory of Tr'ondëk Hwëch'in, partially within the traditional territory of Selkirk First Nation and First Nation of Na-cho Nyäk Dun, and partially within the asserted territory of White River First Nation. The Project contains several gold occurrences within an exploration concession covering an area of more than 600 km^2. The Mine Site will be accessed by road from Dawson via a 16-km stretch of Klondike Highway and 192-km all-season road, referred to as the Northern Access Route (NAR) (Figure 1-1). The NAR includes seasonal barge crossings on both the Stewart and Yukon rivers, with ice bridges and a seasonal winter road in the winter months.

The Project is comprised of four open pits: Supremo, Latte, Double Double, and Kona. Waste rock is proposed to be permanently stored in the Alpha Waste Rock Storage Facility (WRSF) (Figure 1-2). The ore production rate is proposed to be up to approximately 9.0 million tonnes (Mt) per year, producing an estimated total of 67 Mt of heap leach feed over the 10-year Operation Phase. The conceptual-level estimate for waste material to be moved over the life of mine (LOM) is up to approximately 330 Mt based on an average strip ratio of 5.0:1. The ore will be crushed and transported to the Heap Leach Facility (HLF) via overland conveyor or trucks for nine months of the year. During the three coldest months of winter, run-

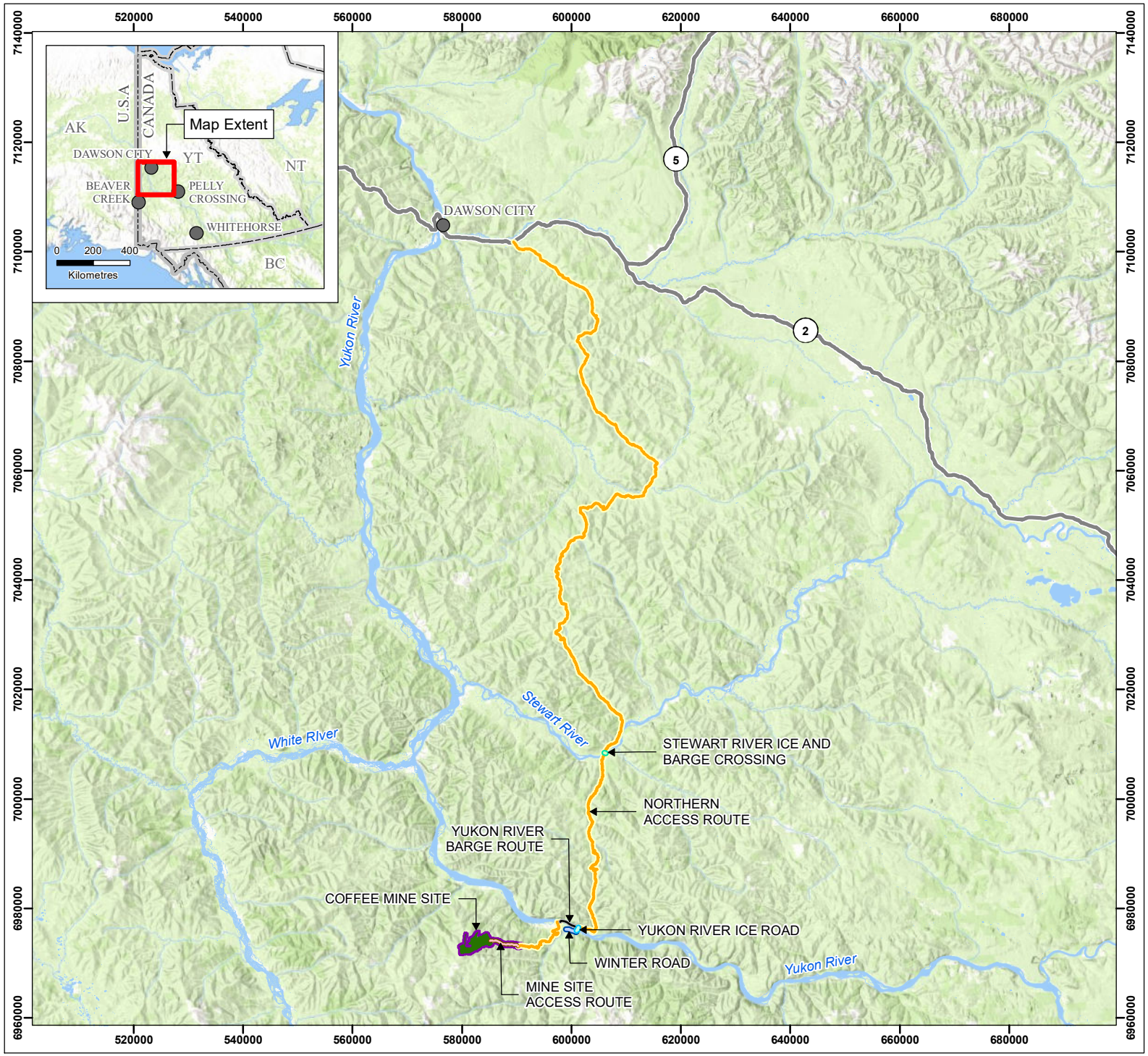
of-mine (ROM) ore will be stockpiled in the ROM stockpile. Gold will be extracted from gold-bearing leach solution by a six tonnes per day (t/d) adsorption, desorption, recovery carbon plant with mercury retorting to produce a final gold doré product. A total of 2.6 million ounces of gold is planned to be recovered over a 10-year mine life.

The Project phases are defined as follows:

- Construction Phase: Q2 Year –3 to end of Year –1 (30 months)
- Operation Phase: Year –1 to end of Year 9 (10 years)
- Reclamation and Closure Phase: Year 10 to end of Year 21, including a 6-year Post-Mining Closure Stage and a 5-year Active Closure Stage (11 years)
- Post-Closure Phase: Year 21 onwards as determined to be required.

These phases broadly describe the activities occurring within a particular time period; however, some activities will continue from one phase to another as mine site development advances with operational activities (e.g., Open Pits, WRSF). When areas that support mine operations are no longer required, they will be progressively reclaimed. The overall Project schedule is the general expected scenario for mine construction and operation; detailed activities are subject to change depending on detailed mine planning and the timing of receipt of authorizations.

The key Project components as well as the Mine Site layouts for specific periods (i.e., current conditions, two-years forward, and end of mine life) are provided in Section 5. An overview of the Project schedule is described in Section 1.1.1, the regulatory context for the Project is outlined in Section 1.1.2, and information regarding the closure philosophy and guiding principles for reclamation and closure planning is provided in Section 1.2.



COFFEE GOLD MINE

Coffee Project Location and Northern Access Route

Legend

- Stewart River Ice and Barge Crossing
- Yukon River Barge Route
- Yukon River Ice Road
- Winter Road
- Mine Site Access Route
- Northern Access Route
- Project Area
- Project Footprint
- Highway
- Waterbody

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Topographic Map
4. Inset Basemap: ESRI World Topographic Map

N

1:1,000,000

0 5 10 15 20 25

Kilometres

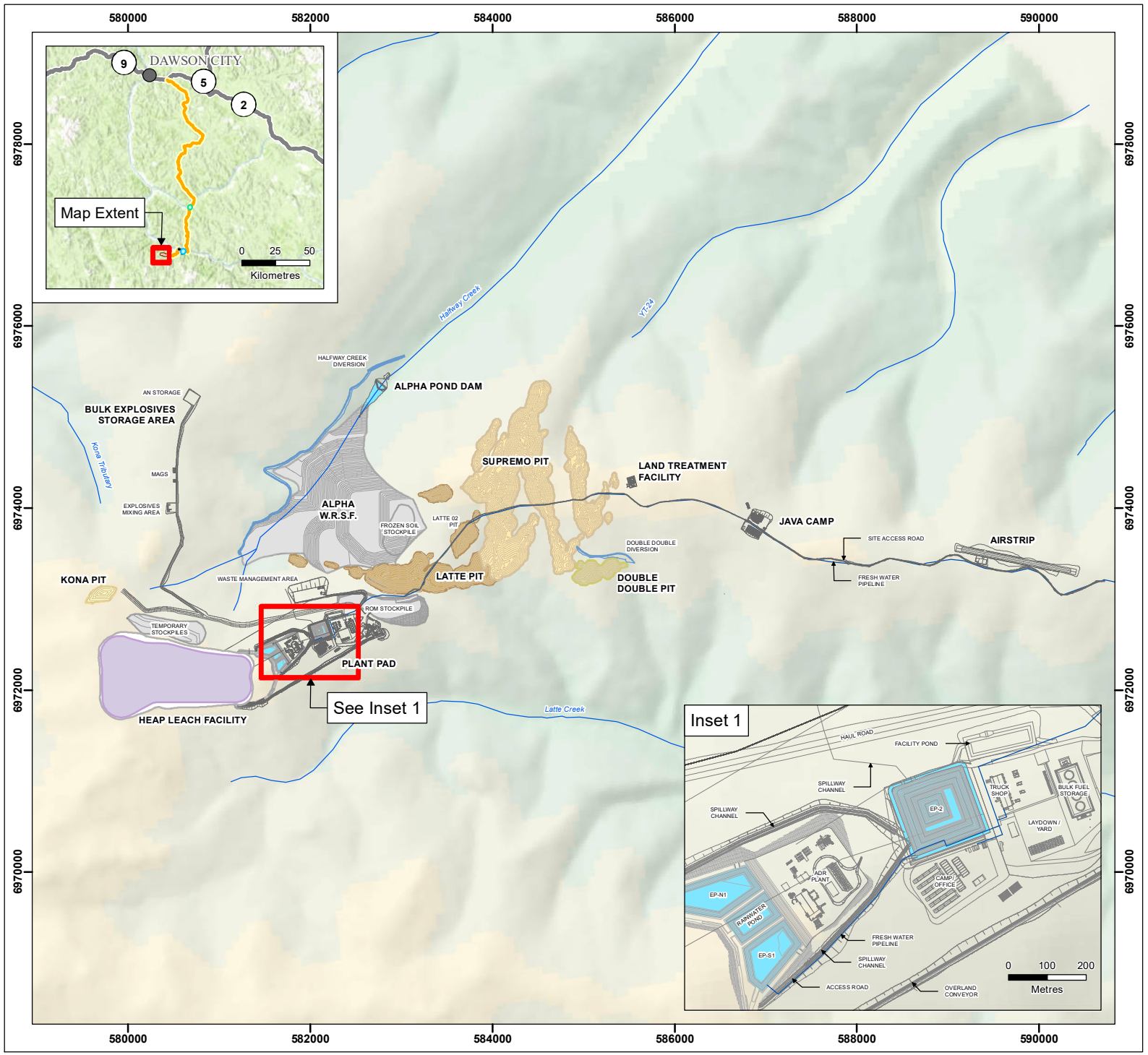
NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 1.1	Date: Mar 2, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\1038620\1mxd\Fig1_1_1038620_03_CoffeeProjectLoc_NorthernAccessRoute_230302.mxd



COFFEE GOLD MINE

General Arrangement - Mine Site

Legend

- Double Double Pit
- Kona Pit
- Latte Pit
- Supremo Pit

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Inset Basemap: ESRI World Topographic Map

N

1:60,000

0 0.5 1 1.5 2 2.5

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 1.2	Date: Oct 6, 2023	Drawn by: AS	Reviewed: CH

Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MXDFig1_2_103862_03_GeneralArrangement_231006.mxd

1.1.1 Project Schedule

An overview of the Project schedule from discovery of the deposit to the completion of reclamation and closure activities (Post-closure Phase) is shown in Figure 1-3. Additional information on the history of the Project is provided in Section 5.1, and a detailed Project schedule that outlines key activities expected to occur during the Construction and Operation Phases is provided in Section 5.2. Figure 1-3 outlines the expected scenario for mine development, operation, and closure, with the phases broadly describing the activities occurring within that particular time period. The Operation Phase of the Project commences when first gold is produced. The Project phases and anticipated durations are as follows:

- Construction Phase: Q2 Year –3 to end of Year –1 (30 months)
- Operation Phase: Year –1 to end of Year 9 (10 years)
- Closure Phase: Year 10 to end of Year 21, including a 6-year Post-Mining Closure Stage and a 5-year Active Closure Stage (11 years)
- Post-closure Phase: Year 21 onwards as determined to be required.

These phases broadly describe the activities occurring within a particular time period; however, some activities will continue from one phase to another as mine site development advances with operational activities (e.g., Open Pits, WRSF). When areas that support mine operations are no longer required, they will be progressively reclaimed. The overall Project schedule is the general expected scenario for mine construction and operation; detailed activities are subject to change depending on detailed mine planning and the timing of receipt of authorizations.

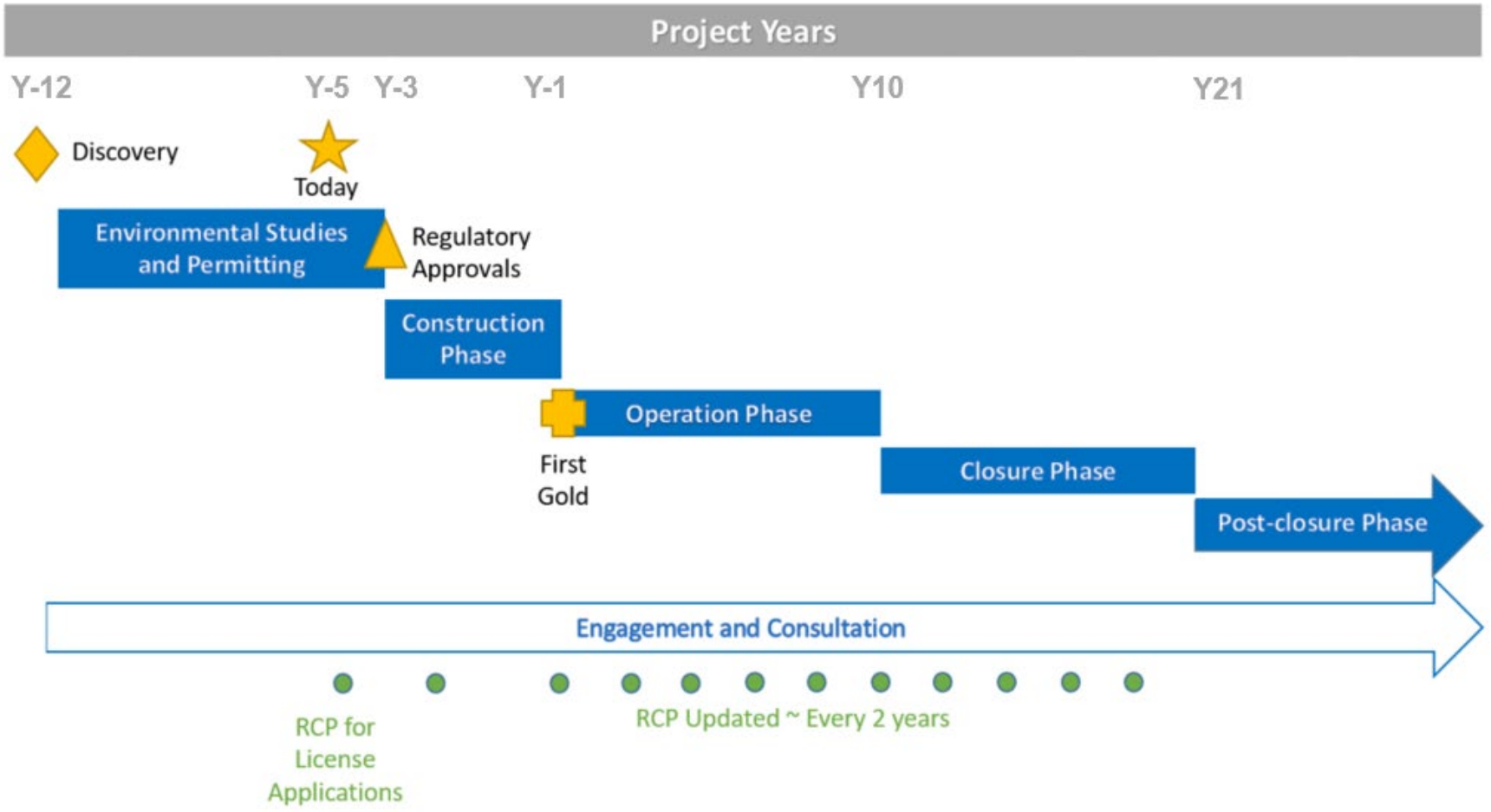


Figure 1-3 Coffee Project Schedule Overview

1.1.2 Regulatory Context

An environmental and socio-economic assessment was completed for the Project pursuant to *Yukon Environmental and Socio-economic Assessment Act* (YESAA) and was subsequently screened by the Yukon Environmental and Socio-economic Assessment Board (YESAB) Executive Committee. A Final Screening Report and Recommendation was issued to the Project's Decision Bodies in February 2022. Following consultation with affected First Nations, the Decision Bodies (Government of Yukon, Natural Resources Canada, and Transport Canada) issued the Decision Document in March 2022 allowing the Project to proceed. As such, Newmont is in the process of developing the requisite licence and permit applications from federal or territorial regulators, municipal governments, and/or First Nations, to advance the Project. Of key importance for the commencement of mine development are the Type A Water Licence and the Quartz Mining Licence.

This Plan has been developed in accordance with the plan requirements and closure costing guidance provided by Yukon Water Board (YWB) and Yukon Department of Energy, Mines and Resources (EMR) (2013) and was also guided or informed by the following documents:

- Yukon Mine Site Reclamation and Closure Policy (EMR 2006)
- Quartz Mining License Application Guide (EMR 2010)
- Preferred Practices for Works Affecting Yukon Waters (YG 2019)
- Guidance Document on Water and Mass Balance Models for the Mining Industry (Golder Associates 2011)
- Dam Guide: Design Expectations and Required Information (YESAB and Yukon Environment 2012)
- Type A and B Quartz Mining Undertakings – Information Package for Applicants (YWB 2012)
- Yukon Mine Site Reclamation and Closure Policy - Financial and Technical Guidelines (EMR 2013)
- Yukon Mine Site Reclamation and Closure Policy - Financial Guidelines (EMR 2014)
- Planning for Integrated Mine Closure: Toolkit (ICMM 2008)
- Umbrella Final Agreement between the Government of Canada, the Council for Yukon Indians, and the Government of Yukon (1993)
- TH Final Agreement (1998)
- SFN Final Agreement (1997).

Appendix 1-A provides a Table of Concordance for Yukon requirements for reclamation and closure plan content and closure costing information, as outlined in YWB and EMR (2013). Newmont commitments that were made during the screening and assessment process, terms and conditions of the Decision Document, and feedback that has been received through consultation related to reclamation and closure planning are provided in Appendix 1-B and have been incorporated into the RCP.

1.2 Mine Closure Philosophy and RCP Guiding Principles

Newmont is the world's leading gold company focused on responsible and sustainable mining through principled environmental, social, and governance practices. As a leader in sustainability in the mining industry, Newmont understands that an effective reclamation and closure plan supports the goal to act as a catalyst for local economic development through transparent and respectful stakeholder, Project partner,

and First Nations engagement, and as responsible stewards of the environment. Newmont integrates closure and reclamation into its business planning, factors it into financial decisions, and considers social benefits in every phase of mining.

Newmont's vision is to make mine closure a smooth transition, with careful management of the environmental and socio-economic challenges as the operation moves through reclamation, monitoring, passive care, and eventual transfer to the government or surrounding communities. Newmont's goal is to perform comprehensive land reclamation to ensure that the local ecosystem is healthy, thriving, and supportive of meaningful uses for nearby communities.

The International Council on Mining and Metals document entitled *Planning for Integrated Mine Closure: Toolkit* (ICMM 2008) highlights the importance of developing a holistic vision for closure through a collaborative and inclusive approach. Figure 1-4 outlines the continuous process for closure planning, which is initially conceptual in nature and progressively becomes more detailed as a mine advances. Reclamation and closure planning, including cost estimating, is a fundamental aspect of meeting Newmont's regulatory and social responsibility and managing the financial health of the company. As such, Newmont is committed to leaving the site in a condition that is safe and stable, that minimizes environmental impacts.

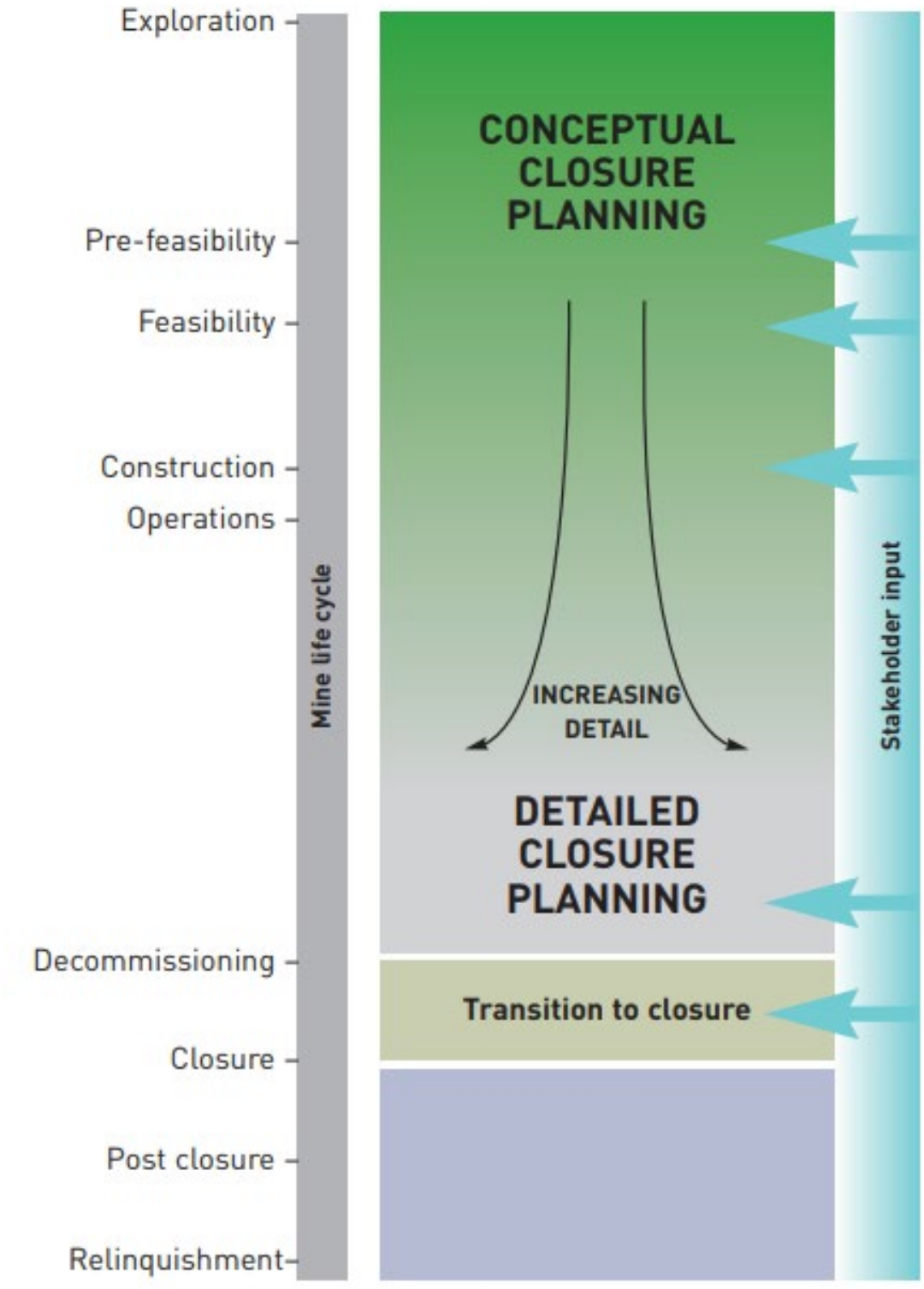


Figure 1-4 Continuous Closure Planning Concept (ICMM 2008)

1.2.1 Newmont Internal Standards

As an important part of Newmont's internal governance process, Newmont has implemented Global Policies and Standards (Global Standards) that are reviewed and preliminarily approved by a Global Policies & Standards Committee. The Global Standards provide the framework and standards for Newmont sustainability management and ensures a consistency of approach for implementing these global policies across the Company.

The Global Standards apply to all directors, officers and employees of Newmont Corporation, its subsidiaries, and any other entities that it controls. A variance request process for existing or future conditions is in place. The process provides an alternative mechanism for those instances where a Newmont site/operation cannot logistically or feasibly conform to a requirement established in a Standard due to special conditions or unique hardships. The Global Standards are intended to be fully integrated into all core business functions, and they emphasize sustainability, responsibility, and accountability at all organizational levels.

The list of Standards is provided in Table 1-1.

Table 1-1 Newmont Global Standards

Global Standards	
Air Emissions Management Standard	Land Acquisition and Involuntary Resettlement Standard
Biodiversity Management Standard	Local Procurement and Employment Standard
Closure and Reclamation Management Standard	People Policy
Code of Conduct	Product Stewardship Standard
Community Investment and Development Standard	Social Baseline and Impact Assessment Standard
Cultural Resource and Management Standard	Stakeholder Relationship Management Standard
Drug and Alcohol Policy (Coffee-Specific)	Tailings Storage Facility and Heap Leach Facility Environmental Standard
Hazardous Materials Management Standard	Tailings Storage Facilities Technical and Operations Standard
Health and Safety Policy	Waste Management Standard
Human Resources Standard	Waste Rock and Ore Stockpile Management Standard
Human Rights Standard	Water Management Standard
Indigenous Peoples Standard	

Reclamation and closure planning follows the Newmont *Closure and Reclamation Management Standard*, which identifies requirements to responsibly close and reclaim mine sites in accordance with Newmont's commitment to protect human health, community needs, and the environment, and to create a positive legacy for future generations. The Newmont *Closure and Reclamation Guidance* document provides specific requirements to implement the Closure and Reclamation Management Standard and outlines the strategies for planning and design, implementation and management, and performance monitoring in alignment with Newmont principles and philosophies. Specifically, the guidance document describes the requirements for:

- Stakeholder engagement

- Developing closure and reclamation strategy and costs
- Collaborative RCP development
- The closure planning process
- Post-mining landform criteria
- Closure and reclamation planning updates
- Record keeping
- Performance monitoring
- Data and information management.

1.2.2 Coffee Gold Mine Guiding Principles and Closure Philosophy

The Yukon Water Board emphasizes the importance of robust reclamation and closure planning, stating that it will endeavour to "…issue licences only when there is a reasonable certainty that an acceptable level of reclamation of the site can be achieved during mining and/or following cessation of mining" (YWB 2012). A principal philosophy followed during Project development of this Plan was to work towards an eventual closure that requires minimal long-term monitoring and maintenance. Newmont intends to implement a technically feasible RCP that is environmentally sound, while respecting local laws, traditional land uses, and public interests. To ensure that this closure philosophy can be achieved, the following guiding principles were emphasized during the development of the Plan:

- Protection of public health and safety.
- Designing for closure, including reclaiming disturbed areas progressively during the Operation Phase, to ensure land use commensurate with surrounding lands.
- Implementing environmental protection measures that minimize adverse environmental and socio-economic impacts (e.g., reducing affected water and controlling contaminants at source).
- Planning for long-term monitoring and maintenance, while minimizing long-term operational activities, to assess effectiveness of closure measures over the long term.

2.0 RECLAMATION AND CLOSURE PLANNING

In order to leave behind local ecosystems that are healthy, thriving, and supportive of meaningful post-mining land use, Newmont is committed to ensuring that reclamation and closure planning begins at the initial stages of a project's planning and development process and continues throughout the mine's lifecycle. Newmont believes that local communities should be involved in closure planning from the outset in order to understand the challenges and to provide an opportunity for communities to become active participants in decision-making.

As per good industry practice and YWB and EMR (2013) guidance, this RCP was developed with input from and in consideration of views of potentially-affected communities and First Nations. The following subsections describe consultation and engagement activities undertaken in support of Project planning, as well as the processes and approaches used to develop this Plan and inform the reclamation and closure planning process.

2.1 Consultation and Engagement Activities

Project engagement with potentially affected parties, including governments (First Nation, Federal, Territorial), local communities, assessment or regulatory authorities, and non-government organizations has been an essential strategy from the onset of Project planning in 2013. Newmont has focused on building relationships into meaningful partnerships, and views consultation not as a single conversation but a series of conversations allowing the creation of capacity and understanding of the Project among potentially affected First Nations and communities.

Consultation and engagement outcomes have led to a greater understanding of expectations and concerns for reclamation and closure of the Project. Input received regarding Project planning, design, implementation, and monitoring for activities or developments that are open to modification has been incorporated in order to minimize potential adverse effects and ensure the Project generates mutual benefits for all partners. Reclamation and closure planning consultation that has been carried out prior to licencing is outlined in Appendix 2-A. Engagement activities related to Project decommissioning, closure, and reclamation for licencing have been completed and will continue throughout the mine life.

Workshop discussions recently held with Newmont and First Nations have provided an opportunity for Newmont to receive various perspectives on important issues to First Nations and affected communities. These workshops have been critical to maintaining clear lines of communication between Newmont and First Nations to identify common goals to advance reclamation and closure planning. Updates based on the outcomes of these discussions have been incorporated into the RCP were applicable, and further updates based on ongoing feedback will be summarized in future iterations of the RCP. First Nation engagement and consultation is ongoing, and any feedback that is received or concerns that are heard during consultation will be incorporated into this plan, where applicable.

Examples of updates that have been incorporated to this RCP based on recent discussions include:

- A commitment to conduct a Failure Modes and Effects Analysis (FMEA) workshop with First Nations to review the base case closure measures with each iteration of the RCP (every 2 years) (Section 2.3.4.4).

- A commitment to revisit the closure alternatives assessment to include additional alternatives that are identified through consultation and engagement, and to revisit the feasibility determinations on alternatives that were considered as the Project advances (Section 2.3.4).
- Clarifying objectives of the Reclamation Research Program to include the intent of protecting the receiving environment (Section 2.3.1).
- Basing “continuous improvement” on enhancing the level of use protection in Halfway Creek (Section 2.3.1).

The outcome of additional discussions related to concerns and feedback received through these workshops will be incorporated into future iterations of the RCP. There is an expectation by all parties consulted that mine development will be carried out in a responsible manner and that measures will be put in place for the protection of the environment as well as human health and safety. In addition, the parties look to see socio-economic benefits from the mine, and that business opportunities accrue to the Yukon. Newmont will continue to consult and work with communities on reclamation and closure plan updates, which will include mitigation measures identified through the Socio-economic Monitoring Plan (SEMP) and activities related to socio-economic aspects of closure (e.g., community contributions, partnerships).

2.2 Sequences and Phases of Reclamation and Closure Planning

This RCP represents the first closure plan for the Coffee Gold Mine submitted for the purposes of mine licensing. Over the life of the mine, successive iterations of this RCP will be reviewed on a regular basis or when there is a significant material change at the site or in the local area and will be submitted at least every two years in accordance with the Yukon Mine Site Reclamation and Closure Policy (YWB and EMR 2013).

Subsequent RCP iterations will continue to advance the level of design for facilities and infrastructure, as well as additional details from lessons learned through reclamation research programs, exploration-related activities, investigative studies, and monitoring programs. Subsequent RCP iterations will provide more detail from reclamation research program and monitoring program results as well as mine operation and will have greater certainty regarding the sequence of closure and reclamation activities to occur progressively during the Operation Phase and during the Closure Phase.

Details on Project sequencing, including the anticipated submission timing of successive iterations of this RCP, are illustrated in Figure 1-4. Each RCP is only considered to be a ‘final plan’ for the period of time for which it is written, as the RCP will continue to evolve as the Project advances through the Operation Phase and into the Closure Phase.

2.3 Designing and Operating for Closure

The Project is designed and will be operated with closure in mind by integrating closure considerations into the mine’s planning and operational processes, minimizing ongoing intervention or operating activities after the completion of mine reclamation and closure activities, as well as planning for long-term monitoring.

Key elements of reclamation and closure planning include:

1) Conducting reclamation research.
2) Scheduling closure and reclamation activities to occur progressively.

3) Designing the Project to minimize effects.
4) Conducting an assessment of closure alternatives for major mine components.

These elements are described below.

2.3.1 Reclamation Research

Reclamation research that is completed or underway at the Project provides substantial direct and indirect benefits to reclamation planning and execution at the site. Knowledge gained through previous reclamation research projects will contribute to the success of achieving the overall Project goals and objectives, and on-site opportunities will be advanced during mine operations to refine various reclamation and closure techniques to achieve the Project-specific closure objectives. The reclamation research program will be advanced based on the end land use planning approach for the site as well as the component-specific closure objectives. The general intent of the programs will be based on the goal of protecting the receiving environment, with continuous improvement focused on enhancing the level of use-protection in Halfway Creek. Planning and advancement of the reclamation research program will be carried out in collaboration with First Nations during construction and operations and will incorporate inputs from continued end land use planning.

Since progressive reclamation is a key activity during the Operation Phase (Section 2.3.2), reclamation prescription testing in actual site conditions as the Project advances, including implementing an appropriate schedule, will allow for refinement prior to the commencement of the Closure Phase. Progressive reclamation opportunities will allow for reclamation prescription refinement to be directed by the ability to achieve the specific performance criteria for each major mine component throughout operations. Ultimately, broad application of successful revegetation treatments can be achieved through on-site trials during progressive site reclamation activities.

In addition to the reclamation evaluations described within this section, Newmont will continue to explore on-site opportunities to study various Project-specific reclamation and closure techniques and work with specialist consultants, First Nations, and other technical groups to address potential constraints to achieving Project-specific closure objectives. Input from Project partners, First Nations and stakeholders regarding the reclamation research program will be incorporated into reclamation planning and design on an ongoing basis; hence, the programs are expected to evolve over time.

Previous reclamation research efforts at the site have been carried out by Newmont and through the Yukon Mining Research Consortium (YMRC), which is facilitated through Yukon University in collaboration with the Natural Sciences and Engineering Research Council of Canada (NSERC). The YMRC is comprised of six major mining companies in northern Canada, including Newmont, with vested interest in developing mining reclamation research projects in northern Canada. A key part of the research process for projects carried out through the YMRC is community engagement, incorporating Traditional knowledge and First Nations world view into the projects. Collaboration on reclamation research activities between industry and First Nations through the YMRC is critical to the development of successful northern mine remediation research programs and will continue through the advancement of research programs at the site.

This section provides a summary of the reclamation research that has been completed to date for the Project, research currently ongoing, and future proposed studies, with results included where possible. The research is presented in three categories: revegetation, treatment technologies, and site characterization.

2.3.1.1 Revegetation Reclamation Research

Revegetation helps to achieve a variety of closure objectives by reducing water infiltration, providing habitat, limiting erosion, and meeting aesthetic expectations (YWB and EMR 2013). Newmont is committed to an adaptable revegetation research program based on the continued end land use planning that will allow the local ecosystem to be left in a healthy state that is supportive of meaningful post-closure land use. The program will be developed with the overall objective of developing successful revegetation protocols throughout mine planning and development for broad application in closure. Outcomes from the program are intended to inform the closure measures and implementation strategies for the site, as well as increase the level of confidence that Project-specific closure objectives will be met.

Component-specific revegetation prescriptions have not yet been evaluated in the early stages of the Project; however, they will be developed as the Project advances, and land use plan evolves, and reclamation material becomes available. Seed sourcing for the revegetation research programs will be carried out through integrated community involvement incorporating Traditional knowledge as well as outcomes of previously completed reclamation research programs. Areas of the Project that are currently identified for revegetation prescriptions as part of final reclamation and closure measures include:

- Disturbed areas around open pits
- The disturbance footprint of the soil stockpiles
- The HLF and event ponds
- Ore crushing and stockpile areas
- Plant site
- Camp site
- Disturbed areas where water management infrastructure has been removed
- Haul roads and mine site roads
- Laydown areas
- Bulk Explosive Storage Area
- Land Treatment Facility.

Other areas, such as the NAR and airstrip, will have surface preparation to promote vegetation establishment without active seeding or planting conducted.

Completed Revegetation Research Programs

Various revegetation research projects have been completed at the Project to support the preliminary development of revegetation prescriptions, including site preparation techniques, and seed collection and mapping. Details of the revegetation research that has been conducted for the Project are provided in Appendix 2-B and are summarized below.

- **2013 Demonstration Site Program – investigation of site preparation techniques and prescriptions:** An assessment of vegetation regeneration success involving combinations of

mechanical reclamation[1], raking pre- and post-seeding, seeding, and bio-engineering in various site prescriptions was initiated in 2013. The assessment was carried out at demonstration sites disturbed by previous exploration activities, including 1m^2 monitoring plots, and cut slopes. In 2015, percent coverage measurements were collected at the site to determine establishment success.

- **2015 Seed Program and Candidate Reclamation Species – seed collection, inventory, and mapping exercise:** A seed collection, inventory and mapping program was implemented in 2015 to determine target plant species for site restoration. In conjunction with this program, Newmont supported the development and implementation of two training programs in partnership with TH and Yukon College, including the Centre for Northern Innovation in Mining and the Yukon Research Centre. These training programs (Introduction to Environmental Monitoring Pilot Project and Northern Terrestrial Restoration) were provided to local First Nations students to promote awareness and understanding of environmental monitoring requirements and to offer students the opportunity to gain experience in experimental design, field sampling techniques, and native seed collection.

  Disturbed and undisturbed vegetation communities were surveyed to identify species naturally recolonizing disturbed areas. A seed source map for target revegetation species was created that integrated both scientific knowledge as well as traditional ecological knowledge from TH elders. The seed map exercise identified over 30 native plant species for potential use in revegetation at the site from 26 different locations.
- **2015 Greenhouse Trials – soil amendments and ecosystem recovery processes using arctic lupine:** At the Yukon Research Centre, greenhouse laboratory experiments using Arctic Lupine[2] were conducted in 2015 to test the relationship between soil amendments and the recovery of ecosystem processes. The greenhouse trials identified the potential for the return of natural ecosystem processes, such as nitrogen fixation, following ecosystem disturbance.
- **2015 Plant-root Interface Study:** This study included the characterization of the rhizosphere (i.e., plant-root interface) of northern native plants that are potential candidates for restoration to increase the understanding of mechanistic linkages between the composition and structure of plant roots, soil bacteria, fungi, archaea, and critical ecosystem functions as restoration proceeds.
- **2015 Plant-soil Transplant Trials:** This study examined the response of plant-soil plugs transplanted onto disturbed drilling fences. The evaluation involved establishing a plot on an existing drill pad and planting plugs from undisturbed subalpine areas within the plots. Growth within the plots was monitored for two years following planting to determine aboveground and belowground growth from the plugs, including identifying the vegetation within the plot, and estimating percent coverage of each vegetation type as well as over the total area.
- **2015 Temporary On-site Nursery:** Environmental Monitors and students from the Northern Terrestrial Restoration program established a temporary nursery at the Coffee exploration camp in 2014 and 2015 as part of a pilot project and participated in native seed potting trials and target species transplants. Newmont will continue to explore options for establishing a nursery.

[1] Mechanical reclamation involved the use of machinery and manual labor to replace the original vegetation layer from where it was removed.
[2] *Lupinus arcticus* - a common native species found at the Project site that promotes ecosystem processes.

Ongoing Revegetation Research Programs

Revegetation reclamation research studies that have been initiated and are currently underway for the Project include:

- **2014 Roadside Stakes and Bundles Plots:** An evaluation of the potential implementation of vegetation plots as an erosion and slumping control measure was initiated in 2014. The evaluation involved planting willow, birch, and balsam poplar cuttings as stakes (vertical cutting placement) or bundles (horizontal cutting placement) in three plots on the upslope side of Java Road. Annual observations are made at the plots to measure and record sprouting success rates.
- **2015 Revegetation and Soil Amendment Trials:** The Yukon Research Centre and Kaminak established revegetation and soil amendment trials in 2015 to test various reclamation techniques in different ecotypes present at the site. These trials were established at the site in conjunction with the Northern Terrestrial Restoration course. The trials are intended to assess various combinations of reclamation techniques including the addition of organic matter applied as a soil amendment, fertilizer, and/or seed. The trials are surveyed on an annual basis. Results from the research trials thus far have demonstrated that organic matter and fertilizer amendments have little to no overall effect on germination rates. However, the addition of fertilizer has affected the percent cover of vegetation found growing at sites, suggesting that aboveground biomass production can be promoted by the use of commercial fertilizers.
- **2021 Revegetation Research Project:** The project conducted by Yukon University through the YMRC aims to define revegetation success within the context of local community expectations, and also evaluates the implementation of living and/or non-living snow fences for a successful revegetation program. Local submissions to public engagements related to mining were reviewed to carry out the first component of the research program. The second component of the research program was initiated in 2021 at a nearby mine site and will be carried out over a period of four years to determine the effect of vertical structures (snow fences) on soil moisture and nutrient profiles. Green alder (*Alnus viridis* subsp. *crispa*), smooth-leaf mountain avens (*Dryas integrifolia*), and soapberry (*Shepherdia canadensis*) snow fences will be evaluated as living snow fences for their effect on revegetation success, and orange fence structures will be used to evaluate the effect of a non-living snow fence on revegetation success. Species selection for revegetation will be based on local expectations of reclamation success. The Year 1 Progress Report for this research program including details of the experimental design is provided in Appendix 2-C.
- **2023 Seed Collection / Seed Bank Program:** Newmont is currently updating the seed collection / seed bank program through Yukon Seed & Restoration that was initiated in 2015. The seed collection / seed bank program is aimed at updating the previous inventory and identifying the native seed sources for the Coffee site in support of the re-establishment of local populations during progressive reclamation. The seed collection / seed bank program will be informed by First Nations traditional knowledge and will be used to support the advancement of the Revegetation Research Project that is ongoing through Yukon University.

Proposed Future Revegetation Research Programs

Advancement of the revegetation research program will occur early in Project development as disturbed areas and reclamation materials become available. Future revegetation research will focus on, but will not be limited to, gathering information in the following areas:

- Bioclimatic zones
- Seasonal windows
- Component-specific target species, seed types and seeding rates
- Propagation methods, life cycles, successional tendencies
- Effects of elevation and/or aspects
- Fertilizer types and application rates
- Evaluation of cover materials (nutrient/moisture profiles).

Specific programs that are proposed for future revegetation reclamation research include the following:

- **Evaluation of natural regeneration on exposed waste rock surfaces** - Further evaluations of successional processes and natural regeneration on exposed waste rock will be established through field trials during mine development to inform the re-establishment rates of vegetation in the Alpha WRSF in closure. Field trials for this program would require areas of exposed waste rock, potentially segregated by waste rock type (i.e., schist, gneiss, and granite), and/or by material type.

  Planning of field trial locations will consider proximity to a natural seed source to supply the propagules necessary for natural regeneration as it is unlikely that waste rock material holds any viable seed bank. Field-based investigations will consist of surveys of existing vegetation on disturbed sites, and revegetation trial plots or vegetative ribbons. Revegetation trial plots and ribbons will typically be multi-year studies. Monitoring of trial plots or ribbons will be performed to quantify vegetation growth, condition, and potential inter-species effects. Annual trial plot data will be compared to identify trends in cover change, growth, species composition, and many other factors.

  A representative location will be selected for the trials during the construction phase, which may include the ROM Stockpile, the waste management area, or the Alpha WRSF. The trials are proposed to be carried out for a minimum of 3 years starting in Year 2.
- **Metals uptake in vegetation** – A program designated for vegetation tissue metal sampling of targeted species (ex. Country foods and diet species of key wildlife species) will be established at select locations, onsite and offsite. Designated sampling locations may include vegetated areas in each type of waste rock (i.e., schist, gneiss, and granite). Vegetation metal sampling is often completed in conjunction with soil sampling locations and assessments of metals concentrations in soil. Vegetation sampling methodology and laboratory analysis will be consistent with vegetation sampling and analysis guidelines provided in the Vegetation Monitoring Plan. Analysis of results would involve a comprehensive desktop review to applicable guidelines and toxicity thresholds to inform a human health risk assessment, in the context of food chain and exposure routes. The human health risk assessment will also be informed by First Nations input regarding potential land use patterns, species types, and site-specific consumption estimates.

  This program will likely occur in similar locations and on a similar implementation schedule to the natural regeneration on exposed waste rock surfaces evaluation. This evaluation may also be carried out as part of the HLF cover revegetation trial described below and will be monitored through implementation of the metal uptake monitoring described in the Vegetation Monitoring Plan.
- **HLF Cover System Revegetation Field Trial Program** – A field-based program for researching revegetation of the HLF cover system will commence once surface area and material is available on the completed Stage 1 of the HLF. The field study will focus on revegetation trials on the cover systems planned for closure of the HLF. Test plots will be established on each cover system,

incorporating a type of experimental design that allows for the statistical comparison of revegetation measures (such as the rate of fertilizer application) and control of external variables (such as spatial differences in substrate). The design layout and data analysis will provide more definitive information on the true effects of revegetation treatments such as fertilizer application or the effects of aspect.

Monitoring of trial plots will be performed to quantify vegetation growth, condition, and potential inter-species effects. Annual trial plot data will be compared to identify trends in cover change, growth, species composition, and many other factors. In addition, container tests of various HLF cover systems may be considered as a cost-effective option for single season evaluations such as testing propagation methods of select species. Results of these investigations will inform the final revegetation measures for individual site components and will be used to determine the criteria for performance inspections and monitoring programs.

The HLF cover revegetation trial plots will be established on the HLF once Stage 1 has been constructed to the maximum extent, and a trial cover has been established, estimated to occur in Year 6. The development of a detailed workplan plan will begin in Year 4.

2.3.1.2 Treatment Technologies Reclamation Research

Completed Treatment Technologies Research

Reclamation research studies that have been completed to evaluate treatment technologies at the site include:

- **Phase I – HLF Water Treatment Plant Treatability Assessment:** A treatability assessment and proof-of-concept for the removal of nitrate, arsenic, and uranium from leach waters was conducted in 2016, and consisted of laboratory assessment tests and evaluation of site water chemistry. Tests included a site water chemistry evaluation, microbial screening tests and treatment effectiveness assessment, Electro-BioReactor (EBR) validation testing, and in-situ denitrification testing. Phase I testing demonstrated removal of nitrate, arsenic, and uranium, and suggests the biological treatment would be effective at removing the contaminants of concern. Details regarding the Phase I treatability assessment are provided in Appendix 2-D.
- **Phase II – Bench-scale Testing:** Continuous flow laboratory column tests were established to develop the overall treatment approach for HLF waters. Testing within this phase removed contaminants of concern to below discharge targets and suggested a multi-stage treatment train as the most effective treatment approach. The recommended multi-stage train consists of physico-chemical pre-treatment, biological EBR treatment, and aerobic post-treatment. The Phase II testing established preliminary design and operational parameters for future on-site pilot-scale test work (Phase III). Details regarding the Phase II bench-scale testing are provided in Appendix 2-D. Appendix 2-D also provides a timeline for completion the HLF water treatment evaluations.
- **Pre-feasibility Level Lab-scale Study - In situ passive treatment of HLF drain down solutions:** A workplan describing the activities to support the feasibility assessment of permeable reactive barrier (PRB) technology at the Project was prepared by Lorax Environmental Services Ltd. and is provided in Appendix 2-E. A laboratory column experiment was conducted in collaboration with Lorax and Newmont to evaluate the use of PRB and biological reactor technologies to treat arsenic, nitrate and uranium in HLF rinse water. Three treatment system configurations were established in

plexiglass vertical columns to assess the treatment of drain down seepage in various mediums. The study was intended to demonstrate proof of principle for the effectiveness of in situ treatment of constituents within the heap, as well as to evaluate a dissolved organic carbon amendment for nitrate treatment.

Study findings indicated that treatment systems operating at a 96-hour hydraulic retention time (HRT) were able to reduce arsenic and uranium concentrations. Additionally, carbon amendments improved nitrate removal within some treatment configurations at an increased HRT. Treatment of some metals, including aluminum, antimony, and selenium, was also reported. An analysis of column residues to determine arsenic and uranium removal mechanisms will be carried out as part of the next steps for this research project. Details of the study and results are provided in Appendix 2-F and Appendix 2-G.

Proposed Future Treatment Technologies Research

Proposed reclamation research projects to evaluate treatment technologies at the site include:

- **Feasibility Level On-site Pilot-scale PRB Treatment (Closure Phase):** A semi-passive treatment system based on the principles of PRB technology is being considered for the Closure Phase of the Project as described in the feasibility assessment work plan (Appendix 2-E). Parameters for the on-site pilot-scale test work will be based on results of the pre-feasibility lab-scale PRB study (Appendix 2-F).

  Should passive treatment be required for closure, field scale PRB treatment trials will be proposed near the HLF once Stage 1 of the HLF has been constructed to the maximum extent, estimated to occur in Year 6. The PRB treatment trials would include an evaluation of potential methods for nitrate reduction prior to treatment within the PRB.

  Development of a detailed workplan for the PRB treatment system will begin in year 4. Construction and commissioning of the small-scale passive treatment system would occur during the first two years of the program, followed by approximately three years of data collection, analysis, and system optimizations. The piloting program would be expected to produce results in approximately Year 10. The specific objectives of each phase of the on-site passive treatment piloting program will be refined prior to implementation should this research program be advanced.

  A workplan that includes specifics for the PRB treatment system, including treatment system objectives and implementation schedule, will be provided in the next iteration of the RCP. An annual report will be prepared to provide an update on work that has been completed to advance the PRB treatment system design, work that is progressing, and work that is still outstanding prior to finalizing PRB implementation.

2.3.1.3 Site Characterization Reclamation Research

Completed Site Characterization Research

Site characterization reclamation research studies that have been completed to evaluate site conditions and optimize closure activities include:

- **2017 Soil Nutrient Testing:** Three topsoil samples from within the footprint of the HLF were tested to measure the soil's ability to retain positively charged nutrients (e.g., Ca^{2+}, Mg^{2+}, K^{+}, NH^{4+}) and

provided an indication of soil moisture retaining characteristics. The results are provided in Section 4.1.5.4.

- **2017 Coffee Mine Site Area Testpitting Program:** 42 drill holes and 72 test pits were completed in 2017 by Tetra Tech to investigate the composition, diggability, and thickness of the overburden in the Mine Site area, which provided a material balance. Additional work was completed by JDS in 2018. Reports for the 2017 and 2018 testpitting work are provided as Appendix 2-H and Appendix 2-I, respectively.
- **2018 Preliminary Ecohydrological Modelling Study:** Preliminary ecohydrological modelling that links conventional reclamation actions and surface water balances was carried out by Integral Ecology Group on potential cover and mine-waste materials. The objective of this work was to provide information on the following:
  - Volumes/depths of materials required for rooting-zone layers of reclamation cover systems, given available material properties and closure objectives.
  - Appropriate vegetation species for reclamation, given landform and cover-system characteristics.
- Expected hydrologic and ecologic performance trajectories for resulting ecosystems, including:
  - expected development of vegetation cover/leaf area over time.
  - expected development of evapotranspiration (ET) on reclamation cover systems over time.
  - expected resultant surface water-balance terms over time (e.g., runoff/interflow/net percolation).

The results of the ecohydrological modeling study are provided in Appendix 2-J.

Proposed Future Site Characterization Research

Proposed site characterization reclamation research studies include:

- **HLF Cover design optimization:** Additional research to optimize the HLF cover design including infiltration, erosion, and stability are proposed at the site. Cover design optimization is also proposed to evaluate various cover materials and aspects. This may involve a desktop review of all available information on HLF cover designs, modelling exercise, as well as field investigations to further characterize the properties of the proposed cover.

  Research on cover design optimization will incorporate outcomes and/or elements of the proposed HLF revegetation research program and will help inform the design of a cover system performance monitoring program. The program will be carried out on the HLF in an area that will be undisturbed, once Stage 1 of the HLF has been constructed to the maximum extent, estimated to occur in Year 6. Detailed workplan development will begin in Year 4. Outcomes of the trials may inform potential modifications to the current cover design described in Section 7.3.1 to improve site environmental performance and/or reduce water treatment needs.
- **Site cover design optimization:** Detailed evaluations of the cover design for site facilities, pads, and decommissioned infrastructure (i.e., roads) will be carried out to optimize and refine the proposed cover strategy for the site. At this time, cover placement at closure is based on the reclamation material prioritization evaluation (Section 7.2.4). The cover design optimization program will be carried out to determine cover performance (infiltration), erosional control performance and cover stability of various available reclamation materials once the materials and

representative areas that will not be disturbed become available. The evaluations will consider various aspects and slope angles and may include additional testpitting to further characterize reclamation material types and available volumes.

A representative location will be selected for the trials during the construction phase, which may include the ROM Stockpile, the waste management area, or the Alpha WRSF. The trials are proposed to be carried out for a minimum of 3 years starting in Year 2.

- **Soil nutrient assessment:** A detailed assessment on the nutrient profiles within various types of soil/reclamation materials at the site may be proposed to support the revegetation research program and to optimize revegetation efforts for each component based on growth medium that is available. This may include characterization of salvaged materials, including overburden and subsoil materials as well as a reference ecosystem with a similarity index to the salvaged material. Soil sampling locations will be selected as sites typical of the soils that the samples are intended to represent. Samples of undisturbed soils would generally be collected on a horizon or homogenous layer basis. Whereas salvaged soils would be collected on the basis of type of material, such as subsurface and overburden material, and on depth intervals within each discrete layer. Depth of sampling will be determined based on the type of material present.

  Nutrient sampling and analysis will be conducted and will likely include at least particle size distribution, percent saturation, electrical conductivity, soluble cations, cation exchange capacity, total nitrogen, total carbon, and macronutrient analysis as well as pH. Results of soil nutrient assessments will be used to establish criteria for evaluating reclamation material. The assessment will commence during site excavation activities and will be carried out at a pre-determined frequency throughout the Operation Phase within the soil stockpiles area.

2.3.1.4 Reclamation Research Implementation Schedule

The implementation schedule for reclamation research considers the overall intent of the reclamation research program to optimize preparedness and procedures for closure of specific mine components. Reclamation knowledge gained early in the construction and operation phases allows for maximum preparedness as well as early refinement of reclamation measures, subjective of continued end land use planning for the site. In addition, reclamation research will generally be carried out using areas and materials that are representative of the actual conditions encountered during closure of applicable mine components. Thus, reclamation research programs are planned to be implemented as early as possible once representative areas and materials become available.

Planning for the implementation of the proposed reclamation research programs will occur prior to and during the construction phase, and workplans will be developed with First Nations and affected communities presenting the approach to each proposed research program. Planning will include selecting representative areas and determining the source of materials that will be used for the reclamation research programs, which will consider the specific needs of each program. Workplans will be advanced during operations to refine the specific locations, materials, timelines, and overall approach to implementing the research programs.

Figure 2-1 provides an overview of the estimated implementation schedule for reclamation research programs as well as the estimated timeline for reclamation research program reporting. The schedule will be refined during operations and provided in future iterations of the RCP and will be primarily associated with mine advancement during each LOM milestone.

Key Activity	Project Phase and Year																							
	Permitting		Construction		Operation									Post-mining Closure						Active Closure					Post-closure
	-4	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
Seed Collection / Seed Bank Program																									
Revegetation Research Project (Yukon University)																									
Natural regeneration on exposed waste rock surfaces																									
Metals uptake in vegetation																									
HLF cover system revegetation trials																									
On-site pilot-scale PRB treatment (Closure Phase)																									
HLF cover design optimization																									
Site cover design optimization																									
Soil nutrient assessment																									
*Green highlighted cells indicate years that a report will be produced presenting the outcomes of the research that can be used to inform closure activities.																									

Figure 2-1 Estimated Implementation Schedule for Reclamation Research Activities

2.3.2 Progressive Reclamation

A key element in designing for closure is the incorporation of progressive closure activities including contouring, backfilling, and re-vegetating areas no longer needed for mining during active operations, where practicable. Progressive reclamation will provide opportunities to optimize the reclamation research program in existing site conditions, and will also advance the return of disturbed areas to self-sustaining biological ecosystems, increase confidence and continual improvement in long-term reclamation success, and reduce the overall final cost of reclamation by taking advantage of operational efficiencies. Newmont intends to maximize all opportunities for the operational implementation of progressive reclamation activities. Specific activities that are currently planned to occur progressively during the Operation Phase (Years -1 to 9) include the following:

- Implementation of the reclamation research program.
- Continuous salvage and stockpile of reclamation material including overburden stripped during operations (i.e., expansions of pits, development of new areas). Stockpile management during operations will be imperative to ensure that suitable reclamation material is available at closure. Strategic stockpile placement will also reduce costs associated with long haul distances and reduces requirements to re-handle material.
- Progressive reclamation of disturbed areas within the Mine Site footprint that are no longer required to support mine operations, including rough and loose site preparation and revegetating inactive areas as soon as practical.
- Progressive closure of haul and mine site roads no longer required to support operations.
- Reclamation of exploration areas (re-grade, scarify, and revegetate roads, fill and revegetate trenches) when access is no longer required.
- Proper construction and maintenance of water management structures (channels, ditches, berms, settling basis, etc.) during operations. In the context of these progressive reclamation activities, it is imperative that water management and erosion and sediment control around reclaimed areas is carefully planned to maximize reclamation success, limit the need for future disturbance, and divert clean water away from project areas.
- Regular removal of recyclable / salvageable material and equipment, using available back-hauls during the Operation Phase.
- Minor re-sloping of the Alpha WRSF near the end of the Operation Phase to maintain an overall slope of 3:1, achieve long-term physical stability criteria and appropriate water conveyance for closure.
- Near the end of the Operation Phase, material stored in the frozen soil storage area (FSSA) and deemed unsuitable for reclamation will be co-disposed in the Alpha WRSF. Placement methods, layer continuity, spacing, and thickness will be designed to ensure final stability of the Alpha WRSF landform.
- Partial backfill of Latte and Supremo Pits and closure of disused haul roads.
- Complete backfill of Kona Pit and Double Double Pit, and closure of disused haul roads.
- Progressive regrading of the HLF near the end of operations to maintain the base case closure design.
- Installation of water treatment facility and commencement of water treatment of excess water from the HLF.

Progressive reclamation effectiveness monitoring will be carried out through routine monitoring and visual inspections of progressively reclaimed areas. Results of the effectiveness monitoring will be compared to the performance targets and component-specific closure objectives for the facilities that have been reclaimed. The results will also be compared against the outcomes of reclamation research that has been completed to date. Results of the progressive reclamation effectiveness monitoring program will be used to inform future reclamation research programs and will be used to refine or optimize the closure measures for each facility.

2.3.3 Minimizing Project Effects

The Project has been designed and will be constructed and operated to minimize environmental and socio-economic effects. For example, the use of diversions to minimize the amount of non-contact water from becoming exposed to mine-related contaminants has been incorporated into the water management infrastructure design. Project design has also incorporated various measures for controlling contaminants, such as waste segregation, specific waste storage locations, liners, covers, water collection and treatment, and others. Such measures are described for the various Project components in Section 5.

Conservation of soil is also a very important aspect of minimizing effects, and erosion and sediment control measures will be implemented in all Project phases. Measures to prevent soil loss may include:

- Minimizing the size of the disturbed area (e.g., Project footprint).
- Maximizing the retention of natural vegetation cover and maintaining vegetation buffers (particularly near water).
- Avoiding or minimizing work in unstable areas and steep slopes and limiting disturbance of permafrost.
- Scheduling construction activities and the installation of perimeter sediment controls to mitigate sedimentation in higher risk areas.

Another important aspect of minimizing long-term Project-related effects is to reduce the potential for the establishment of invasive plant species. For this, Newmont has developed several mitigation measures and monitoring activities for implementation during mine operations, which will reduce and mitigate the potential for establishment of invasive plants at the mine in closure. The annual invasive plant surveys will be carried out along the proposed NAR alignment south of the Stewart River, from Maisy May to Ballarat and including the Coffee mine site.

With respect to minimizing long-term adverse social effects, potential risks will be minimized through careful planning and collaboration with Project partners, stakeholders, and First Nations to achieve a holistic understanding of the social context and to create corresponding management plans to monitor and manage risks. Socio-economic monitoring and mitigation measures to minimize potential negative effects to local communities and individuals will be described in the SEMP as well as in future iterations of the RCP.

2.3.4 Alternatives Assessment Overview

Throughout the closure planning process, Newmont has identified and assessed alterative options for closing the major mine components to achieve the Project-specific closure objectives as well as the closure vision for the site. The Closure Alternatives Assessment Report (Appendix 2-K) describes the approach to assessing the various alternative options and identifies the current base case design for closing the major

mine components. The base case closure measures may be re-evaluated as the end land use planning for the Project is advanced in alignment with a final landform that reflects the interests of all stakeholders, First Nations, and the local community. Therefore, although this alternatives assessment was carried out to verify a base case closure design, the process will remain open to including additional alternatives that may be identified through ongoing engagement and Project planning, as well as revisiting the feasibility determinations for each alternative as detailed designs are advanced.

A description of the alternatives assessment process and outcomes are provided here, a summary is provided in Table 2-1, and the detailed report is provided in Appendix 2-K.

The Project mine plan is designed to integrate closure considerations into the planning and operational processes; therefore, the alternatives assessment included both the location of facilities and infrastructure as well as the measures to close them. Specifically, the following aspects were assessed, as relevant to the major mine components:

- Component location for supporting mine development and Coffee Gold Mine closure objectives.
- Means of reclaiming and closing or decommissioning components to meet Coffee Gold Mine closure objectives.
- Timing of closure, involving the reclaiming and closing components either progressively or post-mining.

In the absence of specific Yukon guidance on the assessment of alternatives, this alternatives assessment has been conducted in accordance with the requirements of the *Canadian Environmental Assessment Act, 2012* (*CEAA;* Government of Canada 2012) and the Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under CEAA 2012 (OPS; Government of Canada 2015). The four steps outlined in OPS to determine the preferred means are as follows:

- **Step 1:** Identify technically and economically feasible alternative means
- **Step 2:** List their potential effects on valued components
- **Step 3:** Select the approach for the analysis of alternative means
- **Step 4:** Assess the environmental effects of alternative means.

These steps were modified in this assessment to evaluate relevant aspects of each component (i.e., both component location and closure measures), optimize and integrate workshop discussions, and to identify 'base case' closure alternatives. The steps that were followed for this assessment are as follows:

- **Step 1:** Identify technically and economically feasible alternative means
- **Step 2:** Identify Potential Effects on Coffee Closure Values
- **Step 3:** Identify Preferred Alternative Means
- **Step 4:** Failure Modes and Effects Analysis.

The following aspects were considered in this assessment:

- Backfilling of open pits
- Location of waste rock storage facilities
- Cover for water rock storage facilities

- Location of heap leach facility
- Cover for heap leach facility
- Decommissioning of water management infrastructure including the Alpha Dam/Pond and west diversion
- Decommissioning of the NAR.

Alternatives to the location and/or closure of other Project components such as mine site roads, haul roads, and buildings have not been evaluated further than what was described in the YESAA Project Proposal, as this type of infrastructure is currently planned to be decommissioned and reclaimed as per Yukon Government requirements or guidelines (EMR 2006, EMR and YWB 2013).

2.3.4.1 Step 1: Identify Feasible Alternative Means

Technical feasibility relates to the appropriateness of an alternative from an engineering or operational perspective and incorporates aspects of known performance, reliability, and implementation for the Project. Economic feasibility of an alternative relates to the overall costs including capital, operating and maintenance, as relevant to the closure aspect. The following approach was taken to identify and describe technically and economically feasible alternative means of closing the Project:

- Select potential alternative means
- Develop criteria to measure the technical and economic feasibility of the alternative means
- Identify the alternative means that are technically and economically feasible based on qualitative evidence and professional judgment
- Document the rationale for the alternative means retained for further consideration in the assessment.

The selection and feasibility assessment of alternative means was informed by a review of available reports, consultation with qualified professionals, and input from various levels of government and First Nations in support of the Yukon Environmental and Socioeconomic Board (YESAB) Executive Committee Project Proposal. Feedback received during various evaluations carried out during Project review under YESAA, including the Preliminary Project FMEA (Appendix 2-L), were integrated into this assessment process. The following technical criteria were used to evaluate the technical feasibility of each alternative:

- Long-term chemical and/or geochemical stability
- Long-term physical stability of infrastructure or facilities
- Physical stability of cover material
- Quantity of natural cover material available
- Ability to meet technical design criteria
- Ability to be progressively reclaimed
- Supports the mine development plan with respect to mining stages
- Location or design provides required capacity/storage
- Does not impound water.

The following economic criteria were used to evaluate the economic feasibility of each alternative:

- Cost to implement is acceptable
- Will not result in resource sterilization
- Maintenance liability is finite.

If an alternative was considered to not meet one or more technical or economic criteria, it was no longer considered a viable option and was eliminated from further consideration. Where technical and economic feasibility screening identified only one feasible closure option, this option was advanced as the base case, and no further evaluation was conducted. Where more than one feasible closure option was identified, the options were advanced for further evaluation under Step 2 of the assessment. Details of the feasibility screening are provided in Appendix 2-K.

2.3.4.2 Step 2: Identify Potential Effects on Coffee Closure Values

Alternative closure measures that were identified as feasible during Step 1 were advanced for further consideration in Step 2 to compare the merits of each alternative in relation to the Project-specific closure values that may be adversely or beneficially affected by them. The assessment was carried out at a level sufficient to distinguish the relative merits of the different options based on the consideration of the advantages and disadvantages of each. The following closure values were selected to represent the intermediate components (ICs) and valued components (VCs) of the Project in this step of the assessment:

- Physical and chemical stability
- Health and safety
- Ecological processes and functions
- Land use
- Socio-economics
- Aesthetics.

The Step 2 evaluations were carried out through workshops held with TH and SFN in August 2018. The closure values were assigned a weight to provide a relative scoring matrix, and the feasible alternatives were ranked to indicate the relative effects on each closure value between alternatives. Based on the descriptors of the advantages and disadvantages of each alternative, the preferred alternative(s) was identified under Step 2 of the assessment, and alternatives requiring further evaluation were identified. The alternatives were then advanced to Step 3 to carry out the additional evaluations and identify the base case closure measures. The alternative rankings carried out under Step 2 are described in Appendix 2-K.

2.3.4.3 Step 3: Identify Preferred Alternative Means

The intent of Step 3 of the assessment was to inform the selection of alternatives that would be identified as the base case closure approach by carrying out the technical and economic evaluations on the alternatives that were identified as requiring additional evaluation. The evaluations that were carried out for select alternatives are described in Appendix 2-K, and include but are not limited to:

- Economic evaluations
- Water management evaluations
- Water quality/balance modelling
- Material balance evaluation

- Cover material performance
- Cover material prioritization
- Cover slope/sediment and erosion stability
- Heap seepage rate
- Infiltration/draindown modelling.

Based on outcomes of the evaluations, as well as results of the Step 2 evaluations, the base case closure measures were identified, and are summarized in Table 2-1. The material balance evaluations will be advanced throughout operations as well as the end land use planning, which may require further evaluation and consideration of alternatives that were not identified as the base case for closure during this Step 3 evaluation.

Additional assessments will be conducted as part of the reclamation research program throughout operations in existing site conditions to optimize the performance of reclamation material. The reclamation research program will include evaluations of cover thickness/type, as well as cover system revegetation capacity and infiltration. Results will be integrated into the closure plan to optimize site reclamation activities.

2.3.4.4 Step 4: Failure Modes and Effects Analysis

The FMEA was completed under Step 4 of the assessment to identify and prioritize key risks of the base case design in order to outline strategies for risk mitigation and maximize risk control resources. A workshop was held in February 2022 to collaboratively rank the failure modes that were identified with respect to the overall objectives for the Project. During the workshop, ten failure modes were evaluated as severe or high-risk. No identified failure modes were evaluated as a fatal flaw that would require modification of the base case design. A residual risk assessment determined that all unacceptable risks could be mitigated, with the exception of three high-risk rankings related to major life of project cost consequences, which were identified as acceptable given the current Project definition.

This FMEA workshop was carried out internally to identify fatal flaws to verify the base case closure design. Future FMEA workshops will be held with every RCP update for alignment with end use planning goals. The future FMEA workshop discussions will include First Nations participation. The FMEA Summary Report is provided in Appendix 2-M.

Table 2-1 Summary of Closure Alternatives Evaluation

Mine Component Considered		Feasible Alternative Means
Open Pit Backfilling	Latte Pit	**Partial backfill- backfill used as haul roads**
		Partial backfill- backfill for other purpose
		Complete backfill – progressively
		Complete backfill – end of mine life
	Double Double	No backfill
		Partial backfill
		Complete backfill
	Kona	No backfill
		Partial backfill
		Complete backfill
	Supremo	**Partial backfill- backfill used to optimize mine development**
		2 WRSFs - West & South
		1 WRSF - Alpha
	Waste storage duration for Kona waste	Temporary Beta WRSF Location
		Permanent Beta WRSF Location
		All Kona waste rock to primary WRSF
Waste Rock Cover	Overall slope steeper than 3:1 but flatter than angle of repose	No cover
		Partial cover on flats
	Overall slope 3:1[1]	**No cover**
		Partial cover on flats
		Complete cover
	Overall slope flatter than 3:1[2]	No cover
		Complete cover

Mine Component Considered		Feasible Alternative Means
HLF Location	**2016 Feasibility Study leach pad**	
	Valley C leach pad	
HLF Cover	2016 Feasibility Study leach pad	*Partial cover*
		(1) 2.5:1 construction and closure slopes; Geosynthetic Clay Liner (GCL) installed on flat surfaces progressively
		(5b) 2.5:1 construction and 3:1 closure slopes by re-grading during closure (wings); GCL installed on flat surfaces progressively and on wings at closure
		(8, 8a) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on flat surfaces progressively
		Complete cover
		(5a) 2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively
		(4) 3:1 construction and closure slopes; all surfaces covered with GCL progressively
		(7) 2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes
		(8b) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces
	Valley C leach pad	Partial cover
		Complete cover
Decommissioning of Water Management Infrastructure	Alpha Dam/Pond	Remove dam completely
		Create channel without completely removing dam materials
	West Diversion	Partial decommissioning at natural depression drainages
		Complete decommissioning (re-grade to slope)
Decommissioning of NAR	**Decommission Project-associated (new) NAR sections (approximately 37 km)**[3]	
	Leave Project-associated NAR sections (approximately 37 km) in place[3]	
	Close additional road sections beyond those that are Project-specific	

Notes: Bolded cells indicate the base case closure option identified though the alternatives assessment process.

[1] Internal slopes are <3:1, but overall slope is 3:1; [2] Assumes re-grading of slopes and no benches; [3] This alternative was based on the previous NAR new road construction length (37 km). 2023 construction updates for NAR include approximately 29 km of new construction.

3.0 CLOSURE OBJECTIVES AND DESIGN CRITERIA

This RCP has been developed using an objectives-based approach that is consistent with Yukon guidance as well as the International Council on Mining & Metals (ICMM) Integrated Mine Closure Good Practice Guide. The RCP presents a post-mine vision, closure principles, Project- specific objectives, and component-specific objectives that have been developed based on stakeholder and community feedback, professional experience, and standard practices, and follow the Yukon Mine Site and Reclamation Closure Policy Financial and Technical Guidelines (EMR 2013). The financial guidelines apply within the context of security provided with a production licence under the *Quartz Mining Act* and security required pursuant to a water licence under the *Waters Act*. The technical guidelines provide direction on the objectives that have been considered in development of the RCP.

The post-mine vision is the foundation for advancement of end land use planning at the site. End land use planning will be used to refine the Project-specific closure objectives throughout the LOM. The project-specific closure objectives as well as end land use planning will be used to guide the reclamation research in future iterations of the RCP. Reclamation research outcomes will in turn be used to refine closure options and may inform continued end land use planning as the Project advances through construction and operations. The approach to advancing end land use planning at the site is described below.

Design criteria have been developed following applicable regulations and available guidance documents to facilitate Project development. Design criteria has been developed for mine components as well as socioeconomic components and are discussed below. Approaches to quality management, survey and materials testing are also described within this section.

3.1 Reclamation and Closure Planning Approach

The principles and approaches outlined in the Reclamation and Closure Planning for Quartz Mining Projects guidance document (YWB and EMR 2013) were incorporated into the development of the Coffee reclamation and closure objectives. The closure principles are defined by Yukon regulators as the Yukon Fundamental Mine Reclamation and Closure Objectives (YWB and EMR 2013). The post-mine vision and the Project-specific reclamation and closure objectives were defined by Newmont in collaboration with stakeholders and First Nations. The overall Project objective is to allow the mine site to be closed in accordance with the Project-specific and component-specific closure objectives in order to achieve the post-mine vision that has been defined for the Project, and also in accordance with end land use planning that is being advanced for the Project. The Project-specific closure objectives presented herein are reflective of discussions that have transpired during the RCP workshops and will evolve as engagement is ongoing. A table outlining the closure principles, Project-specific closure objectives, and component-specific closure objectives along with the base case closure measures as applicable to each major mine component is provided in Appendix 3-A.

3.1.1 Post-mine Vision

Previous discussions of the Project-specific closure objectives during workshops held with Newmont and First Nations lead to the development of a post-mine vision for the Project, which includes the following key elements:

- The site has returned to pre-mining conditions[3] to the extent practicable, with enhancements for future generations.
- By planning for future generations, First Nation rights, titles, and interests within their Traditional Territory have been protected and respected.

The post-mine vision for the site provides the foundation for development of an end land use planning approach that is within the interest of all stakeholders and First Nations.

3.1.2 Closure Principles

The closure principles for this RCP are based on the Yukon Fundamental Mine Reclamation and Closure Objectives defined by the YWB and EMR (YWB and EMR 2013) and are listed in Table 3-1. Newmont has used these closure principles to guide the development of Project-specific and component-specific closure objectives. Newmont does not foresee any constraints to achieving these fundamental objectives, as the overall objectives for the Project are to permanently close the mine with minimal intervention or ongoing requirements, except for periodic inspections and minimal maintenance.

[3] Pre-mining conditions refers to the state of land, air, water, and resources prior to Project-related activities and disturbances associated with both exploration and mining.

Table 3-1 Closure Principles

Coffee Closure Principles	
Physical Stability	• All mine-related structures and facilities are physically stable and perform in accordance with designs. • All mine-related structures, facilities and processes can withstand severe climatic and seismic events.
Chemical Stability	• Release of contaminants from mine-related waste materials occurs at rates that do not cause unacceptable exposure in the receiving environment.
Health and Safety	• Reclamation eliminates or minimizes existing hazards to the health and safety of the public, workers, and area wildlife by achieving conditions similar to local area features. • Reclamation and closure implementation avoids or minimizes adverse health and safety effects on the public, workers, and area wildlife.
Ecological Conditions and Sustainability	• Reclamation and closure activities protect the aquatic, terrestrial and atmospheric environments from mine-related degradation and restore environments that have been degraded by mine-related activities. • The mine site supports a self-sustaining biological community that achieves land use objectives.
Land Use	• Lands affected by mine-related activities (e.g., building sites, chemical and fuel storage sites, roads, sediment ponds, tailings storage facilities, waste rock storage areas, underground workings, etc.) are restored to conditions that enable and optimize productive long-term use of land. Conditions are typical of surrounding areas or provide for other land uses that meet community expectations. • Site access is consistent with community land use expectations.
Aesthetics	• Restoration outcomes are visually acceptable.
Socio-economic Expectations	• Reclamation and closure implementation avoids or minimizes adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits. • Reclamation and closure activities achieve outcomes that meet community and regulatory expectations.
Long-term Certainty	• Minimize the need for long-term operations, maintenance and monitoring after reclamation activities are complete.
Financial Considerations	• Minimize outstanding liability and risks after reclamation activities are complete.

Source: YWB and EMR (2013) – Yukon Fundamental Mine Reclamation and Closure Objectives

3.1.3 Project-specific Closure Objectives

Project-specific closure objectives based on the closure principles are presented in Table 3-2. The objectives were selected, defined, and refined collaboratively by Newmont and First Nations in a series of closure-related workshops that occurred in May, August, and September 2018. Provisions or objectives contained in the Umbrella Final Agreement (1993) (and also contained in the TH Final Agreement (1998), and SFN Final Agreement (1997)) informed the closure objectives defined for each closure value, as noted at the bottom of Table 3-2.

The intent of the Project-specific objectives will be to ultimately advance activities in accordance with end land use planning for the site, to respect the values and expectations of other land users, and to meet or exceed the intent of the closure principles. The Project-specific closure objectives may evolve as the end land use planning approach is refined.

Further collaboration regarding the closure objectives as mine planning advances will include focused discussion and refinement of the social closure objectives throughout the LOM. This focussed discussion will be aimed at developing the specifics of the high-level social closure objectives described in Table 3-2. In addition, the discussions will inform the development of the social performance criteria that are tied to the objectives. The criteria will be based on information gathered through consultation, as well as through monitoring activities outlined in the SEMP, and community investment, and will be refined through ongoing engagement with First Nations and affected communities.

This collaborative approach is a critical part of defining these objectives and characterizing measures of success that are reflective of the local community and economy. Baseline community data will also be used to guide the refinement of the objectives and performance criteria. As such, the development of the social closure objectives is ongoing and advancement of these objectives as well as outcomes of the discussions will be described in future iterations of the RCP.

Table 3-2 Project-Specific Closure Objectives

Closure Principles	Closure Objectives
Physical and Chemical Stability	• All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events.[A] • Protect and maintain the land, air, and water in a condition that provides for sustainable use.[A, B3, B7, B10, B15, B18, B20] • Ensure water remains substantially unaltered from pre-mining conditions[1] to the extent practicable with respect to quantity, quality and rate of flow, including seasonal rate of flow.[A,B13, B14]
Health and Safety	• Protect the health and safety of people and area wildlife using and accessing the site by emulating pre-mining conditions to the extent practicable.[A]
Ecological Processes and Functions	• Protect or enhance ecological processes and functions in order to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities, with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions.[A, B15]

Closure Principles	Closure Objectives
Land Use	• Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development[2].[A, B3, B7, B15, B18, B20] • Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable.[A] • Ensure the site and specific assets are available for use post-closure.[A]
Country Food and Traditional Economy	• To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources.[A, B4, B14, B15, B18]
Participation and Positive Relationship	• Maintain ongoing positive relationships or partnerships between Newmont and Yukon First Nations through closure and post-closure. [A] • Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation.[A, B2, B5, B9, B10, B17, B19, B21]
Culture and Heritage	• Recognize, protect, and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations. [A, B1, B8, B11, B12, B16]
Community Health and Well-being	• Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures.[A, B6] • Protect and promote the well-being of other Yukon residents and the interests of the public.[A, B6]
Economics	• Avoid or minimize adverse economic effects on the potentially affected community and First Nations, while supporting economic sustainability during and beyond the LOM.[A, B3, B22, B23]
Aesthetics	• Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land.[A]
Long-term Certainty	• Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management[3]).[A] • Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks.[A]

Notes: 1. Pre-mining conditions refers to the state of land, air, water, and resources prior to Project-related activities and disturbances associated with both exploration and mining; 2. Sustainable Development, as defined in the Umbrella Final Agreement, means beneficial socio-economic change that does not undermine the ecological and social systems upon which communities and societies are dependent; 3. In this context, adaptive management includes a systematic and iterative process of monitoring and evaluating changing site conditions to inform adjustments to adaptation options and reduce uncertainty over time.

* Contributing sources of information:

A. Goldcorp Coffee Project Closure Workshops with TH (May and August 2018) and SFN (September 2018) – During the May workshop, TH expressed interest in fully reclaiming the site and access road to pre-mining conditions, with agreement from Goldcorp that this would be carried out to the extent practical.

B. Umbrella Final Agreement (1993), TH Final Agreement (1998), and SFN Final Agreement (1997) – Referred to Objectives and Provisions (common to the three agreements) = B1: 11.1.1.3, B2: 11.1.1.4, B3: 11.1.1.6, B4: 12.1.1.1, B5:12.1.1.2, B6: 12.1.1.3, B7: 12.1.1.4, B8: 12.1.1.5, B9: 12.1.1.6, B10: 12.1.1.8, B11: 13.1.1.1, B12: 13.1.1.2, B13: 14.8.1, B14: 14.9.1, B15: 16.1.1.2, B16: 16.1.1.3, B17: 16.1.1.4, B18: 16.1.1.5, B19: 16.1.1.7, B20: 16.1.1.9, B21: 16.1.1.11, B22: 22.1.1.1, and B23: 22.1.1.2.

3.1.4 Component-specific Closure Objectives

Component specific closure objectives were developed for the project based on the First Nations feedback and the base case closure measures as applicable to each component. The component-specific closure objectives include consideration of the following elements:

- Minimizing infiltration/contact water
- Mitigating pathways for metal update in vegetation and wildlife
- Supporting target ecosystems and habitats
- Measures to ensure arsenic concentrations within the top metre of waste rock storage locations will not exhibit an arsenic concentration greater than 60 mg/kg, on average.

The component-specific closure objectives for each major mine component are intended to guide site specific reclamation and closure research as well as closure planning to ensure that public health and safety and environmental protection goals are met. Similar to the Project-specific closure objectives, the component-specific closure objectives will be refined through the advancement of the end land use planning for the site.

Table 3-3 provides the component-specific closure objectives for each major mine component for the Project. Evaluations will be ongoing and the workplans for each major mine component will be advanced as the level of engineering for the closure measures is advanced.

Table 3-3 Component-Specific Closure Objectives and Closure Measures

Component-specific Closure Objective	Open Pits	Alpha WRSF	HLF	Water Management Infrastructure	NAR	Infrastructure
Minimizing infiltration / contact water	• Evaluations will be ongoing and the workplans for each major mine component will be advanced as the level of engineering for the closure measures is advanced.	• May receive cover based on operations material balance. • West Diversion maintained during the Post-mining Closure Phase. • Minor re-sloping in closure to construct appropriate water conveyance.	• Heap surface compacted, engineered cover installed on flat areas. Store and release cover system on slopes. • Surface drainage system established during cover construction.			
Opportunities to mitigate pathways for metal uptake in vegetation and wildlife	• The reclamation research program will evaluate metals uptake in various growth media, including bare waste rock with a range of arsenic concentrations. Site-specific reclamation efforts will be advanced based on outcomes of research.					
Supporting target ecosystems	• Pits backfilled with waste rock. • Spillway channels constructed to prevent erosion and downstream sedimentation. • Disturbed areas around pit perimeters and spill points revegetated.	• Natural revegetation of WRSF. • Revegetation strategy may be updated based on outcomes of reclamation research program and/or end land use planning.	• Active water treatment will remain in effect until passive water treatment system (if needed) commissioned, or until water quality objectives met. • HLF and HLF ponds revegetated.	• The base of sedimentation ponds will be revegetated. Alpha Pond base reshaped to natural streambed. • Strategic breach locations to protect permafrost. • Conveyance structures regraded to pre-mining drainage patterns. • Disturbed areas revegetated.	• New sections of NAR reclaimed. ○ Culverts, bridges removed, pre-construction surface drainage patterns established. ○ Scarifying and re-contouring surfaces. ○ Disturbed areas revegetated.	• Equipment and infrastructure removed. • Hazardous waste removed from site. Other waste transported offsite or landfilled on-site if on approved landfill item list. • Concrete pads broken up. • Disturbed areas covered and revegetated.

Component-specific Closure Objective	Open Pits	Alpha WRSF	HLF	Water Management Infrastructure	NAR	Infrastructure
Measures to ensure arsenic concentrations within the top metre of waste rock storage locations will not exhibit concentrations greater than 60 mg/kg, on average	• Kona and Double Double Pit backfill will be capped with at least one meter of low arsenic material (at or below 60 mg/kg).	• The Alpha WRSF will be progressively capped with at least one meter of low arsenic material (at or below 60 mg/kg).				

3.1.5 Water Quality Objectives

Use protection site-specific water quality objectives (WQO), have been developed for the site based on the primary receiving environment and will be an extension of the operational WQO into closure. WQO will be utilized to develop the effluent quality standards (EQS) for discharge to the receiving environment, and will guide the continuous improvement measures and/or research to reduce loading of contaminants into the receiving environment, including:

- Advancing the proof-of-concept and detailed design for water treatment technologies and optimizing the systems throughout the Project's Operation Phase.
- Evaluating and updating the water treatment and water management strategies as mine planning advances, and closure concepts are refined.

A summary of the use protection WQO are provided in Table 3-4. The WQO will be intended to meet the long-term protection goals for waterbodies downstream of the mine components. Further details regarding the WQO are provided in the Proposed Site-Specific Water Quality Objectives for Primary Receiving Environments Report (Lorax 2021).

Table 3-4 Summary of Proposed WQO for Halfway Creek, Latte Creek, and YT-24

Parameters		Units	Halfway Creek	Latte Creek	YT-24	Regulatory Source
General Chemistry	SO_4	mg/L	218	309	218	BC-MOE
	Nitrate-N	mg/L	8	8	8	SSWQO
	Nitrite-N	mg/L	0.02	0.02	0.02	BC-MOE
	NH_3-N	mg/L	1.5	1.3	1.8	BC-MOE
	CN_{WAD}	µg/L	5	5	5	BC-MOE
Metals	D-Al[1]	µg/L	445	367	274	SSWQO
	T-Sb	µg/L	9	9	9	BC-MOE (I)
	D-As	µg/L	5	5	5	SSWQO
	D-Cd	µg/L	0.2	0.2	0.10	CCME
	D-Cu	µg/L	4.3	4.7	5.3	SSWQO
	T-Fe	µg/L	1,000	1,000	1,000	BC-MOE
	D-Fe	µg/L	350	350	350	BC-MOE
	T-Pb	µg/L	2	3	1	CCME
	T-Hg	µg/L	0.026	0.026	0.026	CCME
	T-Mo	µg/L	73	73	73	CCME (I)
	T-Ni[2]	µg/L	72	96	25	CCME
	T-Se	µg/L	2	2	2	BC-MOE
	Ag	µg/L	0.25	0.025	0.25	CCME
	U	µg/L	86	31	15	SSWQO/CCME
	D-Zn	µg/L	24	31	26	CCME

Notes: [1] Al-D values for open water period of April to October. For winter period of November to March value is 50 µg/L
[2] Interim Ni WQO proposed for Coffee.
T - Total and D – Dissolved forms
BC MOE – British Columbia Ministry of Environment
CCME – Canadian Council of Ministers of the Environment
SSWQO – Site-specific water quality objectives

3.2 End Land Use Planning

End land use planning is advanced through a process that identifies a collaborative vision for the site via information gathering and consultation and includes refinement/evolution of the objectives as Project planning and reclamation research progresses. The end land use planning approach for the Coffee Mine will follow the guidance provided in the Integrated Mine Closure Good Practice Guide (ICMM 2019), which includes consideration of:

- Traditional land use studies
- Land ownership
- Post-closure land configuration
- Capability of the land to sustain the objectives
- Maximizing land use benefits for all stakeholders, Project partners, and First Nations.

This approach builds an informational database to identify the closure options that would ultimately achieve the post-mine vision for the site. The database will be maintained and updated as discussions with First Nations, local communities, and stakeholders are ongoing. The collective database aims to gain a comprehensive understanding of existing ecosystems and habitats, pre-mining and post-mining land use, socioeconomic context, history, and traditional land use to facilitate the advancement of end land use planning for the Project.

Traditional Land Use studies have been carried out by Newmont in collaboration with First Nations and local communities to achieve a greater understanding of the Project area, and Newmont is committed to advancing this knowledge base through further studies and mapping exercises.

Specific end land use planning expectations for each of the considerations listed above will be defined through a collaborative workshop with First Nations and affected communities, and the approach to end land use planning will be reviewed through regular workshops to identify common values for Project, including consideration of potential land uses at the site (e.g., medicinal plants, wildlife habitat). End land use planning may be modified to reflect evolving community and stakeholder interests that are identified through the workshops throughout the LOM.

Advancement of end land use planning at the site will ultimately result in refined project-specific closure objectives and post-mining ecosystem targets and will guide the reclamation research program. Landscape and/or land use maps will be developed and refined to characterize the post-mining landscape, including landform design and key features. These end land use planning components, including outcomes of workshops described above, will be provided in future iterations of the RCP.

3.3 Design Criteria

Project development and reclamation and closure planning has been guided by many design criteria, ranging from regulatory and guidance-based criteria, constraints imposed by the Project location, and local area characteristics, and criteria (including socio-economic monitoring criteria) established through consultation and engagement activities. A quality management program will be developed to outline the Project quality specifications and design criteria that will align with Newmont's quality objectives. Information related to Project component design criteria, socio-economic effectiveness criteria, and quality management is outlined below.

3.3.1 Project Component Design Criteria

The selected means of reclaiming and/or closing Project components, based on information known at this time, dictate which Project components will remain as part of the landscape post-closure. Mine components that are currently anticipated to remain post-closure in either as-developed or post-closure form include partially backfilled Latte and Supremo Pits, the Alpha WRSF, the ROM stockpile pad, and the covered heap leach pad. The design basis that has been developed thus far for these features is described in the RCP in Sections 5.3.1, 5.3.2, 5.3.3, and 5.3.5, respectively. All other components of the Project, except some ancillary components (e.g., Coffee exploration camp), will be decommissioned and disturbance footprints reclaimed in accordance with best practices and site-specific reclamation criteria and measures, which will be informed by advancement of end land use planning as well as the outcomes of reclamation research activities.

Ultimately, all design, reclamation, and closure criteria will be selected with the intent of demonstrating the effectiveness of the component's design towards achieving Project-specific closure objectives. That is, reclamation and closure-related criteria can be linked to Project-specific and component-specific closure objectives to monitor long-term performance of these components and the achievement of the post-mine vision for the Project.

3.3.2 Socio-economic Criteria

Socio-economic criteria that will define the effectiveness for closure of the Project as a whole are described in Section 7.12 and will be updated based on results of the SEMP as well as discussions with First Nations, local communities, and stakeholders as Project planning advances. Criteria will continue to be monitored during the Closure and Post-closure Phases. Results of the SEMP will be reviewed to determine the effectiveness of closure measures in achieving the socio-economic criteria, and to ensure that the Project-specific closure objectives continue to be met well after decommissioning and reclamation activities are complete.

The SEMP has been developed to align with the interests of affected First Nations and will be updated as discussions regarding socio-economic criteria progress through project planning. Commitments made within the SEMP as well as within benefit agreements with affected First Nations will be used to inform social closure planning in future iterations of the RCP.

3.3.3 Quality Management

Project quality is defined as "*the level to which a finished project meets the expectations of the Owner and as further defined in the project specifications*". Project specifications will define specific quality expectations and be a reflection of Newmont's quality objectives. Specifications will include documents such as:

- Project specific standards or codes
- Drawings
- Functional descriptions
- Contractor work scopes.

The quality management program will define the procedures to which the Project Management Team and contractors will adhere in order to ensure project quality objectives are met. The quality management program objectives are as follows:

- Ensure that the Project will operate safety
- Ensure that the Project meets standards and objectives contained within permits, licenses and other commitments Newmont has made
- Protect the project cost and schedule objectives by minimizing damage, waste, and re-work
- Ensure that specifications are understood by vendors and contractors
- Confirm appropriate vendor and contractor quality surveillance is performed
- Demonstrate the delivered project meets project quality objectives by providing documented evidence.

Quality management on the Project focuses on two key elements: conformance to requirements (producing what was specified) and fitness for use (satisfying real needs). The project is committed to a philosophy of "Behavior Based Quality", where each person is responsible for the quality of their own work. The quality management program will focus on achieving its objectives by implementing a quality regime that will:

- Deliver project outcomes that meet or exceed specified project performance requirements through a systematic approach to the management of loss, and integrating reliability and quality with the reduction of risk to people, the environment, assets and production.
- Implement appropriate site processes, systems and procedures to support construction activities.
- Minimize waste, non-conformances and re-work.
- Mitigate turnover and start-up problems.

The site quality management program will be implemented to support construction execution. The program will be reviewed by the Engineer and Newmont to ensure with certainty that it will support construction activities that conform with the specifications, and that it will support speedy acceptance of the work being performed. Contractor Quality Control Plans will be expected to meet or exceed the requirements of the project quality management program.

Primary activities to support quality management will include survey and materials testing.

3.3.3.1 Survey

Survey will be required to provide layout, and to ensure placement of all reclamation material as well as any manufactured material is in accordance with the final reclamation designs. Survey will also play an important role in stockpile management.

3.3.3.2 Material Testing

A mobile lab may be required to ensure appropriate turn-around times for Quality Assurance/Quality Control (QA/QC) testing and would be provided by a specialized contractor. The lab could be staffed with two personnel, with one personnel dedicated to construction monitoring, sample collection, and compaction testing with the other dedicated to testing and analysis. A control test will be taken prior to excavation or in stockpile and a record test will be taken after placement.

American Society for Testing and Materials (ASTM) standard sample collection and testing procedures as specified by the design engineer will be followed. Any material that does not meet specification during a control test will not be placed and any material that does not meet specification during a record test will be excavated and replaced. Specifications for particle size distribution (PSD), laboratory compaction, moisture content, specific gravity, organic content, placed moisture content and compaction (by nuclear methods) and others will be set by the design engineer. Testing intervals will also be specified by the design engineer. On-site or off-site geochemical testing and analysis may be required as described in the Waste Rock and Overburden Management Plan (WROMP), Geochemical Monitoring Plan and as specified in the final reclamation designs to ensure that reclamation material is NAG and non-metals leaching (non-ML).

4.0 ENVIRONMENT AND SOCIOECONOMIC DESCRIPTIONS

This section describes the existing environmental and socio-economic conditions for areas with the potential to be directly or indirectly affected by mine-related activities, as well as conditions in reference areas, where relevant. The characterization of existing conditions is representative of pre-disturbance conditions as the Project areas to be developed are currently undisturbed with the exception of localized exploration-related disturbances (refer to Section 5.4 for more information on current site conditions).

4.1 Physical Environment

The Coffee property is located in the northern Dawson Range, forming a moderate plateau that escaped Pleistocene glaciation. As such, the topography of the area is defined by stream erosion resulting in gently rounded hills with tightly incised valleys. Across the property, elevations range from 400 m to 1,500 m above sea level (masl). The property encompasses an area of partially tree-covered hills on the Yukon Plateau, incised by mature drainages that are part of the Yukon River watershed. The Project is situated along a high, undulating ridge that ascends to more than 1,300 masl.

This section describes the physical elements that influence the geographical area of the Mine Site area, including weather and climate, seismic conditions, and the physical environment components with the potential to be affected by mine-related activities, including air quality, noise, surficial geology, terrain, and soils, hydrology, surface water quality, and groundwater.

4.1.1 Weather and Climate

At present, there are two active and continuously recording climate stations (Kona climate station and Km 11 climate station (locations shown in Figure 4-1). In addition, multiple snow courses have been measured at the property, and two standalone tipping bucket rain gauge stations were installed in 2015 at low (430 m) and high (1,300 m) elevations to further refine the orographic gradients at Site. The rain gauge stations were in operation until 2018. Overlapping climate data from these two weather stations, as well as any supplementary precipitation data collected at the rain gauges and snow courses, will be used to update the characterization of the site climatic regime, and refine the water balance models.

The two Project weather stations collect records for:

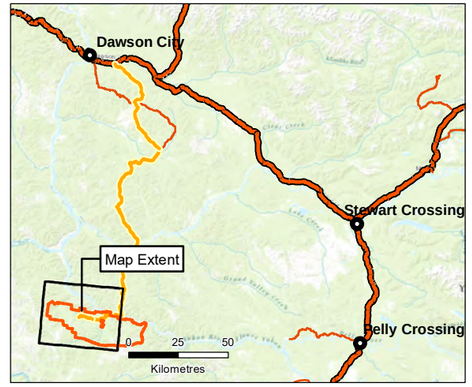
- Air temperature and relative humidity
- wind speed and direction
- solar radiation
- barometric pressure
- precipitation
- potential evapotranspiration
- snow depth and snow water equivalent.

The instrumental record for the Km 11 climate station now exceeds 9 years in duration and is essentially continuous, while the Kona climate record is approximately three years in duration.



COFFEE GOLD MINE

Weather Stations and Snow Course Locations, Coffee Gold Project



Legend

- Automated Weather Station
- Snow Course
- Tipping Bucket Rain Gauge
- Watercourse

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein..

N

1:125,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 4-1	Date: Dec 2, 2021	Drawn by: AL	Reviewed: SJ

Newmont COFFEE

Path: P:\@Drafting\Coffee Gold\Drafting Figures\MxD\Personal_20190627.mxd

There are several regional climate stations operated by the federal agencies of both Canada and the US (Alaska) with sufficient record periods and data quality to inform the characterization of weather conditions at the Mine Site over a longer period of record. To better characterize long-term variability, a synthetic time-series of air temperature and precipitation was derived from statistical relationships between measurements obtained at the Mine Site climate station and the regional climate stations and snow courses. The synthetic record was updated in 2021 to include additional site climate data as well as data from an updated predictor climate station (Dawson A station). Details related to the synthetic climate record are provided in the Site Characterization Plan.

4.1.1.1 Temperature

The Coffee property is located in a subarctic, continental climate with a summer mean temperature of 10°C and a winter mean temperature of -23°C. Summer and winter temperatures extremes can reach 35°C and -55°C respectively.

At the Mine Site, the average annual temperature ranges from -5 to -2°C, with average monthly mean air temperatures ranging from -16.8 to 13.9°C at the Km 11 station, and -15.4 to 11.7°C at the Kona station. Minimum (maximum) recorded temperatures at the Km 11 climate station are -38.2°C (29.7°C), and at the Kona climate station are -36.2°C (23.7°C).

The lowest air temperatures are often experienced in December through February, while July typically experiences the highest temperatures. Evidence of temperature inversion events is present during the winter months in upper elevations of the Project site. Figure 4-2 presents average monthly air temperature from the Mine Site climate stations. Additional information regarding air temperature and temperature inversions are provided in the Site Characterization Plan.

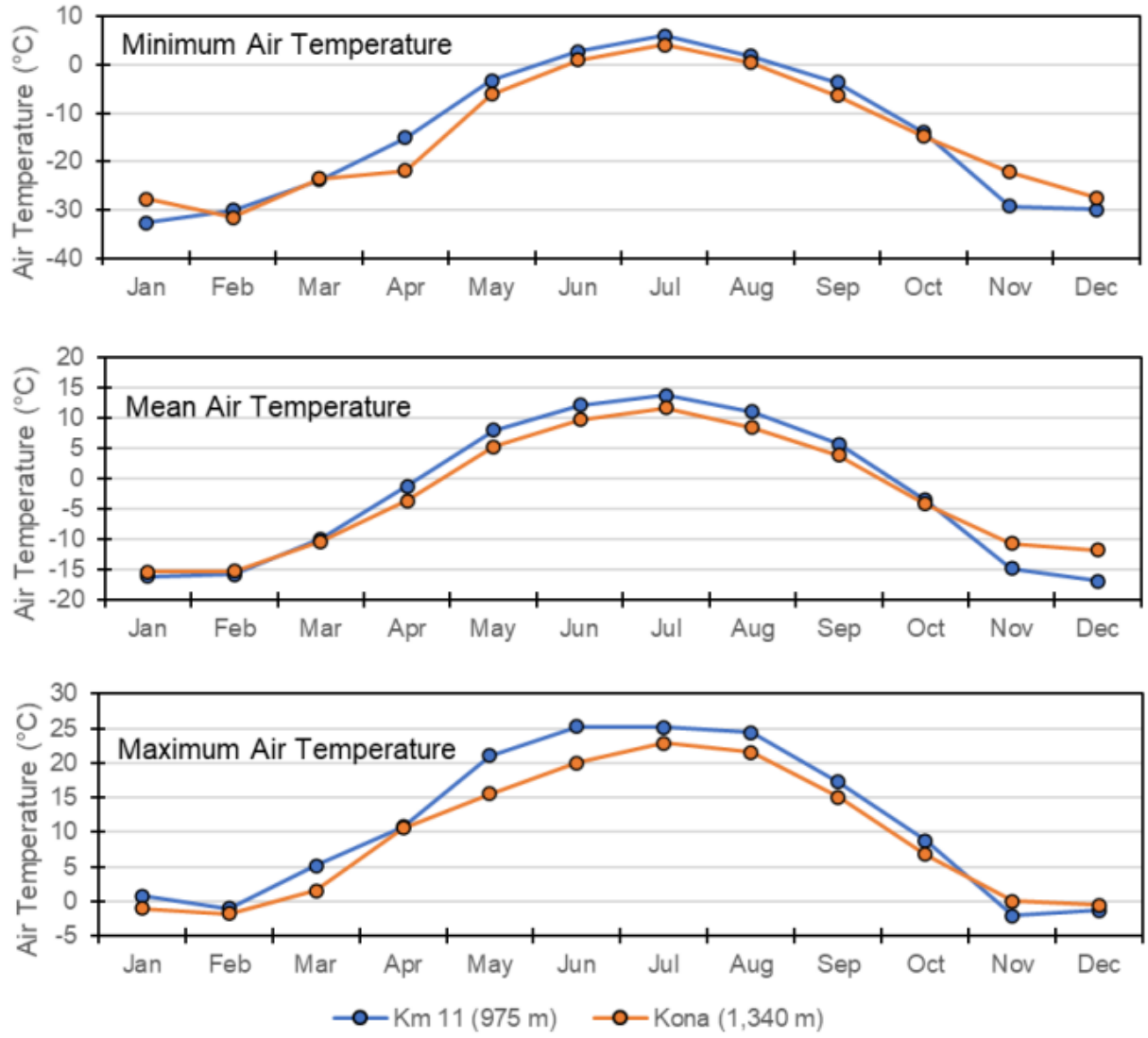
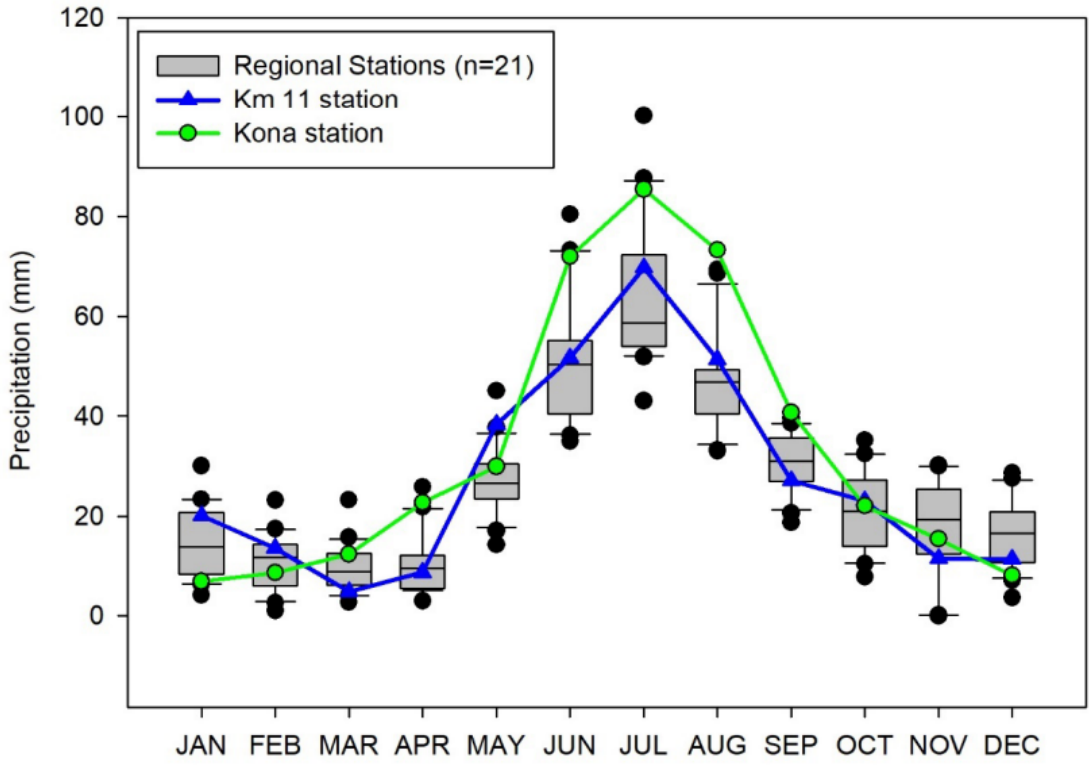


Figure 4-2 **Mean Monthly Minimum (top panel), Mean (middle panel) and Maximum (bottom panel) Air Temperature Records for the Km 11 and Kona Climate Stations**

4.1.1.2 Precipitation

Mean annual precipitation (MAP) at the Mine Site measured through gauge and snow course data gathered during the baseline study was 331 mm at 975 m and 398 mm at 1,340 m, with approximately 30% of this amount falling as snow between October and April, and 70% falling as rain from May to September. Based on the synthetic climate record, MAP is estimated to be 504 mm at the Project.

Figure 4-3 shows regional precipitation data from the Km 11 and Kona climate stations, as well as from nearby climate stations. Overall, site and regional precipitation measurements are closely correlated. A summary of measured precipitation for the Mine Site climate stations are provided in Table 4-1 and Table 4-2. Additional information regarding precipitation at the site is provided in the Site Characterization Plan.



Note: The box and whisker plots show the following statistics for the regional stations: median and quartiles (grey box), 5th and 95th percentile values (tails) and outliers (black circles).

Figure 4-3 Comparison of the Measured Monthly Precipitation Signature for the Coffee Gold Km 11 and Kona Climate Stations to nearest Regional Stations (n = 21) with Long-Term Records

Table 4-1 Summary of Measured Precipitation Data for the Km 11 Climate Station (July 2012 – June 2019)

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2012	Rain (mm)	--	--	--	--	--	--	4.8	37.8	17.8	4.3	0.0	0.0	---
	% Rain	--	--	--	--	--	--	100%	100%	64%	19%	0%	0%	---
	Snow (mm)	--	--	--	--	--	--	0.0	0.0	10.0	18.8	23.4	33.3	---
	% Snow	--	--	--	--	--	--	0%	0%	36%	81%	100%	100%	---
2013	Rain (mm)	0.0	0.0	9.9	20.9	49.3	57.9	89.7	58.7	25.7	5.3	0.0	0.0	317.3
	% Rain	0%	0%	96%	99%	100%	100%	100%	100%	54%	26%	0%	0%	74%
	Snow (mm)	20.1	14.7	0.4	0.3	0.0	0.0	0.0	0.0	21.6	15.0	23.4	16.0	111.4
	% Snow	100%	100%	4%	1%	0%	0%	0%	0%	46%	74%	100%	100%	26%
2014	Rain (mm)	0.0	0.0	0.0	0.0	23.0	3.0	80.0	0.0	16.5	0.0	0.0	0.0	122.5
	% Rain	0%	0%	0%	0%	67%	100%	100%	0%	77%	0%	0%	0%	58%
	Snow (mm)	46.7	23.6	0.3	0.0	11.2	0.0	0.0	0.0	4.8	0.0	0.5	2.0	89.2
	% Snow	100%	100%	100%	0%	33%	0%	0%	0%	23%	0%	100%	100%	42%
2015	Rain (mm)	0.0	0.0	0.0	0.0	24.9	48.8	99.3	73.7	32.0	17.3	0.0	0.0	295.9
	% Rain	0%	0%	0%	0%	100%	100%	100%	100%	79%	52%	0%	0%	77%
	Snow (mm)	19.3	19.3	0.3	0.3	0.0	0.0	0.0	0.0	8.3	15.9	20.6	6.0	89.9
	% Snow	100%	100%	100%	100%	0%	0%	0%	0%	21%	48%	100%	100%	23%
2016	Rain (mm)	5.1	0.5	2.5	14.0	48.8	71.1	68.3	46.0	14.2	0.0	0.5	0.0	271.0
	% Rain	14%	8%	41%	100%	91%	100%	100%	100%	98%	0%	10%	0%	71%
	Snow (mm)	31.0	6.1	3.6	0.0	4.6	0.0	0.0	0.0	0.3	34.8	4.6	23.5	108.5
	% Snow	86%	92%	59%	0%	9%	0%	0%	0%	2%	100%	90%	100%	29%
2017	Rain (mm)	0.0	0.0	0.0	9.1	49.5	43.4	91.7	22.6	13.2	6.9	0.0	0.0	236.5
	% Rain	0%	0%	0%	100%	96%	100%	100%	100%	93%	13%	0%	0%	74%
	Snow (mm)	9.7	7.2	0.5	0.0	1.8	0.0	0.0	0.0	1.0	46.3	10.0	7.9	84.4
	% Snow	100%	100%	100%	0%	4%	0%	0%	0%	7%	87%	100%	100%	26%
2018	Rain (mm)	3.0	0.0	2.3	2.0	36.1	81.0	26.4	115.8	20.6	*0.5*	*0.0*	*0.0*	287.8
	% Rain	63%	0%	16%	46%	100%	100%	100%	100%	100%	*5%*	*0%*	*0%*	84%
	Snow (mm)	1.8	17.6	11.6	2.4	0.0	0.0	0.0	0.0	0.0	*9.6*	*9.2*	*2.4*	54.6
	% Snow	37%	100%	84%	54%	0%	0%	0%	0%	0%	*95%*	*100%*	*100%*	16%
2019	Rain (mm)	*0.0*	*0.0*	*0.0*	*0.0*	19.3	56.4	97.3	56.1	30.7	9.4	0.0	0.0	269.2
	% Rain	*0%*	*0%*	*0%*	*0%*	100%	100%	100%	100%	100%	95%	--	--	92%
	Snow (mm)	*3.9*	*6.0*	*2.7*	*11.8*	0.0	0.0	0.0	0.0	0.0	0.5	0	0	25.0
	% Snow	*100%*	*100%*	*100%*	*100%*	0%	0%	0%	0%	0%	5%	--	--	8%

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
All Years	Rain (mm)	1.2	0.1	2.1	6.6	35.8	51.7	69.7	51.3	21.3	5.5	0.1	0.0	245.3
	% Rain	6%	1%	43%	76%	93%	100%	100%	100%	79%	24%	1%	0%	74%
	Snow (mm)	18.9	13.5	2.8	2.1	2.5	0.0	0.0	0.0	5.7	17.6	11.4	11.4	86.0
	% Snow	94%	99%	57%	24%	7%	0%	0%	0%	21%	76%	99%	100%	26%
	Total P (mm)	20.1	13.6	4.9	8.7	38.3	51.7	69.7	51.3	27.1	23.1	11.5	11.4	331.3

Notes: Values for 2018-19 in italics infilled based on Kona climate station gauge data and gradient 8%/100 m elevation gain between Kona (1,340 m asl) and Km 11 (975 m asl) stations.

Table 4-2 Summary of Measured Precipitation Data for the Kona Climate Station (October 2018 – October 2021)

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2018	Rain (mm)	--	--	--	--	--	--	--	--	--	2.0	0.0	0.0	---
	% Rain	--	--	--	--	--	--	--	--	--	16%	0%	0%	---
	Snow (mm)	--	--	--	--	--	--	--	--	--	10.8	12.1	3.2	---
	% Snow	--	--	--	--	--	--	--	--	--	84%	100%	100%	---
2019	Rain (mm)	0.0	0.0	0.0	0.1	26.3	66.1	102.2	61.8	19.5	4.2	0.0	0.0	280.1
	% Rain	0%	0%	0%	1%	88%	100%	100%	100%	66%	16%	0%	0%	73%
	Snow (mm)	5.2	7.9	3.6	15.6	3.7	0.0	0.0	0.0	10.2	22.5	19.8	15.4	104.0
	% Snow	100%	100%	100%	99%	12%	0%	0%	0%	34%	84%	100%	100%	27%
2020	Rain (mm)	0.0	0.0	0.0	1.9	14.0	93.2	109.3	81.8	12.2	0.2	0.0	0.0	312.4
	% Rain	0%	0%	0%	0%	85%	100%	100%	100%	60%	1%	0%	0%	72%
	Snow (mm)	9.5	6.1	13.2	32.9	2.5	0.0	0.0	0.0	8.2	28.1	14.3	6.0	120.6
	% Snow	100%	100%	100%	95%	15%	0%	0%	0%	40%	99%	100%	100%	28%
2021	Rain (mm)	0.0	0.0	0.0	2.1	35.0	56.6	44.7	76.2	33.1	0.0	--	--	---
	% Rain	0%	0%	0%	0%	81%	100%	100%	100%	46%	0%	--	--	---
	Snow (mm)	6.2	11.9	20.4	15.5	8.5	0.0	0.0	0.0	38.9	20.6	--	--	---
	% Snow	100%	100%	100%	88%	19%	0%	0%	0%	54%	100%	--	--	---
All Years	Rain (mm)	0.0	0.0	0.0	1.4	25.1	72.0	85.4	73.3	21.6	1.6	0.0	0.0	280.2
	% Rain	0%	0%	0%	6%	84%	100%	100%	100%	53%	7%	0%	0%	70%
	Snow (mm)	6.9	8.7	12.4	21.3	4.9	0.0	0.0	0.0	19.1	20.5	15.4	8.2	117.3
	% Snow	100%	100%	100%	94%	16%	0%	0%	0%	47%	93%	100%	100%	30%
	Total P (mm)	6.9	8.7	12.4	22.7	29.9	72.0	85.4	73.3	40.7	22.1	15.4	8.2	397.5

Extreme precipitation events typically occur in summer and are attributable to overland convective events. Rainfall monitoring conducted at the main climate station (Km 11) presents variability in terms of timing and magnitude of storms when compared to tipping buckets located at different elevations across the Project site. These observations along with regional analysis of long-term precipitation records indicate variation in precipitation with elevation and in the distribution of storm events across the Project area.

The hydrometeorology baseline report presented summer rainfall events for seven return periods (1:2 year, 1:5 year, 1:10 year, 1:25 year, 1:50 year, 1:100 year and 1:200 year) for varying elevations (600 masl to 1,300 masl). The Project elevations range from 799 to 1236 masl and an average elevation of 1,300 masl was selected for design purposes. The precipitation depths at 1,300 masl for each return period and a 24-hour duration are presented in Table 4-3.

Table 4-3 Estimated Summer Rainfall Depths at 1,300 m Elevation for Various Intervals and Return Periods based on Historical Conditions

Interval	Rainfall (mm) for Various Return Periods						
	1:2	1:5	1:10	1:25	1:50	1:100	1:200
24-hour	38	56	67	80	89	98	106

4.1.1.3 Snowpack and Melt

The average annual snowfall estimate for the Km 11 climate station is 97 mm, and for the Kona climate station is 99 mm. Figure 4-4 shows snowpack accumulation at the Kona climate station from 2018 to 2021. Snowpack typically begins in mid- to late-October each year, and melts over a one- to two-week period between late-March and late-April. The maximum snowpack depth is expected to occur by approximately April 1. Recurrence interval estimates of maximum annual Snow Water Equivalent (SWE) accumulation based on snow survey data indicate that the maximum annual SWE is predicted to range from 79 to 319 mm in a 1:200 interval for dry and wet years, respectively, with a mean of 159 mm SWE. The estimated recurrence intervals for maximum annual SWE are provided on Table 4-4.

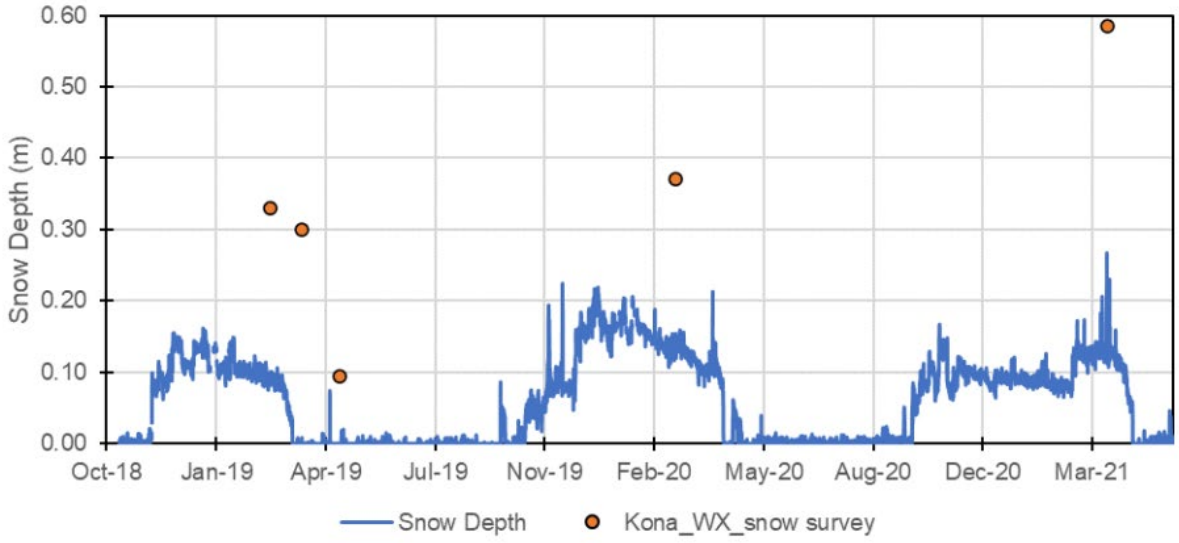


Figure 4-4 Continuous Snow Depth Record Measured at the Kona Climate Station (October 2018 to June 2021)

Table 4-4 Estimated Maximum Snow Pack (Snow Water Equivalent, or SWE) at 1,300 m Elevation for Various Return Periods

	Dry Year						Mean	Wet Year					
Return Period	1:200	1:100	1:50	1:25	1:10	1:5	1:2	1:5	1:10	1:25	1:50	1:100	1:200
SWE (mm)	79	84	91	100	114	128	159	200	225	256	277	298	319

To produce a long-term, daily melt record for Coffee Mine, period of record snow pillow data were assembled from six snow pillow stations in Alaska and the Yukon. Period of record snow pillow data for the six stations indicate peak melt rates of 10-20 mm/day for accumulated snowpack in a typical year. The highest rates calculated from regional data range from 30 to >50 mm/day, which is associated with persisting snowpacks throughout the spring season that are subject to greater solar radiation inputs. This suggests that in a very dry year, the snowpack may melt early in the season, while in a very wet year, the snowpack may melt over a longer period. Additional information regarding snowpack and melt is provided in the Site Characterization Plan.

4.1.1.4 Evaporation

Potential evapotranspiration estimates for both the Km 11 and Kona climate stations indicate average April-October totals of 469 mm and 452 mm, respectively, and are highest throughout the year from May to July. Higher estimates were recorded for the Kona station compared to the Km 11 station from 2019 to 2021 as a result of elevated wind speeds and greater solar radiation associated with higher elevation. Table 4-5 shows the potential evaporation estimates that were derived using the Penman-Monteith and Priestly-Taylor methods. Additional information regarding evapotranspiration at the site, including supplemental calculation methods for comparison, are provided in the Site Characterization Plan.

Table 4-5 Potential Evaporation Estimates for the Coffee Gold Project based on Data Collected at the Km 11 and Kona Climate Stations

Station		Apr		May		Jun		Jul		Aug		Sep		Oct		Apr-Oct	
	Year	P-M	P-T	P-M	P-T	P-M	P-T	P-M	P-T	P-M	P-T	P-M	P-T	P-M	P-T	P-M	P-T
Km 11 (975 m)	2012	---	---	---	---	---	---	---	---	76	72	43	28	9	4	---	---
	2013	37	39	85	88	127	128	93	95	75	75	26	23	16	7	459	454
	2014	50	50	99	91	104	103	93	96	73	72	35	31	5	5	458	449
	2015	53	52	128	114	112	109	87	92	58	59	34	28	8	6	478	461
	2016	55	51	100	96	104	106	84	93	73	72	46	33	8	7	470	458
	2017	56	55	92	89	102	104	98	103	81	79	41	32	10	4	480	465
	2018	57	53	103	92	96	96	113	110	61	62	41	34	25	5	496	452
	2019	58	53	110	96	118	117	101	101	65	61	40	34	12	4	504	467
	2020	49	47	106	96	84	92	87	93	52	57	32	26	12	5	421	416
	2021	58	56	75	74	115	117	109	110	61	61	27	27	12	5	458	450
	Record Period	53	51	100	93	107	108	96	99	67	67	36	30	12	5	469	452
Kona (1,340 m)	2019	59	61	111	105	122	127	107	112	71	80	55	54	20	7	546	546
	2020	56	71	112	113	81	94	94	106	58	72	50	44	18	6	470	506
	2021	68	80	76	87	121	124	119	122	74	81	40	44	13	7	511	543
	Record Period	61	71	100	101	108	115	107	113	68	78	48	47	17	7	509	532

Notes: P-M: Penman-Monteith, P-T: Priestly-Taylor

4.1.1.5 Climate Change

Potential climate change effects for the Project were assessed to guide long-term Project planning. Modelled historical climate averages and future projections were used to calculate temperature, precipitation, and freeze/thaw date projections specific to the available Representative Concentration Pathway scenarios (RCP4.5, RCP6.0 and RCP8.5) for the Project to the year 2100. Climate change for each Representative Concentration Pathway scenario has been accounted for in the water balance that has been developed for the Project (Lorax 2023b). This was done by extending the synthetic 30-year record through three cycles, and incorporating projected changes in temperature and precipitation that are predicted using published climate models for that time frame. The 2015 Climate Change Projections for the Coffee Creek Region are provided in Appendix 4-A.

Overall, average annual temperatures are anticipated to rise significantly, and net precipitation is projected to increase in the region over the next century, with slightly wetter summers and winters expected. The model indicates that warming is anticipated to be particularly pronounced in the summer in the area of the Coffee property, which will lead to a later freeze-up in fall and an earlier thaw in spring. In tandem, this yields a growing season that is as much as one month longer by the end of the century and implies a notably lengthened duration for above zero temperatures and consequent adverse implications for permafrost integrity (i.e., minor degradation) in the region.

The annual average temperature at the site is approximately -2°C and is forecasted to rise by 3 to 5°C by the end of the century. As with mean temperature, net precipitation in the vicinity of the Coffee Gold Mine is projected to increase by 20% to 35% over the course of this century. Additional information regarding the climate change scenarios for the Project are provided in the Site Characterization Plan.

4.1.1.6 Additional Climate Station Data

Relative humidity generally varies between 50% and 85% on an average monthly basis, with the highest relative humidity values in the winter at the Km 11 station, ranging from 76-83% between November and February. The relative humidity signatures at Km 11 display a notable departure at the Kona station, due in part to the noted temperature inversions at site.

Monthly average wind speeds range from 0.9 to 2.8 m/s at the Km 11 station, with higher wind speeds occurring in the months of April through September compared to October through March. The higher elevation Kona station experiences monthly average wind speeds of 3.7 to 5.1 m/s, with a similar seasonal pattern as noted for the Km 11 record, although maximum wind gust speeds are more often noted in the winter and spring months. The dominant annual wind vector at the Km 11 station and the Kona station is from the south and the southwest, respectively.

Monthly average barometric pressure measured at Km 11 climate station ranged from lows of 1003 mb in December to highs of approximately 1015 mb in July. At the Kona climate station, atmospheric pressures track the monthly pattern observed in the Km 11 record, but are approximately 155 mb lower, reflective of this station's higher elevation.

Solar radiation at the site varies from a monthly average high in June of 0.240 kW/m^2 and 0.256 kW/m^2 to a low of 0.003 kW/m^2 and 0.005 kW/m^2 in December, at the Km 11 and Kona climate stations, respectively.

Since July 2012, the highest recorded hourly solar radiation value is 0.991 kW/m^2 at the Km 11 station, and 1.043 kW/m^2 at the Kona station, reflective of the latter stations' higher elevation.

Additional information regarding relative humidity, wind speeds, barometric pressure and solar radiation at the site are provided in the Site Characterization Plan.

4.1.2 Seismic Conditions

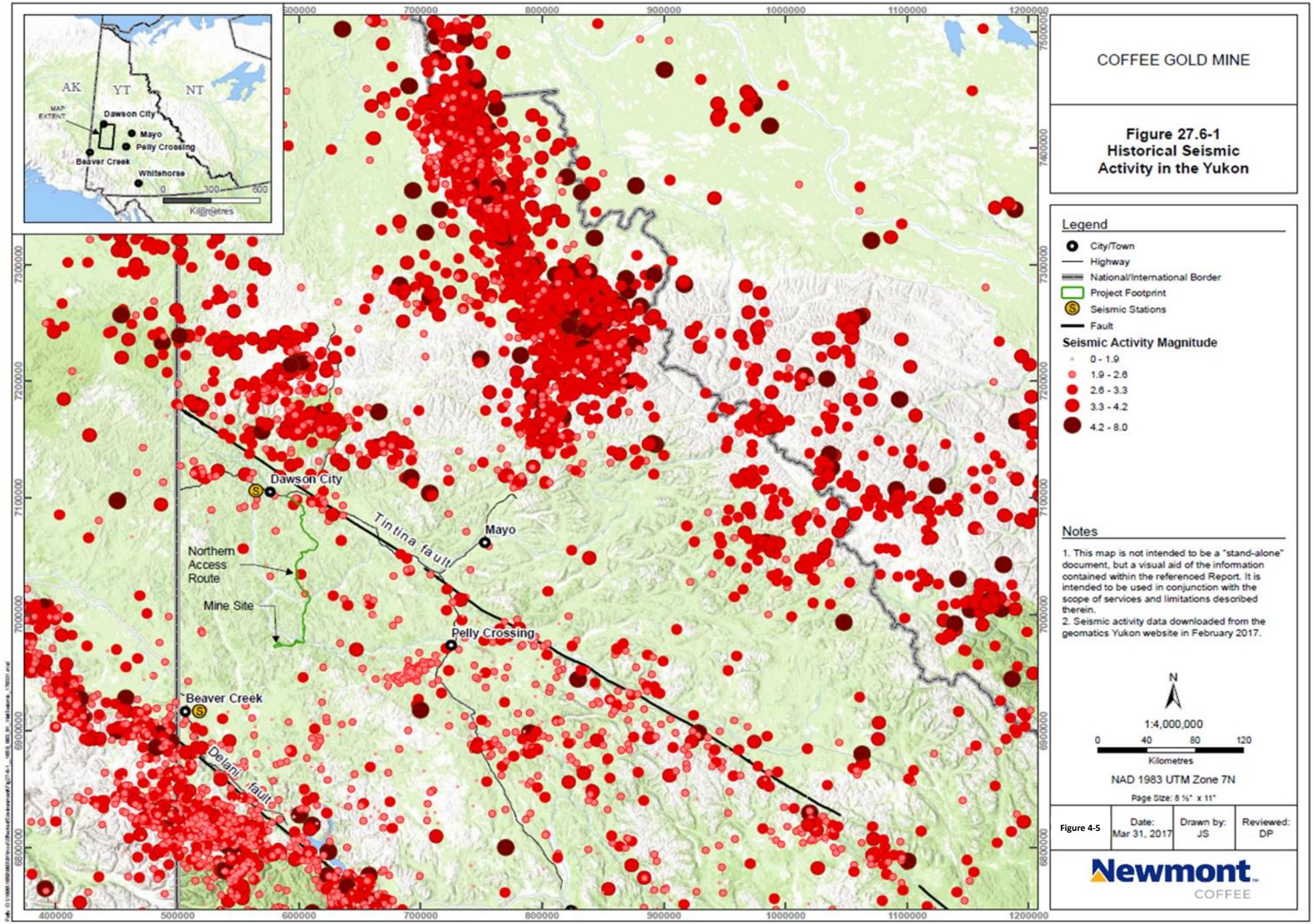
The Project is located in an area of relatively low seismic activity in the St. Elias region, which includes southwestern Yukon Territory, northwestern British Columbia, and southeastern Alaska. The Project is located further northeast, between the Denali and Tintina fault systems, where the rates of seismic activity decrease dramatically (NRC 2016a). Figure 4-5 shows the regional tectonic fault lines and historical seismic activity of Yukon with respect to the Project. In the St. Elias Region, the Pacific tectonic plate is being forced underneath the North American tectonic plate through subduction.

The seismic hazard for the Project area predominantly consists of shallow crustal earthquakes (with magnitudes of up to 7.0 on the Richter Scale) that may occur in the region south of the Project (greater than 100 km) (NRC 2016a). Seismic hazards are influenced by the potential for larger-magnitude earthquakes (with magnitudes from 7.5 to 8.0) occurring further from the Project site (greater than 100 km) on the East Denali fault zone, near the Alaska-Yukon border (NRC 2016a).

A review of the regional tectonics and historical seismicity in the southwest Yukon region was completed to enable the selection of appropriate design earthquake events for key Project components such as the HLF. The closest seismograph stations to the Project are located in Dawson and Beaver Creek (NRC 2016b). The closest historical earthquakes have occurred near Beaver Creek, the most recent being a magnitude 4.2 earthquake in 2012, which is characterized as a light earthquake, slightly felt, but during which zero to minimal damage occurs (Belik 2013, NRC 2016c).

An analysis of seismic hazards in the Project area was performed using the 2015 National Building Code of Canada (NBCC) seismic hazard calculator (NRC 2016d). The peak ground acceleration (PGA[4]) was calculated for the Project area for several return periods (Table 4-6) (USGS 2011, NRC 2016d). Based on the intensity descriptions developed by the USGS, a PGA of 0.025 g is perceived as light, and is not likely to cause structural damage, while a PGA of 0.080 g is perceived as a moderate quake, with very light potential to result in structural damage (USGS 2011).The worst-case peak ground acceleration of 0.17 g (potentially occurring every 10,000 years) would represent a very strong earthquake with the potential to cause moderate structural damage to buildings and structures.

[4] PGA is a measure of how hard the earth shakes and is measured in units of acceleration due to gravity.



COFFEE GOLD MINE

Figure 27.6-1
Historical Seismic Activity in the Yukon

Legend

- City/Town
- Highway
- National/International Border
- Project Footprint
- Seismic Stations
- Fault

Seismic Activity Magnitude

- 0 - 1.9
- 1.9 - 2.6
- 2.6 - 3.3
- 3.3 - 4.2
- 4.2 - 8.0

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Seismic activity data downloaded from the geomatics Yukon website in February 2017.

N

1:4,000,000

0 40 80 120

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 4-5	Date: Mar 31, 2017	Drawn by: JS	Reviewed: DP

Newmont COFFEE

Table 4-6 Summary of Probabilistic Seismic Hazard Results

Annual Exceedance Probability	0.01	0.0021	0.001	0.000404
Recurrence Interval (years)	100	475	1000	2475
Probability of Exceedance in 50 Years	40%	10%	5%	2%
Period (*s*)	Sa (*g*)	Sa (*g*)	Sa (*g*)	Sa (*g*)
PGA	0.038	0.067	0.086	0.0116
0.2	0.068	0.123	0.161	0.225
0.5	0.049	0.087	0.112	0.151
1	0.034	0.062	0.078	0.103
2	0.22	0.039	0.048	0.063
4*	0.011	0.0195	0.024	0.0315

Notes; * - per the 2010 NBCC the 4s Sa = (2s Sa)/2

4.1.3 Air Quality

Air quality in the Project area is representative of a pristine environment as it is far from any existing industrial or urban areas and has remained unaffected by development. The only existing influence on ambient air quality levels in the Project area is transient forest fire smoke.

Volumetric ambient air quality monitoring of total suspended particulate matter (TSP), PM10 (particulate matter of 10 microns or less), PM2.5 (particulate matter of 2.5 microns or less) was conducted at the Project site in 2015. Table 4-7 provides a summary of 2015 ambient particulate matter concentrations. Very low levels of TSP, PM10, and PM2.5 concentrations were observed in the winter and elevated concentrations were observed in the summer due to the influence of migrating forest fire smoke upwind of the Project site. The conditions during dry summer months are not typical of the region, which are also conducive to high pollen and mold spore counts that can elevate PM2.5 concentrations.

Table 4-7 Ambient Particulate Matter Concentrations Based on Monitoring in 2015 (µg/m^3)

Parameter	AAQS	Season	Minimum Ground-level Concentration	Maximum Ground-Level Concentration	Average Ground-level Concentrations
TSP	120	Winter	1	65	2
		Summer	<1	200	41
$PM_{2.5}$	50	Winter	1	34	2
		Summer	<1	177	40
PM_{10}	25	Winter	1	61	2
		Summer	<1	193	40

Dust fallout rates were measured on site in 2015 using passive dust fall monitoring samplers during the summer and through analysis of particulate matter contained in snow cores during the winter. The average dust fallout rate, measured in milligrams per square decimeters per day (mg/dm^2/day), were 0.17 and 0.5 in the winter and summer, respectively. Organic matter was analyzed to be the primary constituent of the dust deposition, which suggests the Project area under existing conditions is organic in nature (i.e., pollen, mold spores, soot, smoke, etc.).

4.1.4 Noise

Sound surveys were conducted within the Coffee Property in late March 2015 and late June 2015 to record existing conditions during winter and summer, respectively. Existing sound levels (in A-weighted decibels, dBA) recorded at the Mine Site were as follows and are typical for a remote mountainous site:

- During winter, the daytime levels ranged from approximately 25 dBA to 31 dBA
- During winter, the nighttime levels ranged from approximately 22 dBA to 26 dBA
- During summer, the daytime sound levels ranged from approximately 33 dBA to 45 dBA, including time periods with precipitation and periodic thunder
- During summer, the nighttime sound levels ranged from approximately 27 dBA to 57 dBA.

Average daytime noise levels are typically 5 dBA to 10 dBA higher than at night (BC OGC 2009). Noise levels recorded during the summer daytime and nighttime period were elevated due to the prevalence of thunderstorms during the monitoring period. Existing ambient sound levels along the NAR are expected to be relatively consistent with data collected near the Mine Site since population density, land use, and terrain conditions are similar.

4.1.5 Surficial Geology, Terrain, Soils, and Permafrost

The Project area falls within the portion of Yukon that remained unglaciated during the Pliocene to early Pleistocene epochs (3 million to 1.8 million years ago); however, glaciers were present within the Stewart River valley to the north as well as to the west and east of the Mine Site (Duk-Rodkin 1999). This lack of glaciation exposed surficial geology to an extensive period of weathering, resulting in surficial deposits primarily composed of weathered bedrock, colluvium derived from weathered bedrock and loess (very fine-grained silt or clay formed through glaciation and deposited by the wind), and fluvial (river-based) materials.

The Project area is underlain by a package of metamorphosed Paleozoic rocks of the Yukon-Tanana Terrane (which underlies much of central and western Yukon and east central Alaska) that was intruded by a large granitic body in the Late Cretaceous.

The characterization of surficial geology, terrain, soils, and permafrost at the Mine Site was based on the Environmental Baseline Report (Tetra Tech 2016) and was informed by the results obtained through the following investigations and testpitting programs:

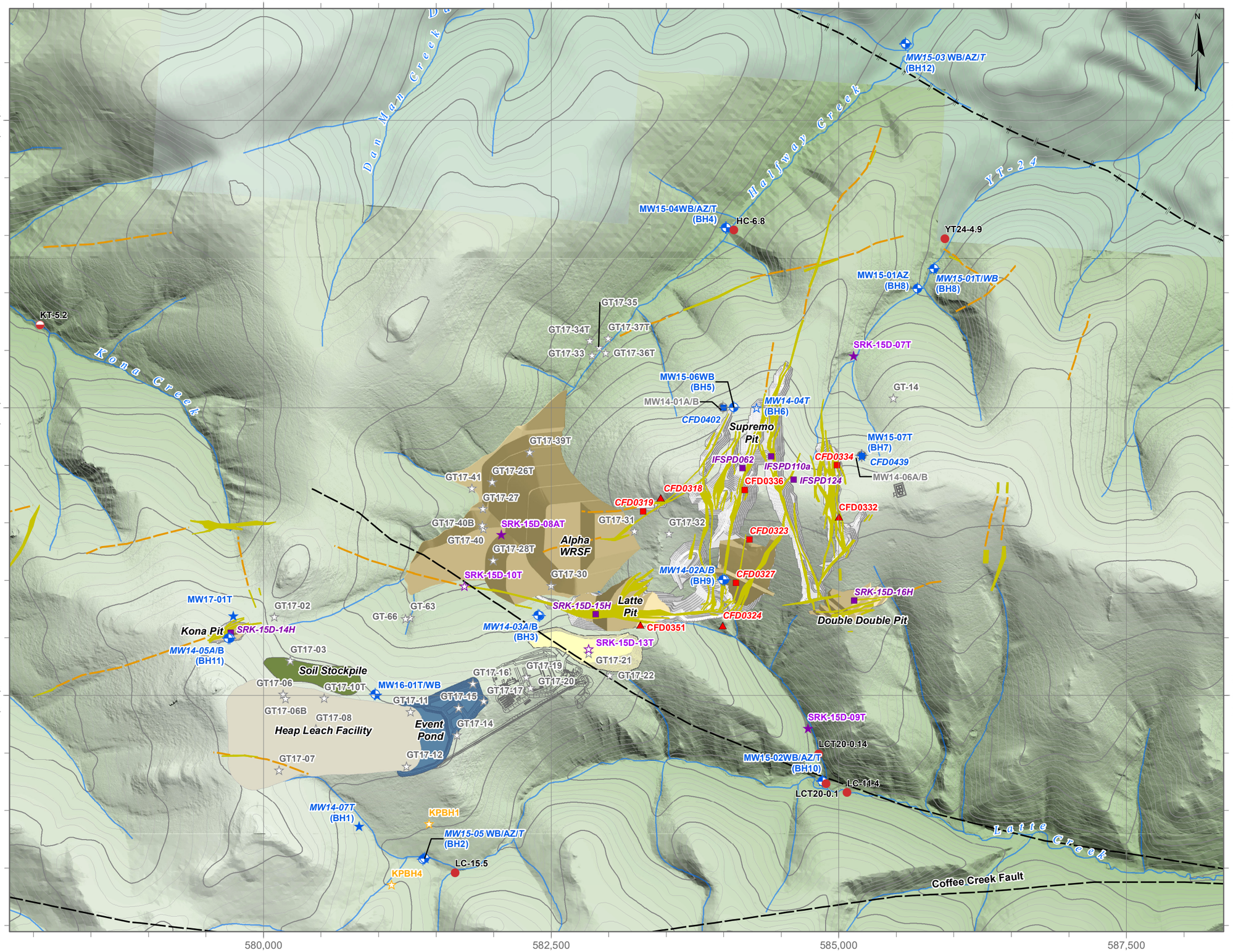
- 2015 Geotechnical Field Investigation Report (SRK 2016)
- Fall 2016 Geotechnical Investigation Data Report (Tetra Tech and SRK 2017)
- Summer 2017 Geotechnical Investigation Data Report (Tetra Tech 2017)
- Fall 2018 Test Pitting Program Data Report (Appendix 2-I).

Figure 4-6 shows the locations of geotechnical and hydrogeologic investigations at the site.

At high elevations and along valley slopes, colluvium is likely to be coarse grained, whereas ice-rich resedimented loess and peat form colluvial aprons on lower slopes, and fluvial deposits are found in valley bottoms. These deposits may be subject to gullying, cryoturbation (mixing of materials from various soil horizons due to freezing and thawing), solifluction (gradual mass wasting slope process related to freeze-thaw activity), permafrost processes, periglacial processes (geomorphic processes from seasonal thawing in permafrost areas), landslides, and snow avalanches.

Soils at the Mine Site are predominantly Cryosols (permafrost soils). Unfrozen soils are represented primarily by Brunisols (one of three soil orders for forested soils in Canada). Parent materials within the Mine Site and along the NAR are predominantly colluvium. The dominance of colluvium may be a factor limiting the quality of soils available for reclamation.

Overall, 128 samples of overburden material have been collected for geochemical characterization along with selected samples of topsoil material from the proposed heap leach area for nutrient analysis and particle size descriptions. The locations of overburden sampling are indicated on Figure 4-7. Overall, the results indicate that ex-pit overburden is consistently non-acid generating (NAG) with low metal leaching potential. Overburden material from in-pit boundaries has more variable metal leaching potential, particularly in regard to arsenic. For additional overburden geochemical characterization details, refer to the Geochemical Source Term Report (Lorax 2023a).



LEGEND

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Monitoring Well (*AZ = active zone, WB = Westbay, A = deep conventional (200+m), B = shallow coventional (150+m), T = thermistor/VWP, BH = original drillpad name*)
- Monitoring Well (collapsed)
- Thermistor (Lorax 2014)
- Thermistor (KP 2014)
- Thermistor (SRK 2015)
- Thermistor (TT/SRK, 2016,2017,2020)
- Thermistor/VWP (Lorax 2015,2016,2017)
- Thermistor/VWP (SRK 2015)
- Vibrating Wire Piezometer (VWP) (EBA 2013)
- Packer Tests (EBA 2013)
- Packer/Slug Tests (Lorax 2014)
- Packer Tests (SRK 2015)
- Drilled Mineralized Structure
- Inferred Mineralized Structure
- Linament (Huscroft, 2002)
- Fault (Approximate) (Grodzicki et. al, 2015).

Proposed Infrastructure

- WRSF/Backfill
- Pit
- Heap Leach Pad Base
- Event Pond
- Stockpile Pad
- Soil Stockpile

Italics in name indicates location was hydraulic tested (packer or airlift)

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:32,000

0 500 1,000 Meters

DATE SAVED:	Feb 03, 2021
DRAWN BY:	GM/AL
REVIEWED:	LF
VERSION:	1

CLIENT:

Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

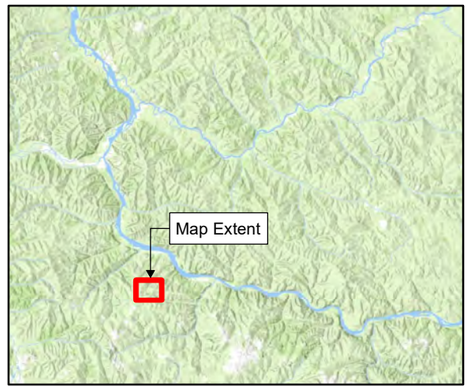
Coffee Mine General Arrangement and Hydrogeological Monitoring Network

PROJECT #: A362-4 *FIGURE:* 4-6

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Fig 1-2_monitoring network_20210201.mxd

COFFEE GOLD MINE

Overburden Drill Core Locations with ABA Samples



Property geology

LOWER EOCENE
- PRCf: Rhyolite Ck: Felsic dykes

LATE CRETACEOUS TO TERTIARY
- LKfC: Casino Suite: porphyry

MID-CRETACEOUS
- mKgW: Dawson Range Granite
- mKqW: Coffee Creek Granite

UPPER CRETACEOUS
- uKC2: Carmacks: andesite
- uKC4: Carmacks: pebble conglomerate

EARLY JURASSIC
- LTrEJgM: Minto Suite: biotite-hornblende granodiorite

LATE TRIASSIC
- LTrgS: Stikine Suite: gabbroic hornblende orthogneiss

MIDDLE PERMIAN
- PqSs: Sulphur Ck Suite: Qtz-felds-biotie schist
- PqS: Sulphur Ck Suite: biotite quartz monzonite gneiss

CARBONIFEROUS AND PERMIAN
- PKf: Klondike Schist: quartz-muscovite-chlorite schist

LATE DEVONIAN TO MISSISSIPPIAN
- LDyMB: Mt Baker: gabbro
- MgSR: Simpson Range: Tonalite, diorite

DEVONIAN, MISSISSIPPIAN
- DMF6: Finlayson: metagabbro
- DMFv: Finlayson: Foliated amphibolite

LATE PROTEROZOIC AND PALEOZOIC
- PDS1: Snoecap Assemblage: quartz-feldspar-biotite ± muscovite schist

Legend

- Test Pits
- Overburden Drill Collars with ABA Samples

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein..

N

0 125 250 500 750 Meters

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 4-7	Date: Aug 10, 2022	Drawn by: AL	SJ

Newmont COFFEE

4.1.5.1 Terrain Stability and Unique Landforms

The majority of the Mine Site is considered to be relatively geotechnically stable, reflective of the gentle to moderate slopes that predominate on lower valley sides and in uplands. Landslide failure scars and other features are shown on Figure 4-8. Landforms that are relatively unique in the area include tors and collapsed and intact open system pingos. Tors are erosional remnants of a higher plateau level, and are located along ridgetops, primarily in the central and western parts of the Mine Site and along the NAR north of the Stewart River. The tors form towers above otherwise smooth, rounded ridges underlain by granitic bedrock, and are surrounded by either thick colluvium (unconsolidated sediments that gather at the foot of a steep slope) or weathered bedrock.

Pingos are perennial frost mounds that consist of a core of massive ice and are covered by soil and vegetation. Open system pingos result when the water forming the dome of frozen ground is supplied by groundwater moving downslope. The location of a collapsed pingo in the Mine Site study area is shown in Figure 4-8. Collapsed pingos are indicative of the former presence of massive ground ice and ice-rich permafrost that has since thawed, leaving behind a low, circular ridge of material as a result of the sides of the pingo slumping, and a depression, which in this case is filled with water.

4.1.5.2 Permafrost

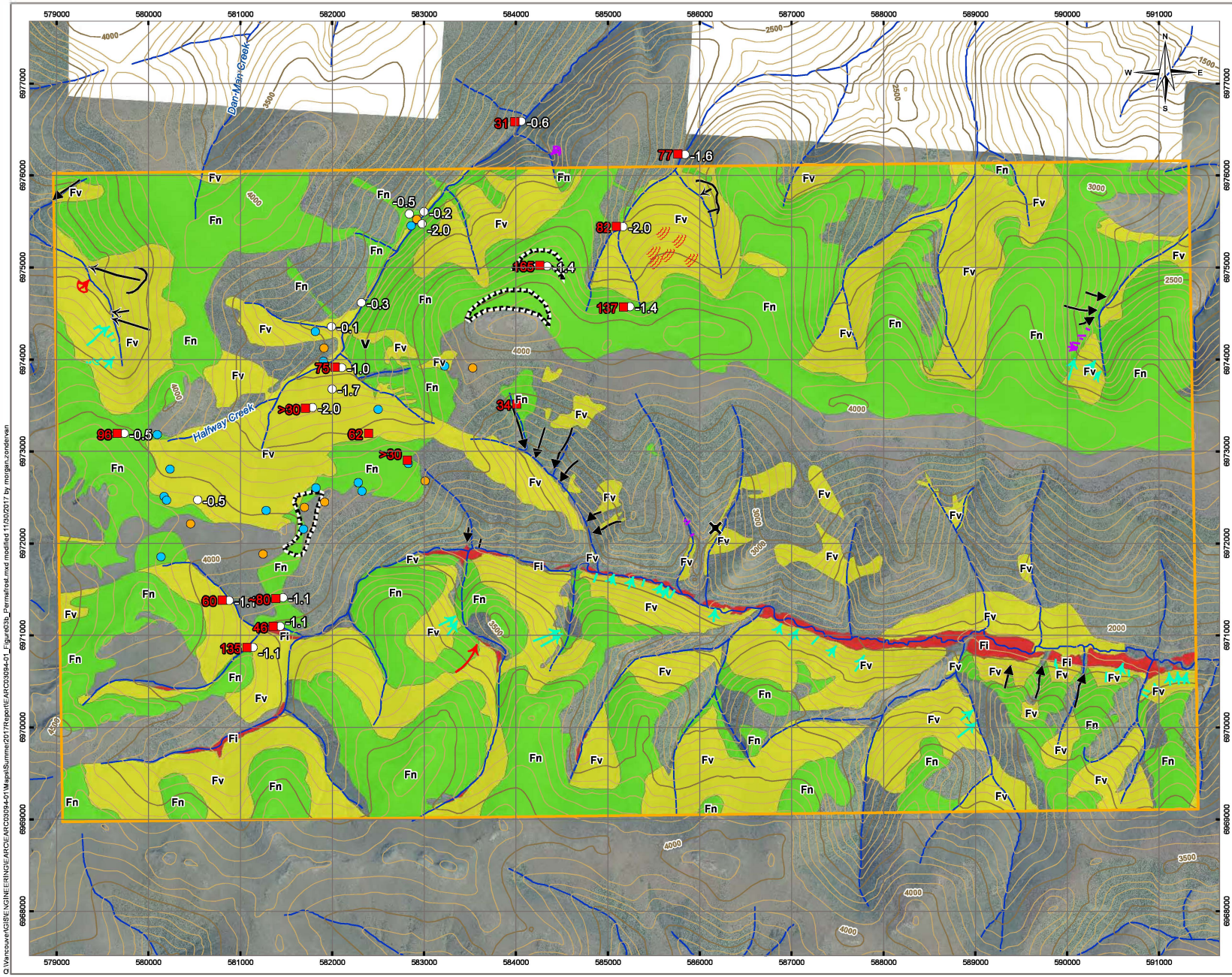
The Mine Site is largely situated in area of discontinuous permafrost, while the NAR crosses areas of limited permafrost to areas of continuous permafrost. Shallow permafrost typically underlies the northeast-facing slopes vegetated by sparse, stunted black spruce with thick moss cover. Southwest-facing slopes are permafrost-free and covered by almost pure stands of trembling aspen, which require warmer air temperatures and deeper root penetration. Permafrost thicknesses within the Project site are highly variable, ranging from approximately 30 m to 165 m. Permafrost reduces hydraulic conductivity, as groundwater freezes, and pores and cracks in bedrock fill with ice. Since it generally behaves as an aquiclude or aquitard, confining groundwater to the thin seasonal active layer above it, or the bedrock beneath it, the effects of permafrost have been taken into account in the water balance and water management plan that has been developed for the Mine Site.

Ground ice content (percent by volume) of the perennially frozen surficial materials is also highly variable. Some areas of the site are permafrost-free. Ice-poor permafrost is common in upland settings along ridges, and on moderately steep valley sides with convex or straight slopes. Ice-rich permafrost is more common in areas with higher organic accumulation and silt-rich sediments in fluvial valley bottoms. Approximately 34% of the Mine Site is underlain by ice-poor permafrost, 27% is underlain by permafrost with visible excessive ice, and approximately 1% is underlain by ice-rich permafrost. Figure 4-8 shows the test pit locations used to determine the presence and ice content of existing permafrost in and around the Mine Site area. Approximately 21% of the NAR corridor is underlain by ice-rich to very ice-rich permafrost[5].

[5] Project-related sections of the NAR proposed in thaw-sensitive warm permafrost areas, which are sensitive to natural and anthropogenic disturbances, will require special geotechnical considerations to avoid erosion and mass wasting associated with permafrost thaw and thermokarst.

Permafrost-related processes that are active within the Mine Site include cryoturbation, solifluction, active layer detachment, slope creep, frost heave, and thermal erosion. Permafrost temperatures within the Project site have been monitored since 2013 and range from -2°C to -0.6°C. The warmest permafrost temperature (-0.6ºC) was recorded at the bottom of the Halfway Creek valley. The coldest permafrost temperature (-2.0ºC) was recorded at the bottom of YT-24 Creek and on the north-facing slope of the upper Halfway Creek valley. The permafrost classification for the Project site is thus “warm” and therefore, the ground is sensitive to disturbance.

Additional long-term permafrost evaluations were carried out at the Project to determine the timeframe and general thaw duration for permafrost rich soils and the embedded massive ice lenses existing at the mine site. Rate of thawing and thaw duration was evaluated for various climate scenarios. Results from the study indicated perpetually frozen ground in a ‘no climate change’ scenario. Results for various climate change scenarios indicated gradual processes that will see stratified thawing of the sand and gravel material above the ice lenses, followed by thawing of the ice lenses, then thawing of the sand and gravel material below the ice lenses. The Ground Temperature Monitoring Report provided in Appendix 4-B. Additional descriptions of the baseline permafrost conditions at the site are provided in the Site Characterization Plan.



LEGEND

- -20 Permafrost Temperature (°C) recorded with GTC
- Permafrost Thickness (m)
- Location of Single-bead Thermistor Indicating Permafrost Condition
- Location of Single-bead Thermistor Indicating Unfrozen Condition
- Collapsed Pingo
- Solifluction Feature
- Thermal Erosion Feature
- Cryoplanation Terrace
- Gully
- Landslide Failure Scar
- Landslide Headscarp
- Recent Landslide Failure Scar
- Recent Landslide Headscarp
- Retrogressive Thaw Flow Scar
- Retrogressive Thaw Flow Headscarp
- Active Layer Detachment Scar
- Active Layer Detachment Headscarp
- Mine Site Study Area

Permafrost Characterization by Ground Ice Content

- Fi — Perennially frozen ground – predominantly very ice-rich with ground ice content locally exceeding 50% by volume of visible ice
- Fv — Perennially frozen ground – predominantly ice-rich with ground ice content generally ranging between 10% and 50% by volume of visible ice. May include patches of ice-poor permafrost and/or unfrozen ground
- Fn — Perennially frozen ground – predominantly ice-poor with ground ice content generally less than 10% by volume of visible ice or not visible ground ice. May include patches of ice-rich permafrost and/or unfrozen ground
- Predominantly permafrost-free. May include patches of permafrost
- Intermediate Contour (100 ft)
- Index Contour (500 ft)
- Watercourse

NOTES
1. Base Data Source: Imagery provided by Kaminak (2011). CanVec 1:50,000

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
SUMMER 2017
GEOTECHNICAL DATA REPORT

Coffee Mine Site Area, Permafrost and Related Geohazards

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	

Scale: 1:40,000
500 250 0 500
Metres

FILE NO.
EARC03094-01_Figure03b_Permafrost.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	MEZ	SL	VER	0

DATE: November 30, 2017
PROJECT NO.: ENG.EARC03094-01

TETRA TECH

Figure 4-8

Q:\Vancouver\GIS\E:\GIS\ENGINEERING\EARC\EARC03094-01\Maps\Summer2017Report\EARC03094-01_Figure03b_Permafrost.mxd modified 11/02/2017 by morgan.zondervan

4.1.5.3 Alpha WRSF Area

Geotechnical investigations have been conducted to characterize the subsoil conditions within the Alpha WRSF foundation footprint, which determined that the Alpha WRSF area is underlain by poorly to well graded, grey to dark brown silt, sand, gravel, and cobble mixtures. Surface boulders cover up to 30% of the ground. The extrapolated overburden thickness within the Alpha WRSF footprint ranges from approximately 0.5 m and 2 m on the slopes with depths of up to approximately 10 m in the valley bottoms.

Within the footprint of the Alpha WRSF, the surface is covered with light brown to green, coarse fibrous moss up to 200 mm thick containing rootlets and wood. Dark brown to reddish brown fibrous peat up to 300 mm thick is found beneath the moss or at the surface in some areas. Vegetation in this area generally consists of low shrubs and sparse stunted black spruce.

Northern portions of the Alpha WRSF footprint are on west-facing slopes that contain perennially frozen ground, which is predominantly ice-poor (i.e., with no visible ground ice), and on permafrost-free southeast-facing slopes. Western portions of the Alpha WRSF footprint are on east-facing slopes, which are interpreted to be mostly permafrost-free terrain with the exception of a tributary valley. Additional information regarding the geotechnical conditions in the Alpha WRSF area are provided in the Summer 2017 Geotechnical Investigation Data Report (Tetra Tech 2017) as well as in the Ground Temperature Monitoring Update Technical Memo (Tetra Tech 2023).

4.1.5.4 Heap Leach Facility

The heap leach pad (HLP) and associated ponds will be located on a ridgeline, which slopes from west to east at 7.5% to 20%. The overburden soils in the area typically consist of sandy or gravelly silts, silty or gravelly sands, and silty or sandy gravels. Silty or sandy gravel, rubble (rockfall) or weathered bedrock was observed within the overburden material on the tops of the ridges. Fine contents varied by sampling location, ranging from 12% to 50%. Soil samples from the HLF study area exhibited low to non-plastic characteristics overall. Overburden soils had an average depth of 2 mbgs, with a minimum of < 1 mbgs to a maximum of > 9 mbgs.

Topsoil within the footprint of the HLF primarily organic rich and contains ice. Under the overburden soils exists primarily granitic hard rock materials with a smaller portion of schist below the easternmost portion of the HLF site. Additional geotechnical information in the HLF area is provided in the Heap Leach and Process Facilities Management Plan.

Soil nutrient testing was conducted on three topsoil samples from within the footprint of the HLF and results are summarized in Table 4-8. The nutrient test sample at location TP17-05 O as indicated in Table 4-8 was collected at a depth of approximately 50 cm. The surficial materials at this location were described as moss to a depth of 20 cm and peat to a depth of 40 cm. The nutrient test sample at location TP17-06 O was collected at a depth of approximately 30 cm, and TP17-06 R was collected at a depth of approximately 1 m. The nutrient test sample at location TP17-09 O was collected at a depth of approximately 50 cm, and TP17-09 R was collected at a depth of approximately 1.4 m.

Soils collected from this area are generally sand to sandy loams with low cation exchange capacity (CEC). CEC provides a measurement of a soil's ability to retain positively charged nutrients (e.g., Ca^{2+}, Mg^{2+}, K^{+}, NH^{4+}) and an indication of soil moisture retaining characteristics. Generally, soil with low CEC have a lower water holding capacity than soils with high (e.g., >15 meq/100g) CEC. The low CEC for soils from the HLF area is supported by the low organic carbon content of the samples.

Table 4-8 Summary of Soil Nutrient Characteristics from Coffee Proposed Heap Leach Facility Area

Parameter	Units	TP17-05 O	TP17-06 O	*TP17-06R*	TP17-09 O	*TP17-09 R*
Particle Size						
% Gravel (>2mm)	%	16.7	18.7	21.8	11.2	20.5
% Sand (2.0mm - 0.063mm)	%	60.7	54.7	75.0	32.7	69.5
% Silt (0.063mm - 4um)	%	17.7	21.1	2.6	45.7	7.9
% Clay (<4um)	%	4.9	5.5	<1.0	10.4	2.1
Texture	-	Sandy loam	Sandy loam	Sand	Silt loam	Sand
Organic / Inorganic Carbon						
Total Organic Carbon	%	0.417	1.13	0.09	0.401	0.077
Plant Available Nutrients						
Cation Exchange Capacity	meq/100g	6.04	8.31	1.94	9.95	2.54
Available Nitrate-N	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Available Phosphate-P	mg/kg	3.9	5.4	2.3	3.2	2.2
Available Potassium	mg/kg	26	26	35	34	42
Saturated Paste Extractables						
SAR	SAR	0.77	0.55	1	0.85	0.73
Calcium (Ca)	mg/kg	1.84	2.70	0.910	1.67	0.745
Chloride (Cl)	mg/kg	2.25	1.91	2.69	2.29	1.60
Conductivity	dS/m	0.101	0.118	0.090	0.103	0.071
Magnesium (Mg)	mg/kg	0.56	0.70	0.33	0.45	0.240
Paste pH	pH	5.36	5.19	6.31	5.13	6.38
Potassium (K)	mg/kg	<0.42	<0.46	0.82	<0.50	0.37
% Saturation	%	20.8	23.2	21.3	25.2	18.4
Sodium (Na)	mg/kg	2.12	1.90	2.01	2.40	1.21
Sulfate (SO4)	mg/kg	<1.0	<1.2	1.2	<1.3	<0.92
TGR(sodic)	t/ha	<0.10	<0.10	<0.10	<0.10	<0.10
TGR(brine)	t/ha	<0.10	<0.10	<0.10	<0.10	<0.10

4.1.5.5 Soil Stockpiles and ROM Stockpile Area

Foundation soils within the footprint of the soil stockpiles are anticipated to consist of relatively shallow residual soil and colluvium over competent bedrock. Geotechnical investigations identified a thin (up to 200 mm thick), brown to reddish brown, fine to coarse fibrous moss layer at the surface (Tetra Tech and SRK 2017, Tetra Tech 2017). These thin organic mineral soils are underlain by brown to olive grey sand, silt, cobbles, and rubble up to 2.6 m thick. Trace organics found within the silt and sand layer suggest that this site is colluvial.

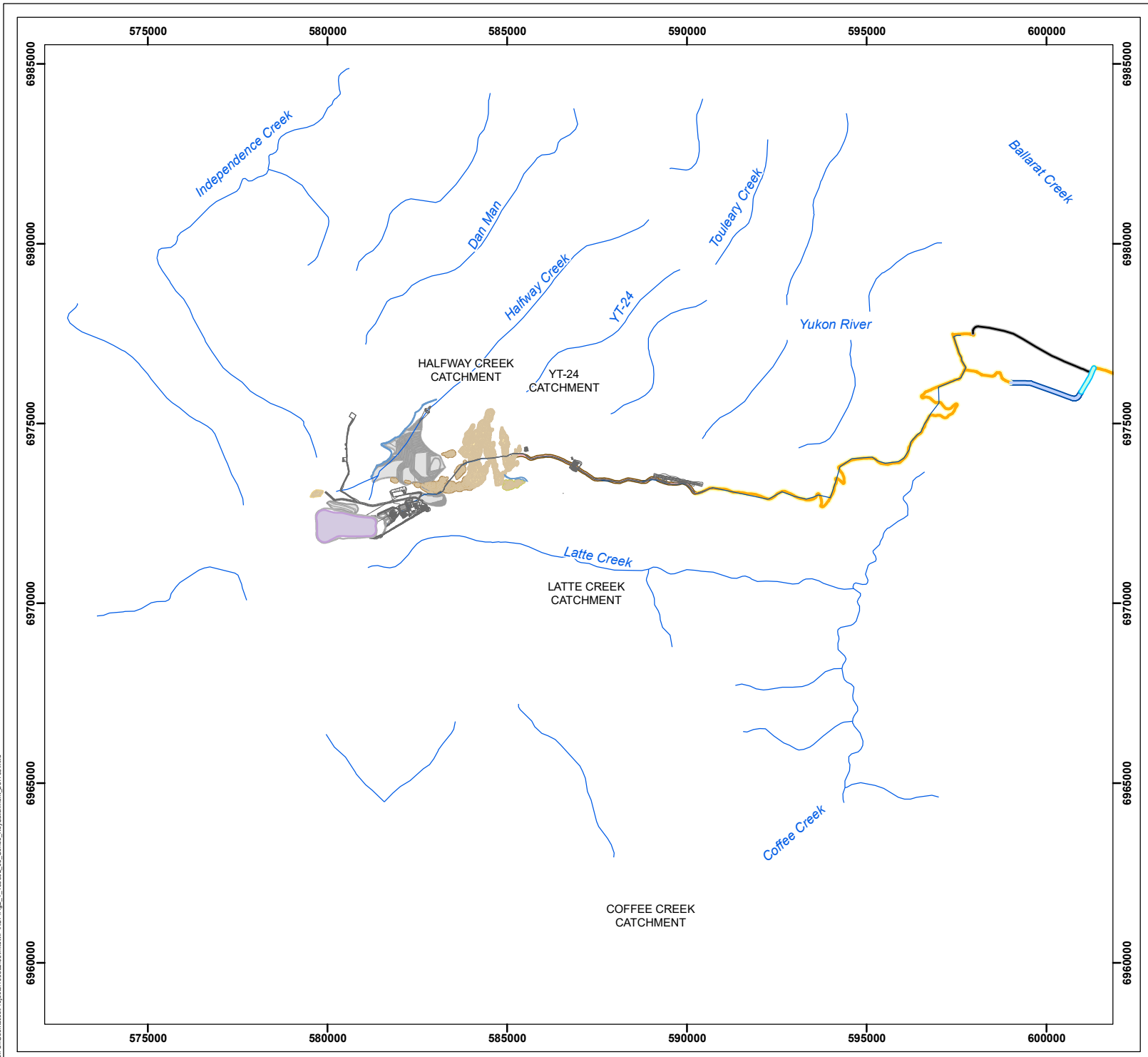
Granite bedrock encountered within the area was completely to moderately weathered and medium to coarse grained Permafrost conditions with excess ice were observed in the soil stockpiles area. Excess ice content in frozen overburden material ranged from 2% at a depth of approximately 1.9 m to 45% at a depth of approximately 0.4 m.

Geotechnical investigations within the footprint area of the ROM stockpile indicated permafrost-free conditions. This area was generally overlain with a 100 - 150 mm thick organic layer comprised of roots

and dark moss. An overburden layer approximately 1 m thick was present in the area, consisting of gravel and/or sand. Additional details regarding the geotechnical conditions of the soil and ROM stockpile areas are provided in the test pitting program reports (Tetra Tech and SRK 2017, Tetra Tech 2017).

4.1.6 Watercourses and Surface Hydrology

For Project catchments the dominant drivers of runoff during the open water season are the spring snowmelt during May and June, and intense convective rainfall that occurs frequently from June through September. Surface water is limited to a number of small watercourses that originate on the ridge and flow into the Yukon River. The four catchments near the Mine Site include Latte Creek, Coffee Creek, Halfway Creek, and Yukon Tributary 24 (YT-24), the locations and sizes of which are shown in Figure 4-9. Latte Creek drains the south face of this ridge and has a catchment area of approximately 70 km. Latte Creek flows eastward to its confluence with Coffee Creek, which has a total catchment area of approximately 487 km^2 and generally flows from south to north to the Yukon River. The north face of the ridge is drained by Yukon Tributary 24 (YT-24), located on the eastern side of the Mine Site. YT-24 has a total catchment area of approximately 12 km. Halfway Creek drains the western side and has a total catchment area of approximately 27 km^2. Both YT-24 and Halfway Creek flow northeast to their confluences with the Yukon River.



COFFEE GOLD MINE

Coffee Mine Key Catchments

Legend

- Yukon River Barge Route
- Yukon River Ice Road
- Winter Road
- Mine Site Access Route
- Northern Access Route
- Double Double Pit
- Kona Pit
- Latte Pit
- Supremo Pit
- Watercourse
- Waterbody

Pre-Mine Catchment Area

- Halfway Creek Catchment
- Latte Creek Catchment
- YT-24 Catchment
- Coffee Creek Catchment

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Topographic Map

N

1:150,000

0 1 2 3 4 5

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 4-9	Date: Nov 3, 2023	Drawn by: AS	Reviewed: KP

Path: S:\Geomatics\Projects\103982\03\mxd\MP\RCP\Fig2_1_103982_03_Coffee_KeyCatchment_231103.mxd

Local patterns of streamflow in these catchments are dominated by a snowmelt freshet that typically occurs between late April and early June. These creeks experience peak flows in May due to melting snowpack. Following freshet, stream flow is dominated by precipitation-induced runoff events that occur throughout the summer and autumn months. These high-flow, precipitation-induced events are typically short in duration, persisting over a one- to two-day period. Flows in local creeks and streams typically decrease in October in response to reduced precipitation and freezing temperatures, and several local watercourses experience zero flow conditions throughout the winter (i.e., November through the end of March). Aufeis (*i.e.,* frozen groundwater seepage that accumulates within- and adjacent to local watercourses) is pervasive in creeks and streams at the Project site and melts during the freshet but can occasionally persist into the early summer.

Mean annual runoff estimates at the Mine Site vary from basin to basin. Annual runoff generated in the headwaters of Latte Creek is comparatively high (205 mm), and runoff generated by YT24-0.1 is low (50 mm).Runoff generated in the upper Halfway Creek runoff is on par with upper Latte Creek (145 mm); however, closer to the Yukon River runoff is lower, measured at 94 mm.

Based on measurements at Coffee Creek hydrometric stations, average unit yields across the project site are 10.6 L/s/km^2 for the open water season (May to October) and range from 4 to 16 L/s/km^2, with specifics of the runoff regime for each monitoring station being dependent on drainage characteristics (i.e., basin area, shape, mean elevation, extent of permafrost, *etc.*). Unit yields range from 0.8 – 5.1 L/s/km^2 in October and decrease steadily to annual minima in March before increasing again in April in response to low-elevation snow melt and spring rains. Instantaneous peak flows, expressed as unit yields, are typically between 120 and 200 L/s/km^2, but measurements range widely across the site (from 60 to 270 L/s/km^2).

Generally, wet years are expected to produce up to 10 times more surface runoff than an extreme dry year (1:200-year recurrence intervals). The average runoff for the Mine Site is presented alongside the corresponding annual precipitation estimate for each recurrence interval in Table 4-9.

Table 4-9 Annual Precipitation and Average Annual Runoff Recurrence Interval Estimates

	Recurrence Interval (1:years)	Annual Precipitation (mm)	Average Runoff (mm)	Average Runoff Coefficient
Dry-year	1:200	248	31	0.13
	1:100	267	37	0.14
	1:50	288	43	0.15
	1:25	311	52	0.17
	1:10	349	66	0.19
Median	1:2	459	122	0.27
Wet-year	1:10	573	231	0.40
	1:25	611	297	0.49
	1:50	634	352	0.56
	1:100	652	412	0.63
	1:200	668	478	0.72

The peak flow recurrence interval estimates for drainages within the Mine Site area are presented in Table 4-10. These estimates are based on an analysis of regional streamflow records, while the recorded peak flows are based on the site monitoring records that span the period of 2011-2017.

Table 4-10 Instantaneous Peak Yield Recurrence Interval Estimates for Project Basins Derived from Regional Analysis (L/s/km^2)

Station	Drainage Area (km^2)	1:2 year	1:5 year	1:10 year	1:25 year	1:50 year	1:100 year	1:200 year	Measured Peak Yields
CC-11.6	385.6	102	136	156	185	226	264	309	136
LCT20-0.1	3.4	139	213	266	345	452	560	697	129
LC-11.4	23.1	122	178	214	268	341	413	501	388
LC-0.2[2]	69.8	114	160	189	231	291	346	414	127
LC-15.5	9.6	129	193	236	300	388	475	583	268
HC-6.8	14.8	126	185	225	284	364	443	541	173
HC-0.1	27	121	175	210	262	334	403	488	95
IC-16.1	81.1	113	157	186	227	284	338	404	109
ICT15-0.1	17.3	125	183	221	278	356	432	527	62
IC-2.7	222.3	106	143	166	198	245	288	339	207
YT24-0.1	11.8	128	189	231	292	377	459	563	400[1]

Note: [1]Estimated discharge value, hydrometric station was destroyed during July 15, 2017 flood event. Highest recorded water level prior to record interruption returned a unit yield value of 400 L/s/km^2, albeit with a high degree of uncertainty.
[2]This table is referenced from the 2021 Hydro-meteorology Baseline Report which erroneously labels Station LC-0.2 as LC-0.1. This Station ID is corrected to LC-0.2 here.

While the annual low-flow period typically occurs during the months of November to March in the Project site watersheds, many of the streams are frozen and thus there is effectively no flow. During the summer months, the streams respond rapidly to the periodic convective rainfall events, followed by rapid recessions to baseflows. Early in the summer (June) before the progressive melt of the active layer acts to raise baseflows, the low-flow regime can equal that of the winter months. Accordingly, the low-flow recurrence interval estimates presented in Table 4-11 represent the effective annual low flow estimates for the Project site watersheds.

Table 4-11 June – September Minimum 7-day Low Flow Recurrence Interval Estimates for Regional Stations. Values are Unit Yields (L/s/km^2)

Exceed. Prob.	Return Period	09AH003	09AH004	09BC001	09CA003	09CA006	09CD001	09DD003	09DD004	09EA004	09EB003	09EB004
		LP3	LP3	Weibull	LP3	LP3	LP3	LP3	LP3	LP3	LP3	LP3
	Basin Area (km^2)	1,800	6,410	48,900	12,400	7,910	149,000	51,000	4,750	1,090	2,210	3,060
0.5	1:2 (median)	2.08	1.50	7.21	11.66	2.52	9.50	8.14	5.96	10.10	1.42	2.14
0.2	1:5	1.36	0.96	5.38	8.48	1.54	8.17	6.16	4.63	8.11	0.92	1.35
0.1	1:10	1.11	0.76	4.43	7.11	1.20	7.51	5.27	4.06	7.15	0.72	1.05
0.05	1:20	0.94	0.63	3.67	6.11	0.97	6.98	4.62	3.65	6.41	0.58	0.85

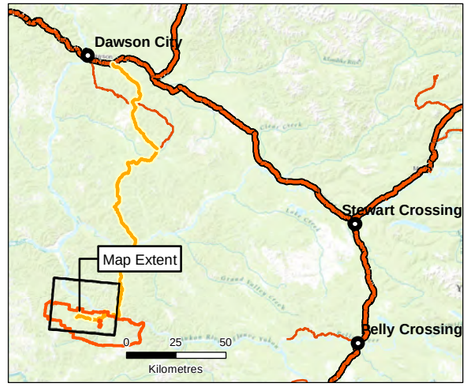
4.1.7 Surface Water Quality

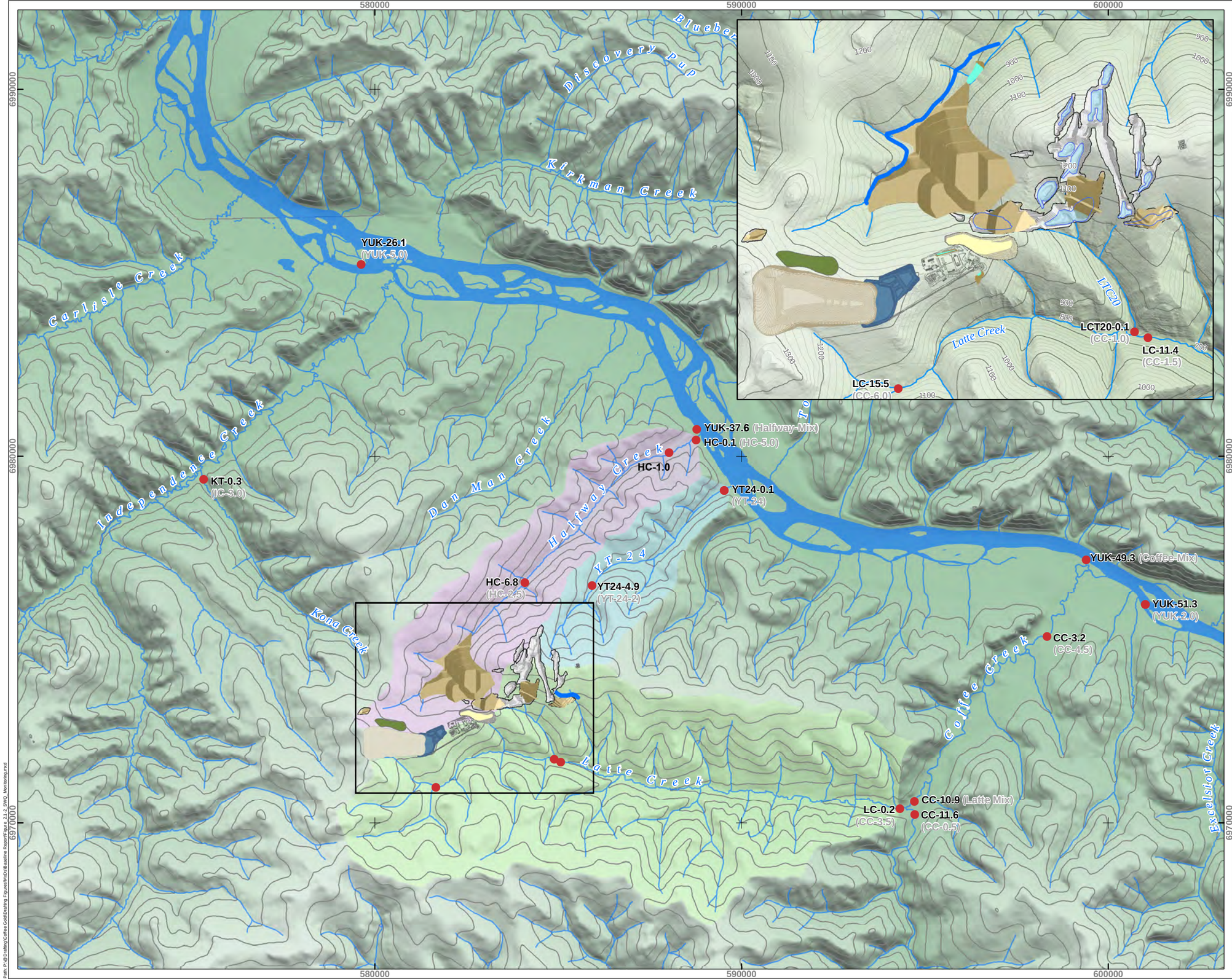
A multi-year surface water quality monitoring program has been conducted at the Project site since fall 2010 to characterize baseline conditions and to inform the water quality model. The program included all of the drainages potentially affected by the Project, including Latte Creek, Coffee Creek, Yukon Tributary (YT-24), Halfway Creek, and the Yukon River. In addition, Independence Creek was included in the surface water quality monitoring program as a reference site. Descriptions of surface water quality are provided below for representative stations.

In general, water chemistry within the catchment areas is influenced by snowmelt-driven surface runoff and/or groundwater inputs to surface flow, which is based on the seasonal water balance. This seasonality is more pronounced higher in catchments. Surface water quality is characterized by soft to moderately soft water that is low in major ions during freshet periods, and hard to very hard waters, with high levels of major ions during winter low-flow periods. Lower in catchments water chemistry shows a similar seasonality, though annual minimum and maximum amounts are less pronounced. pH remains relatively uniform throughout drainages on an annual basis (7.0 to 8.0). A complete description of the water quality variables and stations per catchment can be found in the Site Characterization Plan and the locations of monitoring stations described below are illustrated in Figure 4-10.

COFFEE GOLD MINE

Surface Water Quality Monitoring Locations





Legend

- Municipalities
- Waterbody
- Watercourse
- Pit
- WRSF/Backfill
- Halfway Creek Catchment
- Latte Creek Catchment
- YT-24 Creek Catchment

N

1:100,000

0 400 800 1,200

Meters

NAD 1983 UTM Zone 8N

Page Size: 11" x 17"

Figure 4-10	Date: Nov 14, 2023	Drawn by: AL	Reviewed: SJ/DF

Newmont COFFEE

Path: P:\@Drafting\Coffee Gold\Drafting Figures\MxD\Baseline Report\Figure 4-10_SWQ_Monitoring.mxd

4.1.7.1 Latte Creek

Water chemistry in the Latte Creek can be divided between upper Latte Creek, where the primary inputs are from surface runoff, and mid to lower Latte Creek, which is influenced by both groundwater discharge, as well as surface runoff during the ice-free periods.

Table 4-12 provides a summary of the surface water quality in relevant stations of the Latte Creek catchment. A comprehensive list of surface water quality parameters in Latte Creek is provided in the Site Characterization Plan. Relevant stations include:

- LC-15.5 (Upper Latte Creek)
- LC-11.4 (mid- to lower-reach of Latte Creek)
- LC-0.2 (mid- to lower-reach of Latte Creek).

Limited water samples have been collected at the Upper Latte Creek sampling locations due to lack of measurable flow in winter months, which is likely a function of minimal groundwater discharge in this area.

Table 4-12 Summary of Monthly Mean Values for Water Quality in Latte Creek

LC-15.5 (Upper Latte Creek)													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH	pH-L	-	-	-	6.5	6.1	6.6	6.7	6.8	6.9	6.9	6.3	-
mg/L	TSS	-	-	-	3.0	6.3	5.1	4.9	8.6	3.5	17	1.4	-
mg/L	T-Hard	-	-	-	21	11	11	11	11	11	12	13	-
ug/L	D-Al	-	-	-	210	300	280	200	170	140	130	97	-
ug/L	D-Cu	-	-	-	1.8	2.1	2.0	1.6	1.5	1.4	1.2	1.0	-
ug/L	D-Fe	-	-	-	140	243	288	166	170	150	150	82	-
ug/L	T-As	-	-	-	0.49	0.38	0.52	0.56	0.81	0.55	0.52	0.41	-
ug/L	T-Cd	-	-	-	0.11	0.032	0.019	0.011	0.015	0.0096	0.0094	0.0052	-
ug/L	T-Cr	-	-	-	0.40	0.45	0.57	0.67	0.81	0.52	0.51	0.39	-
ug/L	T-Se	-	-	-	0.04	0.042	0.047	0.045	0.047	0.044	0.042	0.040	-
ug/L	T-U	-	-	-	0.46	0.62	0.56	0.53	0.52	0.43	0.42	0.34	-
LC-11.4 (mid- to lower-reach of Latte Creek)													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH	pH-L	8.1	8.0	8.0	8.0	7.4	7.6	7.7	7.8	7.8	8.0	8.0	8.1
mg/L	TSS	1.4	7.3	15	16	5.9	8.4	2.5	19	2.0	1.6	1.3	1.9
mg/L	T-Hard	390	420	400	320	55	87	110	130	120	240	350	370
ug/L	D-Al	10	7.9	7.3	56	280	210	140	100	100	41	17	11
ug/L	D-Cu	1.1	1.0	0.95	1.3	2.0	1.9	1.7	1.6	1.6	1.2	1.2	1.0
ug/L	D-Fe	5.5	4.1	4.4	42	210	160	99	85	66	26	10	5.0
ug/L	T-As	1.1	1.4	2.4	1.5	0.75	0.76	0.65	0.88	0.63	0.73	0.79	0.93
ug/L	T-Cd	0.015	0.013	0.023	0.026	0.034	0.2	0.014	0.014	0.0099	0.0081	0.01	0.0089
ug/L	T-Cr	0.24	0.21	0.54	0.26	0.58	0.68	0.51	0.81	0.39	0.26	0.15	0.13
ug/L	T-Se	0.27	0.28	0.26	0.16	0.061	0.071	0.085	0.097	0.11	0.15	0.21	0.23
ug/L	T-U	30	31	30	20	3.7	5.0	6.3	7.2	6.6	14	23	29

LC-0.2 (mid- to lower-reach of Latte Creek)													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH	pH-L	7.9	7.9	8.0	8.1	7.6	7.8	7.8	7.8	7.9	7.9	7.9	7.9
mg/L	TSS	1.5	6.0	5.2	2.5	7.7	14	1.3	2.4	1.2	1.6	1.5	1.5
mg/L	T-Hard	213	210	240	230	79	130	110	120	130	170	190	200
ug/L	D-Al	15	14	11	32	190	100	100	77	58	30	19	15
ug/L	D-Cu	0.83	0.79	2.2	0.96	1.8	1.7	1.7	1.5	1.4	1.2	0.98	0.88
ug/L	D-Fe	7.9	7.5	12	36	190	85	82	59	35	13	9.3	6.5
ug/L	T-As	0.26	0.31	0.33	0.39	0.57	0.55	0.41	0.4	0.37	0.34	0.27	0.26
ug/L	T-Cd	0.0080	0.011	0.027	0.028	0.022	0.017	0.011	0.0093	0.0063	0.0072	0.007	0.0067
ug/L	T-Cr	0.11	0.15	0.13	0.19	0.56	1.1	0.5	0.39	0.31	0.25	0.13	0.11
ug/L	T-Se	0.085	0.066	0.083	0.13	0.071	0.078	0.084	0.079	0.092	0.087	0.1	0.079
ug/L	T-U	11	11	12	31	5.6	8.3	4.9	6.1	6.2	9.9	11	9.9

Notes: Total Suspended Solids – TSS; - not available; T-Total; D-Dissolved

4.1.7.2 Coffee Creek

Background water chemistry in Coffee Creek can be divided between upper Coffee Creek (e.g., above the confluence with Latte Creek) and lower Coffee Creek. Table 4-13 provides a summary of the surface water quality in relevant stations of the Coffee Creek catchment. A comprehensive list of surface water quality parameters in Coffee Creek is provided in the Site Characterization Plan. Relevant stations include:

- CC-11.6 (Upper Coffee Creek; upstream of Project influences)
- CC-3.2 (Lower Coffee Creek; downstream of confluence with Latte Creek)
- CC-10.9 (immediately downstream of confluence with latte Creek).

Coffee Creek is generally characterized by moderately hard with lower levels of major ions during the open water period of May to September. During low-flow periods, water chemistry is dominated by hard to very hard waters with high levels of dissolved solids.

Table 4-13 Summary of Mean Monthly Values for Water Quality in Coffee Creek

CC-11.6													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH	pH-L	7.9	7.9	7.9	7.9	7.2	7.6	7.5	7.6	7.6	7.7	7.7	7.8
mg/L	TSS	1.9	1.2	1.6	5.7	23	17	18	6.5	1.4	2.6	2.4	2.6
mg/L	T-Hard	190	220	220	280	60	72	56	66	69	91	130	160
ug/L	D-Al	14	10	11	54	250	160	150	100	94	53	30	20
ug/L	D-Cu	0.93	0.69	0.87	1.2	2.6	2.6	2.6	2.4	2.3	1.8	1.4	1.1
ug/L	D-Fe	60	75	79	73	220	140	140	96	82	46	33	25
ug/L	T-As	0.37	0.35	0.34	0.64	0.86	0.6	0.68	0.54	0.47	0.41	0.34	0.31
ug/L	T-Cd	0.026	0.0098	0.0074	0.034	0.038	0.021	0.024	0.021	0.014	0.011	0.01	0.012
ug/L	T-Cr	0.38	0.16	0.10	0.24	1.0	0.76	1.1	0.52	0.44	0.3	0.21	0.24
ug/L	T-Se	0.11	0.07	0.063	0.43	0.072	0.086	0.099	0.1	0.1	0.1	0.13	0.12
ug/L	T-U	17	14	8.7	30	5.8	5.6	3.1	3.7	3.8	6.7	15	17
CC-3.2													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH	pH-L	7.7	7.7	7.5	7.8	7.3	7.6	7.5	7.6	7.6	7.7	7.7	7.2
mg/L	TSS	2.3	9.4	1.4	5.2	20	24	9.1	2.4	3.9	1.5	2.3	2.9
mg/L	T-Hard	120	127	140	140	56	82	62	75	79	96	110	123
ug/L	D-Al	29	27	27	53	220	140	130	86	79	45	32	27
ug/L	D-Cu	1.3	1.5	2.0	1.5	2.5	2.5	2.4	2.2	2.1	1.8	1.5	1.3
ug/L	D-Fe	11	9.4	11	43	210	120	120	76	64	32	19	12
ug/L	T-As	0.27	0.26	0.27	0.39	0.74	0.71	0.55	0.47	0.43	0.36	0.3	0.26
ug/L	T-Cd	0.021	0.012	0.023	0.021	0.033	0.039	0.018	0.011	0.01	0.011	0.011	0.014
ug/L	T-Cr	0.25	0.22	0.16	0.27	0.83	1.4	0.72	0.41	0.39	0.27	0.22	0.17
ug/L	T-Se	0.065	0.056	0.087	0.085	0.079	0.085	0.095	0.088	0.097	0.086	0.079	0.072
ug/L	T-U	1.3	1.2	1.4	5.5	3.3	3.4	2.3	2.9	3.1	4.0	3.4	2.5

CC-10.9													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH	pH-L	8.2	8.2	8.1	8.2	7.8	7.7	8.0	7.9	7.9	8.0	8.1	8.1
mg/L	TSS	1.5	1.0	1.1	1.0	11	2.5	45	4.4	1.3	1.7	1.1	1.0
mg/L	T-Hard	265	254	260	356	100	101	114	103	104	119	149	203
ug/L	D-Al	5.1	7.1	5.6	20	27	201	247	172	97	85	34	19
ug/L	D-Cu	0.54	0.62	0.46	1.2	0.81	3.0	3.0	2.7	2.2	2.0	1.6	1.1
ug/L	D-Fe	17	2.6	2.8	70	68	157	212	158	88	71	30	22
ug/L	T-As	0.27	0.3	0.35	0.95	0.53	0.47	0.89	0.56	0.46	0.49	0.39	0.29
ug/L	T-Cd	0.0054	0.0050	0.0056	0.032	0.023	0.013	0.026	0.011	0.0096	0.0097	0.0091	0.0086
ug/L	T-Cr	0.10	0.19	0.18	0.52	0.37	0.51	1.7	0.69	0.48	0.42	0.20	0.13
ug/L	T-Se	0.16	0.24	0.18	0.22	0.067	0.075	0.11	0.12	0.17	0.11	0.19	0.14
ug/L	T-U	17	20	23	124	8.0	7.6	7.8	6.9	6.4	12	20	18

Notes: Total Suspended Solids – TSS; - not available; T-Total; D-Dissolved

4.1.7.3 Halfway Creek

Two stations are described for Halfway Creek, HC-6.8, approximately mid-way down the watershed, and HC-1.0, at the mouth of Halfway Creek prior to entering the Yukon River. Water quality parameters for these stations are summarized in Table 4-14. A comprehensive list of surface water quality parameters in Halfway Creek is provided in the Site Characterization Plan.

Parameters and their seasonal variations are consistent with Latte Creek and Coffee Creek catchments, with maximum annual TSS concentrations occurring in summer, coinciding with snowmelt and intense summer rainfall events. Despite seasonal peaks, mean monthly concentrations of total and dissolved trace elements are typically low; however, precipitation events produced elevated concentrations of total As, similar to elevated TSS during these periods.

Table 4-14 Summary of Monthly Mean Values for Water Quality in Halfway Creek

HC-6.8													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH	pH-L	7.9	7.9	7.9	8.0	7.2	7.5	7.7	7.7	7.8	7.9	7.9	8.0
mg/L	TSS	1.5	1.0	1.2	1.8	6.3	13	3.0	14	1.7	1.3	1.7	1.1
mg/L	T-Hard	190	189	200	180	51	58	73	79	81	120	160	180
ug/L	D-Al	10	8.9	8.2	67	310	280	150	120	110	52	18	12
ug/L	D-Cu	0.85	0.69	0.79	0.97	2.0	1.9	1.6	1.6	1.9	1.2	0.92	0.8
ug/L	D-Fe	5.0	4.4	4.5	50	280	260	120	100	85	34	10	5.9
ug/L	T-As	0.7	0.68	0.6	1.1	1.2	1.5	1.2	1.5	1.1	1.1	0.91	0.73
ug/L	T-Cd	0.012	0.0078	0.011	0.014	0.025	0.02	0.013	0.013	0.0078	0.0069	0.0072	0.0084
ug/L	T-Cr	0.21	0.12	0.1	0.27	0.75	0.91	0.57	1.0	0.52	0.31	0.19	0.12
ug/L	T-Se	0.11	0.12	0.1	0.14	0.067	0.066	0.072	0.067	0.085	0.09	0.1	0.097
ug/L	T-U	70	80	84	72	16	15	19	20	20	37	53	60
HC-1.0													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH	pH-L	8.0	8.1	-	8.0	7.5	7.7	7.9	7.8	7.9	7.9	7.9	7.5
mg/L	TSS	17	3.3	-	1.5	11	12	1.5	40	1.3	1.4	1.8	1.0
mg/L	T-Hard	134	175	-	170	66	89	96	87	92	110	120	136
ug/L	D-Al	18	15	-	35	190	130	50	71	50	34	23	23
ug/L	D-Cu	2.6	1.6	-	1.1	1.9	1.9	1.8	1.9	1.8	1.7	1.6	1.5
ug/L	D-Fe	16	11	-	33	180	120	39	70	39	24	13	14
ug/L	T-As	0.43	0.46	-	0.64	1.1	1.1	0.72	1.6	0.69	0.6	0.51	0.51
ug/L	T-Cd	0.065	0.028	-	0.01	0.016	0.012	0.0051	0.018	0.0059	0.011	0.0076	0.072
ug/L	T-Cr	0.50	0.23	-	0.19	0.7	1.9	0.39	2.1	0.35	0.29	0.25	0.30
ug/L	T-Se	0.087	0.11	-	0.11	0.06	0.071	0.072	0.073	0.067	0.076	0.068	0.060
ug/L	T-U	17	30	-	18	12	9.3	9.5	8.0	9.0	10	11	14

Notes: - not available; T-Total; D-Dissolved

4.1.7.4 Yukon Tributary 24 (YT-24)

Two stations are described for YT-24, near the mouth at station YT24-0.1 and mid-creek at station YT24-4.9. Monthly water quality parameters for these stations are summarized in Table 4-15. A comprehensive list of surface water quality parameters in YT-24 is provided in the Site Characterization Plan.

Hardness for the Yukon Tributary is characterized as moderately hard to very hard at YT24-4.9 and soft at YT24-0.1. Unlike the Coffee Creek catchment, baseflow in YT-24 is not strongly associated with groundwater recharge. The pH in YT24 is circumneutral (i.e., pH between 6.3 and 7.8).

Measured TSS concentrations in both stations are typically low, although peak flow events are associated with elevated TSS. Consistent with the dominant contribution of snowmelt-driven surface runoff to stream flow, water chemistry commonly shows elevated levels of dissolved organic carbon (DOC), although monthly mean concentrations of most trace elements are low.

Table 4-15 Summary of Monthly Mean Values for Water Quality in Yukon Tributary (YT-24)

YT24-4.9													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH units	pH	-	-	-	6.3	7.1	7.3	6.8	7.3	7.1	6.3	-	-
mg/L	TSS	-	-	-	8.1	1.6	1.0	12	6.6	16	8.1	-	-
mg/L	T-Hard	-	-	-	18	24	30	21	32	30	18	-	-
ug/L	D-Al	-	-	-	422	258	103	218	79	97	422	-	-
ug/L	D-Cu	-	-	-	2.5	2.4	1.8	1.8	1.6	1.7	2.5	-	-
ug/L	D-Fe	-	-	-	324	169	46	282	46	83	324	-	-
ug/L	T-As	-	-	-	1.2	0.98	0.79	1.2	0.99	1.5	1.2	-	-
ug/L	T-Cd	-	-	-	0.023	0.01	0.0069	0.013	0.0086	0.011	0.023	-	-
ug/L	T-Cr	-	-	-	0.89	0.76	0.40	1.0	0.50	0.63	0.89	-	-
ug/L	T-Se	-	-	-	0.049	0.062	0.062	0.065	0.054	0.056	0.049	-	-
ug/L	T-U	-	-	-	0.36	0.41	0.36	0.36	0.31	0.39	0.36	-	-
YT24-0.1													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH units	pH	-	-	-	7.7	7.7	7.7	7.8	7.6	7.8	7.7	-	-
mg/L	TSS	-	-	-	2.8	3.7	13	3.6	14	1.1	4.4	-	-
mg/L	T-Hard	-	-	-	310	110	86	91	77	90	95	-	-
ug/L	D-Al	-	-	-	180	160	110	64	93	51	42	-	-
ug/L	D-Cu	-	-	-	1.9	2.6	2.0	1.9	2.0	1.9	1.8	-	-
ug/L	D-Fe	-	-	-	142	140	88	46	81	31	23	-	-
ug/L	T-As	-	-	-	0.6	0.68	0.63	0.55	0.72	0.47	0.46	-	-
ug/L	T-Cd	-	-	-	0.021	0.017	0.0098	0.0074	0.012	0.0054	0.0086	-	-
ug/L	T-Cr	-	-	-	0.31	0.51	0.5	0.46	0.72	0.35	0.33	-	-
ug/L	T-Se	-	-	-	0.097	0.075	0.067	0.071	0.070	0.084	0.085	-	-
ug/L	T-U	-	-	-	94	16	2.3	2.0	1.8	1.9	1.2	-	-

Notes: Total Suspended Solids – TSS; - not available; T-Total; D-Dissolved

4.1.7.5 Independence Creek

Independence Creek is characterized by water quality measured at Station IC-2.7 (Figure 4-10) which reflects water quality conditions in lower Independence Creek and downstream of contributions from three small catchments. The catchments drain the east slope of the drainage divide between upper Latte Creek and Independence Creek (IC-16.1 and IC-14.6) and the eastern slope of the drainage divide of Halfway Creek and Independence Creek (KT-0.3) in Kona Creek. Table 4-16 summarizes the surface water quality at location IC-2.7. A comprehensive list of surface water quality parameters at station IC-2.7 is provided in the Site Characterization Plan.

Parameters and their seasonal variations are consistent with Latte Creek/Coffee Creek, with maximum annual TSS, dissolved organic carbon, dissolved Al, total Fe occurring in summer. Despite seasonal peaks, mean monthly concentrations of total and dissolved trace elements are typically low, with the exception of dissolved Al and total Cu.

Table 4-16 Summary of Mean Monthly Values for Water Quality in Independence Creek

IC-2.7													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH units	pH	7.5	7.7	7.3	7.7	7.3	7.5	7.6	7.6	7.6	7.6	7.6	7.5
mg/L	TSS	6.1	1.0	2.7	4.4	11	19	2.7	28	1.3	1.3	1.6	1.3
mg/L	T-Hard	100	123	120	120	49	57	56	60	61	80	89	96
ug/L	D-Al	42	41	44	71	210	160	120	120	110	59	48	41
ug/L	D-Cu	1.9	1.3	1.6	1.4	2.2	2.5	2.7	2.3	2.2	1.9	1.7	1.4
ug/L	D-Fe	18	12	19	62	210	140	100	120	100	49	24	15
ug/L	T-As	0.37	0.29	0.3	0.41	0.61	0.69	0.53	0.97	0.5	0.4	0.32	0.29
ug/L	T-Cd	0.043	0.014	0.046	0.037	0.037	0.028	0.021	0.031	0.014	0.011	0.019	0.02
ug/L	T-Cr	0.52	0.21	0.52	0.26	0.76	0.97	0.5	1.6	0.48	0.31	0.26	0.21
ug/L	T-Se	0.089	0.088	0.072	0.13	0.082	0.084	0.088	0.092	0.089	0.083	0.073	0.08
ug/L	T-U	0.51	0.44	0.46	2.4	1.8	1.5	1.2	1.3	1.3	1.2	0.67	0.5

4.1.7.6 Yukon River

Table 4-17 summarizes the baseline water quality in the immediate vicinity of the proposed project, at stations YUK-51.3 and YUK-26.1. These stations are located immediately upstream of Coffee Creek and downstream of Independence Creek, respectively (Figure 4-10). A comprehensive list of surface water quality parameters at Yukon River monitoring stations is provided in the Site Characterization Plan.

Yukon River is characterized by consistently hard waters with low to moderate levels of major ions. Measurements for pH are generally circumneutral to slightly basic. The strong seasonal water quality signature is largely absent from the Yukon River, presumably due to its large catchment. The Yukon River shows concentration peaks for certain organic parameters during summer high flows. Despite annual concentration peaks for certain parameters during summer high flows, mean monthly concentrations of total and dissolved trace elements are typically low, falling below CCME and BC long-term guidelines. The pH in Yukon River is relatively consistent between the stations throughout the year (pH of approximately 8.0). TSS concentrations in the Yukon River show maxima coinciding with peak snowmelt months. Mean monthly concentrations of total and dissolved trace elements and most notably for U, are typically low, falling below CCME and BC long-term guidelines.

Table 4-17 Summary of Mean Monthly Values for Water Quality in Yukon River

YUK-51.3													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH units	pH	8.0	8.0	8.0	8.0	7.9	7.9	8.0	7.9	8.0	8.0	7.9	7.9
mg/L	TSS	2.5	1.1	2.3	22	150	44	25	16	9.7	5.7	2.1	6.9
mg/L	T-Hard	100	110	100	98	96	93	92	89	96	94	110	120
ug/L	D-Al	4.7	2.1	1.6	4.8	43	28	21	24	20	13	11	3.3
ug/L	D-Cu	0.66	0.51	0.37	0.57	2.1	1.1	0.83	0.77	0.73	0.6	0.66	0.75
ug/L	D-Fe	6.3	4.8	4.6	10	77	26	13	11	14	11	22	4.4
ug/L	T-As	0.39	0.37	0.36	0.58	1.9	0.88	0.79	0.67	0.54	0.46	0.44	0.41
ug/L	T-Cd	0.055	0.035	0.024	0.072	0.4	0.12	0.078	0.069	0.051	0.071	0.032	0.067
ug/L	T-Cr	0.95	0.23	0.13	0.47	2.1	0.67	0.73	0.49	0.31	0.25	0.15	0.31
ug/L	T-Se	0.34	0.39	0.39	0.34	0.44	0.48	0.38	0.36	0.39	0.34	0.37	0.42
ug/L	T-U	1.1	1.2	1.1	1.1	1.1	0.88	0.93	0.96	1.0	1.0	1.2	1.2
YUK-26.1													
Units	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
pH units	pH	8.0	8.0	7.9	8.0	7.9	8.0	8.0	7.9	8.0	7.9	7.9	7.9
mg/L	TSS	10	22	1.2	5.4	71	48	25	22	7.1	2.9	5.0	1.0
mg/L	T-Hard	110	96	110	110	90	91	87	87	89	92	100	119
ug/L	D-Al	2.3	2.3	1.4	5.1	55	28	23	30	18	14	6.0	2.5
ug/L	D-Cu	0.57	0.44	0.36	0.57	2.0	1.1	0.88	0.9	0.75	0.62	0.66	0.48
ug/L	D-Fe	6.3	6.4	4.1	13	82	26	14	23	14	12	10	4.4
ug/L	T-As	0.38	0.33	0.19	0.38	1.5	0.87	0.79	0.74	0.5	0.44	0.43	0.32
ug/L	T-Cd	0.043	0.056	0.031	0.04	0.26	0.11	0.075	0.061	0.036	0.054	0.027	0.026
ug/L	T-Cr	0.19	0.31	0.11	0.24	1.8	0.72	0.66	0.73	0.26	0.44	0.17	0.10
ug/L	T-Se	0.38	0.44	0.47	0.38	0.39	0.42	0.31	0.35	0.31	0.31	0.3	0.44
ug/L	T-U	1.3	1.0	1.3	1.3	1.3	0.92	0.97	0.99	1.1	1.0	1.2	1.2

4.1.8 Groundwater

Existing conditions are provided below for groundwater quantity and groundwater quality. Groundwater quantity refers to the distribution of groundwater and related volumetric fluxes while groundwater quality refers to its chemical composition. Multiple hydrogeological programs have been undertaken at the Coffee mine site to characterize the physical and chemical groundwater system. Data collected in these investigations has been supplanted by geotechnical programs. The well-developed groundwater monitoring network includes eleven conventional monitoring wells, seven Westbay multilevel groundwater monitoring systems, nine combination vibrating wire piezometer (VWP)/thermistor strings, plus twelve stand-alone thermistor strings, twenty-five stand-alone shallow thermistor beads, and four stand-alone VWP strings. The installations span elevations of ~560 masl to ~1,250 masl on multiple slope aspects (Figure 4-11).

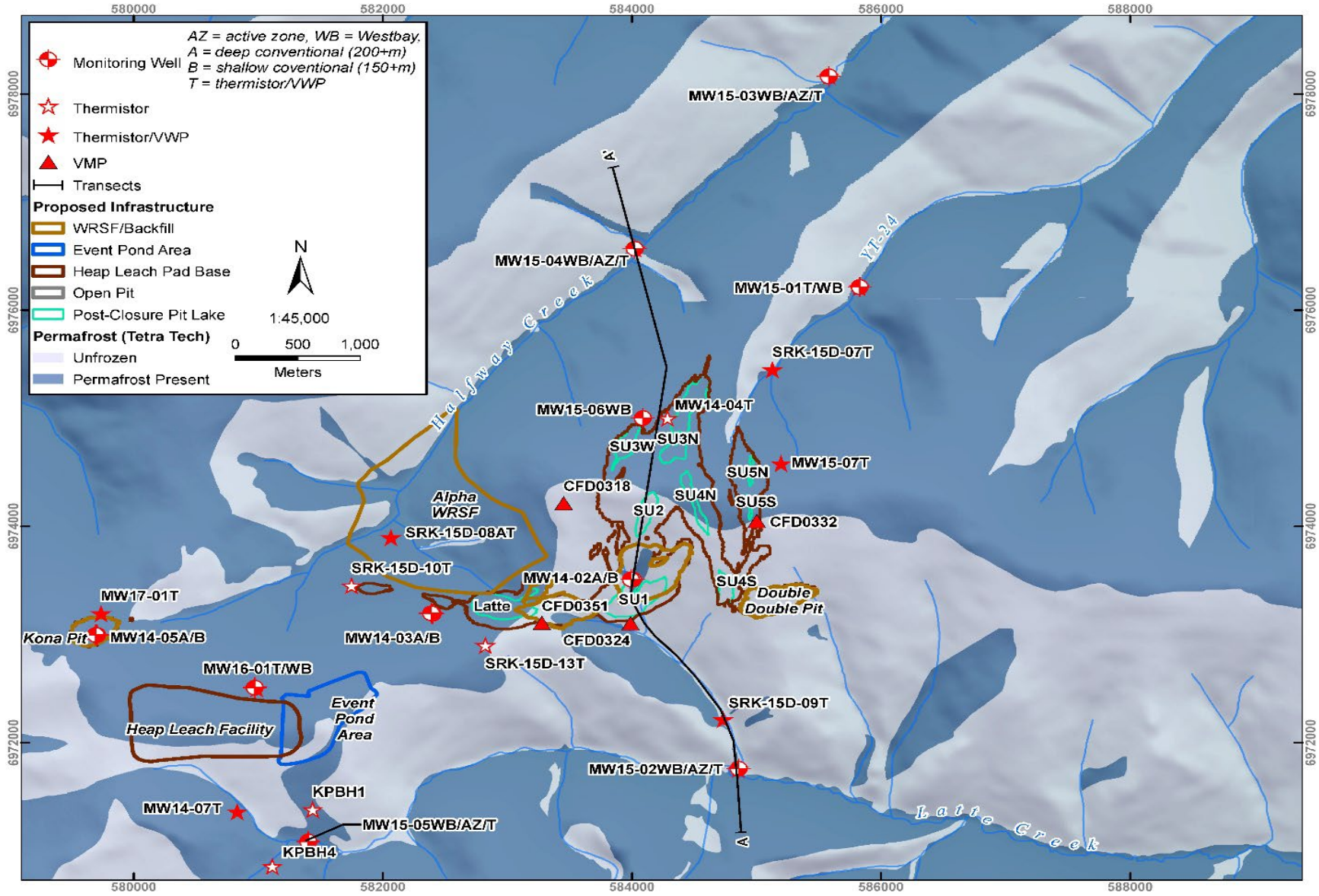


Figure 4-11 Groundwater Instrumentation at the Coffee Project

4.1.8.1 Groundwater Quantity

Overall, the physical hydrogeological data reveal a complex groundwater system influenced by both discontinuous permafrost and a well-developed fracture system. As indicated in Section 4.1.5.2 and illustrated in Figure 4-11, permafrost underlies ~60% of the Mine Site. Overall, permafrost extends to greatest depths in ridge areas and appears to reduce in thickness towards areas of lower elevation; north-facing slopes tend to have thicker and more prevalent permafrost than south-facing slopes. Permafrost is of hydrogeological significance as it is considered to behave like an aquiclude or an aquitard and can confine sub-permafrost groundwater, isolating it from a thin seasonal active layer above it. Hydrogeologic investigations at the Mine Site have focussed on the sub-permafrost groundwater system.

4.1.8.2 Hydraulic Conductivity

Hydraulic testing of bedrock at the Coffee project has been undertaken on multiple lithologies located within pit footprint areas and farther afield. The hydraulic conductivity data are typical of a fractured bedrock system, ranging over several orders of magnitude with values exceeding 1E-06 m/s and others below the resolution of the testing method. Based on the widespread in values for the major rock units and combinations thereof, rock type does not appear to exert a large influence on hydraulic properties. Rather, structural features, which crosscut all lithologies, impart the dominant control on hydraulic conductivity.

Bedrock hydraulic conductivity values are observed to broadly decrease with depth with the exception of deeper tests that specifically targeted geologic structures intersecting the proposed pits and in the currently proposed HLF footprint (Figure 4-12). These structures report a mean K value of 2E-07. Borehole testing near creek channels infer that major creek traces (i.e., Halfway Creek and YT-24) represent permeable fault structures.

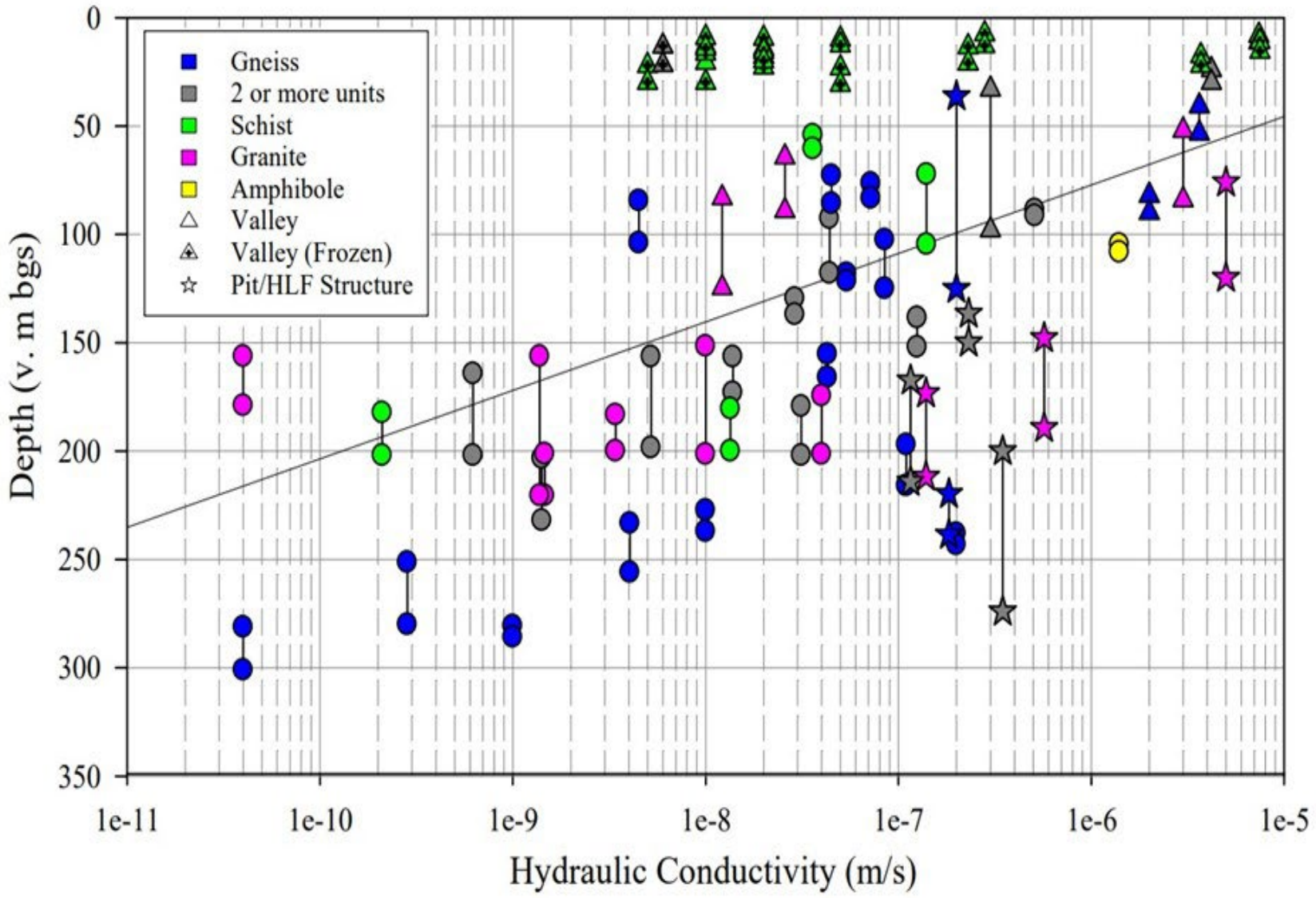


Figure 4-12 Bedrock Hydraulic Conductivity versus Depth

4.1.8.3 Groundwater Levels

In general, groundwater levels are very deep in ridge areas, ranging from 130 m to over 220 m below the ground surface, but artesian conditions are encountered even at moderate to high elevations in the drainages. Water level hydrographs indicate variable response to seasonal recharge patterns, with fluctuations ranging from approximately <1 m to over 30 m. Fluctuations in the range of 0 m to 10 m are typical. The magnitude of seasonal fluctuations is not clearly correlated to well collar elevation, nor to the presence of permafrost. The continuous water level record indicates that the hydrographs at most wells are reasonably insensitive to individual rainfall events; rather, they follow a gradual seasonal increase that peaks anywhere between late summer and winter. The timing of peak groundwater levels is highly variable across the site.

Nested instrumentation revealed both upward and downward vertical hydraulic gradients in both upland and low-lying areas. In some instances, horizontal hydraulic gradients exceed topographic gradients. At monitoring locations where permafrost depth is accurately known, groundwater pressures can exceed the base of permafrost, demonstrating confined conditions. The notable exceptions are the slope draining the SU3W Pit, where the water table is inferred to be at least 50 meters below the base of permafrost, and the slope draining Kona Pit, where water levels are about 20 m below the base of permafrost.

A map of bedrock groundwater head contours is provided in Figure 4-13. Groundwater flows from high elevation (recharge areas) to low elevation, discharging along drainages inferred to represent fault structures. This is evidenced by seepage at surface and upward artesian groundwater pressures registered at piezometers along drainage traces. Where drainages intersect areas underlain by permafrost, the drainage itself may present as a diffuse through-talik that permits discharge of deeper, sub-permafrost groundwater to surface. This phenomenon has been observed in reaches of Halfway Creek. A deeper groundwater flow path ultimately flows toward the Yukon River and deflects northwest toward a regional topographic low point.

Groundwater discharge to creeks (i.e., baseflow) is often overwhelmed by surface runoff and active layer flow during the open water season except following an extended dry period. Minimum baseflow measured in late winter is considered equivalent to groundwater discharge; winter basin yields are estimated to range from 0.0 to 0.7 L/s/km^2. As baseflow component of streamflow increases, concentrations of some parameters including uranium, calcium, magnesium, and strontium are observed to increase in surface water.

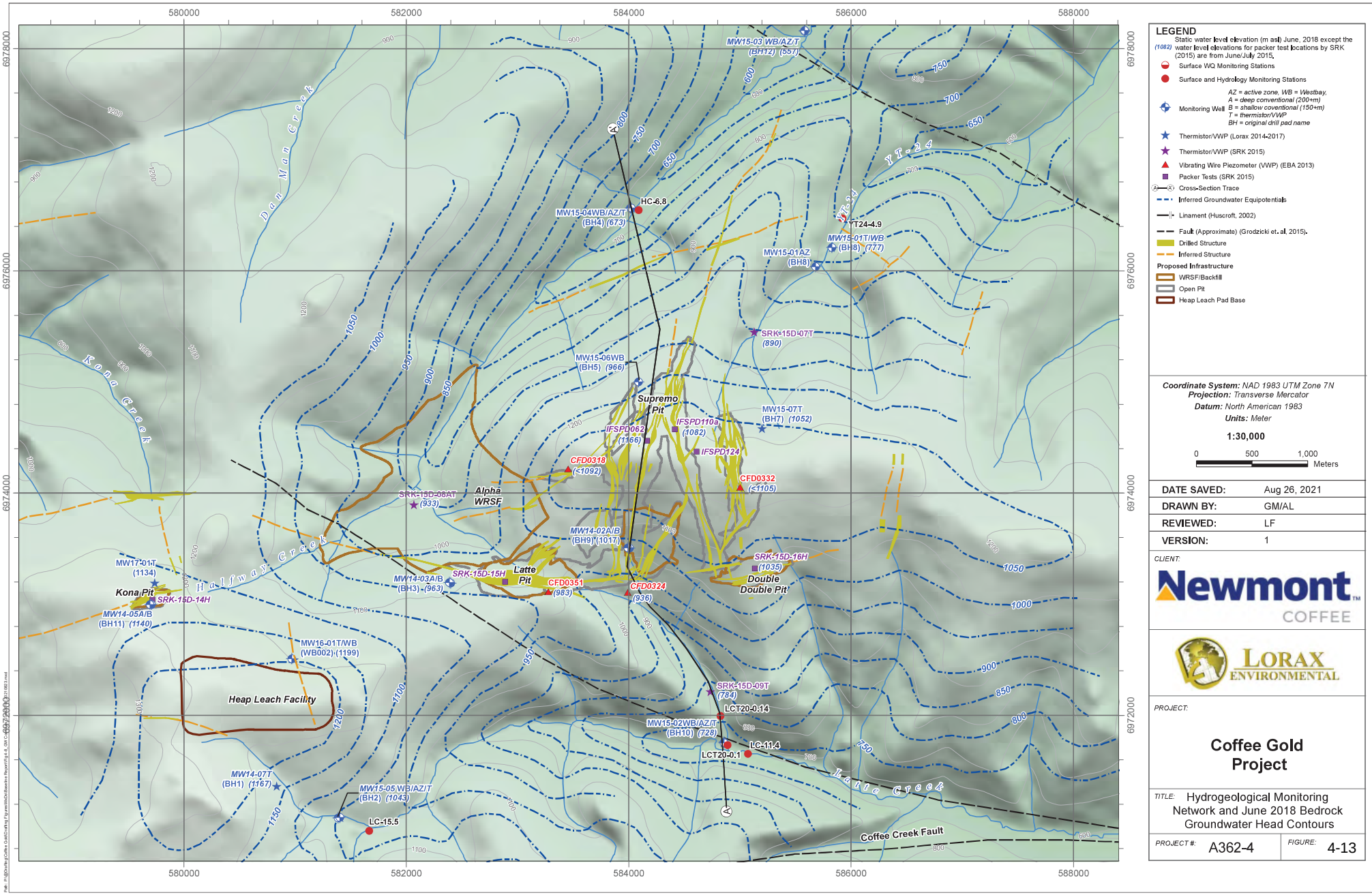
4.1.8.4 Groundwater Quality

Groundwater quality is described according to screened lithology. Monitoring wells screened in schist are distributed on the north and south sides of the Mine Site in the vicinity and downstream from the proposed Latte Pit. Monitoring wells screened in gneiss are situated on the north side of the Project in the Halfway Creek and YT-24 drainages. Monitoring wells screened in granite are located adjacent to Latte Creek downstream from the proposed HLF and in the Kona Pit area. One well pair located in the south Supremo/Latte area screens hydrothermal breccia.

Groundwater across the mine site is predominantly circum-neutral (pH 6 to 8), with most samples characterized by pH 6.5 and 8. Groundwater wells show variable influence from weathering of sulfide minerals or dissolution of sulfate minerals, either from the deposits or other disseminated mineralization

across the Project area. This is evidenced by low to substantial sulfate (SO_4) concentrations, which range from 7 mg/L to 1,120 mg/L and variable salinity with specific conductance ranging from 28 microsiemens per centimeter (µS/cm) to 2390 µS/cm. The most saline groundwater is encountered at the most downgradient wells in Halfway Creek and YT-24 (Figure 4-11). These wells lie within a lineament (fault) that crosscuts several drainages and imparts a unique chemical signature on groundwater.

A piper plot of major ion chemistry of groundwater within the Project area is provided in Figure 4-14. The groundwater in gneiss has a wide-ranging major ion chemical signature which ranges from calcium-bicarbonate to mixed magnesium-calcium-sodium-sulphate-type water, reflecting variable influence of sulfide weathering. Groundwater in the granite is calcium-bicarbonate-type but is generally more sodic than other groundwater on site. The groundwater sampled from the hydrothermal breccia and schist tends to be calcium-bicarbonate to magnesium-sulphate.



LEGEND

Static water level elevation (m asl) June, 2018 except the (1082) water level elevations for packer test locations by SRK (2015) are from June/July 2015.

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Monitoring Well — *AZ = active zone, WB = Westbay, A = deep conventional (200+m), B = shallow conventional (150+m), T = thermistor/VWP, BH = original drill pad name*
- Thermistor/VWP (Lorax 2014-2017)
- Thermistor/VWP (SRK 2015)
- Vibrating Wire Piezometer (VWP) (EBA 2013)
- Packer Tests (SRK 2015)
- Cross-Section Trace
- Inferred Groundwater Equipotentials
- Lineament (Huscroft, 2002)
- Fault (Approximate) (Grodzicki et. al, 2015).
- Drilled Structure
- Inferred Structure

Proposed Infrastructure

- WRSF/Backfill
- Open Pit
- Heap Leach Pad Base

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:30,000

0 500 1,000 Meters

DATE SAVED:	Aug 26, 2021
DRAWN BY:	GM/AL
REVIEWED:	LF
VERSION:	1

CLIENT: Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE: Hydrogeological Monitoring Network and June 2018 Bedrock Groundwater Head Contours

PROJECT #: A362-4 *FIGURE:* 4-13

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Fig 4-8_GW Contours_June2018_20210823.mxd

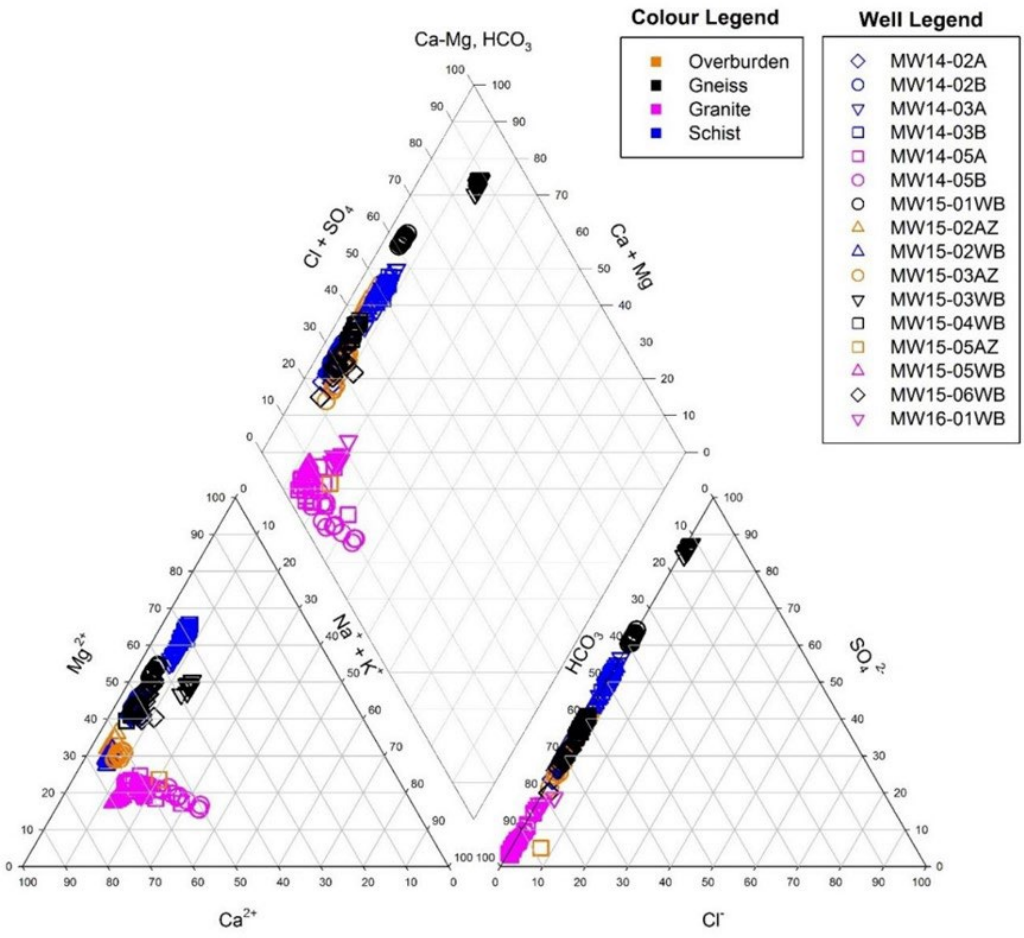


Figure 4-14 Piper Plot of Coffee Groundwater Quality Data (2014 - 2019)

Redox conditions within a groundwater system can be assessed based on the presence and concentration of oxidized and reduced inorganic compounds in groundwater samples. For classification purposes, mildly reducing waters may accompanied contain oxidized compounds such as nitrate (NO_3^-) and nitrite (NO_2^-) in combination with reduced compounds such as ammonia (NH_3) and dissolved manganese (Mn^{2+}). Oxic waters do not contain any reduced compounds. Moderately reducing waters generally lack oxidized parameters while presenting reduced compounds (NH_3, Mn^{2+} and/or dissolved iron (Fe^{2+})). Strongly reducing waters also contain dissolved sulfide (S^{2-}).

Groundwater redox conditions are highly variable across the site. Groundwater sampled from shallow groundwater wells screening overburden is oxic to moderately reducing. Groundwater screened in gneiss varies from oxic to strongly reducing. Groundwater draining gneiss downgradient of the Alpha WRSF is mildly to moderately reducing while groundwater sampled further at the lineament in the Halfway Creek and in the YT-24 drainage is moderately to strongly reducing.

Groundwater redox conditions at monitoring wells screened in granite are mildly to strongly reducing. Monitoring wells in the Kona Pit area present moderately to strongly reducing conditions while groundwater

sampled downstream of the HLF in the upper reaches of Latte Creek is less reducing based on an absence of measurable S^{2-}.

Monitoring wells screened in schist span the entire range of redox conditions from oxic to strongly reducing. The well pair adjacent to the proposed Latte Pit screened mildly to strongly reducing groundwater. Near the Supremo Pit, groundwater-screened hydrothermal breccia is oxic or oxygenated, with very low to negligible concentrations of reduced species.

Average concentrations for selected parameters of concern are summarized in Table 4-18 and Table 4-19. A comprehensive list of dissolved metals concentrations in groundwater is provided in the Site Characterization Plan. Baseline groundwater quality in the Project area is characterized the presence of elevated dissolved arsenic (As) and uranium (U). Dissolved As and U concentrations are generally highest in the bedrock groundwater, ranging from 0.12 to 2650 µg/L and 1.2 to 589 µg/L, respectively.

Dissolved As is measurable in a number of monitoring wells at the site. The highest As concentrations in the Project area were observed in the granitic bedrock beneath the Kona Pit. It is also notable that granite material at the Kona Pit has the highest solid-phase. As concentrations measured in the Project area. It appears that As is naturally attenuated along groundwater pathways.

Dissolved U is generally elevated (> 15 µg/L) across the site, with the highest concentrations measured in wells screening gneiss. Dissolved U concentrations are highest in gneiss in the YT-24 drainage and the Halfway Creek drainage. Notably, the concentrations of dissolved U are lower in the downgradient well in Halfway Creek along the lineament. This drop in U concentrations appears to be related to lineament itself, as dissolved U appear behaves more conservatively than As in the groundwater environment.

Table 4-18 Ranges of Selected Dissolved Metals of Concern Measured in Groundwater Screening Overburden, Breccia, and Schist

Well ID	MW15-02AZ	MW15-03AZ	MW15-05AZ	MW14-02A	MW14-02B	MW14-03A	MW14-03B	MW15-02WB
Lithology	Overburden			Crackle Breccia	Schist			
Sample date	August 2018	August 2019	September 2015	August 2019	August 2019	August 2019	August 2019	August 2019
Catchment Area	LC	HC	LC	LCT	LCT	HC	HC	LCT/HC
Dissolved Metals (µg/L)								
Aluminum	5.05	13.6	189	2.4	1.06	7.3	5.9	2.81
Antimony	0.119	0.176	0.084	0.658	4.65 ↓	0.13	0.054	0.084
Arsenic	0.848	0.62	2.28	56.4	37.2	30.7 ↓	15.4	2.03
Cadmium	<0.0050	0.0063	0.022	<0.0050	<0.0050	<0.010	<0.010	0.0094
Chromium	<0.10	0.22	0.7	0.54	0.52	0.34	0.2	0.18
Cobalt	0.081	0.0323	2.49	0.0118	0.0648	1.28	4.46 ↓	0.147
Copper	0.713	1.48	1.86	<0.050	<0.050	<0.10	1.45	0.254
Iron	5.9	6.6	931	<1.0	<1.0	3750 ↓	1310	301
Lead	<0.0050	<0.0050	0.033	<0.0050	<0.0050	0.026	0.087	0.0442
Mercury	<0.0020	0.0054	0.0054	0.006	0.0022	0.003	0.0108	0.005
Nickel	0.593	0.802	1.23	0.035	1.19↓	1.34	10.8 ↓	0.972
Selenium	0.198	0.075	0.069	0.256	0.35	<0.080	0.101	<0.040
Uranium	31.4 ↑	25.3	0.899	42.3	66.7	88.3	58.2 ↑	33

Notes: Highlighted values are the maximum of element measured across all monitoring wells in the LSA.
HC = Halfway Creek; LT = Latte Creek; LCT = Latte Creek Tributary
↑ = parameter concentration shows an increasing trend; ↓ = parameter concentration shows a decreasing trend

Table 4-19 Ranges of Selected Dissolved Metals of Concern Measured in Groundwater Screening Granite and Gneiss

Well ID	MW14-05A	MW14-05B	MW15-05WB	MW16-01WB	MW15-01WB	MW15-03WB	MW15-04WB	MW15-06WB
Lithology	Granite				Gneiss			
Sample date	August 2019	August 2019	August 2019	August 2019	August 2019	August 2019	August 2019	August 2019
Catchment Area	HC	HC	LC	HC	YT-24	HC	HC	HC
Dissolved Metals (µg/L)								
Aluminum	20.4	1.73	0.84	0.52	3.5	8.2	0.91	2.78
Antimony	0.57	0.102	0.167	0.065 ↓	0.057	0.047	1.48 ↓	0.287
Arsenic	2080 ↑	209	0.893	4.37	10.9 ↓	0.282	1.38	123 ↑
Cadmium	<0.025	<0.0050	<0.0050	<0.0050	<0.010	<0.010	0.0226	<0.0050
Chromium	<0.50	0.16	<0.10	<0.10	<0.20	<0.20	0.19	<0.10
Cobalt	0.24	0.331 ↓	0.0419	0.0161	0.256	0.013	0.187	0.129
Copper	<0.25	0.075	0.071	0.925	<0.10	0.12	1.17	0.052
Iron	12000 ↑	6150 ↑	4.1	1900	943	357	15.2	952
Lead	<0.025	<0.0050	0.0094	0.0201	<0.010	0.023	0.282	0.0145
Mercury	0.0051	<0.0020	0.0055	<0.0020	<0.0020	0.0024	<0.0020	0.0081
Nickel	0.39	0.264	0.187	0.301	0.794	0.971	0.514 ↓	0.295
Selenium	<0.20	<0.040	<0.040	0.068	<0.080	<0.080	0.369	0.046
Uranium	4.04 ↓	1.46	79.7	2.36	532	5.82	128	33.4

Notes: Highlighted values are the maximum of element measured across all monitoring wells in the LSA.
HC = Halfway Creek; LT = Latte Creek; YT-24 = YT-24 Drainage
↑ = parameter concentration shows an increasing trend; ↓ = parameter concentration shows a decreasing trend

4.2 Biophysical Environment

The sections below describe existing conditions in the aquatic and terrestrial environments, including species and habitat distributions, traditional and current uses of resources, and metals levels (if relevant).

4.2.1 Aquatic Environment

The aquatic environment, including current and historical fish presence, distribution, and habitat use, and aquatic resources, is described below based on published and unpublished scientific data. Traditional and local knowledge and survey information collected in the region from 2000 to 2018 at and downstream of the proposed Mine Site area and along the NAR corridor was also used to inform the aquatic environment. Detailed studies have included the following:

- In 2013, Access Consulting Group (ACG) undertook preliminary studies focused on describing fish habitat in the vicinity of the proposed mine site and documenting potential salmon spawning and the distribution of fish species within tributary streams of the Yukon River (ACG 2014).
- In 2014 and 2015, Palmer Environmental Consulting Group collected baseline data to characterize fish and aquatic resources around the proposed mine site and, in 2015, along the NAR (Palmer 2017).
- From 2016 to 2021, EDI Environmental Dynamics Inc. (EDI) collected additional baseline data in local watercourses and along the NAR, including salmon spawning surveys, fish sampling/habitat assessments, periphyton sampling, as well as metals analyses of sediments, benthic invertebrates, and fish tissues.

Aquatic environment surveys and studies that were completed are detailed in the Site Characterization Plan.

A total of 14 fish species inhabit the watercourses adjacent to or downstream of the proposed Mine Site and the NAR, including two species of salmon and 12 resident freshwater fish species. The majority of these species are found only in the Yukon River and Stewart River. There are no aquatic species listed under Yukon or federal *Species at Risk Act (SARA)* listings within the local or regional watercourses.

Slimy sculpin (*Cottus cognatus*), Arctic grayling (*Thymallus arcticus*), and juvenile Chinook salmon (*Oncorhynchus tshawytscha*) are present in Coffee Creek and the Yukon River year-round. Among Yukon River tributary creeks, the highest species diversity and abundance of fish have been documented in Coffee and Independence creeks, which are the two largest creeks in the mine area. These species were also the most common species encountered along the NAR. As the lower portions of Halfway Creek freeze to bed in winter, slimy sculpin is not likely to remain in this portion of the stream.

Arctic grayling are the most widespread species in the local area as they have also been found in Latte, Halfway and YT-24 creeks. They use these smaller creeks for summer rearing only; eDNA data from March 2016 confirmed that Arctic grayling overwinter in Coffee Creek and the Yukon River, but not in any other streams within the local area. It is common for Arctic grayling to use different streams for important life history periods such as spawning, summer rearing, and overwintering.

Fish access to upper reaches of the headwater streams within the proposed mine footprint is limited by gradients, impediments, and low water temperatures (limiting primary production). Along the NAR, fish

presence is typically associated with the larger streams that are crossed, and the likelihood of fish presence decreases with distance from mainstem habitat. Recent surveys have identified Arctic grayling further upstream in Halfway Creek than in previous years, partly owing to changes to a log jam barrier that was previously impeding fish. In addition, a local flooding event in 2017 resulted in changes to the YT-24 Creek stream channel morphology and low water levels, and few fish have since been observed within this channel. An expansion of the study area in recent surveys identified fish presence in Independent Creek tributaries A and B, Dan Man Creek, and Kona Creek. The Stewart River backchannel has been identified as a seasonal fish habitat for fish species including northern pike (*Esox Lucius*), burbot (*Lota lota*), lake whitefish (*Coregonus clupeaformis*), and longnose sucker (*Catostomus catstomus*).

Traditional and current uses of fish resources in the region are generally concentrated in the Yukon River and Coffee Creek. The Yukon River in the vicinity of Coffee Creek has long been an important salmon fishing location for First Nations (TH 2012a), as the area provides rearing, migration, and spawning habitat for Chinook salmon (*Oncorhynchus tshawytscha*) and Chum salmon (*Oncorhynchus keta*); fish camps were set up annually near the mouth of Coffee Creek by several First Nations groups. Traditional Knowledge and current land use speaks to the importance of the Yukon River watershed for these species (Bates and DeRoy 2014, TH 2012a, DRPC 2013). Other fish species of traditional importance that are present in the Yukon River include Arctic grayling, whitefish species, northern pike, burbot, inconnu (*Stenodus leucichthys*), and longnose sucker. During the Project consultation process, First Nations emphasized the importance of the Coffee Creek corridor for salmon runs, wildlife and vegetation, as well as traditional uses, including for travel and fishing.

Traditional Knowledge indicates that Chinook salmon used to spawn in Coffee Creek (TH 2012a). Although spawning Chinook were not documented in Coffee Creek during surveys in 2000, 2001, and 2014 through 2019, spawning chum were observed in groundwater fed side channels of the Yukon River in the local area, and in similar habitats in the Stewart River downstream of the NAR. Coffee, Independence (and occasionally the lower portion of Halfway) creeks are used by juvenile Chinook as non-natal rearing habitat, and Coffee Creek provides Chinook overwintering habitat.

Primary production was found to be very low for all sampling stations, which is typical of northern, nutrient poor aquatic habitats. Chlorophyll-a concentrations increased in samples collected further downstream in each of the watersheds, as stream flows, water temperatures, and nutrient inputs increased. For benthic invertebrates, mean total abundance was variable throughout the local area, with the highest abundance in Independence Creek, followed by YT-24, Coffee, Latte and Halfway creeks.

4.2.1.1 Metal Concentrations

Arctic grayling, slimy sculpin, and juvenile Chinook salmon caught within the local area were analyzed for metal concentrations in tissues. Benthic invertebrate and sediment baseline metal concentrations were also analyzed from these creeks. Methylmercury levels in all slimy sculpin, Arctic grayling, and juvenile Chinook salmon tissues exceeded the Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota (CCME 2000a). Baseline concentrations of selenium in slimy sculpin exceeded the United States Environmental Protection Agency guideline for whole-body selenium (US EPA 2015) in a small number of samples from fish caught in Coffee and Independence creeks, and Arctic grayling and slimy sculpin sampled from all areas exceeded the BC guideline for selenium (BC MOE 2014).

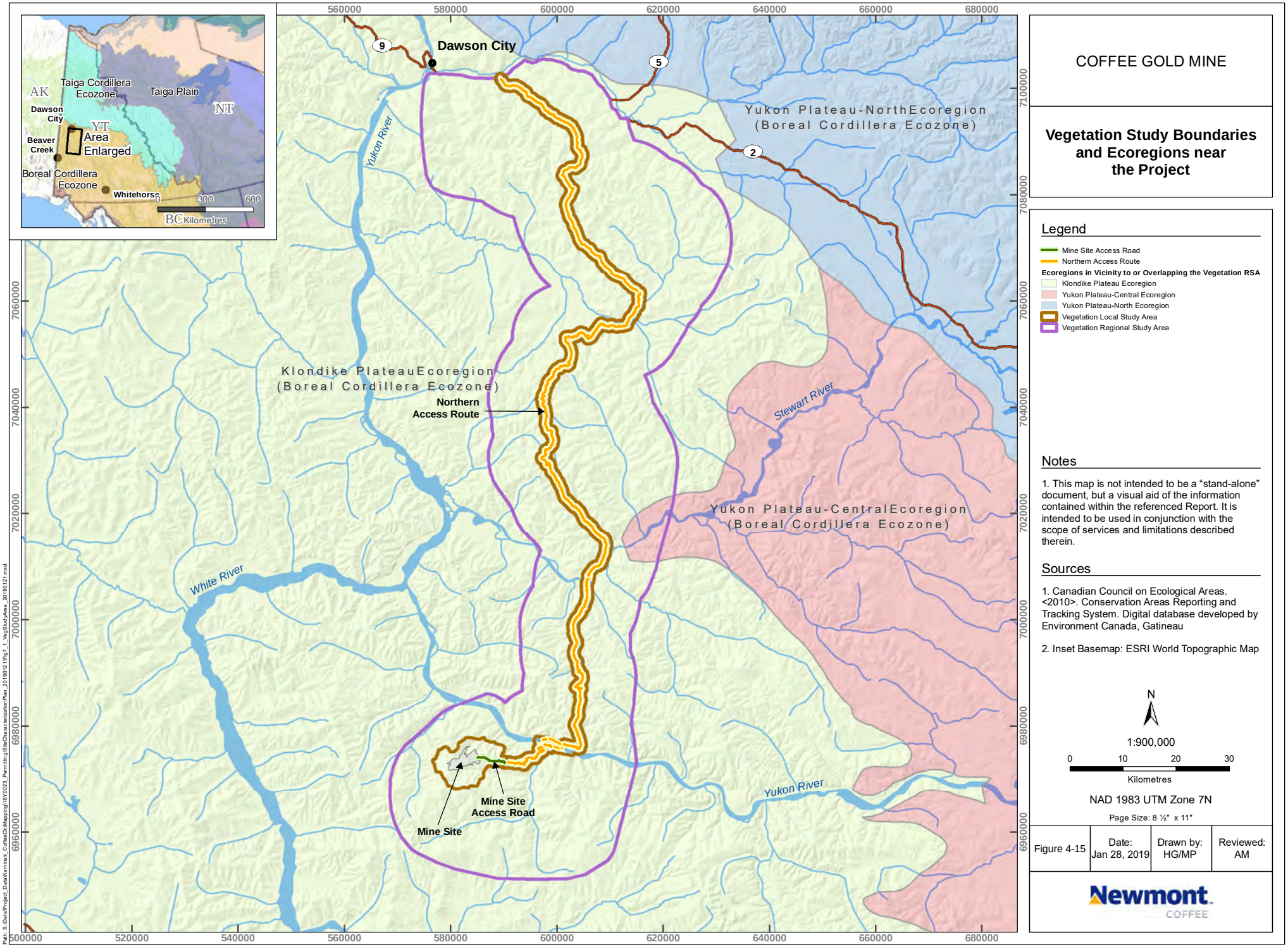
Methylmercury concentrations in all benthic invertebrate tissue samples were below the CCME Guideline set for the protection of piscivorous wildlife. Uranium concentrations in benthic invertebrate tissues were higher in samples collected in March when compared with August data; this correlated with annual peak uranium concentrations during late winter low flows due to increased proportions of groundwater contributions to surface water.

Analyses of sediment baseline metals concentrations collected throughout the local area indicate that arsenic and chromium are consistently present at concentrations that exceed the CCME Interim Freshwater Sediment Quality Guidelines (CCME 2000b) at many sites, and the Probable Effects Level (PEL) at some sites. Additional details regarding fish and aquatic life studies that have been completed for the site are provided in the Site Characterization Plan.

4.2.2 Vegetation

This section provides a description of vegetation communities based on studies conducted in the area, and First Nation traditional and current use of plant species from several Traditional Knowledge surveys (Bates and DeRoy 2014, TH 2012a, InterGroup Consultants Ltd. 2009). The Project is located within the Klondike Plateau Ecoregion of the Boreal Cordillera Ecozone. Approximately 90% of the local study area occurs within the Boreal Bioclimate zones (Boreal Low and Boreal High), with the remaining area occurring in the Subalpine Bioclimate zone.

Vegetation surveys were conducted in 2014 to 2016, and included ecosystem mapping, rare plant surveys, exotic and invasive species surveys, and vegetation and soil sampling for trace metals analyses. The studies were completed in an area encompassing approximately 800 km², which was delineated based on the height of land and encompassed a minimum buffer of 1 km around the proposed mine site footprint. Along the road alignments, including a 1 km buffer on either side, as shown in Figure 4-15.



COFFEE GOLD MINE

Vegetation Study Boundaries and Ecoregions near the Project

Legend

- Mine Site Access Road
- Northern Access Route

Ecoregions in Vicinity to or Overlapping the Vegetation RSA

- Klondike Plateau Ecoregion
- Yukon Plateau-Central Ecoregion
- Yukon Plateau-North Ecoregion
- Vegetation Local Study Area
- Vegetation Regional Study Area

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

1. Canadian Council on Ecological Areas. <2010>. Conservation Areas Reporting and Tracking System. Digital database developed by Environment Canada, Gatineau

2. Inset Basemap: ESRI World Topographic Map

N

1:900,000

0 10 20 30

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 4-15	Date: Jan 28, 2019	Drawn by: HG/MP	Reviewed: AM

Newmont COFFEE

Path: S:\Data\Project_Data\Kamina k_Coffee\Ck\Mapping\18Y0023_Permitting\SiteCharacterization Plan_20190121\Fig7_1_VegStudyArea_20190121.mxd

Combined, the surveys documented 411 vegetation species including seven tree, 60 shrub, 188 forb, 63 grass, 18 fern/horsetail/clubmoss, 2 aquatic, 36 mosses/liverworts, and 37 lichens. Vegetation at higher elevations consists of subalpine habitats dominated by sparse, deciduous shrubs, while mature spruce forests dominate valleys.

The subalpine landscape is dominated by shrub communities overlaying a well-developed feathermoss and lichen layer. Communities of scrub birch (*Betula glandulosa*), Labrador tea (*Rhododendron groenlandicum*), bog blueberry (*Vaccinium uliginosum*), lowbush cranberry (*Vaccinium vitis-idaea*), and crowberry (*Empetrum nigrum*) are common. The widely distributed dry, shallow hillcrests throughout the area commonly support communities of low-growing shrubs and/or ground shrubs, including scrub birch, mountain avens (*Dryas spp*.), crowberry, Arctic white heather (*Cassiope tetragona*), and lowbush cranberry. A sparse conifer canopy (~15% cover) develops over the shrub layer as the subalpine nears the treeline and the boreal transition.

Below the treeline, the vegetation patterns reflect the discontinuous distribution of permafrost throughout the region. Closed canopy pure or mixed stands of white spruce (*Picea glauca*), black spruce (*Picea mariana*), Alaska birch (*Betula neoalaskana*), and trembling aspen (*Populus tremuloides*) occur on neutral and warm, gentle-to-moderate slopes. Understory species in this area typically include Labrador tea, prickly rose (*Rosa acicularis*), lowbush cranberry, tall bluebells (*Mertensia paniculata*), bastard toadflax (*Geocaulon lividum*), and feathermosses. Dry, moderate-to steep, south-facing slopes support grasslands and aspen forests, overlaying kinnikinnick (*Arctostaphylos uvaursi*), soapberry (*Shepherdia canadensis*), and grasses.

In contrast, stunted black spruce forests occur on cold, north-facing slopes with imperfect-to-poor drainage due to near surface permafrost. Understory species in this area typically include Labrador tea, sedges, cottongrass (*Eriophorum vaginatum*), and cloudberry (*Rubus chamaemorus*). On gentle toe-slopes underlain by permafrost, black spruce communities containing Labrador tea, sedges, red bearberry (*Arctous rubra*), and lichens predominate. Black spruce forests with high lichen cover also occur on better drained, coarser-textured upland, north-facing, lower-to-upper slopes.

Frequent fires in the area has led to young, deciduous-dominated, and mixed wood stands being more common than mature conifer-dominated stands. Wetland and floodplain ecosystems exist in valley bottoms throughout the area but represent a small component of overall area. In additionally, the region has a long history of placer gold mining, and many valley bottoms include historic and/or active placer mines.

No federally listed at risk plant species (i.e., listed either under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and/or *SARA*) were observed during rare plant surveys; however, populations of four Yukon Watch List plant species were found:

- Coffee Creek Scorpionweed (*Phacelia mollis*)
- Spotted Lady's Slipper (*Cypripedium guttatum*)
- Small Enchanter's Nightshade (*Circaea alpina ssp. alpina*)
- Dry-spike Sedge (*Carex siccata*).

Baseline surveys for exotic and invasive plants documented populations of 18 invasive plant species, including five rank 1 invasive species (invasive plants range in degree of invasiveness (i.e., concern) from high priority (1) to least concern (7)). The observed rank 1 invasive species are: smooth brome (*Bromus*

inermis), narrow-leaved hawksbeard (*Crepis tectorum*), perennial sow-thistle (*Sonchus arvensis spp. uliginosus*), white sweetclover (*Melilotus albus*), and yellow sweetclover (*Melilotus officinalis*). Invasive plants were most prevalent along roadsides north of the Stewart River, with scattered occurrences along roadsides between the Stewart and Yukon rivers; very few were found within the tenure.

Trace metals sampling was conducted in the vicinity of the proposed mine site to determine the baseline concentrations in soils and four plant species including the following: willow (*Salix* spp.), fruticose lichen (*Cladina* spp.), horsetails (*Equisetum arvense, Equisetum pratense*, and *Equisetum sylvaticum*), and lowbush cranberry.

Trace metal concentrations in soil were below the CCME soil quality guidelines, except for arsenic and chromium, which were naturally elevated in 27% and 4% of the samples collected, respectively. Samples with naturally elevated arsenic levels were generally collected in close proximity to the proposed mine site, while samples with naturally elevated chromium were collected close to the proposed mine site and at control sites ≥15 km relative to the proposed Project footprint. A few soil samples also reported mercury and selenium above the laboratory reportable detection limit. No CCME guidelines currently exist for trace metals in vegetation; therefore, the results were compared to CCME guidelines for soil quality. Additional information regarding trace metals sampling of vegetation is provided in the Site Characterization Plan.

Many of plant species found in the area are currently, or have been previously, used by local First Nations as a source of food, or for medicinal and spiritual use, while others have more practical or decorative uses. Both TH and WRFN members report harvesting berries and other edible plants from the area which would supplement the meat and fish they also harvested from the land (TH 2012a; Bates and DeRoy 2014). According to the Coffee Creek Traditional Knowledge Survey (TH 2012a):

> “Harvesting berries was also an important activity in the Coffee Creek area, where high bush and low bush cranberries could be found. Blueberries were picked in the flats and soap berries were plentiful. William also mentioned gooseberries, which Roland thought to be mossberries.”

Similarly, WRFN members report picking blueberries, highbush cranberries, and blackberries in the Project area (Bates and DeRoy 2014). TK also contains accounts of the continued importance of berries to local First Nations:

> “Among the plants still collected and consumed today [within NND traditional territory] are largely berries such as Low-bush Cranberries, Blueberries, Black Currants, Raspberries, Stone Berries, and High Bush Cranberries” (InterGroup Consultants Ltd. 2009).

Plants have also been harvested for medicinal use such as the pitch from trees and the root or leaves of certain species (Popadynec 2007; InterGroup Consultants Ltd. 2009; TH 2012b; Bates and DeRoy 2014). Use of plants for medicinal and other uses have been documented as follows:

> “Some of the leaves are good, certain leaves are good for medicines…some you make salves. Some are plants. Some are the flowers and all that” (Bates and DeRoy 2014).

> "As the spruce gum is chewed it produces a juice which is swallowed to treat a sore throat. When boiled, spruce gum tea is also used to treat colds. The sticky gum can be used as a salve on cuts or to help remove slivers. Other parts of the spruce tree, such as the cones, the inner bark and the young spruce tips may be used for medicine as well." (Popadynec 2009).

> "Some plants were traditionally collected for medicinal purposes by the Na-cho Nyäk Dun. These plants included yarrow, spruce, pine, balsam, Labrador tea, caribou horn (lichen) and puffballs (fungi)... Most of the medicinal plants used in the area are commonly found throughout the boreal forest." (InterGroup Consultants Ltd. 2009).

In addition to plants harvested for food or medicine, plants were harvested for making tools and equipment, such as baskets, sleds, and snowshoes (Bates and DeRoy 2014, Popadynec 2009). WRFN members report having collected birch bark in the areas around Coffee Creek for use in basket making (Bates and DeRoy 2014). Labrador tea (*Rhododendron groenlandicum*) and bear root (*Hedysarum alpinum*) are other commonly harvested plants (TH 2012a, Bates and DeRoy 2014, Popadynec 2009).

4.2.3 Wildlife

Detailed descriptions of existing conditions for wildlife and wildlife habitat in the area are provided below and are based on wildlife studies undertaken from 2011 to 2018. Additional wildlife investigations were conducted through winter 2019/2020 and summer 2021 that focused on specific target species. Additional details regarding the recent wildlife investigations are provided in the Site Characterization Plan.

Wildlife descriptions below are based on regional and local areas of approximately 13,661 km² and 473 km², respectively, (Figure 4-15) to assess the abundance and distribution of most large and smaller wildlife species in the Project region, respectively. The local area includes the proposed mine site area, the proposed NAR to the junction with the Klondike Highway, and a minimum 1 km buffer around the proposed Project footprint. The regional area encompasses all Game Management Subzones that intersect or are adjacent to the proposed Project footprint. It is bounded on the north by the Klondike Highway, to the east by Grand Valley creek and Dip Creek, and on the south and west by the White and Yukon rivers.

Wildlife species that were traditionally harvested in the region by First Nations include caribou (*Rangifer tarandus*), moose (*Alces americanus*), Canada lynx (*Lynx canadensis*), wolverine (*Gulo gulo*), red fox (*Vulpes vulpes*), American marten (*Martes americana*), American mink (*Neovison vison*), American beaver (*Castor canadensis*), common muskrat (*Ondatra zibethicus*), porcupine (*Erethizon dorsatum*), and snowshoe hare (*Lepus americanus*), among others (Mishler and Simeone 2004, InterGroup Consultants Ltd. 2009, TH 2012a, Bates and DeRoy 2014). The Coffee Creek area in particular was noted as being an important trapping area (TH 2012a, Dobrowolsky 2014).

Focal species and species groups were identified as those of conservation concern, those that are harvested by Indigenous or non-Indigenous hunters, those raised as a concern during Project consultation, those selected as focal species for previous Yukon environmental assessments, and those with the potential to interact with the proposed Project. The focal species include: caribou, moose, thinhorn sheep (*Ovis dallii*), mule deer (*Odocoileus hemionus*), grizzly bear (*Ursus arctos*), black bear (*Ursus americanus*),

grey wolf (*Canus lupus*), wolverine (*Gulo gulo*), a variety of furbearers, collared pika (*Ochotona collaris*), bats, and small mammals; these and other notable species are described further below. The comprehensive list of focus species is provided in the Site Characterization Plan.

Baseline surveys have confirmed the presence of several wildlife species federally listed as at risk by *SARA*, and/or COSEWIC that occur, or have the potential to occur in the Project area, including woodland caribou, grizzly bear, wolverine, cougar (*Puma concolor*), collared pika, and little brown myotis (*Myotis lucifugus*). The comprehensive list of at-risk wildlife species is provided in the Site Characterization Plan.

Three caribou herds, representing two subspecies of caribou, may be found in the regional area. The Fortymile and Nelchina caribou herds are classified as *Rangifer tarandus granti*, which includes the large migratory herds; their status has not yet been assessed by COSEWIC. The Klaza Caribou Herd is classified as *Rangifer tarandus caribou* and is a part of the Northern Mountain population of woodland caribou, which has been assessed by COSEWIC as a species of Special Concern within Canada. Of these, the current annual range of the Fortymile and Klaza caribou herds overlaps the regional area, while the Nelchina Caribou Herd range is on the periphery of the regional area. A small number of Nelchina caribou may enter the regional area during winter, but the number of caribou and time spent is expected to be very low.

The Fortymile Caribou Herd, with an estimated population of approximately 72,000 individuals (2017 minimum count), has been identified as a focal species for the Project due to the recent population recovery and re-establishment of previously abandoned herd range in the north and central Yukon. The herd is known for its long-distance movements between its calving range in east-central Alaska and a large winter range. Historically, the herd used the regional area extensively in all seasons except calving. Following a population crash in the mid-1900s, the herd abandoned large portions of its historic range, including all its range in Yukon. Recent population recovery has resulted in the re-establishment of winter range in Yukon (since 2002) and the regional area (since 2013).

The herd has also increasingly been found in Yukon during the summer months, although use of the regional area since 2013 has, to date, been limited to the winter months. Based on current use patterns, the Fortymile Caribou Herd has the potential to occur within the regional area seasonally between October and April; further population growth and/or further expansion of the herd range may result in the Fortymile caribou also being present in the regional area during the summer months. At present, licensed caribou harvest is closed year-round in all game management sub-zones that overlap the Project footprint, and TH has a voluntary no-harvest program in place for the Fortymile Caribou herd.

The Klaza caribou herd, currently estimated at 1,179 individuals (2012 population estimate), has an annual range that overlaps the southern portions of the regional area, south of the Yukon River. Within this area, small numbers of Klaza caribou are expected to occur during the spring, summer, and/or fall months.

Moose are widely distributed across the region and their overall densities in the regional area are close to the Yukon average, with some northern regions possibly containing higher-than-average densities. Moose densities within 10 km of the NAR are estimated at 247 moose per 1,000 km² based on a 2015 survey, while in the southern sections of the regional area, moose densities are estimated at 170 per 1,000 km² based on a 2012 survey of the region (O'Donoghue et al. 2013). Moose are the primary harvest species within the regional area and are a highly valued species for both First Nations people and licensed hunters. Between 2006 and 2015, 480 moose were harvested by licensed hunters within the regional area (Government of Yukon 2016). With a total mean annual harvest of 48 moose, between 5% and 10% of the

total Yukon annual moose harvest occurs within the regional area. Habitat analyses for the Project focused on the early winter season, when moose congregate in high elevation shrub communities, and late winter habitat, when moose are more restricted in their habitat use. The analyses identified several key concentration areas along the NAR where moose are abundant in the early winter season and indicated that the regional area contains abundant and widespread high quality late winter moose habitat. Additionally, baseline surveys in 2017 identified a mineral lick used by moose located along the NAR between the Yukon and Stewart rivers, which was further monitored in 2020 showing consistent results. Mineral licks are important to ungulate species as they provide essential mineral nutrients which otherwise might be lacking in an ungulate diet (Rea et al. 2004). The 2020 camp wildlife log identified moose, along with black bear, as the most common species reported at the Project site.

Thinhorn Sheep occur in low densities at sporadic, isolated locations within and adjacent to the regional area. Within the local area, a small population of sheep occur along the steep, south-facing bluffs above the Yukon River (referred to as the Ballarat Creek occurrence area). In the past, a maximum of eight sheep have been documented in the Ballarat area (including rams, ewes with young lambs, and assorted nursery sheep); however, more recent Project surveys have documented a maximum of five sheep and no lambs in the Ballarat area 2014-2018. A 2020 aerial survey observed one group of three unclassified sheep on a cliff west of Ballarat Creek, and a solitary unclassified sheep east of Ballarat Creek. Additional information is provided in the Site Characterization Plan.

Thinhorn sheep are known to be a traditional seasonal food source for all four First Nation groups with asserted or established traditional territories that overlap the Project (Bates and DeRoy 2014; InterGroup Consultants Ltd. 2009); however, the areas where sheep hunting traditionally occurs are well outside the RSA. There is no documented Traditional Knowledge of sheep being targeted where they occur along the Yukon River and sheep are not known to be harvested within the regional area at the current time.

Mule deer (*Odocoileus hemionus*) occur in the regional area, but at low numbers along the south-facing slopes of the Yukon, Stewart, and potentially Indian River valleys, and along the Klondike Highway. According to trapping concession holders whose traplines overlap the regional area, mule deer have been present in the Coffee Creek/Yukon River area for at least 30 years and the population appears to be increasing.

Limited information is available information on grizzly bear abundance and distribution within the regional area, but based on observations and harvest records, it can be assumed that grizzly bears use the entire region but occur at relatively low densities (estimated densities for the Klondike Plateau ecoregion and the Yukon Plateau-Central ecoregion are 11 and 15 bears per 1,000 km² respectively). Den surveys conducted in 2016 and 2017 did not locate any grizzly bear dens within 2 km of the NAR and 5 km of the proposed mine site; however, given their large ranges and diverse habitat requirements grizzly bears have the potential to interact with all aspects of the proposed Project footprint. Traditional knowledge in the area notes the White River area is good habitat for grizzly bears, in particular, due to the abundance of highbush cranberry in that area (Calliou 2012a).

Black bears (*Ursus americanus*) are considered abundant and have commonly been observed in the regional and local areas during the May to October non-denning period. During grizzly bear den surveys conducted in 2016 and 2017, several black bears and suspected black bear den sites were located, predominantly on warm-aspect slopes. As a result of their diverse seasonal habitat needs, black bears have the potential to interact with the proposed Project across the entire extent of the Project footprint. The 2020

camp wildlife log, which can be found in the Site Characterization Plan, identified black bear, along with moose, as the most common species reported at the Project site.

Wolverines occur in the regional area and have been observed on a number of occasions during wildlife baseline surveys. A wolverine denning habitat model using remotely sensed snow cover estimates from 2006 to 2015 found that the area likely contains limited high-quality denning habitat. Given the large size of wolverine home ranges there is potential for wolverines to occur at low densities across the entire extent of the Project footprint.

Wolves are assumed to occur throughout the regional area, wherever available prey exists. Although the population in the regional area is unknown, local knowledge and survey observations indicate that wolf populations within the region are healthy and relatively abundant, with 'lots of wolves in the area' (Interview 14, pers. comm. 2016; Interview 15, pers. comm. 2016).

According to Yukon Conservation Services, the regional area overlaps a very active trapping area (K. Meister, pers. comm. 2016). Based on current trapping records, Canada lynx and American marten are key harvest species in the region; however, various other species are also important to local trappers including red fox, coyote (*Canis latrans*), red squirrel (*Tamiascurus hudsonicus*), American mink, river otter, a variety of weasel species and American beaver. Many of the species currently harvested in the regional area have a long history of harvest in the region. The trapping of furbearers for their furs and meat was, and continues to be, an important way of life for local First Nations (InterGroup Consultants Ltd. 2009; Calliou Group 2012a; TH 2012b; Bates and DeRoy 2014).

Collared pika have been assessed by COSEWIC as a species of Special Concern and are known to occur in the region. Baseline surveyed documented the species in many of the talus patches located in the southeastern sections of the regional area; however, no collared pika were observed during targeted surveys in the local area. The little brown myotis, listed as an Endangered species under *SARA,* has been documented in the local area, and is expected to be present in low numbers, in suitable habitats throughout the regional area. A habitat model of potential roosting habitat for little brown myotis indicated that suitable roosting habitat was found in small areas scattered throughout the lower elevations (i.e., below 1,000 masl) of the regional area. Other small mammals that have the potential to occur in the Project area include Arctic ground squirrel (*Spermophilus parryii*), Northern flying squirrel (*Glaucomys sabrinus*), snowshoe hare, and several species of mice, voles, and shrews. While none of these small mammal species are a conservation concern federally or territorially, they remain ecologically important as prey species of larger carnivores and furbearers.

Wood frog (*Lithobates sylvaticus*) is the only species of amphibian expected to occur in the regional area. Adult and juvenile wood frogs were observed incidentally by Project staff on several occasions in lowland habitats within the Yukon and Stewart River valleys, and this species is assumed to occur throughout the regional area in appropriate wetland habitats.

4.2.4 Birds

Bird studies undertaken in the local area from 2013 to 2017 included cliff-nesting raptor surveys, common nighthawk (*Chordeiles minor*) /short-eared owl (*Asio flammeus*) stand-watch surveys, waterfowl surveys, point count surveys for upland birds, sharp-tailed grouse (*Tympanchus phasianellus*) lek surveys, and the collection of incidental observations (EDI 2018a). Bird species distributions and habitat in the local and

regional areas (areas shown in Figure 4-15) are described below. The local area, inclusive of a minimum 1 km buffer around the following infrastructure, encompasses the proposed mine site area, the NAR, as well as previous road alignments to Casino and through the Dawson Goldfields. The RSA included a 10 km buffer around these components.

The Project area lies within the core of Bird Conservation Region (BCR) 4- Northwestern Boreal Forest. The conservation plan for BCR 4 identifies 77 priority bird species within the region, of which 55 are known or expected to occur within the regional area. A total of 119 bird species are expected to occur in the regional area, of which 88 have been documented to date. The diversity of birds within the regional area is representative of the avian community within the central Yukon; however, the lack of lakes and large waterbodies is reflected by the absence of species associated with those habitats.

The regional area provides habitat for nine species at risk or species of conservation concern assessed by COSEWIC and listed under *SARA*, including: horned grebe (*Podiceps auratus*), red-necked phalarope (*Phalaropus lobatus*), peregrine falcon (*Falco peregrinus*), common nighthawk, short-eared owl, olive-sided flycatcher (*Contopus cooperi*), bank swallow (*Riparia riparia*), barn swallow (*Hirundo rustica*), and rusty blackbird (*Euphagus carolinus*). These species have all been documented in the regional area or are expected to occur based on knowledge of regional bird distribution. The Project's potential species list includes 13 species which are on the Yukon Conservation Data Centre (Yukon CDC) Track List and 14 species on the Watch List.

Important raptor habitats within the regional area include cliff faces along the Yukon and Stewart rivers and rock outcroppings (tors) in alpine and subalpine areas, which provide nesting sites for golden eagle (*Auila chrysaetos*), peregrine falcon, and potentially gyrfalcon (*Falco rusticolus*). Baseline surveys documented several active nest areas along the Yukon and Stewart River cliffs used by golden eagle, peregrine falcon, and common raven (*Corvus corax*). Forested habitats also provide habitat for a number of other raptor species including several species of hawks and owls. Most raptor species found in the RSA are migratory and spend only the summer months in the area; however, some species such as northern goshawk (*Accipiter gentilis*), gyrfalcon, and most of the owl species may be year-round residents.

Waterfowl (i.e., ducks, swans, and geese) and other waterbirds (e.g., loons, grebes, gulls) are relatively uncommon in the region due to the limited availability of lakes and large wetlands. Some species of waterfowl can be found in small wetlands within the Yukon River floodplain and along the Stewart River where suitable habitat is present. In the case of the Stewart River, a relatively large wetland complex on the margin of the local area, upstream of Maisy May Creek, had the greatest diversity of waterfowl with species such as trumpeter swan (*Cygnus buccinator*) and Pacific loon (*Gavia pacifica*) encountered. Along the NAR, the Indian River and Dominion Creek valleys contain a combination of natural ponds and ponds created due to placer mining activity that also provide habitat for some species of waterfowl.

Shorebirds in the regional area occupy a variety of habitats including stream margins, wetlands, and alpine areas. The most common shorebird species associated with wetland habitats included Wilson's snipe (*Gallinago delicate*), solitary sandpiper (*Tringa solitaria*), and lesser yellowlegs (*Tringa flavipes*). Spotted sandpiper (*Actitis macularius*) is also relatively common along the margins of larger streams. A single surfbird (*Calidris virgate*) was detected at the extreme southeast margin of the regional area and is notable given that this species is relatively uncommon within the alpine areas of the Dawson Range. Additional shorebird species associated with alpine habitats may also occur within the regional area despite not being detected during field surveys; examples of such species include American golden plover (*Pluvialis*

dominica) and upland sandpiper (*Bartramia longicauda*). Alpine habitats are limited in extent at the southern margin of the regional area.

Upland bird species within the regional area include game birds (grouse, ptarmigan), common nighthawk, belted kingfisher (*Ceryle alcyon*), woodpeckers, and passerines (songbirds); passerine species include flycatchers, shrikes and vireos, jays and crows, larks, swallows, chickadees, kinglets, thrushes, waxwings, warblers, longspurs and sparrows, blackbirds, and finches. Densities of upland bird species are variable throughout the area with the highest density and species diversity occurring in areas disturbed due to forest fires and placer mining activities. Upland coniferous and riparian forest (coniferous, deciduous, and mixed) also had notable densities of birds and contained habitat specialists (e.g., Townsend's warbler (*Setophaga townsendi*)) and species at the northern extent of the breeding range in Yukon (e.g., warbling vireo (*Vireo gilvus*)). Baseline surveys documented 12 bank swallow nesting colonies within the regional area, of which, seven are located in the local area. Sharp-tailed grouse surveys completed along the NAR confirmed the presence of six probable leks in a variety of disturbed habitats including regenerating burns and areas in various stages of placer mining activity; however, all identified lek sites were located more than 3 km from the Project footprint. Traditional knowledge studies available for the area include specific reports of ptarmigan in the Coffee Creek area and some TH members report harvesting grouse there (TH 2012a).

Traditional and current harvest species include various ducks (i.e., species of the genera *Aix*, *Anas*, *Aythya*, *Bucephala*, and *Melanitta*), Canada Geese (*Branta canadensis*), swans, Dusky Grouse (*Dendragapus obscurus*), Ruffed Grouse (*Bonasa umbellus*), Spruce Grouse (*Falcipennis canadensis*), Sharp-tailed Grouse, Willow Ptarmigan (*Lagopus lagopus*), and Rock Ptarmigan (*Lagopus muta*) (Dawson Indian Band 1988, Pearse and Weinstein 1988, Mishler and Simeone 2004, InterGroup Consultants Ltd. 2009, Calliou Group 2012a, Bates and DeRoy 2014).

4.3 Socio-economic Conditions

Baseline socio-economic conditions are described below for the following valued socio-economic components: demographics, economic conditions, social economy, community infrastructure and services, education services, land and resource use, community health and well-being, and heritage resources. The socio-economic monitoring plan (SEMP) that will be implemented during the Project will be used to inform social closure planning, including updating the socio-economic conditions at the site. The updates will include contextual community information that is not typically publicly available. Commitments made in benefit agreements with affected First Nations will also be used to inform social closure planning and socio-economic conditions in future iterations of the RCP.

4.3.1 Demographics

This section describes existing demographic conditions to provide a local and regional context. The Local Study Area (LSA) includes Whitehorse, Dawson, Pelly Crossing, Beaver Creek, and Mayo. Due to Dawson's geographic location in relation to the Project, this community is a key provider of labour, goods, and services associated with the Project. Dawson and Whitehorse are also likely to experience a population influx from Project workers. The Regional Study area includes Yukon Territory and provides broader regional context.

4.3.1.1 Population

The population of Yukon in 2021 was 40,232 people, approximately 0.1% of Canada's population (Statistics Canada 2022). Yukon experienced population growth of over 12% since the previous census in 2016 (Statistics Canada 2022), which represented the largest increase of any province or territory in Canada, and above the average national growth of 5% (Statistics Canada 2022). This growth was mainly due to immigration from other jurisdictions (CBC News 2022). Population density in Yukon is 0.1 persons per square kilometer, well below the national average (4.2 persons per square kilometer) (Statistics Canada 2022).

Whitehorse has the largest population in Yukon, with 34,268 people, representing 78% of Yukon's population (Yukon Bureau of Statistics (YBS) 2022b). Dawson City's population (2,327) is the next largest. The communities of Beaver Creek, Mayo, and Pelly Crossing each have populations of less than 500 individuals (see Table 4-20). The population of Whitehorse has grown by 7,711 (21.5%) between 2011 and 2021, while Dawson City has grown by 393 (20.3%) during the same period. Other smaller communities have experienced reductions in their population since the previous census.

The population of Whitehorse, Dawson City and Pelly Crossing are relatively young compared to the national average, with median ages of 37.7, 39.6 and 36.8 years respectively, compared to 41.1 years at the national level.

Table 4-20 Summary of Local Populations, 2021

Municipality	Population 2021	Percent (%) change since 2016 Census	Men (%)	Women (%)	Median Age
Whitehorse	34,268	+12.4	49	51	37.6
Dawson City	2,323	+14.7	50	50	39.6
Beaver Creek	113	-16.1	54	46	42.8
Mayo	463	-6.0	49	51	48.8
Pelly Crossing	407	-10.5	47	53	36.8

Sources: YBS 2022b, Statistics Canada 2022

First Nation communities report different population figures from the Census. Table 4-21 shows government data compared with data from First Nations government websites or from other documentation. Registered membership does not indicate residence in the local or regional area.

Table 4-21 Summary of First Nation Registered Members

First Nation	Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) 2021 (as of April 2022)				Number of Registered Members reported by First Nations
	Registered Population	Men (%)	Women (%)	Median age	
Tr'ondëk Hwëch'in	946	50	50	N/A	1,100[6]
Selkirk First Nation	673	49	51	36.3	671
First Nation of Na-cho Nyäk Dun	551	46	54	43.0	602
White River First Nation	164	46	54	36.5	220[7]

Sources: FNNND 2022; Government of Canada 2021b, SFN 2022, TH 2022.

Figure 4-16, the 2021 population pyramid presented by YBS (YBS 2022a), shows population stratified by age and sex. Approximately 51% of Yukon's total population is male and 49% female (YBS 2022b). The age structure of Yukon is changing. In 2021, about a quarter of people living in Yukon were between 30 and 44. These age group have grown substantially over the last 10 years in Yukon, with a growth of approximately 39% between 2011 and 2021 (YBS 2022b).

6 2016 data.
7 Data provided from the 2012 White River – Quartz Exploration Report, provided by WRFN.

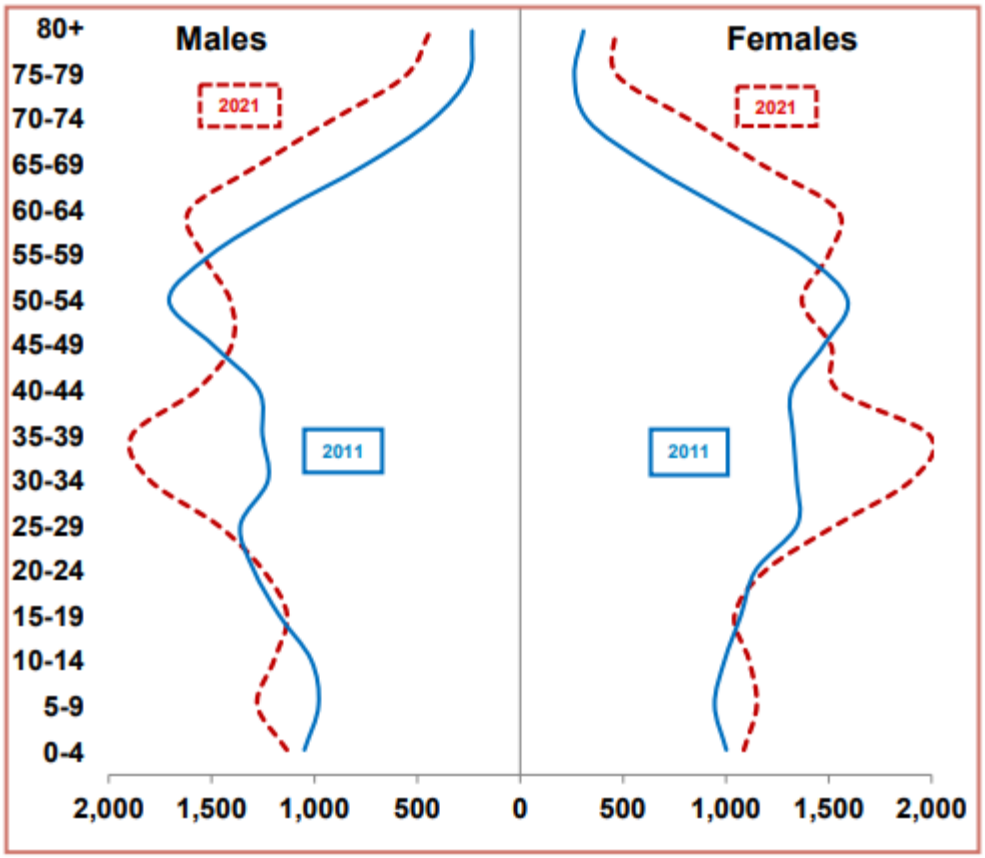


Figure 4-16 YBS 2022 – Population by Age Group and Sex, Yukon, December 31, 2011, and December 31, 2021

The number of senior citizens (60 or over years old) has increased by approximately 3,900 people or 71.7% since 2011, and the number of 30- to 44-year-olds has increased by just over 3,000 people (38.9%). The number of youth has remained steady, with moderate increases in population in some age groups, in particular in the 5 to 9 age group (24.4% increase). The working-age population (aged 15 to 64) represents 70% of the population, compared to 75.2% in 2011.

4.3.2 Economic Conditions

4.3.2.1 Income and Income Distribution

Income levels and distribution vary across the local and regional areas. Table 4-22 displays average income (in dollars) after tax and demonstrates that Whitehorse had the highest median individual income (after tax) in 2016 ($44,183) (Statistics Canada 2016a). All local area communities saw an increased median individual income from 2001 to 2016. (Statistics Canada 2003, 2017).

Table 4-22 Summary of Average Income Among Local Populations

Municipality	Average income ($) 2001	Average after-tax income in 2015 among recipients ($)
Whitehorse	35,040	48,704
Dawson City	28,523	41,316
Beaver Creek	Not Available	Not Available
Mayo	25,027	Not Available
Pelly Crossing	21,330	30,487

Sources: Statistics Canada 2003, 2017.

4.3.2.2 Labour Market

Yukon's April 2022 labour force comprises of 24,500 workers (YBS 2022b), with 23,200 people employed. The Aboriginal[8] labour force comprised 3,700 workers in 2015, or 18% of Yukon's labour force (Statistics Canada 2016a). Yukon's 2022 employment rate was 69.7% in 2022, while the unemployment rate was 5.3% (YBS 2022a). Aboriginal unemployment from the 2016 census was 22.3% (Statistics Canada 2016a).

Sales and service; trades, transport, and equipment operators; and education, law and social, community and government services occupations are the most prevalent occupations for Yukon's labour force. Yukon's 2016 Aboriginal labour force consisted of occupations primarily in trades, transport, and equipment operators; sales and service; and business, finance, and administration (Statistics Canada 2016a, 2016b).

Although mining contributes substantially to Yukon's economy, mining is not a major employer. The goods-producing sector (e.g., forestry, mining, construction) has been negatively affected by the COVID-19 pandemic (Government of Canada 2021a). Less than 16.5% of employment in Yukon come from the goods-producing sector (Government of Canada 2021a). With two new mines soon to be open, Yukon's economic growth is projects to be strong (Government of Canada 2021a).

4.3.2.3 Employment Type and Tenure

Approximately 84% of employed Yukoners worked full-time in 2021, the other 16% worked part-time (YBS 2022c). Labour force participation rate is much lower among Indigenous people in comparison with non-Indigenous people (Government of Canada 2021a). Dawson City's local economy sees seasonal expansion and contraction – both tourism and mining are seasonal - as well as longer-term boom and bust cycles relating to mineral prices.

4.3.2.4 Economic Activity

Yukon's economic sectors include agriculture, energy, film and sound, fishing, forestry, hunting, mining and exploration, tourism, and trapping. The global mineral market dictates Yukon's mineral exploration,

[8] This report uses the term "Indigenous" when referring to individuals identifying themselves as 'First Nations peoples, Métis or Inuit'. Information and data sourced from government agencies and authorities that use other terminology have not been altered and appears in the report as it appears in the original publication. For example, Statistics Canada uses the terms "Aboriginal Peoples," "Aboriginal Population" and "Aboriginal Identity" throughout its tables.

development, and production and plays a key role in Yukon's economy (Government of Yukon 2021a). The mining sector has remained active during the COVID-19 pandemic, supported by strong prices for metals (Government of Yukon 2021a).

Key economic drivers for Whitehorse include government services, tourism, and mining. Dawson City's local economy is currently driven by placer mining and tourism. Community-level data on economic activity in Mayo, Pelly Crossing, and Beaver Creek was not available.

Yukon's cost of living is higher than in southern Canada, and even higher in Yukon communities outside of Whitehorse (Government of Yukon 2021a). High costs of living, in particular fuel and resource costs, were identified as a local challenge in local communities (City of Dawson and TH n.d.).

Between 2011 and 2020, Yukon's gross domestic product (GDP) grew on average 1.9% per year (YBS 2020). Over that time period, GDP ranged from -7.6% to 7.2% (YBS 2020). Forecasted economic growth over the next three years is estimated between 2.4% and 5.5% (Government of Yukon 2021a).

4.3.3 Social Economy

4.3.3.1 Non-wage Economy

Nonprofits provide a diverse array of services and activities to Yukoners. There were 591 non-profit organizations operating in Yukon Territory as of March 2012 (SERNNoCa 2012). Yukon had a 49% volunteer rate in 2010 (Statistics Canada 2015a). Volunteering is prevalent in the Dawson City region (Local Business Focus Group 2016) and is a strategy the Dawson City community uses to address service or funding gaps (KDO 2011a). Bartering[9] is active in the Klondike Region. It contributes to Dawson City's social cohesion by promoting individuals to work together and decreases the cost of living (Interview 11, pers. comm. 2016).

Broad subsistence activities (e.g., hunting, fishing, gathering plants) are conducted by both First Nation and non-First Nation Yukoners (March TH TWG Meeting 2016, Usher and Staples 1988). Subsistence activities contribute significantly to Yukon's economy and are closely related to other socio-economic values including culture, health, and wellness (Usher and Staples 1988).

4.3.3.2 Traditional Economy

The traditional economy is an active and culturally important part of the societies in the First Nations in the Project's local area. The traditional economy involves a complex system of harvesting, processing, production, and technological adaptation. Practices include hunting, trapping, fishing, plant gathering, wood cutting, berry picking, and creating goods from materials gathered from the land (Dobrowolsky 2014, Calliou Group 2012a, KCB 2013).

Tr'ondëk Hwëch'in (TH) are active in the subsistence and traditional economy. This means that families commonly work together to share goods and materials harvested from the land. Instead of paying with

[9] Examples of bartering include exchanges of livestock for services, and vegetables for equipment (Interview 11, Personal Communication 2016).

money, TH citizens give back and reciprocate to those who have shared goods or services by an exchange of other goods and materials. TH's traditional economy contributes to family social cohesion as they promote time spent on the land together. Elders said they see less traditional economy participation now than when they were young. TH citizens do not tend to assign a monetary value to traditional economic activities (TH 2016). Half the survey respondents indicated that they do not sell goods or services from the land, while 25% estimate that they make between $0 and $500, and 12.5% estimate that they make between $2,001 and $5,000. Focus group attendees said they did not give meat or food with the expectation of getting something in return (TH 2016).

White River First Nation's (WRFN's) traditional economy is considered active: over a 13-month study, 90% of members reported hunting, 30% trapped, 95% fished, and 70% conducted gathering activities for a total of 238 harvesting trips (Calliou Group 2012b). No data were available to describe the economic value of the WRFN traditional economy. WRFN does not endorse efforts to monetize its traditional economy.

SFN citizens have reported being actively engaged in traditional use activities throughout the year (KCB 2013). No data were available to describe the current economic value of the overall SFN traditional economy. Previous research found that "…it is estimated that a portion of many of the SFN family's annual income is derived from traditional activities…these products may be sold, used for subsistence purposes, or traded" (KCB 2013).

First Nation of Na-cho Nyäk Dun (FNNND) citizens are active in traditional activities that contribute to well-being and community life including economic, culture, diet, and health. They also facilitate linkages with the land culture, and provide savings compared to store-bought food (DPRA 2010, FNNND 2008).

4.3.4 Infrastructure and Services

This section describes the existing conditions of community infrastructure and services, including the regulatory context.

4.3.4.1 Housing and Accommodation

The City of Whitehorse's 2010 Official Community Plan (City of Whitehorse 2013) calls for more land for residential development and secondary suites to increase housing stock. The draft Official Community Plan (City of Whitehorse 2022) outlines goals and policies related to providing a range of housing types, rental options, and inclusive housing for an aging population. Vulnerable people experience difficulty in finding affordable accommodation in Yukon (Independent Author 2022). With recent migration and population growth in Whitehorse, housing options are expensive and securing accommodations can be competitive.

A Statistics Canada 2011 Household Survey found that housing was the primary change recommended to improve the Dawson City area (Statistics Canada 2013, KDO 2011b). Yukon Housing Corporation says "the increasing (Dawson City) population has resulted in…tightening in rental vacancy rates, accompanied by rising rents and a very large increase in home prices" (YHC 2013). Because rents are relatively high, it can be difficult for lower-income households to find affordable housing (YHC 2013). Dawson City offers accommodation options in the summer, including two campgrounds, an RV park, bed and breakfasts, inns, cabins, hotels, and motels. Many facilities close in the winter months, and accommodation is limited at that time.

4.3.4.2 Physical Infrastructure

Physical infrastructure discussed in this section include landfill services, water and sewage, fire, police, and childcare services in Dawson City. Dawson City is the focal community of this section because of its proximity to the mine site.

The Quigley regional landfill services Dawson City, the Klondike Valley, the Dempster Highway, and the North Klondike (City of Dawson 2016). A community compost is available at Quigley Landfill, as is an E-waste facility, and a free store (City of Dawson 2022a). The landfill is approaching capacity but could be expanded with additional recycling and composting facilities (Interview 4, pers. comm. 2016).

In Dawson, water and wastewater services are supported by Public Works. A public bulk fill station, drinking water come from four groundwater supply wells were brought online in later 2015 (City of Dawson 2022b). A population increase in Dawson City would require expansion of water and sewer infrastructure (Interview 7, pers. comm. 2016).

Dawson City and surrounding area are served by the Dawson City Community Hospital.

Dawson City is served by a volunteer fire department of approximately 25 to 35 members (Interview 4, pers. comm. 2016). Dawson City Fire Department has a municipal coverage area, as well as a mutual aid agreement with a second department, the Klondike Valley Fire Department, which serves the area outside of municipal limits of Dawson City (Interview 4, pers. comm. 2016).

The Dawson City RCMP detachment provides policing services within its jurisdiction, which covers a large area including the Goldfields, the proposed Northern Access Route (NAR), and the Project area.

Dawson City has experienced a shortage in child-care availability that has adversely affected people's ability to work (Windeyer 2015).

4.3.4.3 Transportation

Yukon in general, is served by the Erik Nielsen Whitehorse Airport (YXY), a controlled international airport that supports commercial traffic. Dawson City is served by a Transport Canada-certified regional airport, Dawson City Airport (YDA), which is an uncontrolled airport.

The highway systems of interest for this Project include the Alaska Highway to the North Klondike Highway and the North Klondike Highway to Dawson City. The Alaska Highway extends from Watson Lake through to Whitehorse and continues to Haines Junction and on to Alaska. Traffic for the Project will turn north from the Alaska Highway to the North Klondike Highway at the junction just west of Whitehorse. Upgrades to the highway for the section through Whitehorse are currently underway. The North Klondike highway travels from its junction with the Alaska Highway through the communities of Carmacks, Pelly Crossing, and Stewart Crossing, and turns west north of the Stewart River to the Dempster Highway and Dawson City.

The existing road network extending south from the Klondike Highway that is relevant to the Project include Hunker, Sulphur, Dominion, Black Hills, and Maisey May roads, which are used seasonally by placer miners and not cleared in winter.

A notable component of transportation infrastructure related to this Project is the NAR. The NAR is a 214-kilometre road which provides access to the mine site from the North Klondike Highway (Government of Yukon 2016). The access road will require upgrades of existing roads and the construction of new road.

4.3.5 Education Services

There are 28 schools in Yukon, 15 schools in Whitehorse, and 14 in rural communities. The territory has two post-secondary institutions: Yukon University and Yukon School of Visual Arts. Yukon University has 13 community-based campuses. The main campus is located in Whitehorse, with an average total enrollment of 5,671 students per year since 2008 (Yukon College 2016). Currently, Yukon University's goal is to provide as many community-based programs in communities such as Dawson City, Beaver Creek, Pelly Crossing, and Mayo as possible (Interview 2, pers. comm. 2016). The Yukon School of Visual Arts is located in Dawson City (Yukon School of Visual Arts n.d.). Dawson is relatively well served in terms of facilities and infrastructure, although shortcomings are well-documented (City of Dawson and Tr'ondëk Hwëch'in n.d.).

School enrolment across the territory has increased, as expected with the recent population growth. In 2021, 5,704 students were enrolled in Yukon, compared to 5,102 in 2011; this represents a 12% increase (Government of Yukon 2021b). Whitehorse schools saw steadily increasing enrolment, while enrolment at other community schools was more volatile, fluctuating over time (Government of Yukon 2021b).

4.3.6 Land and Resource Use

4.3.6.1 Non-traditional Land and Resource Use

The majority of land in the local area is Yukon public land, with the exceptions of privately held land in the Klondike Valley. Land use planning takes place at a territorial, regional, and municipal level in accordance with Yukon First Nation Final Agreements (YLUPC 2015).

Water licences within the local region of the Project are for the purposes of placer mining, with the exception of the water licence held by Newmont. The local area falls within the Game Management (GMA) Zone 3 and Zone 5. Currently, caribou and sheep hunting are closed in the GMA 3. Moose are the most popular target animal in the zone. Trapping and small animal hunting is also considered popular within GMA 3. (Interview 13, pers. comm. 2016). The local area overlaps with guide outfitter concession area ID 11 at the barge crossing of the Yukon River and the winter ice road between the Yukon River and Coffee Creek. In Yukon, a valid Yukon hunting licence, angling licence, sportfishing licence, as well as additional permits and stamps for certain species are required (Government of Yukon 2016).

Placer mining activity is focused in the northern portion of the Regional Area near Dawson City, although placer mining has also taken place throughout the local area. There are Prospecting Leases with applications for claims along Coffee and Ballarat creeks within the local area near the Yukon River. Within Yukon, Minto copper-gold-silver mine is the sole operating hard rock mine. Operation at Bellekeno is suspended, Casino and Dublin Gulch proposed mines are under assessment, and the remainder of mining licenses are for exploration (YGS 2015).

The three Forest Resources Management Plan (FRMP) Units which overlap with the Project are the Yukon River South, Stewart River, and Gold Fields. Both the Yukon River South and the Stewart River were

designated as medium and low planning priority. The Goldfields are high planning priority (Dawson FRMP 2013). Recreation in the local area is an economic opportunity for the community (KDO 2011a).

Tourism plays a key role in community economic development. Visitors to Dawson City vary by year but have generally increased recently from 24,060 visitors in 2012 to 37,569 in 2015 (Yukon Department of Tourism and Culture 2015). There are several annual races (dog sleds, canoes, etc.) held within the local area and regional area, which attract local and international participants. Access to and within the regional area is by road, air, water, and non-road access with all-terrain vehicles (ATVs) and snowmobiles, depending on the season.

4.3.6.2 Traditional Land and Resource Use Existing Conditions

Existing conditions for traditional land and resource use are summarized in Table 4-23.

Table 4-23 Traditional Land and Resource Use Activities

	Habitation	Transportation	Subsistence	Cultural and Spiritual Values	Environmental Values
Tr'ondëk Hwëch'in (TH)	TH citizens continue to live on the land at different times of the year in areas which overlap with the local area (Interview 14, pers. comm. 2016; Interview 22, pers. comm. 2016).	Historically, TH are known to have used the rivers and creeks across their Traditional Territory for transport, including the area along the Yukon River close to Coffee Creek, as well as overland routes (Dobrowolsky and Hammer 2001, TH 2012b). Most contemporary traditional land and resource use tends to occur in accessible areas along roads and rivers (TH 2012b).	The land and resources across TH's traditional territory have been providing for their subsistence needs for thousands of years (Ecofor 2012) through seasonal hunting, trapping, and fishing and plant gathering (known to have occurred in the Coffee Creek area) (Dobrowolsky 2014).	The practice of conducting traditional use activities creates important time spent together for families. Coffee Creek and the surrounding area continue to be a place of cultural and spiritual importance to TH citizens (Interview 14, pers. comm. 2016; Interview 22, pers. comm. 2016).	TH citizens are highly aware of the holistic nature of the environment and the complex relationships that characterize it. They value key habitat areas that support wildlife. TH view the animals on their Territory as an economic resource that supports their traditional lifestyle and economy (TH 2012b).
White River First Nation (WRFN)	The mouth of Coffee Creek is an important permanent and temporary habitation area where WRFN ancestors are known to have lived, gathered, and traded (Bates et al. 2014, Easton et al. 2013, TH 2012b, Yukon River Commercial Fishing Association and TH 1997).	As WRFN were historically nomadic people, overland and water transportation linkages played a central role in facilitating the seasonal round, as well as other cultural and spiritual activities.	Subsistence harvesting such as hunting, trapping, and fishing continues to be an important value and contributes to current collective understanding of WRFN's sense of place, as well as food security. (YESAB 2012, Calliou Group 2012b). WRFN members report hunting in a variety of locations throughout the exploration area of the Project.	Use of the land and resources across WRFN's territory facilitates the transmission of language, knowledge, stories, traditional values, and cultural practices (Bates et el. 2014). The Coffee Creek area is culturally and spiritually important because this was a birth and burial place for WRFN ancestors and was the place of marriages and baptism ceremonies (Bates et al. 2014).	WRFN values both the biophysical and inorganic components of the environment and have specific concerns for water quality (YESAB 2012). The Coffee Creek area has environmental value as it is inherently linked to all other aspects of the landscape.

	Habitation	Transportation	Subsistence	Cultural and Spiritual Values	Environmental Values
First Nation of Na-cho Nyäk Dun (FNNND)	Coffee Creek was an important gathering place where ancestors of FNNND would historically stop during their seasonal round (TH 2012b).	Traditionally, FNNND people would travel long distances in accordance with the seasonal round to conduct different subsistence activities (InterGroup Consultants Ltd. 2009).	Traditional foods harvested from the land have always maintained a central role in the diet of FNNND citizens. They continue to comprise a substantial portion of citizen's diet and contribute to FNNND culture (DPRA 2010).	Traditional activities conducted across FNNND traditional territory support socio-cultural ties through the harvesting of traditional foods and the act of sharing and consuming them (DPRA 2010).	Environmental values of FNNND are intrinsically linked to cultural values and practices. For FNNND, maintaining and enhancing the environmental health of their traditional territory is an important value (FNNND 2008).
Selkirk First Nation (SFN)	Historically, SFN ancestors would gather and live at Coffee Creek (Easton et al. 2013, Yukon River Commercial Fishing Association and TH 1997, TH 2012b).	Depending on the season, SFN members would travel by boat or on trails, including by dogsled. There previously was an overland route between Fort Selkirk and Coffee Creek (TH 2012b).	SFN traditional land and resource use has historically and currently remains a central component of SFN culture. SFN uses a diverse range of plants, animals, and resources (Castillo 2012).	Cultural activities continue to contribute to the SFN's social cohesion and community well-being. In the past, Selkirk people used to gather and conduct important cultural and spiritual activities at Coffee Creek (Easton et al. 2013, TH 2012b).	The environment is highly valued by SFN and its citizens, and sustaining a healthy environment is of upmost importance (KCB 2013).

4.3.7 Community Health and Well-Being

A summary of existing regulatory and baseline conditions regarding community health and well-being is provided below.

4.3.7.1 Environmental Quality

The areas at and around the proposed Mine Site were generally undisturbed before mining began. Dust fall in the area reflects natural sources of dust such as tree pollen, as well as deposits during forest fires. Baseline noise is consistent with a quiet environment. Similarly, the areas adjacent to the NAR can be considered in a generally natural state regarding air quality, water quality, soil quality, and the quality of country foods, except perhaps in limited locations around active placer mines. Baseline data shows that natural resources in important harvesting areas such as the mouth of Coffee Creek are good quality, and provide good nutritional, medicinal, and cultural resources.

4.3.7.2 Socio-economic Factors in Health

Socio-economic health factors are described for the region and for the local area where available.

Social Determinants of Health: The health and well-being of individuals and communities are affected by social circumstances and realities such as living conditions, socioeconomic status, and community and family structures.

Health-related Behaviours: Health-related behaviours are individual choices such as not smoking, exercising regularly, and eating nutritiously, which are associated with reducing the incidence of health conditions including diabetes, heart disease, cerebrovascular disease, and certain cancers. Health-related behaviours are often understood by considering social determinants of health.

Housing: Overall, access to housing is an issue, particularly for people who are at risk of homelessness (Independent Author 2022). Housing was frequently mentioned as a concern in Dawson City, in terms of availability, affordability, and adequacy (Interview 2, pers. comm. 2016; Interview 7, pers. comm. 2016; Interview 8, pers. comm. 2016; Interview 20, pers. comm. 2016; Interview 21, pers. comm. 2016; Interview 28, pers. comm. 2016). In 2011, 29% of Yukon First Nations members lived in homes needing major repairs, and 7% lived in crowded homes, with more than one person per room. The corresponding figures for the non-Indigenous population were 12% and 4% respectively (Arriagada 2016).

Family Structure: There is a higher percentage of common-law families with children in Yukon (25.1%), as well as a higher percentage of lone-parent households (20.5%), than in Canada as a whole (16.7% and 16.3%, respectively) (Statistics Canada 2016a).

Children in Care: The Child and Family Services division of Yukon Government Health and Social Services (YGHSS) and the Child Protection Branch respectively provide child placement services and programming intended to reduce family violence, child abuse, and neglect (Government of Yukon 2015a, Government of Yukon 2015b). A recent Children in Care report specified that 64% of Yukon children in care are Indigenous, although only 33% of the child population is Indigenous (Aboriginal Children in Care Working Group 2015).

Children and Youth: With respect to physical and mental health among children and youth, younger urban students are reported better health than their older rural counterparts (Lambe et al. 2019). Mental health

among youth is trending downwards as more youth report feeling sad or hopeless (Lambe et al. 2019). Health of children and youth is dependent on meaningful relationships with family, friends, and the community.

Crime: In 2020, the crime rate in Yukon was the third highest in Canada, behind Nunavut and Northwest Territories, at 22,912 incidents per 100,000 people (YBS 2021).

Family Violence: Yukon recorded a rate of family violence of 707 per 100,000 population in 2019, the third highest rate in Canada behind Nunavut and NWT (Statistics Canada 2021).

Food Security: Yukon households both with and without children have rates of food insecurity somewhat above the national average.

Accidents and Injuries: Yukon has very high rates of unintentional injuries causing death and is typically ranked as the third leading cause of death, behind cancer and heart disease (Statistics Canada 2015b).

Transportation-related Injuries: Motor vehicle collisions in Yukon cause 9.5 deaths per 100,000 people and 441 injuries per 100,000 people, both figures are above the Canadian average (Transport Canada 2020).

Aviation Incidents: Overall, fatality rates for aviation incidents in Yukon are low (TSB 2014a, 2014b).

Infectious Disease: Giardiasis, campylobacteriosis, salmonellosis, and cryptosporidiosis have been observed in Yukon, in addition to *E. coli* and Hepatitis A (YGHSS 2013). Tuberculosis declined in 2012 to 2.9 per 100,000 from a peak of 24.2 cases per 100,000 in 2008 (Government of Yukon 2013). Chlamydia rates are higher in Yukon than in southern Canada (PHAC 2008), but steadily decreased from 2007 to 2012 (Government of Yukon 2013).

Non-infectious Disease: Yukon rates of diabetes appear to be generally lower than the overall Canadian rate and (Statistics Canada 2016b) and obesity rates for Yukon appear to be similar to those for Canada (PHAC 2011).

Mental Health and Wellness: Overall, Yukoners report high rates of community belonging and life satisfaction, although perceived mental health has been decreasing over the past decade. Mental wellness and substance use resources are available and being developed to support, although use and performance of these resources is undetermined (Independent Author 2021). Barriers to accessing mental health supports are prevalent (Government of Yukon 2020).

Workplace Mental Health: Stress and workplace bullying have been found to negatively affect health (Goh et al. 2015, MacIntosh et al. 2014). Shift work and fly-in, fly-out work schedules can be stressful for workers and their families. Mobile workers can experience exhaustion, loneliness, stress, and anxiety.

4.3.7.3 Health Services Structure and Capacity

Access to Medical Care: All Yukon communities have access to a community health centre. 78.8% of Yukoners have access to a regular healthcare provider, compared to 84.9% of Canadians (Government of Yukon 2020). First Nations citizens report racism and stereotyping when accessing health services;

Francophone citizens report the importance of bilingual health and social services (Government of Yukon 2020). Equitable access to medical care that is culturally safe remains a priority.

4.3.8 Heritage

Examination of the ethnography and ethnohistory of the relevant First Nations groups is provided in the Heritage Resources Overview Assessment (HROA) and Heritage Resources Impact Assessment (HRIA) reports.

4.3.8.1 Archaeological and Historical Resources

The Regional Study Area and Local Study Area possess potential for precontact heritage sites that are at least 10,000 years old. Based on previous assessments, 29 heritage sites were identified and recorded within the Local Area. Five are located within the Mine Site. These include three prehistoric lithic sites, one historical artifact site, and one World War II-era plane wreck. Also, 24 previously recorded archaeological and historical sites, including six prehistoric lithic and 18 historical sites, were identified along the NAR. An additional 13 heritage resources had been identified and previously recorded in the Regional Area.

4.3.8.2 Paleontological Resources

The major creek and river valleys as well as areas of permafrost within the Local Area possess potential for the preservation of paleontological resources.

5.0 PROJECT DESCRIPTION

This section provides a brief description of the Coffee Property history (Section 5.1), outlines the Coffee Gold Mine Project schedule (Section 5.2), and describes Project and ancillary components plus associated processes and activities (Section 5.3). In addition, Sections 5.4 to 5.6 describe current conditions (Year -5), conditions two-years forward (Year -1) from start of construction (Year -3), and conditions at the end-of-mine life (end of Year 9), respectively. Sections 5.7 and 5.8 outline proposed monitoring and surveillance activities and the approach to risk management and adaptive management during mine development and operation.

5.1 Coffee Property History

From the turn of the century until 1981, the Coffee Property and surrounding area in the White Gold District in west-central Yukon was explored by sporadic placer expeditions with limited reconnaissance activities for porphyry copper in the 1960s and 1970s. A brief exploration program conducted in 1999 and 2000 resulted in the identification of an open-ended soil gold anomaly. Further grid and ridgetop soil sampling was conducted in 2006 and 2007. In 2009, the Coffee Property was acquired by the original Kaminak Gold Corp. (KGC) from prospector Shawn Ryan.

Upon acquisition of the property, exploration programs were expanded to identify bedrock mineralization through surficial trenching and soil sampling. Through these programs, KGC identified a number of high-tenure soil anomalies for drill follow-up. In subsequent years, KGC continued soil sampling and trenching programs, and undertook drilling programs to test the identified soil anomalies. From 2010 to 2015, KGC completed more than 270,000 metres of drilling across the property, focusing on the Supremo, Latte, Double Double, and Kona deposits. These efforts led to the completion in 2015 of a NI43-101 Feasibility Study (JDS 2016). In July 2016, KGC and the Coffee Property were fully acquired by Goldcorp with the intent of advancing the Project through assessment and licensing and permitting stages, then into construction, operation, closure, and post-closure, as defined below. In 2019, Newmont and Goldcorp combined to become Newmont Goldcorp Corporation, now referred to as Newmont.

5.2 Project Schedule

The Project phases are defined as follows and illustrated along with key activities (based on current information) in Figure 5-1.

- Construction Phase: Q2 Year –3 to the end of Year –1 (30 months), in which mine site components are constructed and pre-production mining occurs
- Operation Phase: Year –1 to Year 9, in which the mine is in operation, with progressive reclamation and closure activities occurring where practicable in areas no longer needed for mining
- Closure Phase: Year 10 to the end of Year 21, during which the rinsing of stacked ore (also referred to as heap leach or heap) on the heap leach pad (HLP) and water treatment activities continue until no longer required, and decommissioning, reclamation, and closure activities are completed. The Closure Phase includes:
    - Post-mining Closure Phase: Year 10 to Year 15, which will focus on HLF re-circulation, cover placement and active water treatment of HLF drain down; and
    - Active Closure Phase: Year 16 to Year 21, which will focus on decommissioning water management infrastructure and site roads.

- Post-closure Phase: Year 21 onward (as determined to be required), in which monitoring and inspections are performed and maintenance activities occur, as needed.

For each phase (after the mine is operational), a summary of general requirements related to reclamation, closure, and/or monitoring activities is provided in Table 5-1. Construction and operation details are provided by Project component in subsequent sections, and final closure measures for each component are provided in Section 7.

Key Activity	Project Phase and Year																							
	Permitting		Construction		Operation									Post-mining Closure					Active Closure					Post-closure
	-4	-3		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
Studies/Permitting																										
Northern Access Route Construction																										
Mine Site Construction																										
Mining (including pre-production)																										
Ore Processing (including pre-production)																										
Progressive Reclamation																										
Heap Leach Rinsing																										
Water Treatment																										
Site Infrastructure Decommissioning																										
Surveillance and Monitoring Activities																										
Community Engagement																										

*Green highlighted cells indicate years that passive water treatment will be in effect, if required

Figure 5-1 Schedule of Key Activities by Project Phase and Year

Table 5-1 Closure and Monitoring Activities Planned during the Operation, Closure, and Post-closure Phases

Planned Reclamation and Closure Activities	General Monitoring Activity Requirements
Operation Phase (Closure-related Activities from Year –1 to end of Year 9)	
Closure activities will be undertaken in a progressive manner when pits, the Alpha WRSF and frozen soil stockpile area (FSSA), and stages of the HLP are no longer required to support mine operations. Activities planned during the Operation Phase include the following: • Implementation of the Reclamation Research Program to evaluate site-specific reclamation prescriptions such as revegetation, cover design, and reclamation materials. • Continuous salvage and stockpile of reclamation material including overburden stripped during operations (i.e., expansions of pits, development of new areas). • Progressive reclamation of disturbed areas within the Mine Site footprint that are no longer required to support mine operations. • Progressive regrading of the HLF. • Reclamation of exploration areas (re-grade, scarify, and revegetate roads, fill, and revegetate trenches) when access is no longer required. • Regular removal of recyclable / salvageable material and equipment, using available back-hauls during the Operation Phase. • Partial backfill of Latte and Supremo Pits and closure of disused haul roads. • Complete backfill of Kona and Double Double Pits and closure of disused haul roads. • Installation of water treatment facility at the Plant Site and commencement of water treatment of surplus water. • Near the end of the Operation Phase, material stored in the FSSA and deemed unsuitable for reclamation will be co-disposed in the Alpha WRSF.	Routine monitoring in accordance with conditions of mine operating licenses and permits
Post-mining Closure Phase (Year 10 – Year 15)	
Closure activities that are planned during the Post-mining Closure Phase include the following: • HLF recirculation for rinsing and final gold recovery. • Cover construction and revegetation of rinsed areas of the heap. • Continued water treatment of drain-down rinse water from HLF stages until rinsing of the heap is complete, then until effluent is of suitable quality for discharge or until the passive water treatment system, if required, is commissioned. • Reclamation of disturbed areas within the Mine Site footprint that are no longer required to support closure activities. • Equipment removed from service when no longer required to support closure and reclamation activities. • Closure of Latte Pit and Supremo Pit by allowing them to flood and placing boulder fences at the pit rims. • Reclamation of the soil stockpile area footprints, including FSSA, once stockpiled materials have been used. • Reclamation of the run-of-mine (ROM) stockpile area. • Contaminated sites investigation within the areas of fuel storage and transfer, equipment laydowns, and the bulk explosives storage area • Excavation of any contaminated soil followed by either on-site treatment or temporary storage and removal off-site. • If required, construction and commissioning of passive water treatment system for the HLF. • Continued operation of water conveyance structures and sedimentation ponds until water quality in the ponds meets discharge requirements.	Routine monitoring in accordance with conditions of mine operating licenses and permits, and monitoring of reclaimed areas to observe progress towards achieving Project and component-specific closure objectives.

Planned Reclamation and Closure Activities	General Monitoring Activity Requirements
Active Closure Phase (Year 16 – Year 21)	
• If draindown rinse water from HLF requires passive treatment, continue active water treatment during passive water treatment system commissioning and until HLF water quality has been sufficiently treated to qualify for passive treatment. • Decommissioning of Facility Pond. • Decommissioning of the Alpha Dam/Pond by breaching the dam and constructing a drainage pathway through the footprint of the former dam. • Re-grading the West Diversion Ditch to slope and re-establishing drainage patterns to match pre-mining conditions to the extent practical. • Dismantling and removal of process plant, reagent storage area, laboratory, truck shop and warehouse building, emergency response team building, mine dry and office complex, power plant, and bulk fuel storage and liquid natural gas (LNG) storage facility infrastructure at the Plant site, as well as decommissioning of the bulk explosives storage area and water management infrastructure. • Dismantling and removal of dormitories and kitchen, dining, mudroom, and recreation complex buildings, fresh (potable) water and fire water systems, power plant, sewage treatment plant, and waste management building at the Camp Site. • Decommissioning and closure of the HLF and water management infrastructure, followed by reclamation activities, as relevant. • Decommissioning and reclamation of remaining disturbed areas within the Mine Site footprint, and Project-built (new) sections along the NAR, barge landings, the On-site Access Road, Mine Site roads, and the Project airstrip towards the end of this stage. • Dismantling of the Java Camp.	Routine monitoring in accordance with conditions of mine operating licenses and permits, and monitoring of reclaimed areas to observe progress towards achieving Project and component-specific closure objectives.
Post-closure Phase (Year 21 onwards)	
Closure and reclamation activities are complete.	Ongoing monitoring with schedule frequency and locations being reduced as performance criteria is met and Project-specific closure objectives are achieved.

5.3 Project and Ancillary Components

The following sections describe principal and ancillary components that will support Project construction, operation, and reclamation, and closure activities. Information provided for each Project component includes: its purpose, location, key design features, relevant investigation information, construction sequence, and operational aspects. The descriptions are high-level in nature and provide the level of detail necessary for the licensing stage of the Project. Project detail descriptions are based on environmental management plans, studies, investigations, and assessments (including risk assessments) developed for licencing.

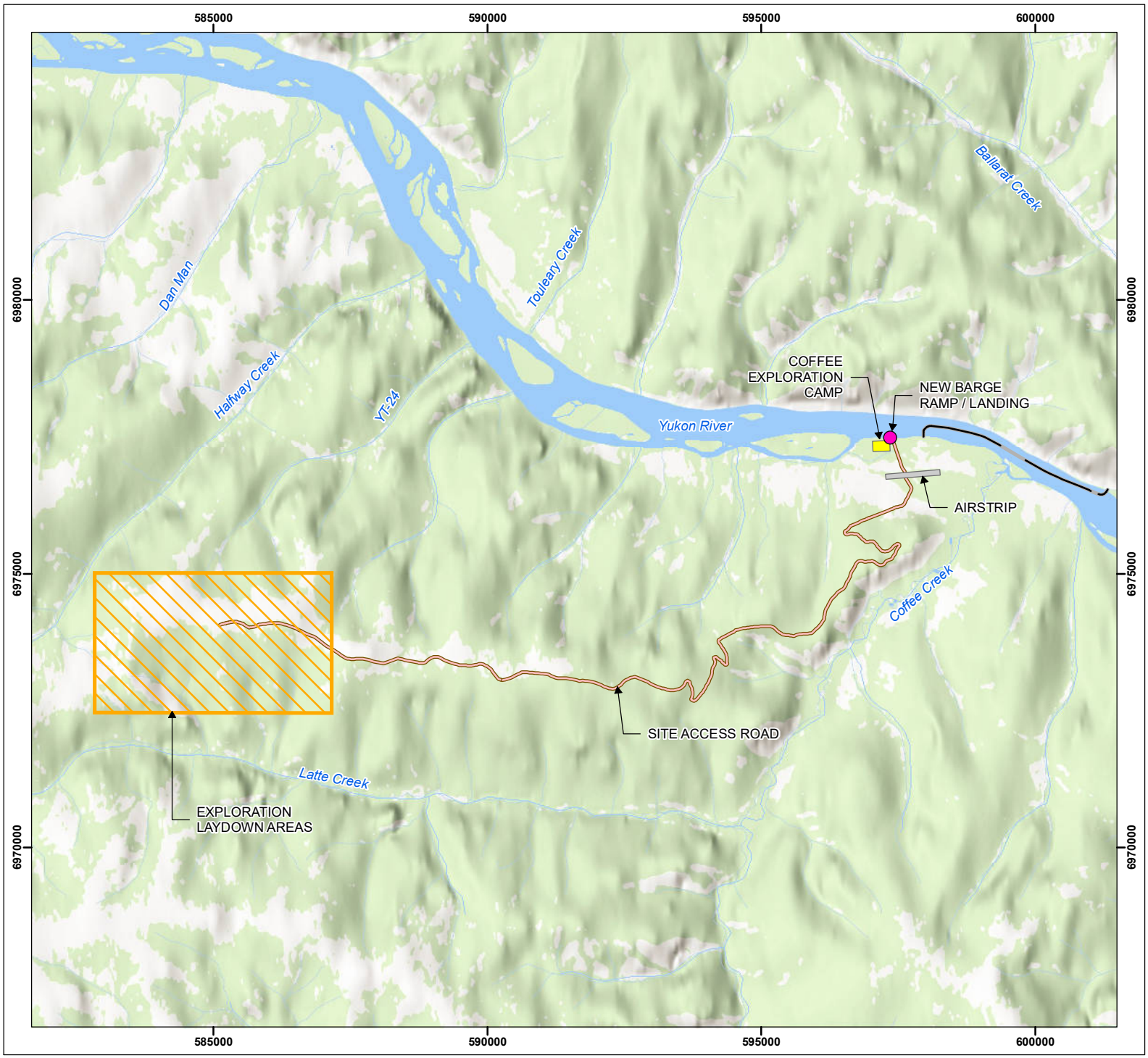
Detailed design and implementation procedures will be finalized following receipt of Project approvals. Designs, methodologies, processes, and procedures will conform to the terms and conditions outlined in the YESAB Decision Document, as well as conditions outlined in regulatory approvals (i.e., Quartz Mining License, Type A Water Use Licence, Yukon *Environment Act* permits, and other permits).

Principal components at the Mine Site include:

- Four open pits – Latte, Double Double, Kona, and Supremo
- One waste rock storage facility (WRSF) – Alpha
- Stockpiles including the FSSA, soil stockpiles, and ROM stockpile
- Crusher system including a 2-stage crushing circuit, crushed ore stockpile, and a conveyor system
- HLF including a lined HLP, event ponds, a rainwater pond, and associated piping and water management infrastructure
- Plant Site including process plant, reagent storage area, laboratory, truck shop and warehouse building, power plant, bulk fuel storage area, and LNG storage facility
- Camp Site including dormitories, kitchen, dining, mudroom, and recreation complex buildings, mine dry and office complex, emergency response team building, potable water and fire water systems infrastructure, sewage treatment plant, and waste management infrastructure
- Bulk explosive storage area
- Land Treatment Facility
- Mine Site roads and haul roads
- Site water management infrastructure including sedimentation ponds and water conveyance structures.

Ancillary components include the Coffee exploration camp and airstrip, and the Java exploration camp, NAR, Project airstrip, and laydown areas.

The Project area encompasses 22,000 hectares (ha), including areas affected and unaffected by the Project. The locations of all components at the Project site are shown on Figure 5-2. Component areas indicated on Figure 5-2 are conservative representations of anticipated component footprints since the layout illustrates the full extent of Project development over the LOM and does not take into consideration areas or components that will be progressively reclaimed. Figure 5-2 provides the layout of the existing components at the site, which includes the ancillary components located to the east of the site.



COFFEE GOLD MINE

Current Conditions

Legend

- New Barge Ramp / Landing
- Access Road
- Yukon River Barge Route
- Watercourse
- Waterbody

Existing Site Feature

- Airstrip
- Coffee Exploration Camp
- Exploration Laydown Areas

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Topographic Map

N

1:100,000

0 0.5 1 1.5 2 2.5

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 5-2	Date: Aug 22, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MP\RCP\Fig5_20_103862_03_CurrentCondition_230728.mxd

5.3.1 Open Pits and Mining Activities

Latte, Double Double, Supremo, and Kona Pits will be developed using standard drill and blast methods and mined using conventional shovel and truck methods.

Ore will be transported to the crusher system, where it will be crushed and, then transported to the HLP. Ore will be placed in the ROM stockpile when the crusher is not running and the HLP is not being loaded (Section 5.3.3.3). Waste rock will be transported the Alpha WRSF, or used for construction of Mine Site infrastructure, if suitable. Waste Rock will also be used to selectively backfill mined out pits at Latte and Supremo in order to create causeways and facilitate more-efficient ore haulage routes to the crusher. Additional information regarding open pit mining design and methods are provided in the Mine Operations Plan. Information on the Alpha WRSF is provided in Section 5.3.2 below.

Open pit dimensions and LOM quantities of contained ore and waste rock for each pit are provided in Table 5-2. Over the 10-year Operation Phase, an estimated total of 60 Mt to 67 Mt of heap leach feed will be produced and approximately 300 to 330 Mt of waste material will be generated, based on an average strip ratio of 5:1. A summary of the LOM production schedule by year is provided in Table 5-3.

Table 5-2 Open Pit Dimensions and Life of Mine Quantities of Contained Mineralized Material and Waste Rock

Open Pit	Max. Length (m)	Max. Width (m)	Max. Depth (m)	Mineralized Material (kt)	Waste Rock (kt)
Latte	1,500	360	140	20,962	62,505
Double Double	640	270	140	1,340	9,281
Kona	375	170	90	946	2,933
Supremo	2,150	570	225	36,902	223,959
Total				**60,150**	**298,678**

Table 5-3 Summary of LOM Production Schedule by Year

Description	Unit	Total	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Mineralized Material	kt	**60,150**	3,317	7,940	7,317	6,946	7,337	7,451	5,402	6,369	5,149	2,921
Au grade	g/t	**1.33**	1.38	1.64	1.57	1.31	1.21	1.15	1.17	1.20	1.30	1.20
Au contained	koz	**2,566**	147	419	369	293	286	275	202	246	215	113
Waste	kt	**298,678**	14,429	30,066	37,495	38,529	36,571	35,081	35,494	35,159	25,512	10,343
Strip Ratio	t:t	**5.0**	4.3	3.8	5.1	5.5	5.0	4.7	6.6	5.5	5.0	3.5
Total Material	kt	**358,828**	17,746	38,006	44,812	45,476	43,908	42,532	40,896	41,528	30,661	13,263
Average Mined	t/d	**99,924**	64,766	104,126	122,772	124,591	120,297	116,525	112,044	113,775	84,004	36,338
Total HLF feed	kt	**60,150**	3,042	7,500	7,490	7,463	7,363	7,451	5,402	6,369	5,149	2,921
HLF head grade	g/t	**1.33**	1.41	1.61	1.56	1.36	1.21	1.15	1.17	1.20	1.30	1.20
Au contained	koz	**2,566**	137	388	376	325	287	275	202	246	215	113

Note: Conceptual-level production estimate only. Unit definitions: t = tonnes, kt = kilotonne; koz = thousand ounces; t/d – tonnes per day; g/t – grams per tonne.

To maximize economic returns and achieve the target ore production annual rate of approximately 9.0 Mt during the 10-year Operation Phase, the sequence of open pit mining from Project Year –1 to Year 9 is expected to proceed as illustrated in Figure 5-3. Backfilling of waste into pits is estimated to occur as follows:

- Double Double Pit will be mined between Year 1 and Year 3. Waste rock produced from the Double Double Pit will be placed in the Alpha WRSF or used as backfill for the Latte causeway. In operating Years 8 and 9, approximately 8.8 Mt of waste rock from adjacent areas of the Supremo Pit will be backfilled into the mined-out Double Double Pit (i.e., the pit will be progressively closed).
- Latte Pit will be mined in Years -1 to Year 9 and in-pit backfilling will occur in the eastern portion of the pit during portions of Years 3 and 4 to construct a causeway to shorten the ore haulage route to the crusher. Approximately 14 Mt of material will be backfilled into Latte Pit.
- Kona Pit will be mined in Years 8 and 9. Although waste rock from Kona Pit is non-PAG, a small area of ore exposed in the completed pit wall has weak PAG tendencies. To limit exposure of this ore seam to potential oxidation, Kona Pit will be backfilled with 2 Mt of waste rock from Supremo Pit in Year 9 (i.e., progressively closed). Backfilling is currently planned as a progressive closure activity in the winter of Year 9, as frozen waste rock will promote the re-establishment of permafrost to depth.
- Supremo Pit will be mined from Year -1 to the end of Year 9. As shown in Table 5-2, approximately 224 Mt of waste rock will be generated from the development of the northern and southern pits. Most of this material will be stored permanently in the Alpha WRSF, 8.8 Mt will be used to backfill Double Double Pit, and 30.2 Mt will be used to construct a causeway in the southern Supremo Pits during Years 6 through 9.

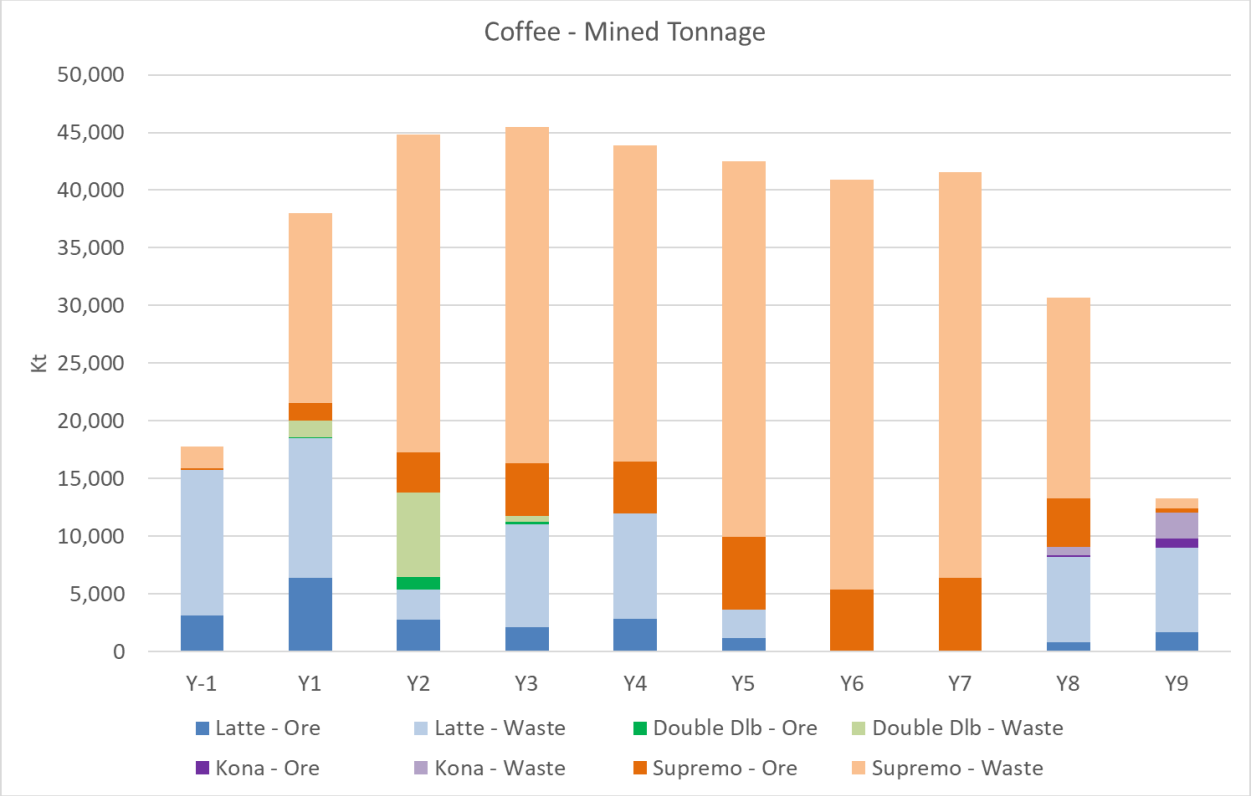
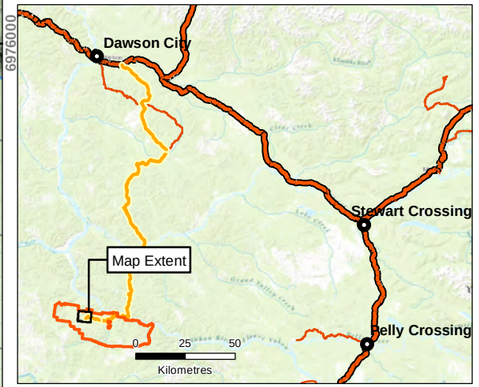


Figure 5-3 Ore and Waste Rock Mining Schedule by Pit Parameters

As the open pits are mined out and closed, some are expected to fill with water and form lakes over time (except for Kona and Double Double Pits which will be completely backfilled during operations), as a result of groundwater, surface runoff, and meteoric water inputs reporting to pits. The location of the in-pit lakes in the Post-closure Phase are shown in Figure 5-4. The rate at which in-pit lakes will develop varies by pit, but all pits are anticipated to fill to their spill elevations within the time frames shown in Figure 5-5. Figure 5-6 and Figure 5-7 show the ultimate drainage patterns from each pit at the end of the Operation and during the Post-closure Phases, respectively. Further details on the open pits and mining activities and water management are provided in the Mine Operations Plan and Water Management Plan, respectively.

COFFEE GOLD MINE

Location of Open Pit Lakes Post-Closure



Legend

- Municipalities
- Waterbody
- Watercourse

N

1:20,000

0 400 800 1,200

Meters

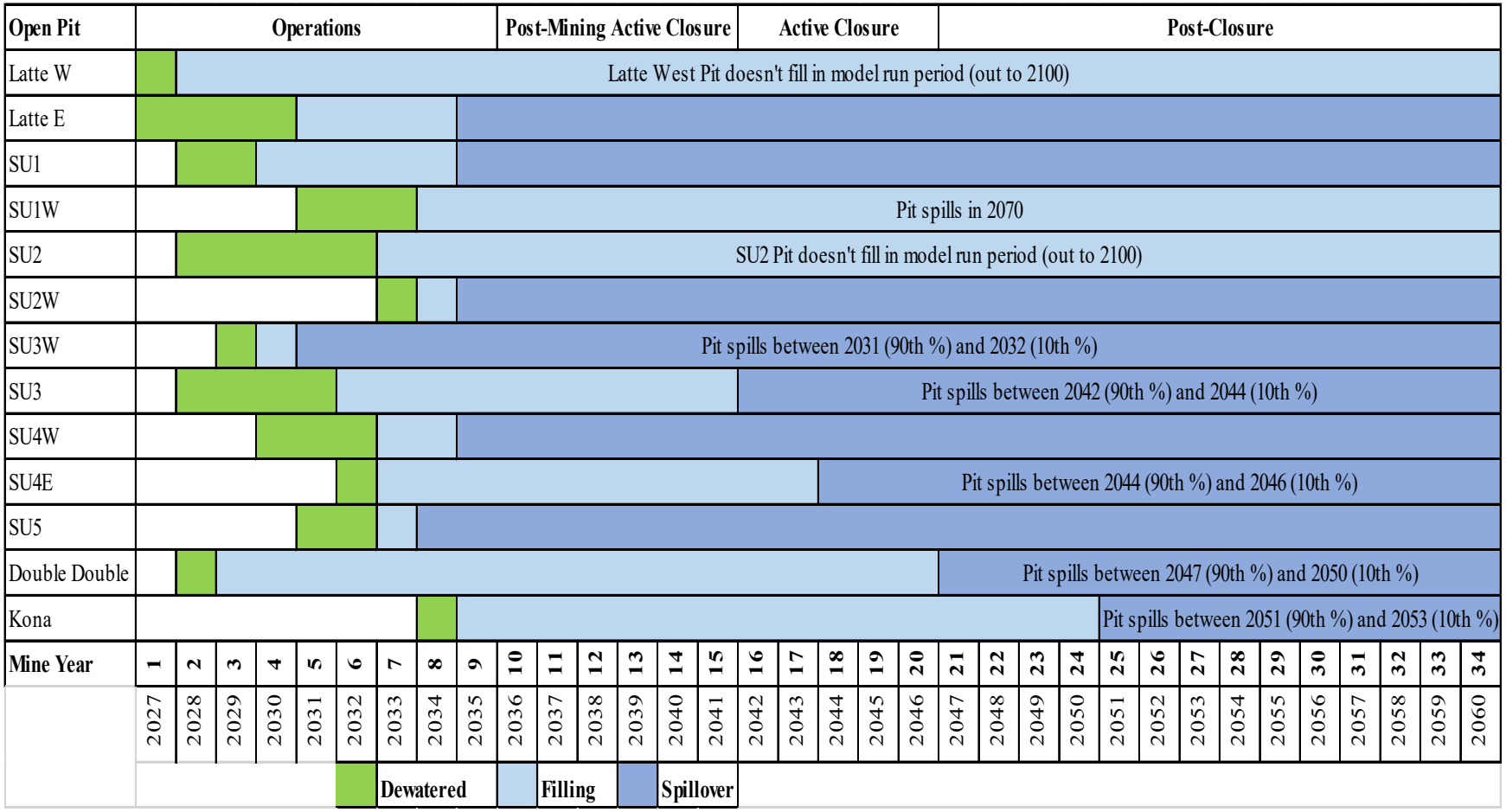
NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 5-4	Date: Aug 10, 2022	Drawn by: AL	Reviewed: SJ/DF

Newmont COFFEE

Path: P:\@Drafting\Coffee Gold\Drafting Figures\MxD\Post Closure_WUL.mxd



Note: Percentile ranges for predicted spill dates are provided where this is not predicted to occur in the same year by all model iterations.

Figure 5-5 Open Pit Dewatering Schedule and Predicted Years to Spillover Elevation

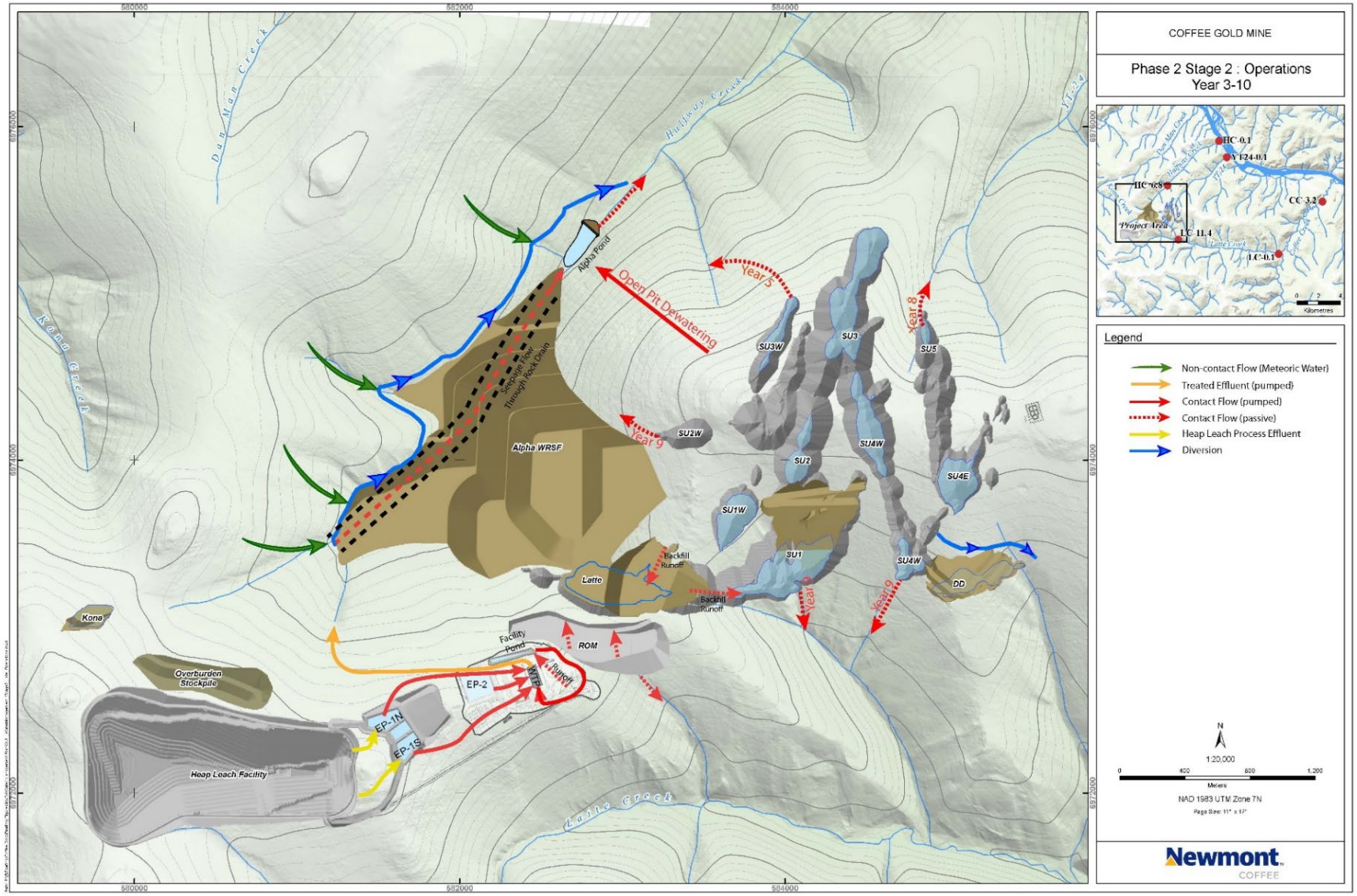


Figure 5-6 Schematic of Predicted Open Pit Drainage Pattern – End of Operation Phase

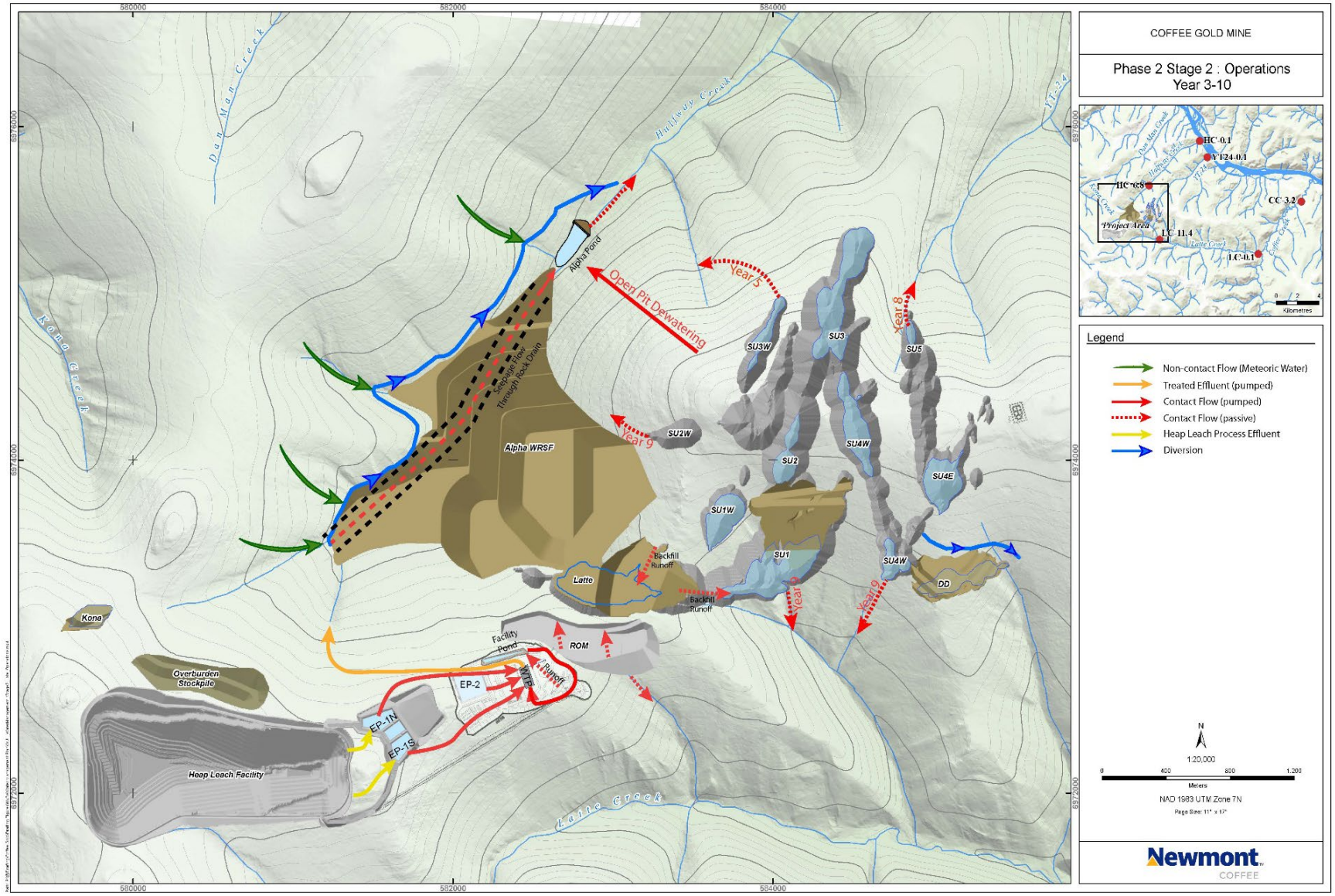


Figure 5-7 Schematic of Predicted Open Pit Drainage Pattern – Post-closure Phase

5.3.1.1 Pit Stability and Bench Face Angles

While there are no Yukon regulations regarding pit slope designs, Northwest Territories Mine Health and Safety Regulations (15.95) (SNWT 1995) state that each catchment berm shall be designed so that its final width will not be less than 8 m. The design bench width will be 8.5 m in all areas, exceeding the minimum criteria. Overall slope stability analyses were completed in 2015, with a supplemental pit slope evaluation completed in 2019 (Appendix 5-A). The analysis considered both global and bench-scale failures[10] and the recommended bench face angles are as follows:

- Supremo Pit - Benches in the Supremo Pit are not anticipated to be significantly affected by structurally controlled instabilities due to the north-south orientation of the pit. As such, a maximum achievable bench face angle of 75° was estimated for Supremo Pit based on standard operational constraints (further defined in Appendix 5-A).
- Latte and Double Double Pits - The stability of benches on the north pit wall in each pit will likely be controlled by dominant southerly (inward) dipping foliation discontinuities. The analyses indicate a maximum achievable bench face angle of approximately 65° for the north pit walls. Based on operational considerations, south and end pit wall benches are not anticipated to be governed by geologic structure controls and are estimated to have a maximum achievable bench face of 75°.
- Kona Pit - Benches on the west Kona Pit wall have a slightly higher probability of structurally controlled instabilities fostered by a moderately east (inward) dipping joint set. The analyses indicate a maximum bench face angle of approximately 70° is achievable on the west wall. Based on operational constraint, the other pit walls are estimated to have a maximum achievable bench face of 75°.

The Alpha WRSF, soil and ROM stockpiles, and in-pit backfill are currently designed to fall within the Moderate Consequence and High Confidence categories based on the “Guidelines for Mine Waste Dump and Stockpile Design” (Hawley & Cunning, 2017). Corresponding minimum recommended Factors of Safety (FoS) are 1.2 to 1.3 for static and 1.0 to 1.05 for pseudo static loading conditions according to the guidelines. Additional information regarding the FoS design acceptability criteria is provided in the MOP.

[10] A global failure is considered to occur relatively deep through the rock mass and is of sufficient scale to impact high inter-ramp and/or overall slopes. Bench scale failures typically involve only one or two bench levels in the pit and can be described as block or wedge-type failures involving the translation of a block of rock delineated by one or more structural features, such as minor discontinuities or faults.

5.3.2 Alpha Waste Rock Storage Facility

Over the LOM, a total of 300 Mt to 330 Mt of waste rock will be produced and transported to either the permanent Alpha WRSF in the headwaters of the Halfway Creek watershed, backfilled to the open pits or used for site construction purposes (Table 5-4). Although the majority of waste rock from the open pits is planned to be deposited in the WRSF, some suitable waste rock will be used in the construction of mine site infrastructure (e.g., site roads, sedimentation embankments, water management structures, laydown areas, heap leach pad and associated ponds).

Table 5-4 Estimated Annual Waste Allocations by Destination

Destination (Mt)	Y- 1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Total
Alpha WRSF	14.4	30.1	37.5	26.0	30.3	26.8	26.5	26.2	17.8	3.2	**238.8**
Alpha WRSF - waste from Kona	-	-	-	-	-	-	-	-	0.7	2.1	**2.8**
In-pit Backfill (LA, SU, and DD)	-	-	-	12.5	6.3	8.3	9.0	9.0	7.0	3.0	**55.0**
In-pit Backfill (Kona)	-	-	-	-	-	-	-	-	-	2.0	**2.0**
TOTAL	**14.4**	**30.1**	**37.5**	**38.5**	**36.6**	**35.1**	**35.5**	**35.2**	**25.5**	**8.3**	**298.7**

The Alpha WRSF will be located on the southeastern slope of the Halfway Creek drainage basin (Figure 1-2). Both the west facing slope below the east side of the ultimate Alpha WRSF, and the southeast-facing slopes below the northwest side of the ultimate Alpha WRSF are interpreted to be ice-poor. The area ranges from permafrost-free terrain on predominantly south-facing slopes to perennially ice-poor frozen ground on slopes with less southern exposure (Section 4.1.5). A tributary valley on northeast-facing slopes were interpreted to be underlain by moderately to ice-rich permafrost with visible excess ice.

The organic layer within the Alpha WRSF footprint will be left in-place to preserve permafrost, except where foundation soil conditions may require removal to bedrock prior to facility development (will be determined by the results of further geotechnical investigations and design studies). The Alpha WRSF will have an estimated capacity of 250 Mt and a total footprint of approximately 210 hectares. Construction of the Alpha WRSF will begin during pre-stripping and will continue until the end of the Operation Phase (Year 9).

The Alpha WRSF will be constructed with primarily 40 m high benches or lifts with a 60 m wide safety berm left on each lift, with progressive regrading during the Operation Phase to achieve final overall slope angles of 3.0H:1V. The slopes of the WRSF are not planned to be re-shaped at the end of mine life. The lowest topographic point of the dump will be 815 masl, and the highest point will be an elevation of approximately 1,150 masl, although the final configuration will be subject to minor revisions during detailed design. The maximum height of waste will be 350 m.

Due to the coarse particle size of stored waste rock material, the Alpha WRSF is anticipated to be free-draining, meaning that water will pass through the waste rock without buildup of significant pore water pressures. For the purposes of effectively managing water, a rock drain will be developed beneath the Alpha WRSF to convey runoff from the upper portion of the Halfway Creek catchment, meteoric water infiltrating through the WRSF, and groundwater discharge to the Halfway Creek channel covered by the WRSF. Where appropriate, surface water will be managed by a series of diversion channels located around

the Alpha WRSF. Section 5.3.11 provides additional information on the rock drain and diversion channels associated with the Alpha WRSF. Further details regarding the Alpha WRSF, including layout and cross-sections, are provided in the WROMP.

5.3.2.1 Alpha WRSF Geotechnical Design Criteria

Newmont will ensure that each WRSF and stockpile is constructed to the appropriate geotechnical design criteria. The geotechnical design criteria for the Alpha WRSF were selected based on guidelines from the British Columbia Mine Waste Rock Pile Research Committee (1991) and experience of the technical experts responsible for the design. The WRSF will be designed to meet or exceed the acceptable design criteria for short-term conditions during operations and long-term closure.

The Alpha WRSF, soil and ROM stockpiles, and in-pit backfill are currently designed to fall within the Moderate Consequence and High Confidence categories based on the “Guidelines for Mine Waste Dump and Stockpile Design” (Hawley & Cunning, 2017). Corresponding minimum recommended FoS are 1.2 to 1.3 for static and 1.0 to 1.05 for pseudo static loading conditions according to the guidelines. Additional information regarding the Alpha WRSF FoS design acceptability criteria is provided in the WROMP.

5.3.3 Stockpiles

5.3.3.1 Frozen Soil Storage Area (FSSA)

Upon excavation, frozen soils will be segregated by type (defined primarily by ice content) to permit recovery of materials for use in reclamation activities. Ice-rich soils, those soils containing more than 15% visible ice, will be stored in the FSSA located on the east side of the Alpha WRSF. As necessary, a small berm will be constructed around the perimeter of the FSSA to provide initial containment and filtering. Eventually all soils placed in the FSSA will be contained by waste rock placed around it as mining progresses. Based on the current material balance (see Appendix 2-I), it is expected that frozen soil will be co-disposed with waste rock in the Alpha WSRF in thin horizontal lifts. Further details regarding the FSSA, including sizing of the FSSA stockpiles and frozen material management, are provided in the WROMP.

5.3.3.2 Soil and Overburden Stockpiles

The Project site will have five temporary stockpiles which will be used for stockpiling material until it is needed for site reclamation and revegetation activities. The stockpiles will be located immediately north of the heap leach pad, and topographically above the Alpha WRSF, with slope angles of approximately 10° to 12°. During mine site construction and over the course of mine operations, overburden material, including organic overburden and mineral overburden, is expected to be removed from the footprints of the four open pits, the HLP, site infrastructure pads and portions of the WRSF footprints, and placed in the soil stockpiles, if suitable as reclamation material.

Material deemed suitable for reclamation purposes is currently assumed to include the upper organics layer and upper silt layers plus 200 mm of the lower gravel layer. These materials, with *in-situ* thicknesses ranging from approximately 1.3 m to 2.7 m across the Mine Site, are not anticipated to be ice-rich. A soil salvage program will be implemented during construction and operations to segregate the organic overburden and mineral overburden to the extent practical to provide suitable material for reclamation. Soil salvage program details are provided in Section 7.9.6. For details on the mine site material balance including sources of

material and estimated thicknesses and volumes, refer to Section 7.10. The total volume of material to be stored is estimated to range from 2.6 Mm^3 to 2.8 Mm^3.

The soil stockpiles have been designed with a cumulative footprint of 35.9 ha and a maximum capacity of 5.1 Mm^3 with side slopes at the angle of repose (approximately 1.7H:1V). A slope stability assessment of this design is provided in Appendix 5-B. The stockpile area is sufficient to hold the current estimated 2.6 Mm^3 to 2.8 Mm^3 of suitable reclamation material to be stripped from the site, assuming a 15% bulking factor, as well as up to approximately 600,000 m^3 of ice-poor frozen soils (i.e., soils that contain less than 15% visible ice), if required. Stored material will be used progressively starting in Year 2 for mine reclamation purposes. Further details regarding the soil and overburden stockpiles are provided in the WROMP.

5.3.3.3 Run-of-Mine Stockpile

The ROM stockpile will be located directly east of the primary crusher and will operate over the entire mine life starting in pre-production. The ROM stockpile foundation will be on mostly permafrost-free southeast- to east-facing slopes near the ridgetop that dip 12° to 19° towards Latte Creek.

Newmont will ensure that the ROM stockpile is constructed to the appropriate geotechnical design criteria. The Alpha WRSF, soil and ROM stockpiles, and in-pit backfill are currently designed to fall within the Moderate Consequence and High Confidence categories based on the “Guidelines for Mine Waste Dump and Stockpile Design” (Hawley & Cunning, 2017). Additional information regarding the ROM Stockpile FoS design acceptability criteria is provided in the WROMP.

The ROM stockpile will be constructed on top of a graded pad that will require approximately 3.9 Mm^3 of waste rock material to construct. The graded pad will have a maximum height above the original ground of approximately 50 m at the southeast corner and the ROM material will be stacked on top of the pad to a maximum height of approximately 30 m. A 20-m-wide safety berm or offset will be left between the crest of the ROM waste rock foundation pad and the toe of the ROM stockpile along the south side where the pad height will reach its maximum of 50 m. This will result in a maximum overall slope angle of approximately 2.0H:1V. A slope stability assessment of this design is provided in Appendix 5-B.

The stockpile is designed with a maximum capacity of 3 Mt within a footprint of approximately 13 ha. The amount of ROM material stored at the facility will fluctuate, with peak volumes expected to occur during the winter months of January to March when the crusher is not running. The ROM stockpile will also be used to temporarily store ore produced during the pre-production period in Year -1 until the HLP is ready to receive crushed ore, as well as to smooth ore feed and grade to the crusher (e.g., ore will be stored on the ROM stockpile when the mining rate or when ore feed exceeds the throughput rate of the crusher).

All ore stored on the pad will be processed during the Operation Phase. Seepage from the ROM stockpile will drain towards Halfway Creek and Alpha Pond. Further details regarding the ROM stockpile, including layout and cross-sections, are provided in the WROMP.

5.3.4 Ore Crushing Facilities

Ore crushing facilities, located south of Latte Pit, and associated equipment will include a haul truck apron, mechanically stabilized earth (MSE) wall, dump hopper, primary and secondary crushing plants, secondary

screening plant, and lime silo, a 10,000-tonne capacity crushed ore stockpile, as well as an interlinking system of conveyors. The crushed ore stockpile will provide approximately 10 hours of material storage for loading into haul trucks and transportation to the HLP. These facilities are located in an area with bedrock relatively close to the surface, and will be placed on mat foundations and slabs, with equipment and column loads supported on pads and pedestals.

ROM ore will be trucked from the open pits to the crushing plant, where it will be reduced to produce the target crush size of 80% of the product passing (P_{80}) of 50 mm. The process flow diagram for primary and secondary crushing is shown in Figure 5-8. The crushing plant and haul trucks will operate for a minimum of 275 days per year (contingent upon operational conditions and pad thermal balance). During the coldest part of the year (January through March) crushing and heap leach pad loading activities will be suspended. Heap leach loading will depend on the seasonal conditions each year and the amount of heat available in the HLP for processing. If conditions allow, crushing may be performed year-round. When the crushing plant is not operational, ROM ore will be stored in the ROM stockpile (Section 5.3.3.3).

Crushed rock will then be conveyed to the crushed ore stockpile via truck or overland conveyor. To aid in dust suppression at the ore crushing facility, dust mitigation between the feed and discharge ends of the screens, crushers, and feeders have been incorporated into the design. All conveyors will be covered between crushing and screening stations. Further details regarding the ore crushing and process facilities are provided in the Heap Leach and Process Facilities Plan.

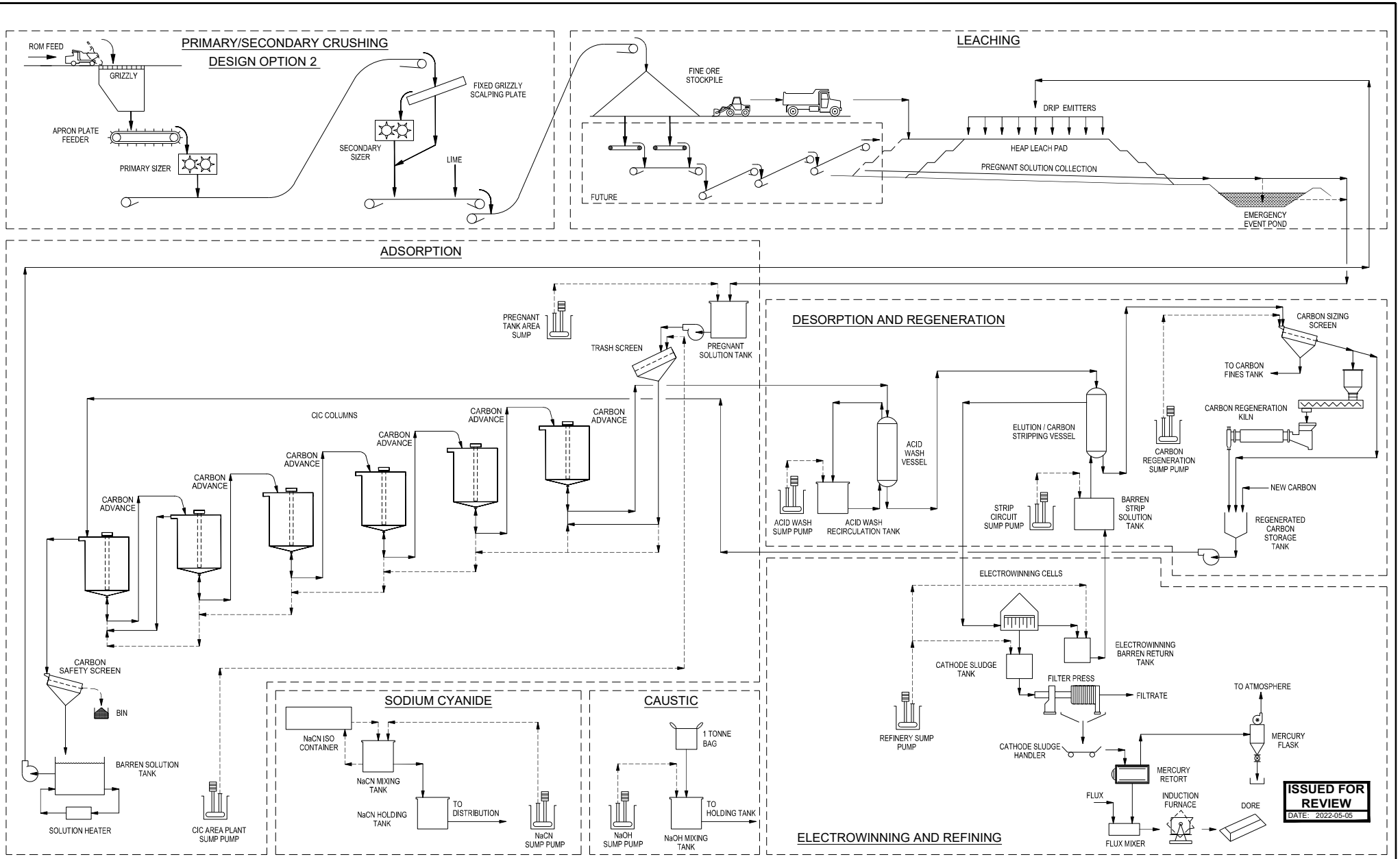


FIGURE 5-8 PROCESS FLOW DIAGRAM FOR ORE CRUSHING, LEACHING, PROCESSING, AND REFINING

G:\Data\Giffen Projects\004 - JDS Energy & Mining\21-100 - Coffee Closure Plan\03 - Engineering\G - Layout\Drawings\NMCCOF03C-G-GAD-0005_Process Flow Diagram.dwg May 05, 2022 - 12:15pm

REFERENCE DRAWINGS

NO.	DWG NO.	TITLE

NOTES:

DRAWING REVISION

NO.	DESCRIPTION	DATE
A	ISSUED FOR INTERNAL REVIEW	2022-03-29
B	ISSUED FOR EXTERNAL REVIEW	2022-05-05

	NAME	DATE
DRAWN BY:	JDS	2022-03-29
DESIGNED BY:	JDS	2022-03-29
CHECKED BY:	DJ	2022-03-29
APPROVED BY:		

JDS ENERGY & MINING PREPARED THIS DOCUMENT FOR THE EXCLUSIVE USE OF THE CLIENT. ANY USE BY THIRD PARTIES IS AT THEIR OWN RISK.

Newmont COFFEE

JDS Energy & Mining Inc.

COFFEE MINE PROJECT
RECLAMATION & CLOSURE PLAN

PROCESS FLOW DIAGRAM FOR ORE CRUSHING, LEACHING, PROCESSING, AND REFINING

DWG NO. NMCCOF03C-G-GAD-0005 REV. B

5.3.5 Heap Leach Facility

The HLF will be located at the top of a ridge in the headwaters of the Latte Creek and halfway Creek watersheds. The HLF will consist of a conventional HLP, three Event Ponds, a Rainwater Pond, solution distribution piping (for delivery of barren solution to the heap), and collection piping (to convey gold-bearing solution to the event ponds and process plant). The general arrangement of the HLF is shown in Figure 5-9 and key operating criteria for the HLF are summarized in Table 5-5.

The design basis and processes specific to the HLP, water collection and storage infrastructure, and heap leaching and rinsing processes are described below. The Heap Leach Pad Engineering Report for the HLF and supporting appendices (containing design criteria, engineering drawings, technical specifications, hydrology and hydraulics, stability analyses, water balance and storm event runoff evaluations, and calculations) are provided in the Heap Leach and Process Facilities Plan. The design of the HLF will evolve as the Project advances and additional studies are completed to inform detailed design.

The designs for the HLP incorporate a single-side textured 2.0 mm linear low-density, polyethylene (LLDPE) liner. A geosynthetic clay liner (GCL) will be used in lieu of a 300mm thick layer of compacted low permeability material. GCL will be placed underneath the geomembrane and will provide equal or greater protection than 300 mm material having a saturated hydraulic conductivity of no greater than 5x10E-9 cm/sec. Additional details regarding the design criteria for the heap leach pad are provided in the Heap Leach and Process Facilities Plan.

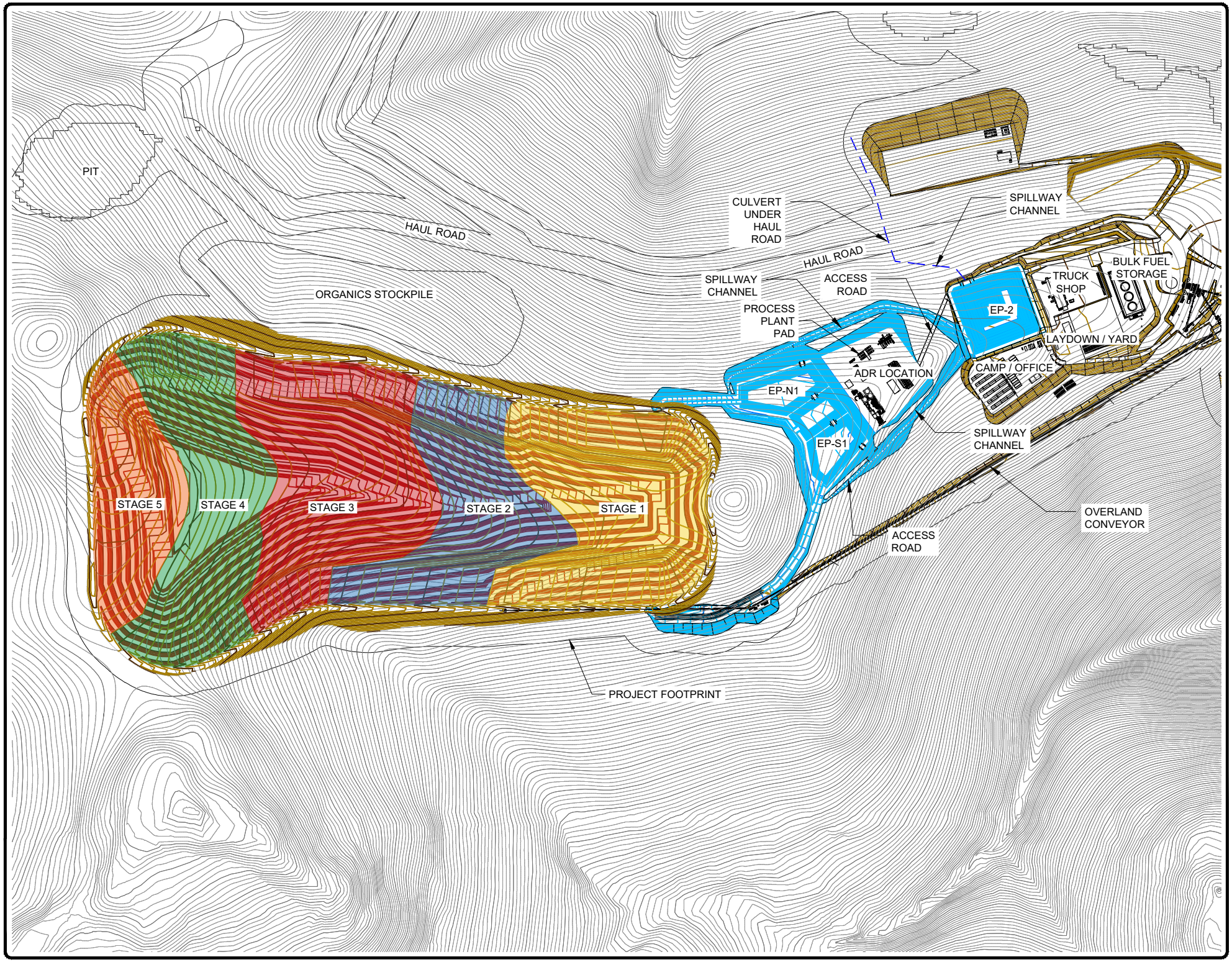

PIT
HAUL ROAD
ORGANICS STOCKPILE
CULVERT UNDER HAUL ROAD
SPILLWAY CHANNEL
HAUL ROAD
SPILLWAY CHANNEL
ACCESS ROAD
PROCESS PLANT PAD
EP-2
TRUCK SHOP
BULK FUEL STORAGE
LAYDOWN / YARD
ADR LOCATION
CAMP / OFFICE
EP-N1
EP-S1
SPILLWAY CHANNEL
OVERLAND CONVEYOR
ACCESS ROAD
STAGE 5
STAGE 4
STAGE 3
STAGE 2
STAGE 1
PROJECT FOOTPRINT

Table 5-5 Heap Leach Facility Key Operating Parameters

Ore Preparation	Crush to P80 = 50 mm No Agglomeration
Ore preparation	Crush to P80 = 50 mm
	No agglomeration
Ore stacking	Truck dumping Conveyor stacking Average annual stacked tonnage: 6.7 Mt/yr 275 days/year (April 1 – Dec. 31, subject to ambient conditions during operations) 67 Mt design heap capacity 69 Mt maximum heap capacity
Heap geometry	~115 m maximum heap height 10 m nominal lift thickness Angle of repose of each lift 10 m to 14 m wide benches between lifts 2.5H:1V or flatter overall toe-to-crest heap slope
Solution irrigation	10 L/m^2/hr 1,100 m^3/hr nominal 365 days per year
Heap rinsing	Solution recirculated for rinsing in 10 areas of the HLP, then controlled draindown.
Barren solution heating	Increase gold-bearing solution temperature to minimum 8° C at process plant (to provide at least 6° C at drip emitters)
Pond Capacities	Total available storage volume at freeboard (at crest): EP-1N: 112,791 m^3 (122,184 m^3) EP-1S: 90,312 m^3 (98,697 m^3) EP-2: 339,819 m^3 (376,942 m^3) Rainwater: 53,016 m^3 (59,326 m^3)
Raincoats	Identified as an opportunity in operations to allow for more flexibility in water quality management but are not required from a flow quantity perspective

Note: a. The capacities of the event ponds include seasonal water accumulation, full heap drainage, the 24-hour PMP storm event, and seasonal solution accumulation.

5.3.5.1 Heap Leach Pad

The heap leach pad will be a conventional, relatively level pad with an ultimate footprint of 1 Mm^2, constructed directly on bedrock or structural fill after the removal of overburden and ice-rich material by grading the local terrain and using competent waste rock for fill that supports a multi-lift, free-draining 67 Mt heap. Major grading of the first stage of the pad area is proposed for Year –2 with the final grade completed in Year –1. The HLP will be developed progressively in five stages over the LOM.

The system consists of two layers of synthetic liners with leak detection below and a hydraulic head control or drainage layer on top of the liners. The leach pad liner system will be a 2.0 mm LLDPE geomembrane over a reinforced GCL liner. The bottom side of the LLDPE liner will be aggressively textured to provide a close bond with the GCL.

Horizontal piezometers will be located in each of the stages to allow measurement of the phreatic surface. A layer of overliner drain fill (ODF), consisting of the engineered specified manufacture rock meeting hydraulic conductivity rates will be place at a depth directly over collection piping and liner for protection. In addition to the best practice QA/QC that is performed during installation of liner, a leak detection survey will be performed after the ODF is placed.

Ore will be transported to the HLP by 144-tonne trucks or radial stacking conveyors and stacked in 10 m lifts at the ore's angle of repose. Benches will be constructed between lifts to produce a 2.5H:1V or flatter overall toe-to-crest slope. Construction and operational stages for the HLP are summarized in Table 5-6. As the pad stages expand to the west, temporary interceptor ditches will be constructed to divert upgradient runoff from tributary areas that are composed of native soils. Information on the leaching and rinsing processes is provided in Section 5.3.5.

Table 5-6 HLP Stacking Metrics by Stage

Heap Leach Pad Stage	Construction Year	Cumulative Pad Stage Area (m^2)*	Pad Cumulative Capacity (Mt)	Heap Crest Elevation (masl)
Stage 1	Year –1	247,000	4	1,324
Stage 2	Year 1	429,000	15	1,350
Stage 3	Year 2	699,000	32	1,388
Stage 4	Year 4	921,000	50	1,392
Stage 5	Year 7	1,053,000	69	1,392

*Leach pad area within the HLF containment system. Does not include lined pond area.

5.3.5.2 HLF Surface Water Management

Conventional external ponds for events and clean water storage from precipitation runoff will be constructed as storage volume requirements increase, as determined by the leach pad area. Small embankment dams will be used to create four ponds: the south Event Pond 1 (EP-1S), north Event Pond 1 (EP-1N), Event Pond 2 (EP-2), and the Rainwater Pond (Figure 5-9).

The HLF Water Balance Model resulted in two distinct inflows for EP-2; therefore EP-2 is segregated into two ponds, one for containment of process solution pond and one for direct precipitation and EP-1N and EP-1S overflow only. The event ponds containing solution will be lined with two high density polyethylene (HDPE) geomembrane liners, separated by a drainage layer and underlain by a GCL. The portion of EP-2 for containment of direct precipitation as well as the rainwater pond will be single lined.

Water will be routed from the heap leach pad to the event ponds via the north and south event and rainwater channels. The Event Ponds are designed to contain a combination of upset conditions including:

- Heap draining during an extended power or pumping outage
- Extreme precipitation and freshet events
- Cumulative water storage during wet years or temporary shut-downs.

The Rainwater Pond is designed to receive water from the interior channel of both the north and south perimeter channels once a channel divider is installed. The primary purpose of this interior channel is to receive solution from precipitation if raincoats were installed.

The event ponds and the rainwater pond will be constructed in Year –1 to provide containment for the drainage the HLP. The approximate capacities of the ponds are:

- EP-1N: 112,791 m^3
- EP-1S: 90,312 m^3
- EP-2: 339,819 m^3
- The Rainwater Pond: 53,016 m^3.

Normal operating volumes in Event Ponds EP-1N and EP-1S will increase over time as the lined footprint of the HLP increases and the system receives more and more meteoric water. Event Pond levels are expected to peak during Stage 3 as the lined footprint grows to nearly three times what it was in Stage 1.

All ponds are sized to contain the following cumulative volume: the runoff from a PMP, full heap drainage during a power outage or pump failure, and seasonal water accumulation. Stormwater conveyance outside the HL footprint otherwise known as interceptor ditches were designed to convey the 100 year 24-hr event. A leak detection sump will be installed in the lowest corner of each pond.

Further details regarding HLF surface water management are provided in the Heap Leach and Process Facilities Plan and the Water Management Plan.

5.3.5.3 Heap Leaching Process

The north and south halves of the leach pad will be separated hydraulically, with the south half sloping and draining to the southeast and the north half sloping and draining to the northeast. The design also includes hydraulic separation of the leach solutions by cell (approximately every 100 m of pad in the east-west or long axis direction) and by stage (Stages 1 through 5). Each cell will be separated by a drainage ditch or berm, preventing solution from one cell from entering the adjacent cell. The stages will be separated in a similar way but with a larger berm to provide more definitive separation. Because there is always some lateral spreading of solution within the heap during irrigation, there will be some solution cross over from a cell under irrigation to an adjacent cell, but this is expected to be limited to a horizontal distance of under half the width of a cell.

Heap leach ore processing will entail the use of dilute cyanide solutions under pH conditions ranging between pH 9 and 10.5. Except for the addition of make-up water, the leaching process circuit is a closed circuit. Barren solution will be irrigated onto the heap using drip irrigation, with each lift irrigated for nominally 45 days before the subsequent lift is stacked and leached. Gold-bearing solution will be collected into the collection piping network at the base of the HLP above the liner system and will flow to the ADR (adsorption, desorption, and recovery) process plant by gravity for gold recovery. During upset conditions solutions are directed through an automatic overflow system or through manual control by the heap leach operators to the event ponds. Any process solution accumulated in EP-2 will be pumped to the process plant and recirculated to the heap or treated in the water treatment plant and discharged to the Alpha Pond via the Alpha rock drain. A secondary option during upset conditions in the ADR plant is to move solution to the event ponds EP-1N and EP-1S by activating control valves.

Outside makeup will not frequently be required. The highest demand for make-up water will occur during winter months when solution storage ponds have been mostly emptied. Each pad stage will be separated from the adjacent stage by a temporary ditch or berm to divert upgradient runoff from tributary areas that are composed of native soils.

While the dissolution of gold is the primary chemical process occurring during cyanide leaching, other metals are liberated during the leaching process, both as a result of complexation reactions with cyanide (e.g., Cu-CN, Cd-CN, Zn-CN) and increased solubility under elevated pH conditions (e.g., As and U). In addition, natural degradation of CN in situ within the heap leach results in elevated concentrations of nitrogen species in heap leach solutions. Development of estimates of HLF solutions is described in detail in the Coffee Project Geochemical Source Term Report (Appendix 7-A).

Solution removal and active treatment is required by Year 2 and continues throughout operations into early closure. Once the heap leach facility has completed closure activities including cover placement and seepage volumes have decreased, seepage waters will be directed to semi-passive treatment using reclaimed event ponds. Estimates of heap leach solution chemistry have been developed from site-specific metallurgical testwork performed on Coffee ores and from analogue gold heap leach operations, including early phase barren solution chemistry from the Eagle Gold Project, YT. Early and late phase HLF solution predictions are summarized in Table 5-7.

Table 5-7 Early and Late Phase HLF Solution Chemistry Estimates

Parameter	Units	Early Phase HLF Solution	Later Phase HLF Solution
pH	s.u.	9 to 10	8.4
$N\text{-}NH_3$	mg/L	72	0.06
$N\text{-}NO_3$	mg/L	50	307
$N\text{-}NO_2$	mg/L	1	1.9
Cl	mg/L	300	123
Sulphate	mg/L	1100	2516
Total Alk	$mg/CaCO_3/L$	600	87
WAD-CN	mg/L	130	0.2
TDS	mg/L	2750	4100
Al-D	mg/L	0.09	0.2
Ag-D	mg/L	0.00045	0.00125
As-D	mg/L	5.0	2.0
Ca-D	mg/L	300	350
Cd-D	mg/L	0.0036	0.00013
Cr-D	mg/L	0.008	0.014
Cu-D	mg/L	2	0.014
Co-D	mg/L	0.5	0.25
Fe-D	mg/L	2.3	0.5
Hg-D	mg/L	0.005	0.00026
Mg-D	mg/L	2	155
Mn-D	mg/L	0.27	0.06
Mo-D	mg/L	0.125	0.105
Na-D	mg/L	580	1168
K-D	mg/L	8	11
Ni-D	mg/L	0.019	0.006
Pb-D	mg/L	0.0002	0.0013
Sb-D	mg/L	0.09	0.5
Se-D	mg/L	0.007	0.005
U-D	mg/L	0.1	0.685
Zn-D	mg/L	0.7	0.052

From Year 10 through Year 15 no additional ore stacking will occur, but irrigation of the heap will continue for gold production and rinsing. Upon completion of active leaching operations, solution management will be required until such time as the closure cover is established, and clean runoff is diverted off the facility. Once the solution draindown rate falls to a level that can be safely and passively contained in the post-closure event pond(s), active solution management can cease (i.e., no pumping).

The results of heap draindown water balance modelling is provided in the Heap Leach and Process Facilities Plan. The model tracked the dewatering of the heap during the Operation and Closure Phases. Predictions incorporated solution application and irrigation rates, dewatering rates, and the site synthetic

climate record (including precipitation, temperature, evaporation) to track heap system storage and volumetric water contents on a monthly basis.

Progressive closure of the HLP is currently anticipated to begin in Year 10, with rinsing starting in 10 recirculation areas as described in the Heap Leach and Process Facilities Plan. A description of HLF closure including rinsing activities is provided in Section 7.3.1.

Suitable final effluent water quality conditions will be achieved prior to final release to the environment through a combination of measures that are further described below, including:

- Chemical stabilization of the heap through recirculation (rinsing) with barren solution until the chemistry of the heap effluent reaches approximate equilibrium with the rinse solution
- Construction of low infiltration covers to limit infiltration and reduced heap seepage volumes
- Provision to implement (if necessary) passive treatment using permeable reactive barriers (PRBs) technology for “polishing” of heap solutions within event ponds.

5.3.5.4 Water Treatment

Operation of the heap leach facility is projected to generate a positive water balance with the need to manage and remove (e.g., discharge) excess solution to maintain adequate storage in the event ponds system (i.e., Event Storage Requirement (ESR)) throughout operations and early closure of the heap leach facility. The most important solution removal strategies include pumping of water to active treatment during both operations and early closure and the release of net infiltration water at closure through semi-passive treatment.

Beginning in about Year 2, the HLF is expected to produce surplus water with elevated concentrations of parameters indicated above. A water treatment plant will be constructed by Year 1 and commissioned in Year 2 or earlier to ensure that there is on-site water treatment capability in advance of surplus water conditions.

The heap leach WBM (Forte 2022) indicates solution removal needs to commence in Year 2 to maintain ESR. The solution removal rates, and schedule utilized in the WBM to maintain ESR for operations and into early closure are:

- **25 L/s** (90 m^3/h) beginning in Year 2 through to Year 7. This is the maximum solution removal rate required during normal operations over this period to maintain the ESR
- **35 L/s** (126 m^3/h) from Year 7 to Year 16 is the max Solution Removal rate required to maintain the Event Storage Requirement Year 7 to Year 16
- **14 L/s** (50 m^3/h) beginning in Year 16 after cover placement is complete.

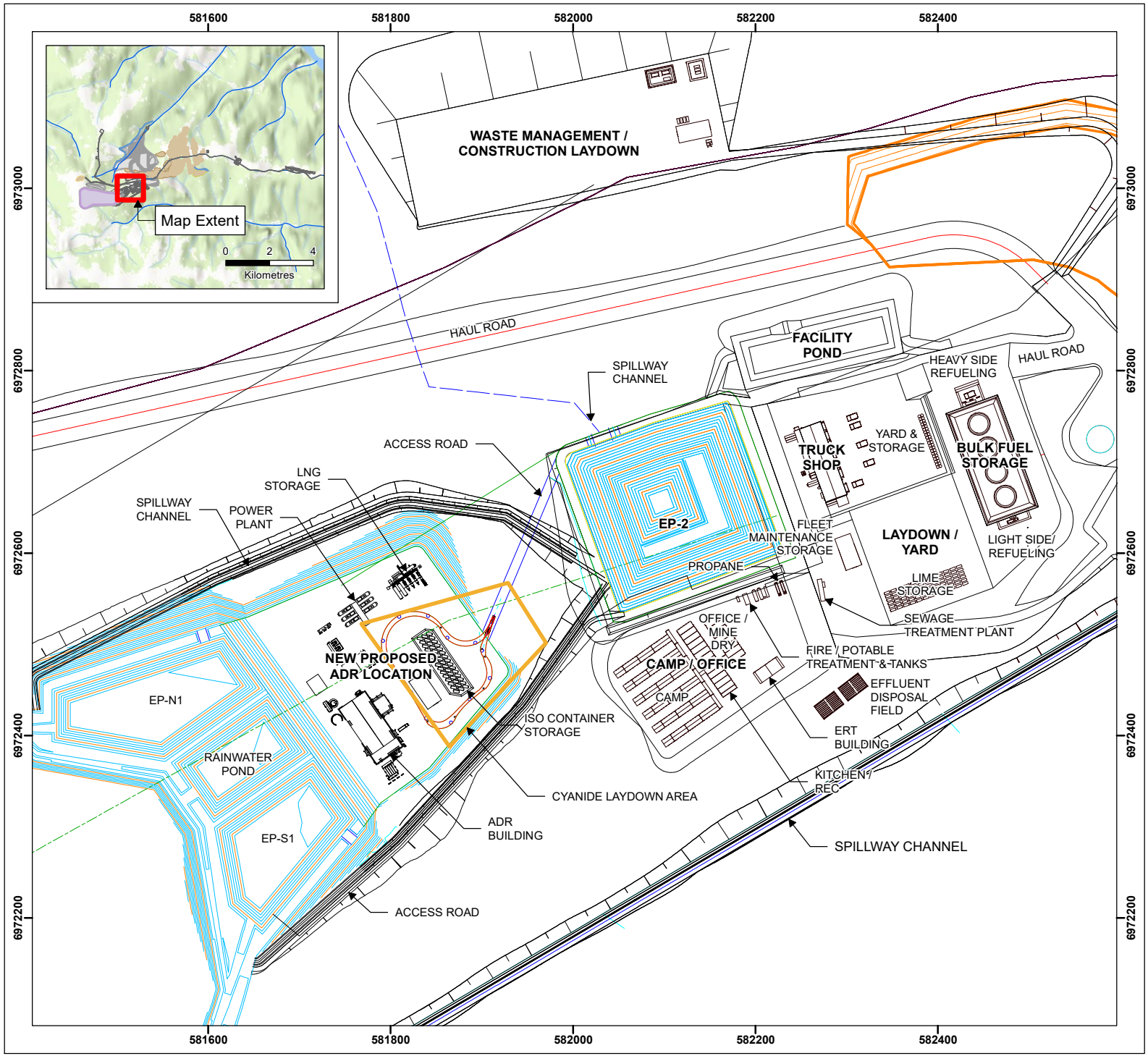
The duration of active water treatment through the WTP is unknown at this time. However, for the purposes of water quality modeling, active water treatment expected to operate up to Year 20 when Alpha Pond is decommissioned and five years following completion of HLF cover placement.

The proposed water treatment system and the results of bench-scale testing is described in the Heap Leach and Process Facilities Plan as well as in the Coffee Mine Conceptual Water Treatment Design for Permitting Report (Appendix 5-C). In summary, the proposed system is a multi-stage process including:

1. Flow Equilibration
2. Cyanide Destruction
3. Breakpoint Chlorination
4. Physico-Chemical Treatment
5. Membrane (UF/RO) Filtration
6. Solids Handling
7. Denitrification

5.3.6 Plant Site

Infrastructure at the Plant Site includes the process plant, reagent storage area, laboratory, truck shop and warehouse building, power plant, bulk fuel storage area, and an LNG storage facility (Figure 5-10). A summary of the Plant Site components is provided below, and additional information is provided in the General Mine Development Plan.



COFFEE GOLD MINE

Plant Site General Arrangement

Legend

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Inset Basemap: ESRI World Topographic Map

N

1:6,000

0 50 100 150 200 250

Metres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 5-10	Date: Nov 7, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MP\Cyanide\Fig4_1_10.3862_03_PlantSite_231107.mxd

5.3.6.1 Process Plant and Reagent Storage Area

The process plant will be located in a pre-engineered building adjacent to the HLF to minimize pumping and piping requirements for gold-bearing and barren solutions. To minimize the potential for differential settlement, the building will be founded on competent bedrock and/or engineered fill.

The external building dimensions will be approximately 33 m wide by 65 m long by 24 m tall (subject to final design refinement). The process plant building will house the barren solution, gold-bearing solution, raw water, and rinse water tanks, the ADR carbon process plant, electrowinning, a control room, and an office (Figure 5-11). Tank and column loads will be supported on pads and pedestals. The building will be equipped with a 10-t overhead crane for equipment maintenance, as well as dust control and fume extraction systems. Process reagents such as sodium hydroxide, hydrochloric acid, and anti-scalant solutions, as examples, will be stored within the building.

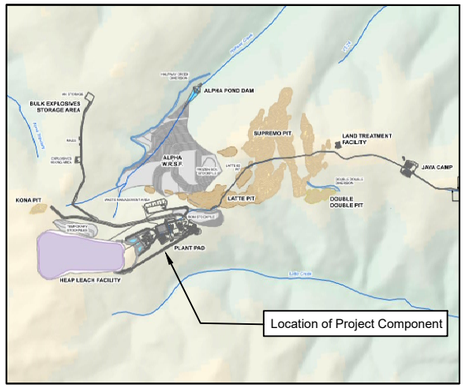
The process plant will have concrete walls for secondary containment around all tanks containing cyanide and other reagents (i.e., containment for minimum of 110% of the largest tank volume). Containment will also be provided around the acid wash, strip, and reagent mixing areas.

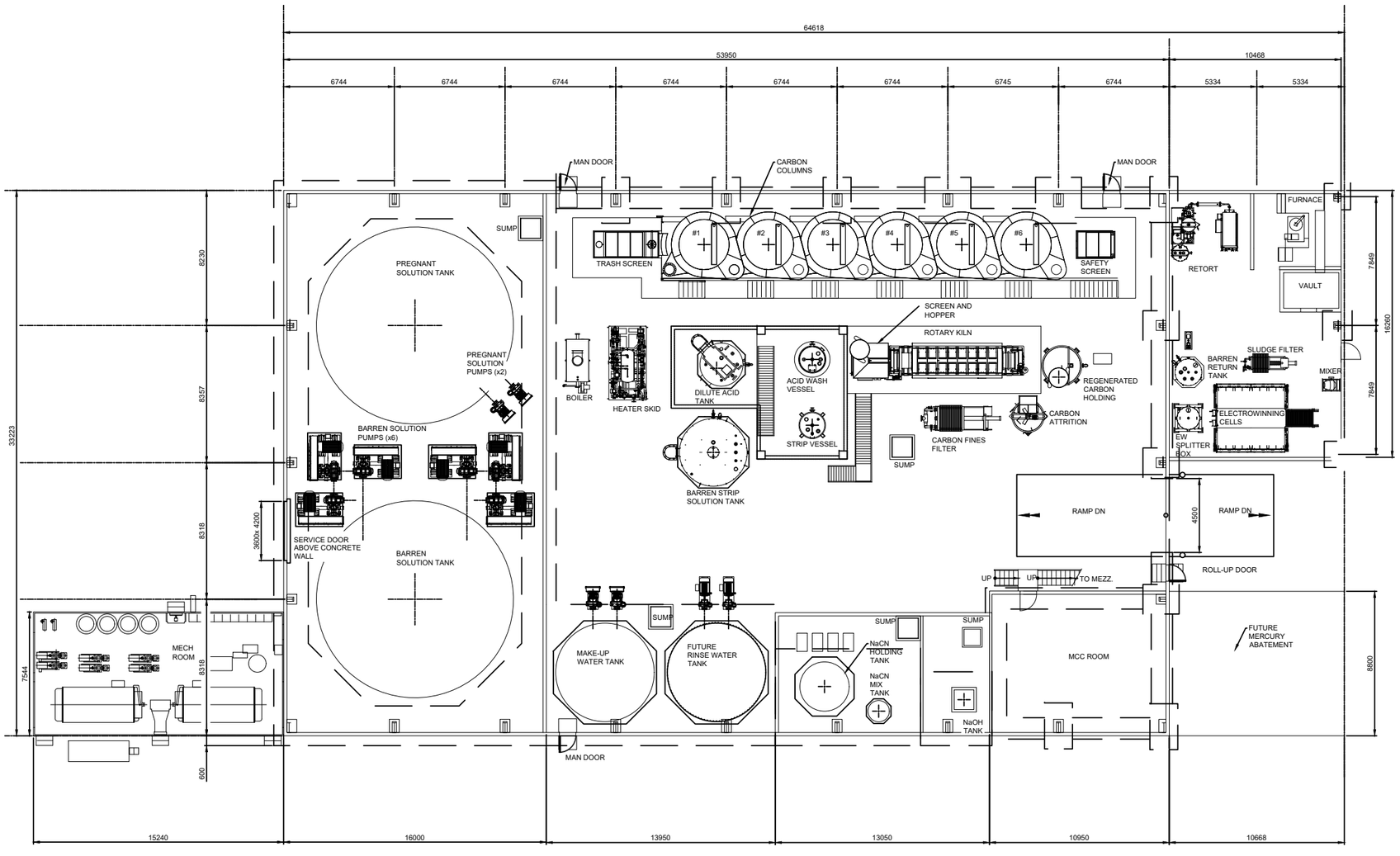
The process plant will be heated by a combination of waste heat from the power plant, along with heat captured from the barren solution boiler, located adjacent to the process plant building. The boiler is designed to heat the solution by a minimum 8°C to provide a minimum discharge temperature at the HLP drip emitters of at least 6°C; final thermal capacity will be determined during detailed design and early-stage operations. Redundancy for process plant heating will come from a truck shop bypass line that allows the truck shop to be isolated from the power plant waste-heat recovery loop. By isolating the truck shop, it will be possible to direct the heat to the process plant if the barren solution boiler is not operational.

As indicated above, gold extraction will utilize sodium cyanide heap leaching technology. Gold-bearing solution will be transported by pipe to the process facility where it will be processed via conventional gold recovery methods at an on-site ADR carbon plant. The end product of the ADR plant is poured doré bars, which will be shipped off-site by aircraft for further refinement.

COFFEE GOLD MINE

Process Plant Layout





PLAN
SCALE: 1:300

Legend

Notes

1. This figure is not intended to be a stand-alone document, but a visual aid to the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations descriped therein.
2. This is a re-creation of JDS drawing number 15VA0067-100-1400-005, project number 15VA0067.

1:300

0 5 10 15

Metres

Page Size: 11" x 17"

Figure 5.11	Date: Nov 7, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\15386\20\mxd\MPC\yardstiel\Fig5_5_v10360_03_ProcessPlant_231107.dwg

5.3.6.2 Laboratory

A small laboratory will allow for the testing of samples from exploration, mining, processing activities, as well as minor environmental testing (e.g., TSS monitoring from water samples). Environmental samples for major environmental testing will be sent off-site to an accredited laboratory for third-party analysis and reporting. The on-site laboratory will be equipped to perform sample preparation and assays by atomic absorption, fire assay, and cyanide soluble analyses. A metallurgical test work area will also be included for process optimization.

5.3.6.3 Truck Shop and Warehouse Building

A truck shop and warehouse will consist of six maintenance bays, one wash bay, and a warehouse. The truck shop complex will be approximately 1,670 m^2, with dimensions of approximately 43-m-long by 40-m-wide by 12-m-tall structural steel, pre-engineered building (subject to final design refinement). The facilities will be designed for repair and maintenance of mining equipment and light vehicles, as well as storage for spare parts, consumables, and other materials and equipment.

5.3.6.4 Power Plant

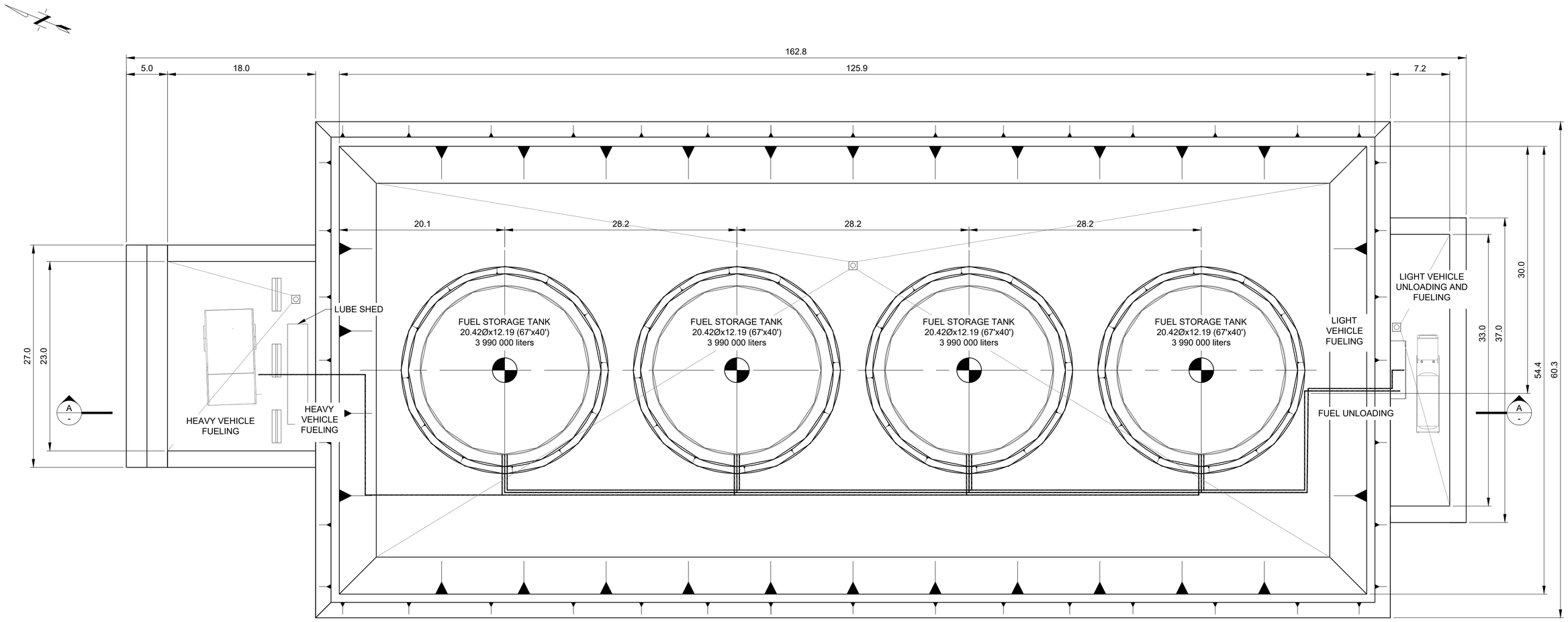
A single captive power plant will be installed to meet the electrical power demand necessary to support the Project. The power plant will be capable of generating 9 megawatts (MW) of electrical power will be installed with N+2 (4+2) redundancy to allow for reliable operations. Each generator will be 2.25 MW or larger and will be capable of burning both diesel and LNG fuels. Subject to final design and procurement, each generator will be prime-rated for 2.250 MW running at 1,800 revolutions per minute (rpm) and generating power of 4,160 volts (V). The peak gross power will be 9 MW (four operating generator sets (gensets) @ 100%; 4 x 2.25 MW). Power will be distributed throughout the Plant Site and to the crusher area at 4,160 V. There will be five distribution feeders, including two spare positions.

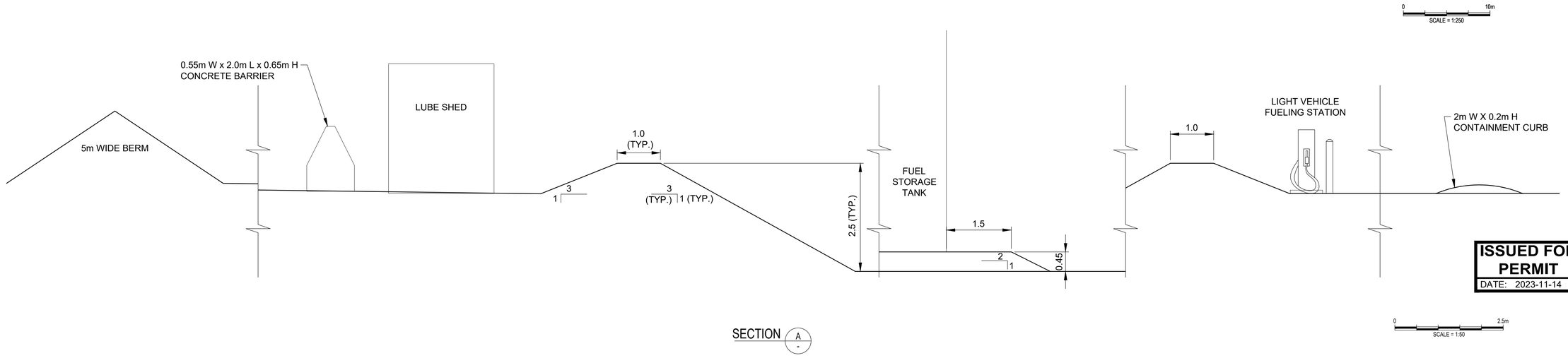
The power plant will be modular with all gensets interconnected. Each genset will be packaged in a walk-in, sound-attenuated enclosure that is constructed, assembled, and tested prior to shipment to site. The power plant will also include an electrical building.

Given the modular and expandable nature of the power plant three gensets will be mobilized in Year –2 to provide Construction-phase power. Two additional gensets will be added in Year –1 in advance of plant start-up, the rest of the gensets will be added in Year 1 to achieve the N+2 (4+2) configuration. However, should procurement opportunities arise, all gensets may be installed simultaneously. During normal power plant operation, genset waste-heat recovery units will be used to heat buildings. Additional temporary heating units will be installed at the camp and power plant, if required, to meet peak winter demands.

5.3.6.5 Bulk Fuel Storage

Four 4 million litre (L) diesel fuel tanks will be field-constructed within the bulk fuel storage area in Year -2. The general arrangement of the bulk fuel storage area and section details are provided in Figure 5-12. Additional infrastructure for tank filling and fuel dispensing infrastructure will be installed once tank construction is completed.





0 10m
SCALE = 1:250

SECTION A -

0 2.5m
SCALE = 1:50

ISSUED FOR PERMIT
DATE: 2023-11-14

NOTES:

REFERENCE DRAWINGS

NO.	DWG NO.	TITLE

DRAWING REVISION

NO.	DESCRIPTION	DATE
0	ISSUED FOR PERMIT	2023-11-14

	NAME	DATE
DRAWN BY:	JDS	2023-11-14
DESIGNED BY:	JDS	2023-11-14
CHECKED BY:	DJ	2023-11-14
APPROVED BY:		

JDS ENERGY & MINING PREPARED THIS DOCUMENT FOR THE EXCLUSIVE USE OF THE CLIENT. ANY USE BY THIRD PARTIES IS AT THEIR OWN RISK.

Newmont COFFEE

JDS Energy & Mining Inc.

COFFEE MINE PROJECT

GENERAL ARRANGEMENT
DIESEL STORAGE
PLAN
Figure 5-12

DWG NO. NMCCOF03C-G-GAD-0009

REV. 0

G:\Data\Giffen Projects\004 - JDS Energy & Mining_Archive\21-100 - Coffee Closure Plan\03 - Engineering\G - Layout\Drawings\NMCCOF03C-G-GAD-0009_Bulk Fuel Storage Area Plan and Sections .dwg Nov 14, 2023 - 8:38am

5.3.6.6 LNG Storage Facility

An LNG storage facility is proposed within the Plant Site. Two Type C LNG ISO-certified tanks rated for 116 psi will be used for storage. The facility will include an earthen impoundment to provide secondary containment for 110% of the maximum storage volume and to contain any spills that occur during offloading from the tanker truck to a storage tank.

5.3.7 Camp Site

The Camp Site consists of the camp facilities and dormitories as well as the mine dry and office complex, emergency response team building, communications systems, waste management infrastructure, sewage treatment plant and fire and potable water infrastructure. The location of the Camp Site is shown on Figure 5-10. A summary of the Camp Site components is provided below, and additional information is provided in the General Mine Development Plan.

5.3.8 Camp Facilities

The operation camp accommodations will consist of single-occupancy rooms with en-suite washrooms. The facilities are planned to include several dormitory wings and centralized kitchen, dining, and recreation buildings that will include a complete kitchen, dry food storage, walk-in freezer, dining room, first-aid room, mudroom, housekeeping facilities, reception desk, lobby, and recreation area.

The facilities will be skid-mounted, hard walled, prefabricated facilities constructed for year-round usage. Primary heating for the camp will be forced air propane, and secondary heat will be electric baseboard heaters.

5.3.8.1 Mine Dry and Office Complex

A single large mine dry and office complex will be assembled from modular units manufactured off-site and placed on wood cribbing. The mine dry facility, with capacity for 85 workers during shift change, will be used during the Construction and Operation phase. The office complex will contain a large open office area, private offices, main boardroom and meeting rooms, and a mine operations line-up area.

5.3.8.2 Emergency Response Team Building

An emergency response building will be located adjacent to the mine dry and office complex. The building will house an ambulance and a fire truck. An emergency medical responder will be on site 24 hours a day to provide emergency care. For additional information regarding emergency response infrastructure, refer to the General Mine Development Plan. For information regarding emergency response equipment, refer to the Emergency Response Plan.

5.3.8.3 Potable Water and Fire Water Infrastructure

Fresh water supplied from a well field that is located near the Yukon River will be transported by a freshwater pipeline or a water truck to the combined fresh/fire water tank at the Camp Site. The fresh/fire water tank is designed at 230 m^3 with 130 m^3 dedicated to firewater and 100 m^3 for process water. The tank has been designed with the bottom of the tank dedicated to fire protection services.

Water for use as potable water will be pumped from the tank to the potable water treatment plant. Potable water treatment will consist of filtration, ultraviolet and chlorine disinfection. Treated water from the potable water treatment plant will be stored in an insulated and heated potable water storage tank capable of accommodating potable water demand variances for distribution to camp, office, plant, and mine dry facilities as needed.

5.3.8.4 Sewage Treatment Plant

The sewage treatment plant will be pre-assembled offsite prior to transportation to and installation at the Camp Site. Sewage will be treated by a membrane bioreactor plant that includes influent screening, an equalization and bioreactor tank (to handle the daily peaks in flow), a membrane system, a treated effluent storage tank, and ultra-violet disinfection. The treated effluent will be sent to a dispersion field that will drain towards the Latte Creek catchment.

Sewage treatment plant sludge will be disposed of in a manner that will not be an attractant to wildlife or pose any human health risk. This may be achieved either through the waste incinerator or by composting to create additional quality soil for reclamation.

5.3.8.5 Waste Management Infrastructure

In addition to waste material or water generated from mining and ore processing activities, several types of waste will be generated during the Project. The waste will be transported to the waste management facility for segregation and management. The waste management facility will include a waste management building, landfill, composting unit/facility, incinerator, and a storage facility. Containment at the waste management pad will include berms, an impermeable liner, and a sump. A fence will surround the perimeter of the waste management area to provide security and restrict wildlife access. The waste management building will have approximate dimensions of 36 m by 18 m and will be located adjacent to the incinerator building.

The landfill will be used for the disposal of inert, solid, non-salvageable, non-hazardous, non-leaching, inorganic, and non-putrescible waste materials. All material disposed of in the on-site landfill will be on the Approved Material List.

Organic kitchen wastes will be separated and burned daily in the incinerator to limit wildlife attraction associated with the disposal of food waste. The dual-chamber diesel-fired incinerator will be capable of burning site waste generated based on maximum daily occupancy. Organic kitchen waste may also be composted to create additional quality soil for reclamation purposes and reduce diesel consumption by incinerator.

5.3.9 Bulk Explosive Storage Area

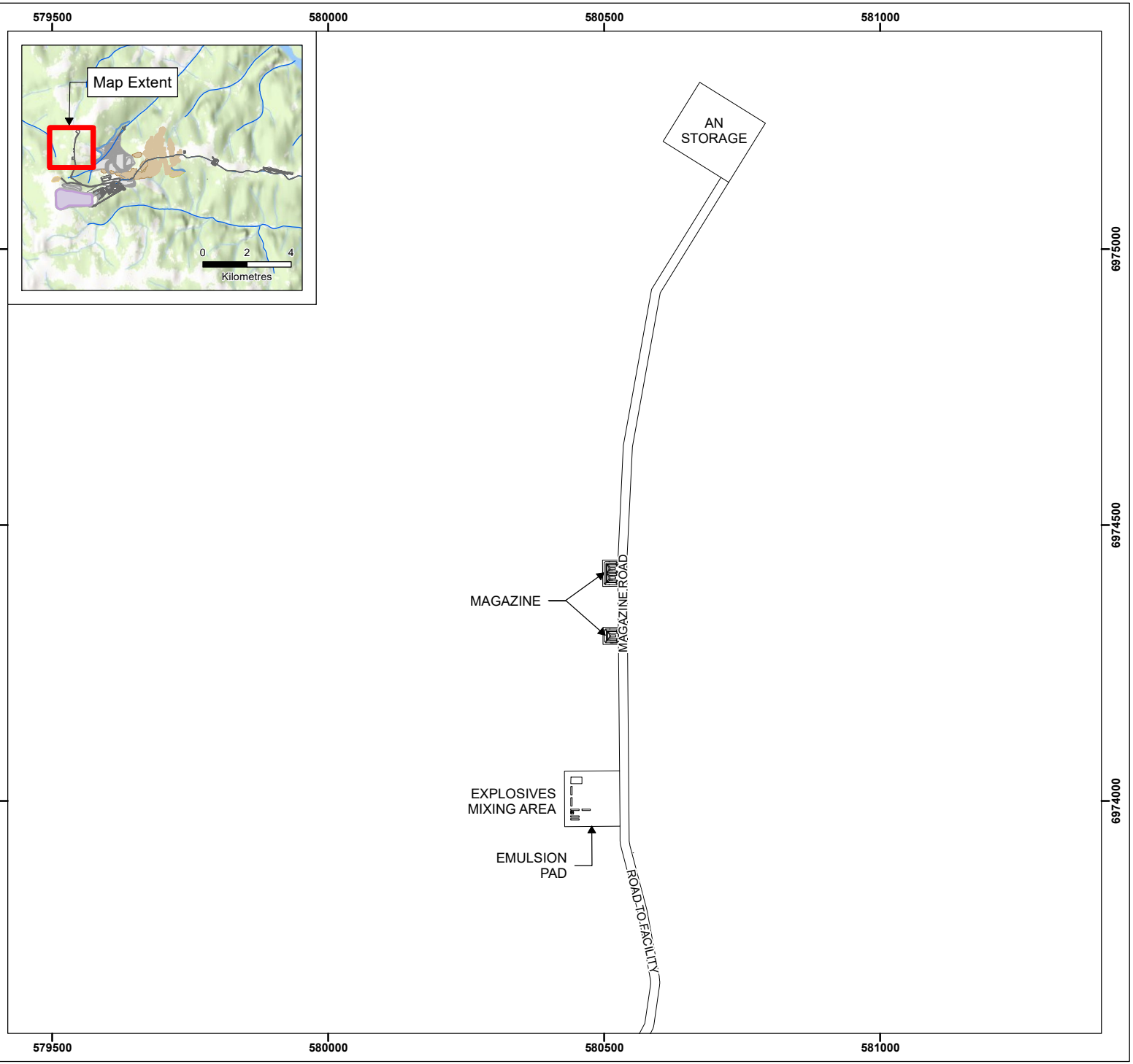
The bulk explosives storage area will be located north of the Kona Pit, as shown on Figure 1-2. As shown in the explosives storage area layout provided on Figure 5-13, the area will consist of three main components: bulk AN storage, emulsion plant and mixing, and storage magazines.

The powder magazine will be two 40-foot container magazines, each capable of holding up to 32 tonnes of packaged explosives products. The cap magazine will be a 20-foot container magazine capable of holding up to 600 cases of detonators and caps. Each magazine will be surrounded on three sides with earthen

berms to prevent propagation and movement. The emulsion plant and mixing area will include a 60 tonne AN silo and a 100-tonne emulsion silo.

The emulsion plant will be constructed on the emulsion pad with a dedicated wash bay, shop, electrical and mechanical buildings, and office for plant operations. All these items will be provided in modular containers for quick assembly and minimal need for civil foundations. Power to this facility will be via a 500-kW generator, filled by the site fuel truck as needed. A 60 tonne AN silo will hold the daily AN requirement of prill (pellets) that will be stored for use during NAR outages. Liquid AN solution will also be stored on this pad for daily consumption during NAR operational periods.

The AN storage area is sized to allow for a minimum 15 weeks of storage or up to 3,100 tonnes of AN prill (pellets) and will be lined with a HDPE liner to provide spill containment. Sufficient quantities of AN prill will be stockpiled in tote bags at the AN facility prior to the close of the NAR during freeze-up and break-up to allow for ongoing blasting operations during these periods. Additional details regarding the bulk explosives storage area are provided in the Explosives Management Plan.



COFFEE GOLD MINE

Conceptual Explosives Facilities Layout

Legend

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

N

1:10,000

0 50 100 150 200 250

Metres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 5.13	Date: Nov 3, 2023	Drawn by: AS	Reviewed: DP

Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MP\Explosive\Fig5_1_103862_03_ExStorage_231103.mxd

5.3.10 Land Treatment Facility

The land treatment facility will be a multi-use facility where different media (i.e., soil, water, snow, and ice) contaminated with hydrocarbons and antifreeze will be treated. The land treatment facility will be located to the east of the Supremo Pit footprint and will have the capacity to treat up to 2,400 m^3 of contaminated media at any one time in treatment cells. The facility will be equipped with a sump for pumping snow melt and/or excess water from the cells, which will then be primarily used for operation of the land treatment facility. A continuous sheet of HDPE impermeable liner sandwiched between layers of geotextile will be installed under the land treatment facility and in its berms. Welds used in installing the liner will be tested to ensure the impermeability of the liner, and records of the welds will be retained on-site.

5.3.11 Mine Site and Haul Roads

The Mine Site road network will include a total of approximately 37 km of mine site haul roads, including the roads used by site personnel to access Mine Site areas and the Project airstrip. While staying within the overall Project footprint, the exact layout and location of haul roads will be modified during mine construction and operations to facilitate safe travel of light and heavy vehicle traffic around the Mine Site, as required.

Mine Site roads will be used for smaller vehicles (e.g., light trucks) to access the Project airstrip, bulk explosive storage area, and other site infrastructure. The mine site roads, which are designed for light and medium trucks, will be constructed with embankment (rock) fill material with a minimum travelling surface width of 8 m and a maximum grade of 10%. Roadbed material thicknesses will depend on existing ground conditions. The rock material will be sourced from infrastructure earthwork activities or from open pit waste rock.

External pit haul roads will be used by mining equipment and heavy-duty vehicles to access the open pits, ore crusher, ROM stockpile, Alpha WRSF, and HLF. To the extent possible, these roads will be constructed using all-fill techniques to achieve design alignment and grade, with suitable non-PAG material sourced from the open pits. The haul roads will be 30 m wide, and the depth of roadbed material will vary depending on the existing ground conditions.

5.3.12 Site Water Management Infrastructure

The Mine Site is located near the headwaters of three watersheds: Halfway Creek, YT-24 Creek, and Latte Creek (Figure 4-9). Surface drainages within the Mine Site are limited to small seeps and springs, which may be encountered during mine development. Water management infrastructure that will be in place during the Operation Phase is shown in Figure 5-14 and at the end of the Closure Phase in Figure 5-15.

Mine site water management is described as follows:

- *Alpha WRSF and Alpha Pond:* The Alpha WRSF will be situated in the upper Halfway Creek catchment and will include a rock drain to safely convey flow beneath the facility into Alpha Pond. Precipitation and snowmelt that infiltrate the Alpha WRSF will report to the rock drain and be collected in Alpha Pond. Contact water collected in Alpha Pond will be discharged to Halfway Creek starting in Year -1. A diversion channel will be developed on the west slope of the Halfway Creek catchment to divert clean runoff away from the Alpha WRSF and into Halfway Creek, downstream

of Alpha Pond. Ultimately, Alpha Pond will be decommissioned during the Active Closure Phase and water conveyed through the rock drain will discharge directly into Halfway Creek.

- *Heap Leach Facility:* From a water management perspective, the HLF will be operated predominantly as a closed system for most of the Operation Phase, as outlined in Section 5.3.5. The highest demand for process make-up water will occur during winter months when solution storage ponds have been emptied. Makeup water will be used, as needed, in priority sequence from the Event Ponds, Rainwater Pond, Facility Pond, open pit sumps or pit lakes, and groundwater wells near the Yukon River. Treatment of surplus rinse water will be required in Year 2 to remove residual cyanide. Treated water of acceptable quality will be discharged towards Alpha Pond via the Alpha Rock Drain, and ultimately discharged into Halfway Creek drainage during the Operation Phase and early Closure Phase (Figure 5-6). The water treatment plant will continue to operate until water volumes (e.g., seepage flow) and quality is suitable for either direct discharge to upper Halfway Creek or receives additional treatment through semi-passive treatment cells within the events ponds and/or through the backfilled Latte Pit (Figure 5-7).
- *Plant Site:* The rock pad foundation for the Plant Site area will be graded to convey contact water to a local sedimentation pond, the Facility Pond, which will be excavated below natural ground beneath the pad. A drainage ditch will be constructed along the perimeter of the ROM ore stockpile to facilitate drainage of runoff and stockpile seepage towards Facility Pond. Water collected in the Facility Pond may be used as makeup water for the HLF, used for dust suppression or discharged via pumped pipeline towards Alpha Pond, pending water quality. The pond will be equipped with an emergency spillway, which will operate under large flood events only, discharging towards Alpha WRSF.
- *Latte Pit:* Latte Pit will be one of the first pits to be developed. The meteoric water that collects in the Latte Pit during mining will be used for dust suppression, pumped to the Facility Pond, used as makeup water to the HLF (by way of the facility pond or pumped to the HLF event ponds), or will be conveyed with excess water from the Facility Pond towards Alpha Pond for sedimentation control and discharge to Halfway Creek. If used for dust suppression, the water sourced from this pit will be used only on mine haul roads, and volume of water applied to road beds will be targeted such that surface runoff is minimal to zero, with no surface discharges to receiving watercourses. Following the completion of active mining in isolated areas of the Latte Pit, inactive mining areas will be used for storage of water collected in other active mining areas. The temporary pit lake will provide sediment control in advance of pumping water for makeup at the HLF or for use in dust suppression. If active monitoring shows that pit lake water quality meets the discharge criteria for the receiving environment (i.e., Alpha Pond effluent quality standards (EQS) or Latte Creek EQS), water may also be discharged directly to the environment via controlled spill point channels.
- As the mine operation phase progresses, water temporarily stored in Latte Pit will be dewatered to the extent required and pumped to the Facility Pond, and ultimately discharged to Halfway Creek via Alpha Pond in the years prior to backfilling. Once backfilling is complete, the main pit will spill towards Latte Creek, while each of the 3 minor pits will spill towards Alpha Pond. Active water quality monitoring during the final pit lake development will determine whether additional water management measures, such as water treatment, will be required to ensure any water that spills towards Latte Creek meets the Latte Creek EQS.
- *Supremo Pit:* During mining, meteoric water that accumulates in active mining areas will be prioritised for use as dust suppression. Additional inflows will be pumped to one of three primary areas. During years where active mining in Latte Pit is complete, water will be pumped for storage

to the Latte Pit, and eventually discharged to Alpha Pond. While active mining or backfilling is ongoing in Latte Pit, water may be pumped to Alpha Pond directly. Following the completion of active mining in these areas, the pits will be flooded. Water from pit lakes may continue to be pumped towards Facility Pond and Alpha Pond to discharge into Halfway Creek throughout the operations period. Spill points from the final flooded pits will discharge to the natural environment via Latte Creek and YT-24, as well as towards Alpha Pond. Active water quality monitoring during the final pit lake development will determine whether additional water management measures, such as water treatment, will be required to ensure any water that spills towards Halfway Creek, Latte Creek or YT-24 meets the site-specific effluent quality standards (Alpha Pond EQS, Latte Creek EQS and YT-24 EQS, respectively).

- *Kona Pit:* During mining, water collected in the pit will be pumped towards Alpha Pond via the Alpha WRSF rock drain. Water may also be pumped towards Event Ponds for water treatment if it does not meet the Alpha Pond effluent quality standards (EQS). Upon completion of mining in Kona, Supremo waste rock (gneiss) will be used to backfill the Kona Pit as the mine schedule permits to cover granite ore exposures which are mildly acidic and attenuate metal leaching and arsenic release from the granite pit walls. The remaining basin will then be allowed to flood, and the final spill point will be towards the Alpha WRSF rock drain. Active water quality monitoring during the final pit lake development will determine whether additional water management measures, such as water treatment, will be required to ensure any water that spills towards Halfway Creek meets the Alpha Pond EQS.
- *Double Double Pit:* A diversion channel will be built to the north side of the Double Double Pit to divert clean runoff (non-contact water) away from the Double Double Pit into Latte Creek. During active mining, meteoric water will be used for dust suppression, pumped towards the Facility Pond or Event Ponds for makeup water or conveyed towards Alpha Pond if water quality meets the Alpha Pond EQS. Following active mining, Double Double Pit may become a temporary pit lake, storing excess pit water collected in surrounding active mining areas. Pending the water quality at this time, water from the flooded Double Double pit lake may be discharged towards Latte Creek if it meets the Latte Creek EQS, or conveyed towards Alpha Pond if it meets the Alpha Pond EQS.

Additional details regarding the site water management infrastructure are provided in the Water Management Plan. Additional details regarding the Alpha WRSF rock drain, including stability analysis, are provided in the WROMP.

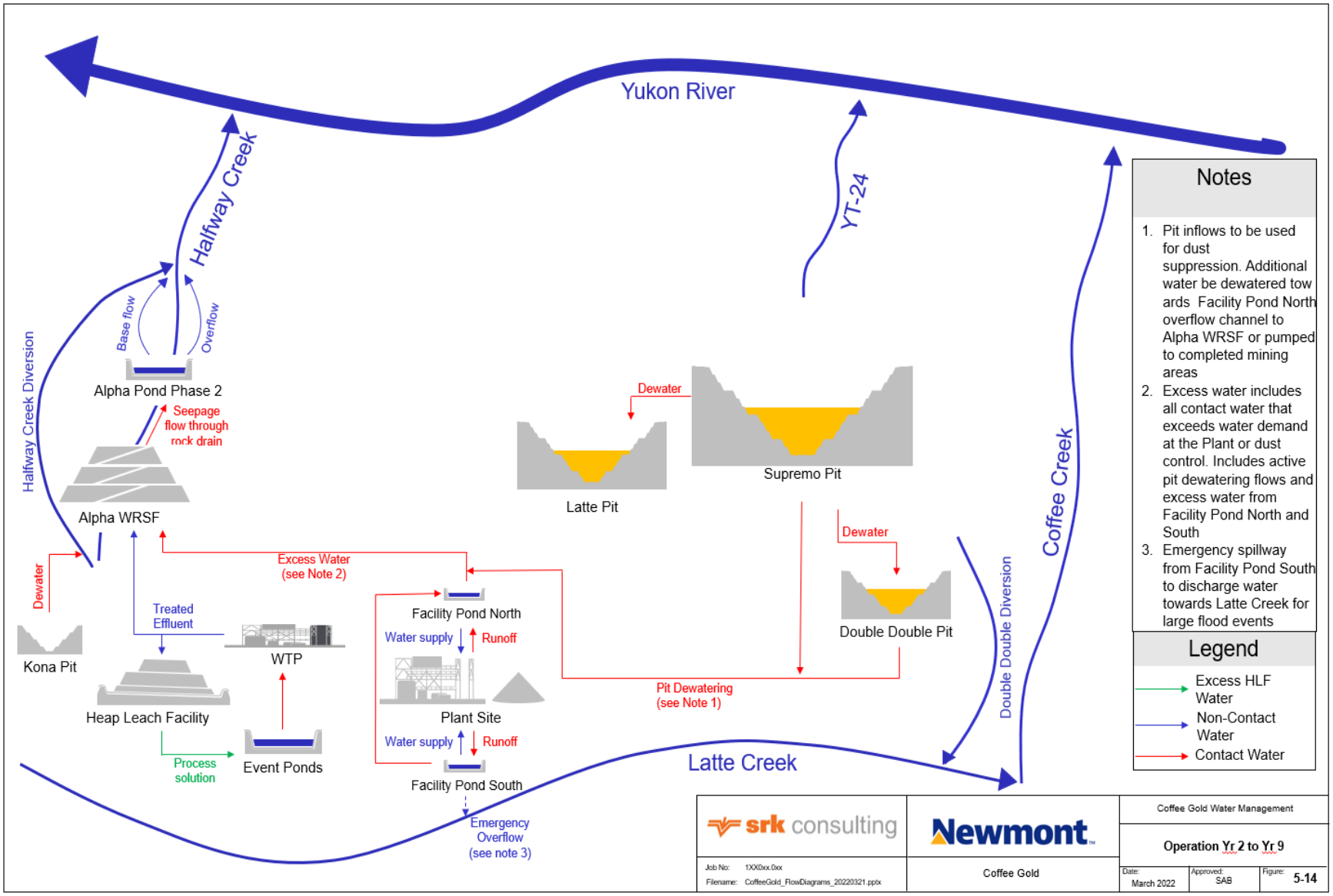


Figure 5-14 Water Management Infrastructure - Operation Phase Activities

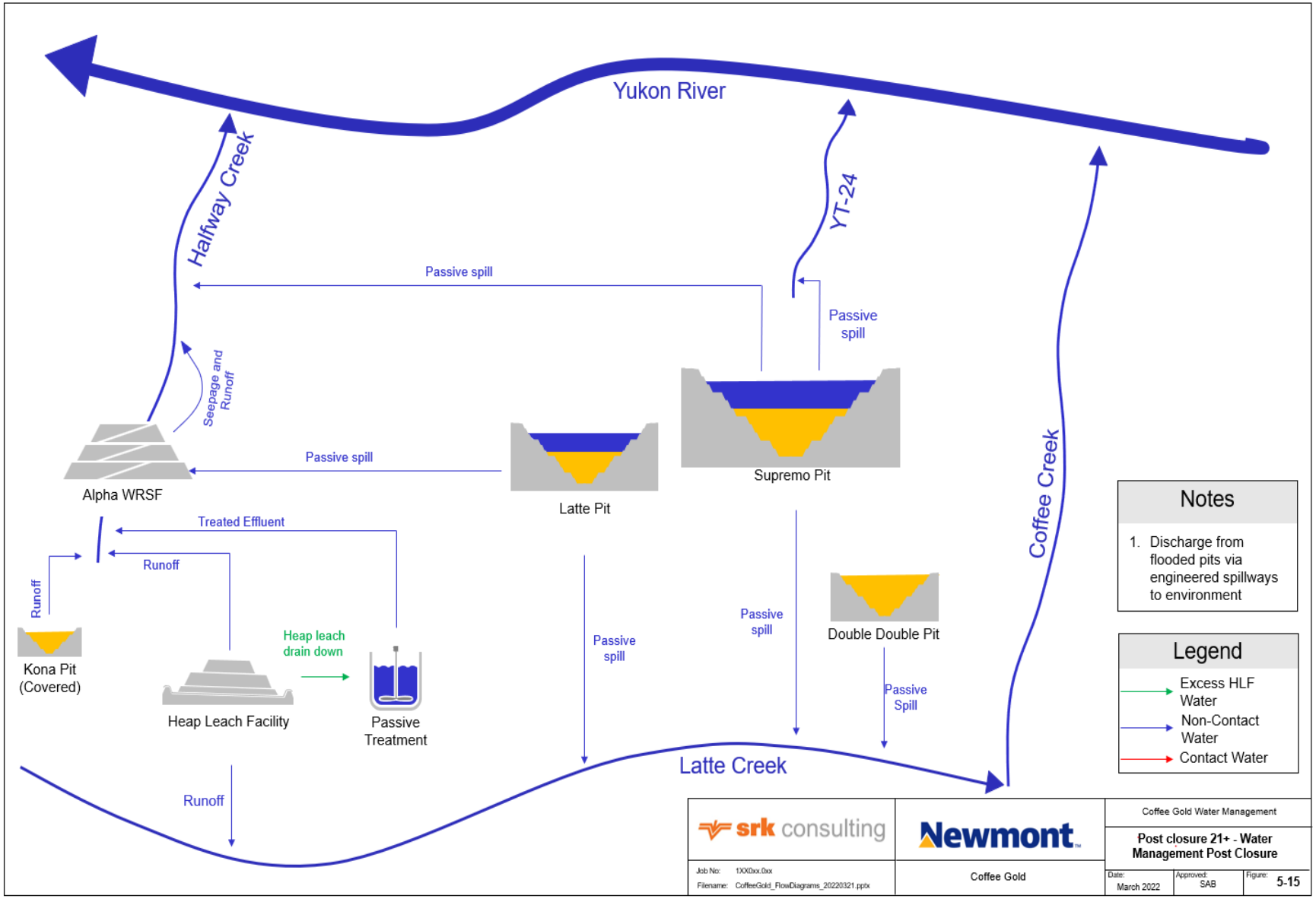


Figure 5-15 Water Management Infrastructure – End of Closure Phase (Year 21)

5.3.13 Ancillary Infrastructure

Ancillary components include the NAR, the airstrip, and laydown areas.

5.3.13.1 Coffee and Java Exploration Camps and Roads

The existing Coffee exploration camp near the Yukon River is currently used to accommodate up to 80 personnel working on the Coffee Project. The general arrangement of the Coffee exploration camp is shown in Figure 5-16. This camp will be used until facilities are operational at the 200-person capacity Java exploration camp.

Existing roads will be used to the extent possible to minimize disturbance, including the 29 km On-site Access Road from the barge landing on the south bank of the Yukon River to the property exploration areas in the Mine Site area.

Once the Project Camp is operational, the Coffee exploration camp is envisaged to be maintained to accommodate exploration personnel, contractors, and visitors, or for cultural events and activities. When the Project Camp is decommissioned during the Closure Phase, the Java camp may be used to accommodate personnel involved with the final reclamation and closure activities and monitoring activities.

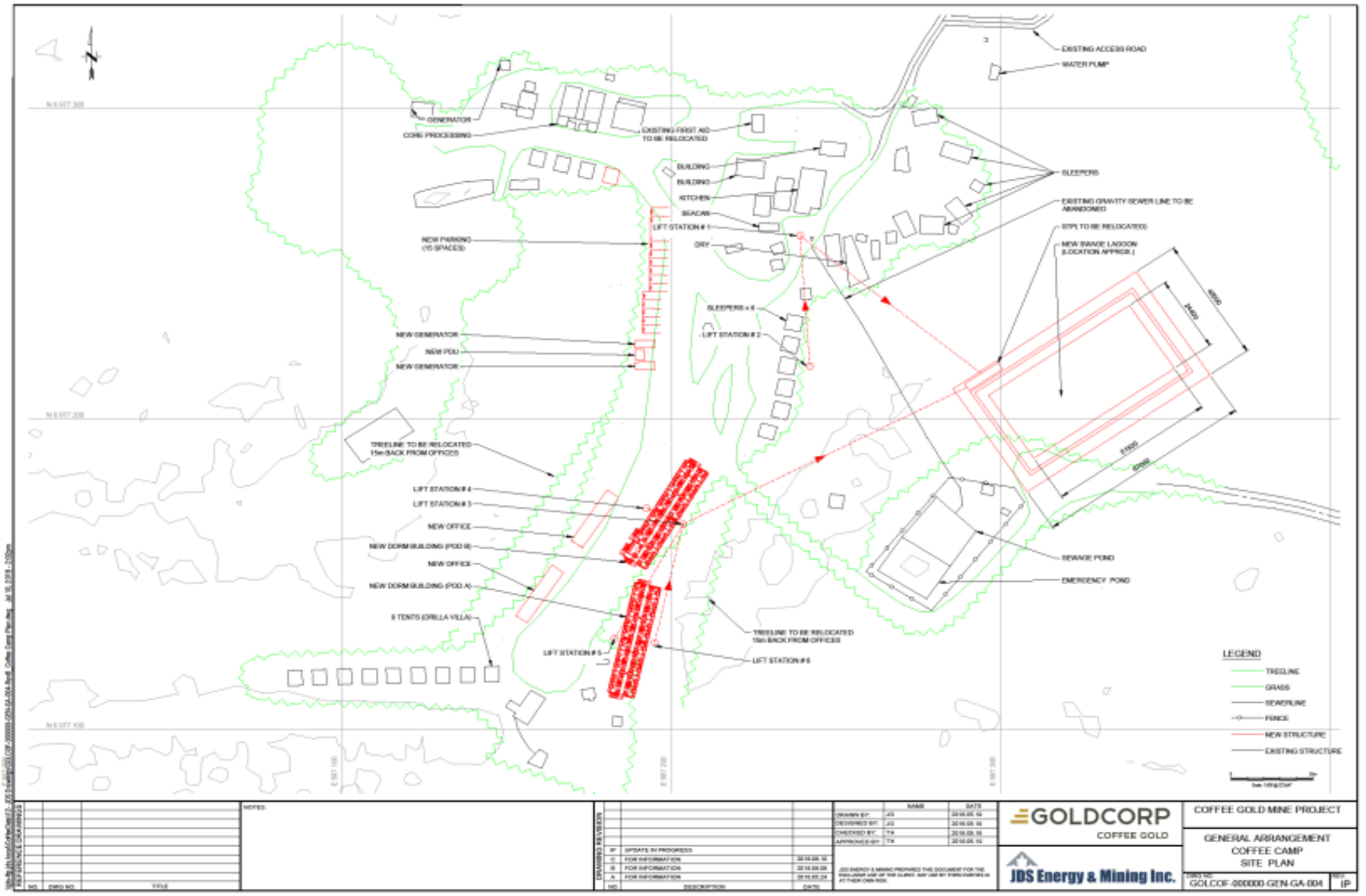


Figure 5-16 General Arrangement of Coffee Exploration Camp

5.3.13.2 NAR

The NAR consists of a 16-km stretch of Klondike Highway and 192-km all-season road. The NAR will be comprised of 61 km of existing Yukon government-maintained road, 5 km of winter road, and 126 km of road modifications, including approximately 31 km of new single-lane, forestry-type access road that will be constructed to support Project construction, operation, and reclamation and closure activities.

The upgraded and newly constructed sections of the NAR road will primarily consist of a single-lane road with pullouts that will support two-way traffic. The finished road will have a width of approximately 5 m, and maximum gradients of between 8% and 10% Design speeds will be between 30 km per hour and 50 km per hour, depending on the terrain.

The NAR will be operated on a year-round basis except for periods when the Stewart River and Yukon River are either freezing up in the fall through early winter or breaking up in the spring. During the open-water period, barges will be utilized to ferry transport trucks delivering fuel and freight across the Stewart and Yukon Rivers. During the winter months when the rivers are frozen, ice roads will be established to enable transport trucks to drive across the rivers.

Four barge landings will be required – two on either side of the Stewart and Yukon rivers. Each barge landing will consist of a concrete ramp for docking of an upstream-facing barge and the ramp will be installed on a grade that will help minimize stream bottom interference. Barge landings will include an area to allow for a B-Train tractor-trailer to easily embark and disembark from the barge then proceed along the NAR. Landings will also allow for storage of the barge, maintenance supplies, and emergency response materials. On the southern bank at each barge crossing, barge fuel will be stored in a single 20,000-L double-walled tank that will be placed inside HDPE-lined berms a minimum of 30 m from the waterline. The fuel tank will be filled by fuel trucks as required.

In conjunction with the ice road on the Yukon River, a 4.1-km-long winter road will be constructed seasonally from the east side of the bridge crossing Coffee Creek to the barge landing on the south side of the Yukon River. Since no river access will be possible during fall freeze-up and spring thaw, the mine plan provides for on-site storage of a sufficient supply of fuel and consumable materials during these periods.

5.3.13.3 Airstrip

Air transportation will be the primary means of transportation for Mine Site personnel and incidental freight. Fixed wing aircraft will be chartered from Whitehorse or the City of Dawson for delivery of bulk freight on an as-needed basis (e.g., for catering supplies during periods when the NAR is closed). Site personnel will be mobilized to site from Whitehorse and Dawson.

The all-weather airstrip will be located approximately 7 km east of the camp site and will be 1,600-m long by 45-m wide, with a 12.5 m safety area on each side and a 60 m safety area at each end. The taxiway to the apron area will be 15 m wide with 6-m graded areas on each side. The concrete apron will be approximately 75 m by 33 m and will be large enough for two aircraft to maneuver and park. The airstrip is designed to handle turboprop passenger aircraft similar in size to an ATR-300 or Dash-8. The airstrip is also sufficiently sized to handle cargo aircraft up to a de Havilland DHC-5A Buffalo.

The airstrip will be equipped with a GPS Instrument Approach system allowing for instrument flight rules approaches and departures under suitable weather conditions. Lighting will include runway edge lighting, taxiway edge lighting, precision approach path indicators, and an omni-directional approach lighting system.

A pre-fabricated modular operations centre containing radio equipment for ground-to-air communications will be located on the airstrip apron. A dedicated diesel generator located at the flight operations centre will provide power for airstrip operations; alternative power generation options for airstrip operations will be evaluated during detailed design, and may include renewable power, if feasible. The airstrip layout is shown on Figure 5-17. Additional details regarding the Project airstrip are provided in the General Mine Development Plan.

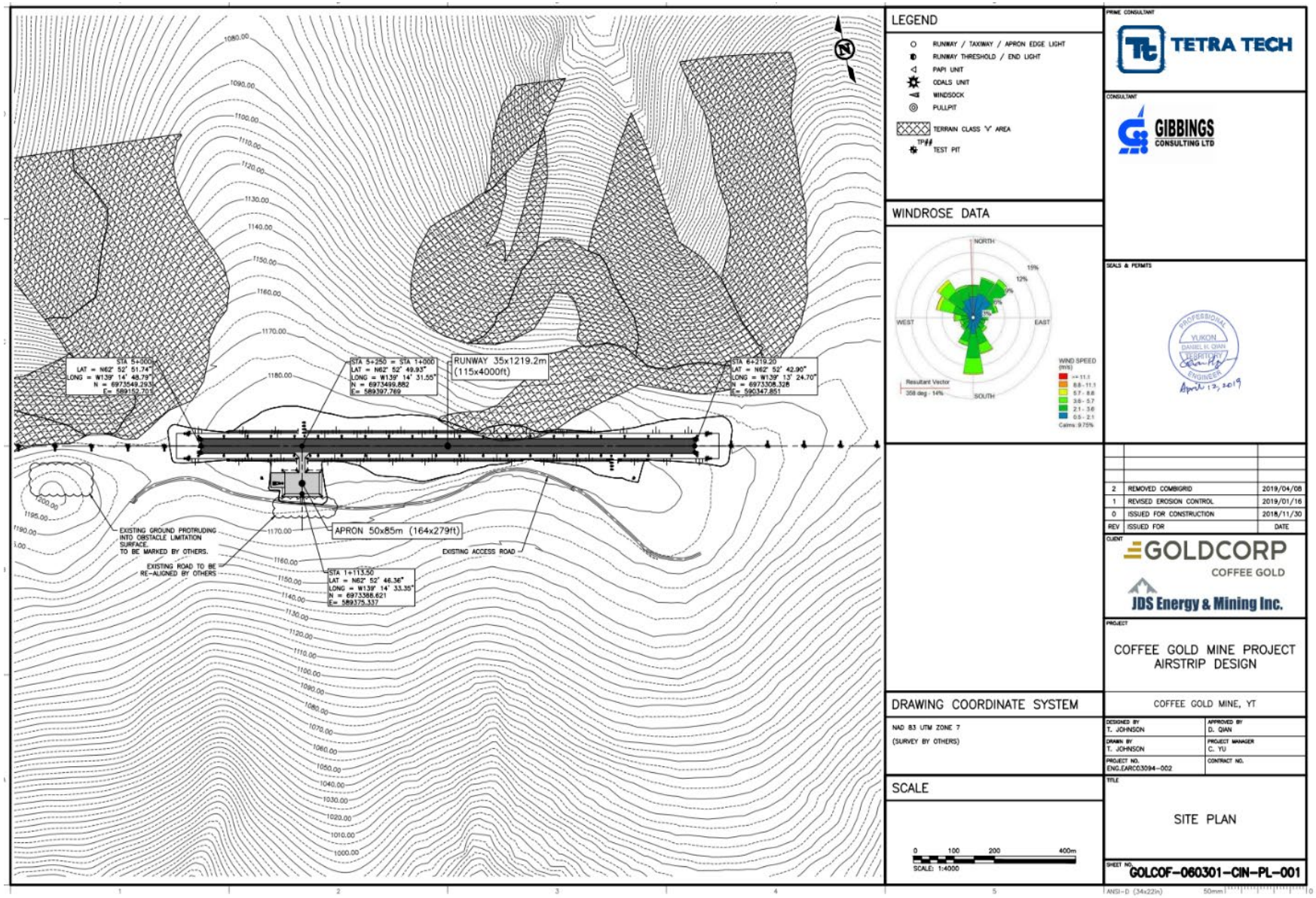


Figure 5-17 Project Airstrip General Arrangement

5.3.13.4 Laydown Areas

Laydown areas for major process plant consumables will be located next to the truck shop building and at the crusher area. Materials that do not require protection from the elements may be stored in the laydown yard.

Additional laydown areas will be created as needed. Should additional storage area for construction materials be required, the area east of the Plant Site may be utilized.

5.4 Current Conditions (Year -5)

Current infrastructure supporting the Coffee Project includes the Coffee exploration camp and airstrip, the On-site Access Road, and exploration laydown areas (Figure 5-2). The Java exploration camp is currently being constructed and only camp pads are in place. The Coffee exploration infrastructure and Java exploration camps will be used to accommodate construction and support personnel until the Camp Site facilities are completed early in the Construction Phase.

Since the existing infrastructure that is used to support exploration activities is permitted under Quartz Mining Land Use Permit #LQ00312 and Type B Water Use Licence MN12-014, the requirements for reclamation of any disturbances and decommissioning of any buildings and infrastructure are addressed under these regulatory instruments. Hence, the liabilities for closure and reclamation of exploration-related infrastructure and disturbed areas are not incorporated as part of the Project closure costing for current conditions at this time. The Java exploration camp and the On-site Access Road will transition to Project-associated liabilities during the Construction Phase and will be included as current liabilities in subsequent iterations of this RCP.

5.5 Conditions Two-years Forward (Year -1)

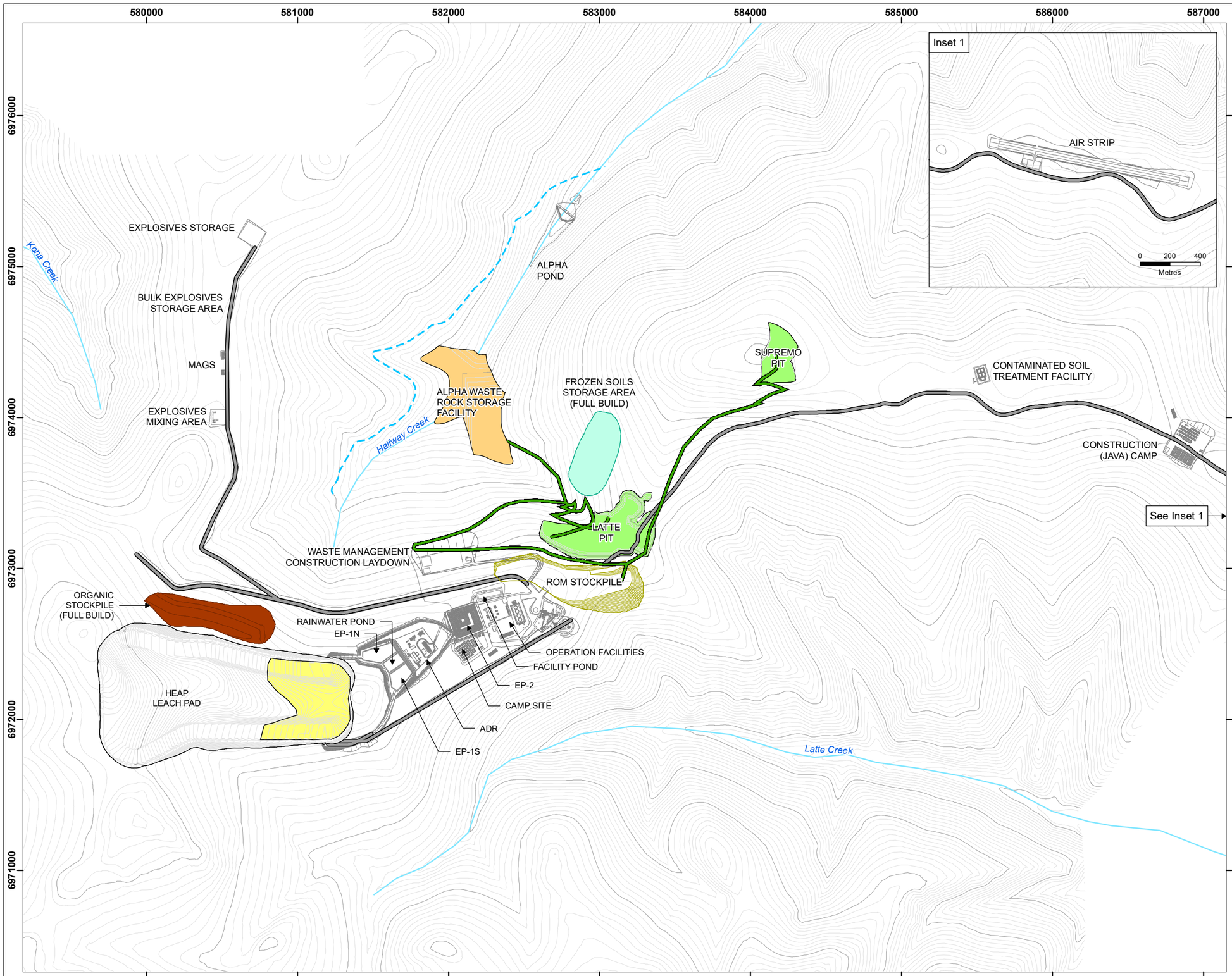
This section describes principal Project components that will be in place to support Project activities occurring by Project Year -1 (two years forward from start of construction (Year -3)), as well as the expected aerial extent of Project-related surface disturbance. The layout of the Mine Site in Year -1 is shown in Figure 5-18 and includes the following infrastructure and facilities:

- Crusher area earthworks
- Heap leach facility earthworks
- Plant Site earthworks including process plant, truck shop and bulk fuel storage pads
- Camp Site including dormitories, and kitchen, dining, and recreation complex buildings, fresh (potable) water and fire water systems, sewage treatment plant, and waste management facility
- Partial soil stockpile and frozen soil storage area
- Bulk explosive storage area
- Mine site and haul roads
- Power plant
- Site water management Infrastructure including Facility and Alpha Ponds and conveyance structures
- Ancillary components within the Mine Site include laydown areas.

Supporting ancillary infrastructure includes the Coffee exploration camp, access infrastructure including the NAR, the Project airstrip, and the On-site Access Road. Key activities conducted by Year -1 are summarized by Project component in Table 5-8.

COFFEE GOLD MINE

Mine Site General Arrangement at End of Year -1



Legend

- Site Feature
- Access Road
- Watercourse
- Diversion Berm
- Haul Road
- Active Pit
- Pit Footprint
- Waste Rock Storage Facility
- Pit Backfill
- Heap Stack

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory

N

1:25,000

0 200 400 600 800 1,000

Metres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 3.1	Date: Aug 23, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\10366.2\20\mxd\MPWROMP\Fig3_103662_03_Life_of_Mine_230609.mxd

Table 5-8 Summary of Key Activities and Infrastructure in Place in Year -1

Project Component	Key Activities
Overall Mine Site	Confirmatory geotechnical drilling in select areas at the Mine Site, as necessary
	Mobilization of mobile equipment and construction materials
	Clearing, grubbing, and grading of areas to be developed within the mine site
	Construction material to provided foundation and fill material for roads construction and other infrastructure development
Stockpiles	Development and use of soil stockpiles for vegetation and overburden
	Development and use of frozen soil storage area
Heap Leach Facility	Construction of Stage 1 of the heap leach pad
Plant Site	Process plant pad earthworks and facilities construction
	Truck shop pad earthworks and facility construction
	Bulk fuel storage pad earthworks and facility construction
	Crusher pad earthworks and facility construction
	Crusher pad Power Plant and facility construction
Camp Site	Construction and operation of dormitories, kitchen, dining, and recreation complex buildings; mine dry and office complex; emergency response and training building; fresh (potable) water and fire water use systems; and sewage treatment plant
	Construction and operation of waste management facilities including incinerator
Waste Management Facilities	Construction and use of waste management facilities
	Construction and use of Landfill
	Construction and use of Land Treatment Facility
Bulk Explosive Storage Area	Construction of storage facilities for explosives components and on-site use of explosives
Mine Site and Haul Roads	Construction and maintenance of mine site service roads and haul roads
Site Water Management Infrastructure	Development and use of sedimentation ponds and conveyance structures, including discharge of compliant water
Ancillary Components	Upgrading of existing road sections for NAR, including installation of culverts and bridges
	Construction of new road sections for NAR, including installation of culverts and bridges
	Development, operation, and maintenance of temporary work camps along road route
	Vehicle traffic, including mobilization and re-supply of freight and consumables
	Development, operation, and maintenance of barge landing sites on Yukon River and Stewart River
	Operation of barges on Stewart River and Yukon River, including barge mobilization of equipment for NAR construction
	Annual construction, operation, maintenance, and removal of Stewart River and Yukon River ice roads
	Annual construction and operation of winter road on the south side of the Yukon River
	Construction, operation, and maintenance of permanent bridge over Coffee Creek
	Construction and maintenance of the Project airstrip
	Construction Project airstrip and use of Project airstrip by aircraft
	Use of laydown areas
	Use of Coffee Exploration Camp and airstrip (and associated air traffic)

5.5.1 Mine-Related Land Disturbance Two-Years Forward

The Project area encompasses 22,000 ha and includes areas unaffected and potentially affected by the Project. The total mine-related land disturbance area (excluding exploration related land disturbances) at the end of Year -1 is estimated at approximately 705.7 ha, as outlined in Table 5-9. The spatial extent of disturbance within the Project area has been estimated based on the footprint areas for Mine Site infrastructure and facilities (shown in Figure 5-18) and transportation infrastructure (shown in Figure 1-2 for the On-site Access Route and Project airstrip and southern portion of the NAR, and Figure 1-1 for the NAR). The footprint areas estimate provided in Table 5-9 include the following buffers to allow for modifications that may arise during detailed design:

- 10 m from the perimeter of mine site infrastructure and facilities (other than transportation corridors)
- 10 m either side of the centerline for the On-site Access Route
- 10 m either side of the centerline for the Yukon River and Stewart River ice roads
- 50 m from the perimeter of the Project airstrip running surface
- 50 m either side of the centreline for the newly constructed portion of the NAR (i.e., those sections that are newly constructed to support Project activities and will be reclaimed)
- 50 m from the perimeter of spoil and borrow sites along the NAR.

Associated liabilities to decommission and close facilities and infrastructure and reclaim disturbed areas for conditions two-years forward are provided in Section 9. In cases where facilities and infrastructure are fully constructed or operational, the closure measures described in Section 7 will apply. For components where earthworks are underway, liabilities reflect reclamation activities including re-sloping and revegetation requirements, as applicable, across the entire component footprint area.

Table 5-9 Mine-Related Land Disturbance Two-Years Forward (Year -1)

Mine Feature	Disturbance Footprint Area End of Year -1 (ha)
Open Pits[a]	**27.9**
Double Double	0
Latte	20.8
Kona	0.0
Supremo	7.1
Waste Rock Storage Facilities and Stockpiles[a]	**80**
Alpha WRSF	36.7
Soil Stockpiles	16.0
ROM Ore Stockpile Pad	23.4
Crusher Area including Crushed Ore Stockpile Pad	3.9
Heap Leach Facility[a]	**129.8**
Heap Leach Pad and Infrastructure	121.8
Event and Rainwater Ponds	8.0
Supporting Mine Infrastructure/Facilities[a]	**43.3**
Plant Site	12.6
Camp Site	4.0
Bulk Explosive Storage Area	8.7

Mine Feature	Disturbance Footprint Area End of Year -1 (ha)
Alpha Pond	7.5
Facility Pond	2.3
Water Management Infrastructure	8.2
Roads and Airstrip	**424.7**
On-site Access Road to Project Airstrip[a]	9.0
Mine Site Haul Roads[a]	20.5
Project Airstrip[b]	15.9
NAR – Project Portion[c]	290
Potential Spoil and Borrow Sites along NAR[b]	n/a
Yukon River and Stewart River Ice Roads[a]	n/a
Yukon River Winter Road	4.3
TOTAL AREA OF DISTURBANCE	**705.7**

Notes:

a. Area includes 10 m buffer from centreline of roads or from perimeter of mine features.

b. Area includes 50 m buffer the perimeter of the Project airstrip running surface and the perimeter of spoil and borrow sites along the NAR.

c. Area represents the approximately 29 km portion of access route that is newly constructed to support mine development and operations and includes 50 m buffer either side of the centerline.

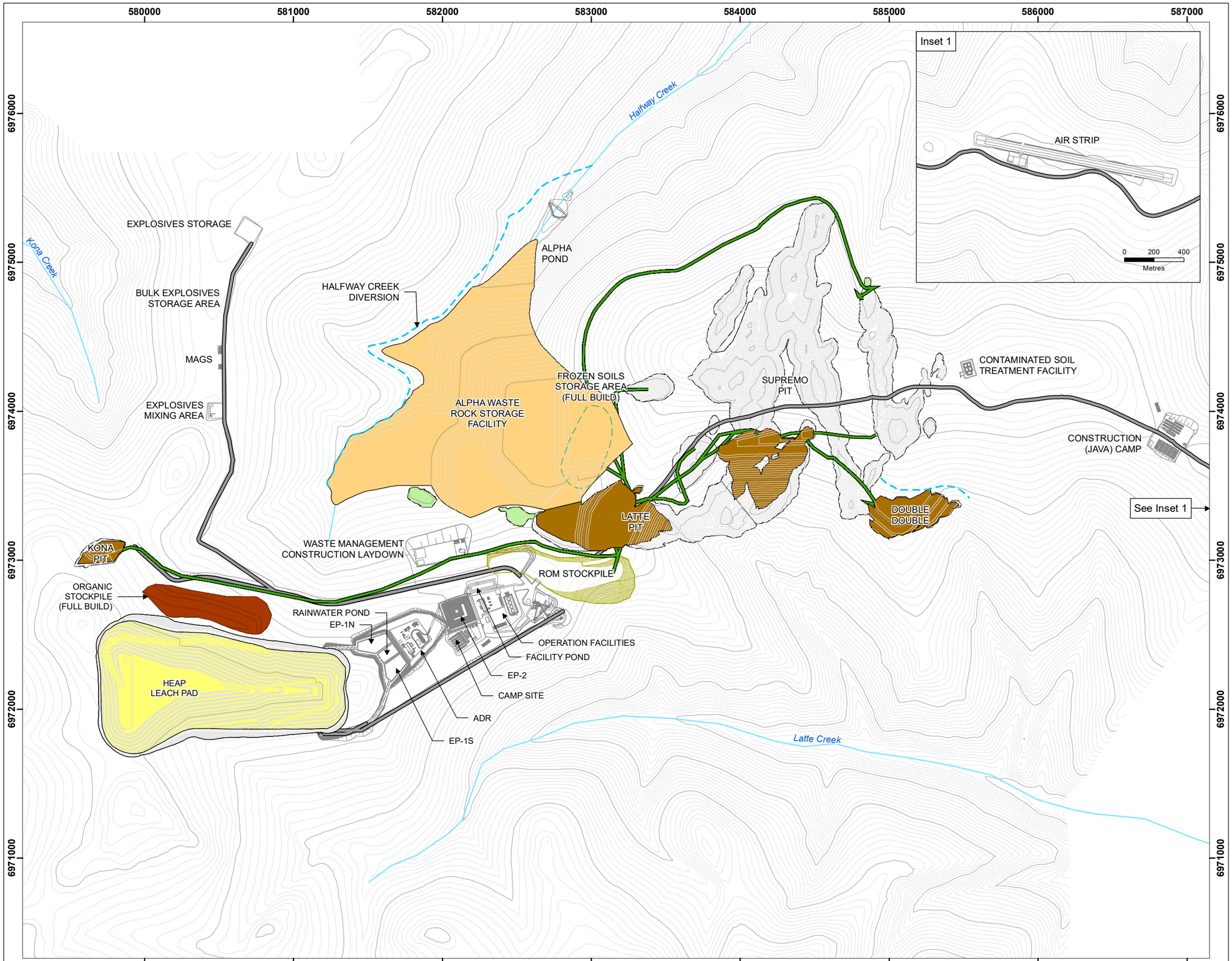
5.6 End-of-mine Conditions (End of Year 9)

For the purpose of estimating liabilities at the end of the LOM (Year 9), this section outlines principal Project components that will be in place at the end of the Operation Phase and the extent of mine-related disturbances. In addition to access infrastructure including the NAR, Project airstrip, and the On-site Access Road, the following mine facilities and infrastructure will exist at the Mine Site at the end of Year 9 (as shown on Figure 5-19):

- Supremo and Latte open pits
- Alpha WRSF
- Soil stockpiles and FSSA
- ROM stockpile pad
- Crusher system including crushing circuits, crushed ore stockpile pad, or crushed ore conveyor system connecting the crusher system area to the HLF
- Heap leach facility with 67 Mt of ore
- Plant Site including process plant, reagent storage area, laboratory, truck shop and warehouse building, power plant, bulk fuel storage area, and LNG storage facility
- Camp Site including dormitories, and kitchen, dining, mudroom, and recreation complex buildings, mine dry and office complex, Emergency Response Team building, potable water and fire water systems infrastructure, sewage treatment plant, and waste management infrastructure
- Bulk explosive storage area
- Mine site and haul roads
- Site water management infrastructure including the Alpha and Facility Pond, diversion, and conveyance structures (i.e., ditches and culverts)
- Laydown areas.

COFFEE GOLD MINE

Mine Site General Arrangement at End of Year 9



Legend

- Site Feature
- Access Road
- Watercourse
- Diversion Berm
- Haul Road
- Active Pit
- Pit Footprint
- Waste Rock Storage Facility
- Pit Backfill
- Heap Stack

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory

N

1:25,000

0 200 400 600 800 1,000

Metres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 3.10	Date: Aug 23, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\10386\2023\mxd\MAPNRCM\Fig3_103862_03_Life_of_Mine_230509.mxd

5.6.1 Mine-Related Land Disturbance at End of Mine (Year 9)

Mine Site and ancillary infrastructure to be closed, decommissioned and/or areas to be reclaimed at the end of Year 9 are summarized in Table 5-10. The total outstanding area of disturbance at the end of Year 9 is approximately 979.9 ha. As with the disturbance area estimates provided in Section 5.5 for the two-years forward condition, the estimates provided in Table 5-10 include buffers to allow for modifications that may arise during detailed design (see table notes for specific distances).

The final measures to decommission, close, and/or reclaim these components are described in Section 7 and associated liabilities to complete all closure measures are provided in Section 9.

Table 5-10 Mine-Related Disturbance Areas at End of Mine Life (Year 9)

Mine Feature	Disturbance Footprint Area End of Year 9 (ha)	Area Progressively Reclaimed
Open Pits[a]	177.0	
Double Double	11.3	Yes – pit completely backfilled
Latte	32.9	Yes – pit partially backfilled
Kona	6.2	Yes – pit completely backfilled
Supremo	126.6	Yes – pit partially backfilled
Waste Rock Storage Facilities and Stockpiles[a]	205.1	
Alpha WRSF	161.8	No
Soil Stockpiles	16.0	No
ROM Ore Stockpile Pad	23.4	No
Crusher Area including Crushed Ore Stockpile Pad	3.9	No
Heap Leach Facility[a]	129.8	
Heap Leach Pad and Infrastructure	121.8	Yes – during Closure Phase
Event and Rainwater Ponds	8.0	No
Supporting Mine Infrastructure/Facilities[a]	43.3	
Plant Site	12.6	No
Camp Site	4.0	No
Bulk Explosive Storage Area	8.7	No
Alpha Pond	7.5	No
Facility Pond	2.3	No
Water Management Infrastructure	8.2	No
Roads and Airstrip	424.7	
On-site Access Road to Project Airstrip[a]	9.0	No
Mine Site Haul Roads[a]	20.5	No
Project Airstrip[b]	15.9	No
NAR – Project Portion[c]	290	No
Potential Spoil and Borrow Sites along NAR[b]	n/a	Yes – reclamation completed post-construction
Yukon River and Stewart River Ice Roads[a]	n/a	Temporary during winter months
Yukon River Winter Road	4.3	No
TOTAL AREA OF DISTURBANCE	979.9	

Notes: n/a – areas progressively closed and/or reclaimed during the Operation Phase, or not requiring further works.
a. Area includes 10 m buffer from centreline of roads or from perimeter of mine features.
b. Area includes 50 m buffer the perimeter of the Project airstrip running surface.
c. Area represents the approximately 29 km portion of NAR constructed to support Project development and operations and includes 50 m buffer either side of the centerline.

5.7 Monitoring Activities

This section outlines the surveillance and monitoring requirements for the Mine Site, the physical and biophysical environments, and socio-economic conditions during the Construction and Operation Phases. Monitoring will be conducted following the procedures outlined in the Environmental Monitoring and Adaptive Management Plan (EMAMP) and associated monitoring plans as well as the SEMP. Where relevant, management and protection plans are referred to, as these documents provide detailed information. Operations monitoring programs will continue into the Closure Phase until the programs are either no longer required or have been adapted for closure. Monitoring and reporting requirements for the Closure and Post-closure Phases are documented in Section 7.11.

5.7.1 Monitoring and Inspections of Mine Site and Supporting Infrastructure

During mine development and operation, regular inspections will be conducted to confirm compliance with applicable permits and licenses. Infrastructure such as the Alpha WRSF, HLF and process facilities, open pits, water management infrastructure, fuel and storage tanks, and all roads (including the NAR) will be inspected to confirm physical stability and integrity in accordance with design criteria. On-site personnel will coordinate follow-up investigations by appropriate professionals, as necessary.

Plans that are relevant to facility and infrastructure performance during mine construction and operation and relevant to operational processes or procedures that will be monitored include the following (and should be referred to for additional information):

- Access Route Construction Management Plan
- Access Route Operation Management Plan
- Air Quality and Greenhouse Gas Management Plan
- Cyanide Management Plan
- Environmental Monitoring and Adaptive Management Plan (EMAMP)
- Erosion and Sediment Control Plan
- Explosives Management Plan
- General Mine Development Plan
- Waste and Hazardous Materials Management Plan
- Heap Leach and Process Facilities Management Plan
- Mine Operations Plan
- Noise Management Plan
- Spill Contingency Plan
- Vegetation Protection Plan
- Waste Rock and Overburden Management Plan
- Wildlife Protection Plan
- Water Management Plan.

5.7.2 Monitoring of Physical and Biophysical Environments

Physical and biological components will be monitored at designated locations in accordance with license conditions, generally as per the monitoring program outlined for the Construction and Operation phases in the EMAMP. Refer to the EMAMP for monitoring details for these specific environmental aspects: meteorological conditions, physical conditions, geochemical conditions, vegetation, surface water quality, hydrology, groundwater, fish and aquatic life, wildlife, air quality and greenhouse gases, and noise.

5.7.3 Monitoring of Socio-economic Conditions

Socio-economic conditions will be monitored during the Construction and Operation phases in accordance with the SEMP. Results from monitoring will be used to evaluate effectiveness of mitigation and enhancement measures and to implement adaptive management, as necessary. Future RCP iterations will by updated with results from the SEMP as well as through consultation with First Nations to reflect the socio-economic conditions of the community through the Closure and Post-closure Phases.

5.8 Risk Assessment, Contingency Planning and Adaptive Management

Newmont understands that the construction, operation, closure, and reclamation of any mine involves performance uncertainty, and that risk management planning is a requirement. Mechanisms to understand and manage risk during all Project phases will include undertaking risk assessments on a regular basis and having a robust adaptive management plan. The approach to assessing Project risks and adaptive management is outlined below.

5.8.1 Risk Assessment

Project-related risks have been assessed during Project planning using the FMEA approach, as discussed in Section 2.3.4. A Preliminary Project FMEA was conducted in March 2018 based on a conceptual level of design to identify potential failure modes for Project components, and their potential causes and consequences. Key Project components assessed in the Preliminary Project FMEA included open pits, WRSFs and material stockpiles, HLF, and water management infrastructure. The 2018 Preliminary FMEA Report is provided in Appendix 2-L.

Based on the preliminary analysis, a total of 158 failure modes were identified, with all but one failure mode assessed to be low or moderate risk. A slope failure around Alpha Pond was identified as a moderately high risk, almost certain to occur, and having the potential to result in minor consequences.

As part of the alternatives assessment, a FMEA workshop was held in February 2022 to identify and prioritize key risks of the base case design and outline strategies / future studies to mitigate Newmont's residual risks within the near- short- and long-term. The base case design represents the closure measures that were identified through the alternatives assessment process as described in Section 2.3.4. The 2022 FMEA process aimed to evaluate risks at the site based on the Project as a whole and focused on specific site components to facilitate this comprehensive analysis.

During the workshop, ten failure modes were evaluated as severe or high-risk. No identified failure modes were evaluated as a fatal flaw that would require modification of the base case design. A residual risk assessment determined that all unacceptable risks could be mitigated, with the exception of three high-risk rankings related to major life of project cost consequences, which were identified as acceptable given the

current Project definition. The FMEA ultimately verified confidence with the Base Case design that was identified through the alternatives assessment process. The 2022 FMEA Summary Report is provided Appendix 2-M.

5.8.2 Contingency Planning and Adaptive Management Approach

Mine sites are management-intense operations, as indicated by the list of management plans provided in Section 5.7.1 for the Coffee Gold Mine. These management plans, which outline management and response actions for expected conditions and anticipated events at the site during construction and/or operation activities, are required for both operational control and regulatory approval. As the Project advances through the detail design stage and mine operations commence, these plans will become more prescriptive, and the uncertainty in the range of conditions expected will be reduced.

A detailed Surface Water Quality and Aquatic Life Adaptive Management Plan (AMP) (provided as part of the EMAMP) was developed to support project licencing, and detailed AMPs will be developed for additional components as the mine planning advances. The Surface Water Quality and Aquatic Life AMP outlines the approach to make efficient and effective decisions to guide responses to unforeseen events or unexpected conditions during the Construction and Operation phases. The water quality early warning triggers for adaptive management that are identified for the site in the EMAMP will be extended for reclamation and closure and will be applied for all watercourses. Conditions at the Project will be managed adaptively when mitigation measures may not function as intended or when broad-scale environmental change occurs. The adaptive management framework that will apply during the post-closure phase will be similar to that applied during the Operation Phase. A specific closure/post-closure AMP will be developed during the Operation Phase and will be based on actual site conditions and data. The detailed Closure AMP will be described in future iterations of this plan once site performance is better understood during construction and operations. For additional details, refer to the EMAMP.

6.0 TEMPORARY CLOSURE

Temporary closure is managed as part of the Yukon Government's commitment to ensure that mining developments are managed in a sound and sustainable manner and with greater benefits for all Yukon residents (Government of Yukon 2014). As per YWB and EMR (2013): Temporary closure is a closure in which mining related activities cease with the intent of resuming activities in the near future. Temporary closure may be planned or unplanned and could arise from a variety of circumstances including financial challenges, design failures, extreme climatic conditions, etc. A temporary closure event "is considered to last more than six months and no longer than five years, unless otherwise specified in an approved reclamation and closure plan." (EMR 2013).

In accordance with YWB and EMR (2013) guidance and the Yukon Mine Site Reclamation and Closure Policy (EMR 2006), the following sections describe the measures and activities related to ensuring public health and safety, protecting the environment, and managing risks associated with potential temporary closure of the site, as well as monitoring and reporting program requirements.

In the event of a Temporary Closure, a full review of the Reclamation and Closure Plans, liability estimate, and security may be undertaken. If, while in temporary closure, the decision is made to enter permanent closure, Newmont will provide regulators with an updated Reclamation and Closure Plan.

To minimize outstanding liabilities and risks while the site is in a state of temporary closure, the primary objectives include:

- Confirming that all mine-related landforms, infrastructure, and facilities are physically and chemically stable and performing in accordance with designs
- Confirming that all mine-related landforms, infrastructure, and processes can withstand severe climatic and seismic events
- Eliminating or minimizing health and safety hazards to site personnel, the public, and area wildlife by preventing access to areas that pose a risk
- Confirming that mine-related disturbances (e.g., building sites, hazardous materials storage sites, roads, etc.) are not going to adversely affect aquatic and terrestrial environments to prevent future long-term uses or a self-sustaining ecosystem.

A hypothetical scenario that is relevant to an early stage of the Coffee Gold Mine and this iteration of the RCP is outlined below, followed by details pertaining to associated on-site activities and socio-economic aspects of a temporary closure.

6.1 Temporary Closure Scenario Description

A temporary suspension of operating activities at the Coffee Project could result with a change in market conditions or mine-related factors and could be either a planned or unplanned event. This section describes the activities to be caried out during a temporary care and maintenance period. For the purposes of this RCP, temporary closure is assumed to occur at the end of Year 1 in the Operation Phase. This hypothetical temporary closure scenario has been selected as this RCP is anticipated to be updated every two years, and it is unlikely that a temporary closure would occur due to market conditions or another unplanned event during the Construction Phase. Subsequent RCPs will describe a temporary closure period mid-way through or towards the end of the Operation Phase. This hypothetical temporary closure scenario occurs

when the heap leach is at its largest footprint before the active water treatment plant is commissioned. Hence, this scenario was selected as it is considered conservative based on water accumulation within the event ponds prior to treatment and release through the active water treatment plant, and also based on the earliest period for a temporary closure to occur that is applicable to this iteration of the RCP.

The suspension of full operations is assumed to occur continuously for a two-year period (note that some operation activities must continue, as described below). The allowable duration of temporary closure would ultimately be defined by conditions specified in Water Licence and Quartz Mining Licence. Temporary closure activities would continue until mining resumes or until the decision is made to permanently close the mine (i.e., prevailing conditions for the resumption of operations are not favorable)[11].

The 'highest risk' scenario for temporary closure will vary depending on the phase of the mine. The 'highest risk' time for a temporary closure to occur early in the mine life is when the heap leach is at its largest footprint prior to the active water treatment plant being commissioned (i.e., end of Year 1). A contingency water treatment plan for the period prior to installation of the active water treatment plant in Year 2 is described within the Contingency Water Treatment Plan (WesTech 2023), appended to the Heap Leach and Process Facilities Plan.

Mine infrastructure and facilities within the Mine Site area at the end of Year 1 are shown in Figure 6-1, and include the following:

- Partially developed Latte, Supremo, and Double Double open pits
- Partially developed Stage 2 of HLF pad, Event Ponds EP-1N and EP-1S, EP2, and a rainwater pond
- Partially developed Alpha WRSF, including the frozen soil stockpile area
- Partially developed soil stockpile
- ROM stockpile area
- Crusher system and crushed ore stockpile area
- Camp and Plant sites, and waste management areas
- Mine site and haul roads
- Emulsion Plant
- Water management infrastructure including the Facility Pond and Alpha Pond, diversion berms, and rock drains
- Airstrip
- NAR and Mine Site Access Route.

11 If temporary closure is going to exceed the allowable duration, permanent closure activities must commence unless an extension to the temporary closure period is approved by regulators.

COFFEE GOLD MINE

Mine Site General Arrangement at End of Year 1

Inset 1

AIR STRIP

0 200 400
Metres

EXPLOSIVES STORAGE
BULK EXPLOSIVES STORAGE AREA
MAGS
EXPLOSIVES MIXING AREA
Kona Creek
Halfway Creek
ALPHA POND
ALPHA WASTE ROCK STORAGE FACILITY
FROZEN SOILS STORAGE AREA (FULL BUILD)
SUPREMO PIT
CONTAMINATED SOIL TREATMENT FACILITY
CONSTRUCTION (JAVA) CAMP
DOUBLE DOUBLE PIT
LATTE PIT
See Inset 1
WASTE MANAGEMENT CONSTRUCTION LAYDOWN
ROM STOCKPILE
ORGANIC STOCKPILE (FULL BUILD)
RAINWATER POND
EP-1N
OPERATION FACILITIES
FACILITY POND
EP-2
CAMP SITE
ADR
EP-1S
HEAP LEACH PAD
Latte Creek

580000 581000 582000 583000 584000 585000 586000 587000
6976000 6975000 6974000 6973000 6972000 6971000

Path: S:\Geomatics\Projects\103862\03\mxd\MPW\RGMP\Fig3_103862_03_Life_of_Mine_230509.mxd

Legend

- Site Feature
- Access Road
- Watercourse
- Diversion Berm
- Haul Road
- Active Pit
- Pit Footprint
- Waste Rock Storage Facility
- Pit Backfill
- Heap Stack

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory

N

1:25,000

0 200 400 600 800 1,000
Metres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 6-1	Date: Aug 23, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

6.2 Personnel and Consumable Requirements

During a temporary closure period, Newmont will be a responsible steward of the site and demonstrate its commitment to re-opening the site by continuing to retain full-time care and maintenance and HLF operations staff. It is anticipated that on-site personnel will include a site manager, environmental technicians, HLF operation staff, and supporting personnel (for site maintenance and camp operation) who will work on shift rotations to provide adequate coverage. On-site staff will be responsible for a variety of measures including, but not limited to, the following:

- Inspecting the site on a daily basis to observe and document the condition of any changes to site security, safety measures, and mine infrastructure
- Monitoring and reporting as per regulatory requirements
- Documenting potential environmental or health and safety issues and response to any security/safety breaches as required
- Implementing and supporting safety and security controls, controlling access to site, first aid, emergency and spill response, and communications
- Coordinating specialist contractors such as mechanics, electricians, biologists, and engineers to assist with requirements on an as needed basis
- Inspecting mobile and stationary equipment to ensure no leaks or tampering has occurred, and installing drip trays underneath all parked mobile equipment
- Providing for snow removal and dust control for roads and the airstrip, as necessary (and other applicable measures)
- Supporting water management activities such as pumping for recirculation and processing activities such as operation of the ADR Plant at the HLF
- Inspecting water management infrastructure to ensure water is flowing as per site designs (ensure channels and culverts are free and clear, ensure no bypass or leakage of ditches and channels, ensure erosion is limited and controlled, etc.)
- Ensuring active water management equipment including pumps are operational and pipelines are clear of blockages and not leaking
- Ensure backup power is available in the quantities required to operate critical systems.

6.2.1 Personnel Requirements

Personnel requirements during temporary closure will be greatly reduced compared to requirements during mine operations. Hiring and staffing best practices will be implemented to ensure sick leave and vacation are covered and the appropriate amount of key personnel remain on site for temporary closure operations. The expected personnel required during this hypothetical temporary closure period and shift rotation details are listed in Table 6-1 by position. Newmont will ensure that the appropriate skilled and experienced personnel are hired, trained, and retained to manage the critical activities on site during temporary closure, specifically operation of the HLF. Operation of the HLF would primarily be the responsibility of the following personnel: Operations Foreman, ADR Operators, Millwrights, Tradespeople, Labourers/Apprentices. Monitoring of the HLF systems from an environmental perspective, including water balance will be the responsibility of the Environmental Personnel.

Table 6-1 Personnel Required for Temporary Closure Period

Position	Total Compliment	Shift Rotation (Weeks in x Weeks out)
Administration		
Site Manager	1	4x3 (days)
Health and Safety Officer	2	2x2
General Administrator	2	2x2
Environmental		
Environmental Superintendent	1	4x3 (days)
Environmental Monitors	2	2x2
Environmental Technician	2	2x2
Operations / Maintenance		
Surface Foreman	2	2x2
Electrician	2	2x2
Facilities Maintenance - Tradesperson	2	2x2
Mobile Equipment Operator	8	2x2
Labourers/Apprentices	2	2x2
ADR Operators	2	2x2
Operations Foreman	1	2x2
Power Plant Operator	2	2x2
Millwright	2	2x2
Barge or ice bridge	4	2x2
Camp Support Services		
Camp Manager	1	4x3 (days)
Catering	6	2x2
Housekeeping	6	2x2
Nurse / Paramedic	2	2x2
Total Temporary Closure Staff	52	
Maximum Expected Staff On-site	29	

6.2.2 Consumable Requirements

Consumables required during a temporary closure period will be significantly reduced from operations of the entire mine, as mining- and processing-related activities will no longer occur or will be reduced. The primary consumables will be diesel fuel and LNG, which is required for power generation to run the HLF pumps, camp, and associated facilities, and for surface equipment operations. Table 6-2 provides the estimated annual power requirements (in kilowatt hours per year (kWh/yr) and fuel requirements (in litres per year (L/yr)) for temporary closure.

Table 6-2 Estimated Annual Power and Fuel Requirements

Area	Power Requirements(kWh/yr)	Fuel Requirements (L/yr)
HLF & Process Plant Facilities	5,000,000	1,270,000
Camp and Infrastructure Facilities	3,000,000	760,000
Surface / Support Equipment	N/A	730,000
Totals	8,000,000	2,760,000

6.3 Site Security, Monitoring and Maintenance

The key measures to be undertaken during a temporary closure period at the Mine Site are associated with ensuring that the site is secure and safe to minimize health and safety risks and ensuring compliance with all regulatory and licensing requirements to manage risks associated with temporary closure of the site.

Prior to the onset of care and maintenance activities during a temporary closure, operations personnel would complete all necessary outstanding repairs; winterize water collection and diversion systems, mobile equipment, buildings, and other site infrastructure. Waste materials stored in waste transfer areas would be transported to appropriate disposal, recycling, or salvage facilities, and hazardous waste materials not required for water treatment or care and maintenance activities would be removed from site. Care and maintenance activities will be planned to adhere to all safety and environmental standards.

At the onset of temporary closure, a care and maintenance program will be implemented to a level such that all mining infrastructure and processes are in operable condition for a period of up to two years (as per the hypothetical scenario) so that full operations can resume in a timely manner should the decision be made to recommence production.

Measures and activities that are likely to be undertaken during a two-year temporary closure are described below, along with specific activities relevant to infrastructure and facilities that will be in place at the end of Year 1.

6.3.1 Site Access Restrictions and Maintenance Requirements

The NAR will remain operational to allow for camp and plant supplies and fuel to be delivered. Access to the site will be restricted and enforced on a 24-hour per day, year-round basis. Site security is expected to be comparable to the operational period with access to the site controlled by the barge crew in the summer and ice bridge attendants at the crossing points on the Yukon River and Stewart River in winter. In the event that an attendant or barge is not required, a gate will be installed along the access road south of the Yukon River to prevent passage. During the spring thaw and fall freeze-up or other river access limiting circumstances, the site will only be accessible from the maintained airstrip. Personnel accessing the site will be required to be on an approved site manifest to ensure that site management has oversight over the personnel accessing the mine site. All visitors will be required to check in with the camp administrator upon arrival.

The NAR will require periodic visual inspections to monitor for physical stability and operational safety concerns, and to minimize potential risks to the surrounding environment in the event of a washout. Additional details pertaining to NAR inspection and maintenance requirements are provided in the Access

Route Operational Management Plan. Site roads and the airstrip will also be regularly inspected and maintained. Care and maintenance personnel will conduct routine maintenance tasks (e.g., snow removal), as required. Private contractors may be retained to complete maintenance of surface drainage infrastructure or grading as conditions warrant.

In addition to restricting mine site access, further security measures may be implemented for open pits, mine and processing facilities, vehicles and equipment, and hazardous materials that are not required during temporary closure. These additional security measures are discussed below.

6.3.2 Open Pit Access Restriction

The development of open pits will cease during temporary closure. The primary goal during temporary closure at open pit locations relates to the protection of human health and safety. Site access control is a key measure to minimize this risk. While access to the open pits will be restricted, they will remain accessible to authorized personnel to complete routine tasks related to water management and geotechnical inspections.

Any road that runs directly adjacent to an open pit will have a berm maintained to ensure that unauthorized access to the pit is restricted. The berm will also act as a visual queue for wildlife to avoid walking into the pit. Large boulders or a gate will be placed at the pit access point(s) to allow for light vehicle and pedestrian access while restricting access for mobile equipment during temporary closure.

A qualified geotechnical professional will establish an open pit inspection schedule that will allow for access by authorized personnel on a regular basis. If the inspection schedule is not followed for any reason, access to the open pit will be completely restricted until such time as an inspection can be completed by a qualified person.

6.3.3 Facility and Infrastructure Security and Hazardous Goods Storage

A portion of the main camp complex will be utilized throughout temporary closure. To support personnel during temporary closure, site services such as the potable water treatment, sewage treatment, power generation, and communication infrastructure will remain operational. All site buildings not in use will be kept locked and secured and structural inspections and maintenance will be provided by care and maintenance staff and qualified personnel, as necessary.

All waste will be handled, stored, managed, and disposed of as per the Waste and Hazardous Materials Management Plan. Domestic waste from camp operations will be the primary source of waste during temporary closure.

The Plant Site will remain operational during temporary closure to support the activities outlined below for the HLF and gold recovery. Routine operating protocols outlined in the Heap Leach and Process Facilities Plan will apply and tanks and storage areas containing hazardous materials such as chemicals and reagents will be secured, with containment provisions complying with applicable regulations. Depending on the nature of temporary closure, other hazardous materials will either be removed from the Mine Site (e.g., bulk explosives) and/or stored in a safe and secure manner with primary and secondary containment, as required. Tanks may be drained and stabilized over the temporary closure period based on recommendations from mechanical and chemical suppliers, contractors, and engineers.

6.3.4 Vehicle and Equipment Use and Storage

Care and maintenance activities during temporary closure for supporting infrastructure and equipment are focused on maintaining all necessary services and equipment to support required activities and to minimize health and safety risks. Hence, vehicles and mobile equipment required for site maintenance will be kept on-site in good operable condition, and mobile equipment not required for site maintenance will be stored in appropriate areas. Mining equipment will be stored on site in no load condition.

All hazardous fluids will be drained from non-essential mobile equipment based on recommendations from mechanical and chemical suppliers and handled and disposed of as per standard procedures. Equipment not required during temporary closure will be stored and secured in laydown or stockpile areas or inside buildings such as the truck shop. Drip trays will be placed under all parked mobile and mining equipment.

6.4 Ensuring Geochemical and Physical Stability

These sections describe measures to be undertaken during temporary closure to ensure geochemical and physical stability of the heap leach pad, ore stockpile, Alpha WRSF, open pits, water management structures, and soil stockpiles.

6.4.1 Heap Leach Facility and ROM Stockpile

Assuming temporary closure occurs at the end of Year 1, approximately 10.54 million tonnes (Mt) of ore will be present on the heap leach pad with an additional ~0.72 Mt on the ROM stockpile. Sources of ore during this period come primarily from Latte (9.53 Mt), Supremo (1.69 Mt) and much lesser quantities from Double Double (0.04 Mt). Ore from Latte, Double Double and Supremo is characterized as non-PAG. Ore material from Latte is dominantly schist and ore from Double Double and Supremo are dominantly gneiss. Both gneiss and schist ore have low sulphide (S) content and sufficient neutralization potential (NP) to maintain a neutral drainage pH (rinse pH of 6.7 – 8.7). Hence, the schist and gneiss ore are classified as non-PAG or non-reactive and therefore present little to no acid generation in the HLF.

While ore material is non-PAG, the geochemical characteristics and cyanide leaching conditions (e.g., elevated CN and pH) result in significant metal leaching potential if left completely exposed. While not subjected to cyanide leaching, run-of-mine ore on the ROM stockpile also has significant metal leaching potential. To ensure that seepage drainage from the ROM stockpile does not result in poor drainage water quality entering the Facility Pond, stockpiled ore remaining on the ROM stockpile pad will be transferred and stacked onto the heap leach pad during temporary closure. If temporary closure commences when the stockpile is frozen, ROM ore will remain in the stockpile until thawed and then placed on the HLF. It is important that non-frozen ore material is stacked on the heap to maintain thermal integrity of the HLP.

Should the temporary closure scenario require material to be stored on the ROM pad for more than one year, an evaluation will be carried out to determine the long-term attenuation capacity of the ROM stockpile pad for key constituents of concerns (arsenic and uranium). This will inform the suitability of short-term storage on the ROM stockpile or additional mitigation measures that may need to be implemented should this be required.

The primary physical stability concern for the HLF is to ensure that it does not freeze and maintains thermal integrity throughout the temporary closure period. Two primary strategies will be used to minimize the potential for freezing, including:

- Continuous circulation of heap leach solutions to provide a heat source to prevent freezing of the ore pile during sub-zero conditions. Recirculation of solutions also maintains the HLF as a "zero discharge" facility during temporary closure and will eliminate the need for water treatment[12]
- Deployment of raincoats (geomembrane covers) to fully cover the heap to prevent meteoric water infiltration into the heap and excess water accumulation, and provide some insulation to the ore, with the exception of areas under operation, reclamation or for other needs. Raincoat inventory requirements on site will consider the amount necessary for a possible temporary closure scenario in Year 1.

6.4.2 Alpha WRSF

At the end of Year 1, waste rock will have been generated from Latte, Double Double, and Supremo Pits. As indicated above, the majority of mining occurs in Latte and Supremo Pits. Approximately 24.72 Mt of waste rock from Latte Pit and approximately 18.32 Mt of waste rock from Supremo Pit will be placed in the Alpha WRSF. Approximately 1.46 Mt of waste material will be produced from Double Double Pit, which also will report to the Alpha WRSF.

Waste rock from these three open pits is non-PAG but exhibits metal leaching potential. Water balance and water quality modeling has indicated that seepage from the Alpha WRSF can report to Alpha Pond and be discharged directly to Halfway Creek (Lorax 2023b). As such, additional geochemical stabilization measures are not required or anticipated for these facilities during temporary closure. Routine water quality monitoring of Alpha Pond and receiving environment will occur during temporary closure to ensure the predictions of the water quality model remain valid.

A geotechnical engineer will be retained to conduct annual physical stability monitoring of the Alpha WRSF. Any repairs or maintenance of the facility, or improvements to runoff, erosion and sediment control will be undertaken on recommendation from the inspections.

6.4.3 Open Pits

Exposed open pit walls in the Latte, Double Double, and Supremo Pits are predicted to be non-PAG; however, metal leaching from contact with meteoric water will accumulate in pit voids. Water quality modeling has indicated that water accumulating in pit voids can be directly discharged (dewatered on a regular basis, from the Supremo (SU1) at a minimum) to the receiving environment without adversely affecting aquatic life. Therefore, additional geochemical stabilization measures are not required for Latte, Double Double, and Supremo Pits.

A geotechnical engineer will be retained to conduct annual physical stability monitoring of the open pits. Any repairs or maintenance of the facility, or improvements to runoff, erosion and sediment control will be undertaken on recommendation from the inspections.

12 The current HLF water balance model indicates there is enough event storage without needing water treatment during care and maintenance. The event storage requirement includes storage for the PMP applied to the lined area of the HLF, plus volume for a 72-hour draindown.

6.4.4 Water Management Structures – Diversion Ditches, Alpha and Facility Pond

The objective during temporary closure for water management facilities is to ensure short-term physical stability to maintain the integrity of the site-wide water management. Maintenance of open pits and the West Diversion Ditch, if built, will be required to maintain the integrity of these structures. Routine inspections of culverts and ditches will be performed to ensure structure integrity (i.e., no sloughing or blockages), especially after significant precipitation events. Excess sediment that accumulates in the ditches will be excavated to maintain open channels. Prior to freshet, visual inspections of snow and ice accumulation will be performed, and excavation of these materials may be necessary for the ditches and culverts to perform during snowmelt runoff.

The Alpha and Facility Pond will be inspected and maintained to ensure that sediment and/or excess water does not accumulate in the ponds to minimize the potential for overtopping of the facilities and to ensure they are physically stable. Care and maintenance personnel will take readings from staff gauges on a daily basis. Accordingly, all electrical and pumping components will remain operable during the temporary closure period. Sediment excavation will occur on an as needed basis if accumulation is hindering the performance of the facilities.

A geotechnical engineer will be retained to inspect the Alpha and Facility Pond on a routine basis. Any repairs or maintenance of the facility, or improvements to erosion protection of the dam facility will be undertaken on recommendation from the inspections.

6.4.5 Organic and Frozen Soil Stockpiles

Organic material and overburden from pre-stripping within the footprints of Project components will be stored in soil stockpiles. There are no concerns with these stockpiles during temporary closure, and the material is available for use as needed for reclamation activities. Temporary soil stockpiles will have small ditches constructed at their toes, along with installation of silt fences and/or stilling basins to mitigate any erosion potential during temporary closure.

Frozen soils excavated during pre-stripping will be stored in the FSSA. There are no concerns with this stockpile during temporary closure, as a small berm will be in place to contain the FSSA on a routine basis to ensure physical stability. Any repairs or maintenance measures will be undertaken on recommendation from the inspections.

6.5 Interim Water and Solution Management

This section outlines the water management and monitoring-related activities to be undertaken during the two-year hypothetical temporary closure period for key infrastructure including open pits, the HLF, and Facility and Alpha Ponds. Where relevant, management plans are referred to for details pertaining to the management of clean water, contaminated water, or process solutions. In addition, for detailed information pertaining to water management equipment and infrastructure, facility designs and drawings, processes, and flow diagrams, etc., refer to Section 5. Specific details regarding control or shutoff switches for all tanks, pumps, pipelines, and ponds will be provided in as-built drawings after construction and will be referenced in future RCP iterations.

6.5.1 Open Pits

At the end of Year 1, Latte, Supremo (SU1), and Double Double Pits will have voids that will collect meteoric water; neither pit is expected to experience groundwater inflows. Pit dewatering capabilities (e.g., sumps and piping) will remain in place to allow for periodic discharge of pit water collected in Latte, Supremo (SU1), or Double Double Pits to minimize the amount of water collecting in these facilities and allow for an easier transition to mining upon termination of temporary closure, provided discharge water quality criteria are satisfied. All pit dewatering operations will be conducted in accordance with the Water Management Plan.

It is relevant to note that pit dewatering is not a necessary activity for physical or chemical stability of the pits and pit dewatering is not required to prevent uncontrolled pit spillover, except for Supremo as described below. At end of Year 1, Latte, Supremo (SU1), and Double Double have approximately 1,649,000 m^3, 17,000 m^3, and 136,000 m^3 of available pit lake volume, respectively. Meteoric inputs to Latte, Supremo (SU1), and Double Double on an annual basis are on the order of 64,000 m^3 (Latte), 121,500 m^3 (Supremo) and 21,500 m^3 (Double Double), which are well below the available storage volume for the Latte and Double Double Pits. At the end of Year 1, Supremo Pit has a relatively large surface area to storage volume ratio, leading to annual inflow rates that are higher than the available pit void storage. It is anticipated that the Supremo Pit will need to be regularly discharged to the environment or stored on-site for treatment during a temporary closure scenario occurring around Year 1.

6.5.2 Heap Leach Facility

There are two primary objectives for managing the HLF during temporary closure include:

- Ensuring the heap leach does not freeze
- Maintaining the HLF in a “zero discharge” condition.

In accordance with the Heap Leach and Process Facilities Plan, a small operations crew will continue to irrigate the heap with barren solution, collect and store gold-bearing solution, operate gold recovery facilities, and maintain the facility as a zero-discharge facility. Maintenance of HLF infrastructure (e.g., process equipment) will be completed as required during temporary closure.

To avoid freezing of the heap leach and to facilitate year-round HLF operation during temporary closure, operating requirements will be similar to those currently proposed during January through March of each year for routine operations. The following activities will be conducted as required:

- Within three months of a temporary closure event, Newmont will provide regulators with a short term (covering at least 2 years) HLF water balance for solution recirculation, contingency volume, and time available and volume and quality of water required for HLF recirculation. This water balance will consider the maximum possible accumulation to increase conservatism associated with water management predictions.
- Other items that will be considered in the HLF water balance and subsequent risk assessment and strategic planning include but are not limited to: event pond storage volume and duration; rinsing and draindown of HLF as opposed to recirculation.
- Within three months of a temporary closure event, Newmont will provide regulators with an implementation plan for the Water Treatment Plant (if not operational), including execution of the start of a pilot plant program if the Water Treatment Plant is not available.

- If Newmont chooses to cease recirculation, the Water Treatment Plant must be constructed and commissioned.
- Barren solution will be heated November through March of each year.
- Gold-bearing, barren, and wash water will be stored in tanks at the plant (rather than ponds, which will only being used in upset conditions).
- The recirculation of process solutions and recovery of gold will continue until operations resume or a decision is made to cease recirculation. The latter may occur once the water treatment plant has been commissioned if all economically recoverable gold has been processed or if the mine progresses towards permanent closure.
- Monitoring of leak detection systems will continue. An annual water balance will be performed to ensure solutions are not accumulating in the HLF. As a contingency, if solutions are demonstrated to be accumulating in the heap, excess water could be released to EP1 and stored until operations resume, or released following water treatment if the ESR is predicted to be infringed upon.
- Raincoats will be deployed to cover the entire stacked ore portion on the HLP to:
    - Maintain ore and solution temperatures within the heap
    - Eliminate dust generation in windy conditions
    - Eliminate or minimize precipitation infiltration into the heap to avoid surplus of water and the associated need to treat for discharge
    - Maximize runoff for storage for later use as make-up water or discharge as non-contact water depending on operational water needs.

A temporary closure scenario was evaluated through the HLF Water Balance Model to assess heap solution buildup within the event ponds and potential water treatment needs should temporary closure occur prior to when the water treatment plant would be commissioned in Year 2. The outcome of the water balance model predicts that, for the period of temporary closure prior to when the water treatment plant is available, the ponds would contain approximately 160,000m^3 of solution, which is within the pond storage volume available for operations. In this scenario, the pond volume infringes upon the event storage requirement (ESR) in Year 10, and overflows in Year 18, if it is maintained as a ”zero discharge” facility. Additional details are provided in the Contingency Water Treatment Plan (WesTech 2023), appended to the Heap Leach and Process Facilities Plan.

6.5.3 Facility and Alpha Ponds

Water management infrastructure will be operated, maintained, and monitored in accordance with license requirements and the Water Management Plan. During temporary closure, monitoring of discharge water quality and downstream water quality will be conducted in accordance with Operation Phase requirements outlined in the Water Management Plan and the EMAMP.

In the Facility Pond, pumping systems will remain in place to allow for control of water volumes in the ponds. Water collected in the Facility Pond during temporary closure will primarily come from runoff of the plant site area. As outlined above, stockpiled ROM ore will be removed and stacked onto the heap leach pad at the onset of temporary closure. Water that meets discharge water quality standards will be periodically released to either the Latte catchment or pumped to Halfway Creek and Alpha Pond.

In Alpha Pond, pumping systems will be maintained to avoid the potential for overtopping of this facility during temporary closure. Discharge rates (linked to flow conditions in Halfway Creek) will be detailed in the Water Management Plan. Water management infrastructure details including process flow diagrams and shut off switches will be provided in future RCP iterations.

6.6 Reporting and Monitoring Requirements

This section summarizes reporting, monitoring, and maintenance requirements during the hypothetical temporary closure period. It is anticipated that at the onset of a temporary closure period, Newmont will submit a notice of closure within a specified period to the appropriate regulators, Project partners, and stakeholders (as dictated by licenses). The notice of closure will describe the following:

- Reasons for and anticipated duration of the suspension of operations
- Actions that will be taken to maintain compliance with mine licenses and permits
- Any events which would reasonably be anticipated to result in the resumption of mining or the permanent closure of the mine.

In addition, Newmont will submit to the appropriate authorities an updated Reclamation and Closure Plan early in the temporary closure period. This updated plan will document any anticipated increases in liability associated with temporary closure, or costs incurred for implementing temporary closure, and will provide an environmental monitoring, management and reporting plan that is consistent with site authorizations. The plan will be implemented to ensure that the site remains secure and stable, and to demonstrate that the site continues to meet performance expectations.

During temporary closure, regular inspections will be conducted to confirm compliance with applicable permits and licenses. Once permit requirements for inspections are known, a detailed inspection frequency schedule will be provided to stakeholders and First Nations. Infrastructure such as the Alpha WRSF, HLF and process facilities, open pits, water management infrastructure, fuel and storage tanks, and all roads (including the NAR) will be inspected to confirm physical stability and integrity. Care and maintenance personnel will coordinate follow-up investigations by appropriate professionals, as necessary. The key management plans that are relevant to facility and infrastructure performance during temporary closure are listed below. In addition, management plans that are relevant to monitoring and maintenance requirements in order to ensure that the site is secure and safe, to minimize health and safety risks, and to remain in compliance with all regulatory and licensing requirements, are listed below.

- Access Route Operation Management Plan
- Air Quality and Greenhouse Gas Management Plan
- Cyanide Management Plan
- Environmental Monitoring and Adaptive Management Plan
- Erosion and Sediment Control Plan
- Explosives Management Plan
- General Mine Development Plan
- Hazardous Materials and Waste Management Plan
- Heap Leach and Process Facilities Plan
- Mine Operations Plan

- Noise Management Plan
- Spill Contingency Plan
- Vegetation Protection Plan
- Waste Rock and Overburden Management Plan
- Wildlife Protection Plan
- Water Management Plan.

Annual geotechnical inspections of the HLF, WRSF, open pit walls, all contact and non-contact water management infrastructure, and any other surface infrastructure elements possibly affecting permafrost will be carried out by a qualified geotechnical engineer licensed to practice in the Yukon. Any repairs or maintenance of the infrastructure or facilities, or improvements to runoff, erosion and sediment control measures will be undertaken and documented on recommendation from the inspections.

Climate, surface water quality, hydrology, groundwater, and biological components will be monitored at designated stations in accordance with the license conditions, generally as per the monitoring program outlined for the Operation Phase in the EMAMP. Care and maintenance personnel will coordinate and support professionals in conducting some elements of the monitoring program, such as non-routine water quality and biological monitoring, as necessary.

Table 6-3 summarizes monitoring and surveillance activity details by mine component. Observed physical changes on the site may warrant a follow-up investigation by appropriate care and maintenance personnel, or specialized contractors or consultants.

Table 6-3 Temporary Closure Monitoring and Surveillance Activity Details by Mine Component

Mine Component	Type of Inspection	Frequency	Responsible Person	Deliverable
Open Pits	Geotechnical	Quarterly	Geotechnical Engineer (Yukon P.Eng)	Inspection Report
	Water Level and General Visual Inspection	Weekly	Care and Maintenance Personnel	Weekly Log, included in Monthly and Annual Reports
	Automated water level reading	Daily	Care and Maintenance Personnel	Electronically stored and reported in Quarterly and Annual reports
Heap Leach Facility	Geotechnical / Detailed per HLF OMS	Per HLF OMS	Per HLF OMS	Per HLF OMS
Waste Rock Storage Facilities	Geotechnical	Bi-annual	Geotechnical Engineer (Yukon P.Eng)	Inspection Report
	General Visual Inspection	Weekly	Care and Maintenance Personnel	Daily Log, included in Monthly and Annual Reports
	Visual Inspection	Event driven	Care and Maintenance Personnel	Included in Annual Reports
	Instrument Readings	Monthly	Environmental Monitors	Included in Annual Reports
Water Management Infrastructure	General Visual Inspection	Weekly	Care and Maintenance Personnel	N/A
	Visual Inspection	Event driven	Care and Maintenance Personnel	Included in Annual Reports
	Instrument Readings	Monthly	Environmental Monitors	Included in Annual Reports
	Inspection of Ice, Blockages	Annual, prior to freshet	Care and Maintenance Personnel	Inspection Report
	Water Samples	As per permitting requirements	Environmental Monitors	Daily Log, included in Monthly and Annual Reports
	Geotechnical / Detailed	Annual	Geotechnical Engineer (Yukon P.Eng)	Inspection Report
Fuel Storage Facility	General Visual Inspection	Weekly	Care and Maintenance Personnel	Inspection Reports
	Tank Dips	Monthly	Care and Maintenance	Tank Inventory Logs

Mine Component	Type of Inspection	Frequency	Responsible Person	Deliverable
Equipment Laydowns including Mobile Equipment	General Visual Inspection	Weekly	Environmental Monitors	Inspection Reports
Land Treatment Facility	Soil Samples	As per permitting requirements	Environmental Monitors	Sample Log and Annual Reports
Waste Management Area and Hazardous Materials Storage Area	General Visual Inspection	Weekly	Care and Maintenance Personnel	Inspection Reports
Site Roads (including the NAR)	General Visual Inspection	Weekly	Care and Maintenance Personnel	Inspection Reports
Pumps / Pipelines	Confirmation of Operation	Daily for operating pumps	Care and Maintenance Personnel	N/A
	Check for Flow and Absence Leaks	Weekly for operating pipelines	Care and Maintenance Personnel	N/A
Buildings and Structures	Structural Inspection	Annual or as required prior to access	Structural Engineer (Yukon P.Eng)	Inspection Report
	Industrial Hygiene	Prior to any resumed occupancy	Contractor	Inspection Report

6.7 Socio-Economic and Community Engagement Aspects of Temporary Closure

Temporary closure has the potential to reduce the Project's direct workforce, as well as business activity from suppliers, who in turn reduce economic activity in the Project's area of influence. The hypothetical two-year temporary closure scenario described above has been used to identify socioeconomic aspects of, and management actions for, temporary closure.

6.7.1 Management of Socio-economic Aspects of Temporary Closure

Temporary closure and permanent closure have similarities, but the management of socio-economic aspects during a temporary closure period differ in some important ways:

- In general, a mine operator does not have the same amount of time to prepare itself for temporary closure as it does for permanent closure. Therefore, there is less lead time to notify key communities and partners such as workers, suppliers, First Nations partners and governments that share revenue, etc., hence, timeframes to manage the socio-economic aspects of temporary closure, including related consultation and engagement, are more compressed at the beginning of a temporary closure period. For this type of hypothetical scenario, market conditions will ultimately determine the timing and length of temporary closure.
- Temporary closure periods are often of an uncertain length, leaving communities, government organizations, and businesses unsure as to how much time and energy to place into shorter-term coping strategies. Therefore, a period of temporary closure involves repeated and/or ongoing engagement to share information with key stakeholders and communities as this information becomes available.

Table 6-4 describes various potential aspects of temporary closure related to socio-economic components and ways in which they could be managed, as well as the various responsibilities for management activities, acknowledging the roles of various groups and parties in the socio-economic context.

Table 6-4 Management of Socio-economic Aspects of Temporary Closure

Valued Socio-economic Component	Potential Direct and/or Indirect Socio-economic Effect from Temporary Closure	Proposed Activities to Manage Potential Socio-economic Effects of Temporary Closure	Proposed Timeframe for Management Activities
Demographics	Changes in populations in the local area as direct and indirect workforce is unsure of employment status and relocates for longer-term employment	Newmont: Share information as soon as possible with First Nations and municipal planners on timing and nature of the temporary closure period. Inform Health and Social Services of the temporary closure as soon as possible and inform them of services that Newmont has in place for affected employees as well as implications outside of Newmont's ability to support. First Nation governments and municipal planners: Ask questions and participate in conversations on workforce	Engagement to begin as soon as a temporary closure is certain to occur. Quarterly meetings to take place during the temporary closure period.
Economic Conditions	Temporary decrease in direct and indirect employment Temporary decrease in Project-related purchases of goods and services Temporary changes to mine-related revenue (royalties and taxes)	**Newmont:** Share information promptly and transparently with potentially affected parties and First Nations, as well as with Health and Social Services, about extent and nature of reductions to workforce and purchases of goods and services. Engage proactively with any parties potentially affected by changes to royalties and taxes. Create a Workforce Transition Strategy to provide information to employees and contractors. Define approach to incentivizing retention of existing staff during the period between announcement and start of temporary closure period. Incorporate temporary-closure-related financial literacy support for workers through the Employee Assistance Program. **Workers and suppliers:** Participate in conversations with Newmont about timing and anticipated length of temporary closure period. Other mining companies: Participate in conversations with Newmont about how to align workforce needs related to temporary closure. **First Nations, territorial, and municipal governments, and local communities:** Participate in conversations about potential effects of temporary closure. Ask questions and raise concerns, as needed.	Engagement to begin as soon as a temporary closure is certain to occur with the following: • Workers • First Nations and other communities • Goods and service suppliers • Territorial and municipal governments • Other mining companies Quarterly meetings to take place during the temporary closure period.

Valued Socio-economic Component	Potential Direct and/or Indirect Socio-economic Effect from Temporary Closure	Proposed Activities to Manage Potential Socio-economic Effects of Temporary Closure	Proposed Timeframe for Management Activities
Social Economy	Temporary increase in non-wage (bartering goods and services, land-based subsistence) and traditional economic activities as a result of a reduction in workforce	**Newmont:** Reinforce the message that site access during Temporary Closure remains the same as during Operations. Develop and share plain language communication materials about the temporary closure period (when, why, how) that includes key contact information and information about access restrictions. **First Nations and local communities:** Participate in conversations about potential effects of temporary closure. Ask questions and raise concerns, as needed.	Distribute plain language temporary closure information to interested parties within one month of notifying of imminent period of temporary closure. Engage communities and First Nations on temporary closure.
Infrastructure and Services	Temporary increase in demand for community-based career services Temporary increase in demand for community services related to health and wellbeing (e.g., prevention of depression, substance abuse)	**Newmont:** Identify community-based partners who may be receiving regular community support either in financial or in-kind donation and ensure that they are informed of any potential changes to the level of support. Develop and share plain language communication materials about the temporary closure period (when, why, how) that includes contact information for support services and key Newmont contacts. **Community-based service providers (careers and community health and well-being):** Participate in conversations about potential effects of temporary closure. Ask questions and raise concerns, as needed.	Distribute temporary closure information to interested parties within one month of notifying of imminent period of temporary closure. Quarterly meetings to take place during the temporary closure period.
Education Services	Temporary increase in demand for industry-related training as workers retrain for potential career changes	**Newmont:** Share information about the extent and nature of reductions to the workforce with education service providers and request feedback regarding available training programs. Develop and share plain language communication materials about the temporary closure period (when, why, how) that includes contact information for education services providers and key Newmont contacts. **Yukon University and other training providers, TH Human Resources & Education Department, SFN Citizen Development Department, WRFN Employment and Training Department, FNNND Education and Training Department, Yukon Department of Advanced Education:** Participate in conversations about potential effects of temporary closure. Ask questions and raise concerns, as needed. Provide feedback to Newmont regarding available training programs.	Distribute temporary closure information to interested parties within one month of notifying of imminent period of temporary closure. Quarterly meetings to take place during the temporary closure period.

Valued Socio-economic Component	Potential Direct and/or Indirect Socio-economic Effect from Temporary Closure	Proposed Activities to Manage Potential Socio-economic Effects of Temporary Closure	Proposed Timeframe for Management Activities
Land and Resource Use	Temporary increase in time for and interest in land and resource use activities due to increased time available	**Newmont:** Share information with land and resource users. Increase signage and/or other forms of notification about access restrictions. Monitor potential trespass events and adapt access controls as needed. Develop and share plain language communication materials about the temporary closure period (when, why, how) that includes key contact information and information about access restrictions. **Trapline holders and other resource users:** Participate in engagement events and share concerns as needed.	Distribute temporary closure information to interested parties within one month of notifying of imminent period of temporary closure. Quarterly meetings to take place during the temporary closure period. Review trespass and potential trespass events monthly.
Community Health and Well-being	Temporary increase in mental and physical health concerns (depression, substance abuse, etc.) related to uncertainty in professional future	**Newmont:** Share information with service providers about the extent and nature of reductions to the workforce and request feedback regarding available health services or programs. Develop and share plain language communication materials about the temporary closure period (when, why, how) that includes contact information for support services. **First Nations, municipal, and territorial governments:** Participate in conversations about potential effects of temporary closure. Ask questions and raise concerns, as needed. Provide feedback to Newmont regarding any updates or changes to available health services or programs.	Distribute information to employees and interested parties within one month of notifying of imminent period of temporary closure. Quarterly meetings to take place during the temporary closure period.
Heritage	No effects to tangible heritage foreseen as a result of temporary closure	No specific actions foreseen	Not applicable

6.7.2 Managing Community Perceptions through Engagement Focused on Temporary Closure Period

Temporary closure may create community misconceptions regarding the nature of closure, the activities permitted on site during temporary closure and the on-going care and maintenance activities conducted during temporary closure. Newmont can pre-empt any misperceptions through targeted engagement and transparent communication. Table 6-5 outlines the various topics and groups Newmont anticipates that it will engage with at the onset of a temporary closure period.

Table 6-5 Engagement to Disseminate Temporary Closure Information

Topic Related to Temporary Closure	Reason to Engage	Groups to Engage	Proposed Engagement Method and Timing
Site access	Potential perception that temporary closure means that pre-development land access can occur. Site access presents human health and safety risks.	Trapline holders First Nations Governments	Develop plain language communication materials about the temporary closure period (when, why, how) that includes contact information and information about access restrictions. Distribute information within one month of notifying of imminent period of temporary closure.
Environmental conditions at site	Potential misperceptions about environmental or health/safety conditions at site could negatively affect Newmont's public image and trust as an operator.	Public at large	Provide ongoing updates through website and annual plain language communication materials that includes environmental monitoring results. Periodic employee highlights on website to communicate ongoing monitoring and compliance reporting activities.
Ability to respond to an accident or malfunction	Potential perception that Newmont would not have the workforce or funding available to respond to or remediate the site should an accident or malfunction occur.	Public at large	Provide ongoing updates through website and annual plain language communication materials that include environmental monitoring results. Periodic employee highlights on website to communicate ongoing site maintenance and oversight.
Communities feel abandoned	Potential perception that Newmont is abandoning the communities in the local area.	Communities and Public at large	Develop and disseminate annual plain language communication materials about the temporary closure period to explain site status, ongoing monitoring and maintenance activities, a summary of environmental monitoring results, and key contact information.
Concern about status of legacy projects	Potential perception that Newmont-funded legacy projects will not be completed.	Communities	Communication with recipients regarding legacy project funding and project status.

6.7.3 Community Commitments, Partnerships and Agreements

Newmont has developed several internal standards to guide the development of beneficial and strategic partnerships as part of mine planning and execution. In alignment with these standards, Newmont is committed to considering the potential for closure events to affect community investments, partnerships, and agreements. These standards include:

- Community Investment and Development Standard
- Indigenous Peoples Standard
- Local Procurement & Employment Standard
- Social Baseline & Impact Assessment Standard
- Stakeholder Relationship Management Standard.

In addition, Newmont is committed to transparent communication with stakeholders as well as respect for all cultures in alignment with the Newmont Internal Sustainability and Stakeholder Engagement Policy. Newmont will respect all bi-lateral agreements with First Nations, and bi-lateral dialogues will be established to ensure commitments to First Nations are upheld. The following sections describe Newmont's approach to implementing these standards in the event of a two-year temporary closure period.

6.7.4 Community Investments

Newmont is committed to reducing potential negative effects to local communities and organizations as a result of temporary closure of the Coffee Gold Mine and the voluntary community investments Newmont may make. Newmont will manage potentially adverse outcomes in two ways:

- **Preventive management:** Newmont will enter into community investment commitments considering whether the partner organization has other sources of funding and will define an exit strategy for its financial participation. Newmont will enter into community investment partnerships that have a low probability of increasing a partner organization's financial vulnerability in the event of temporary closure.
- **Ongoing engagement:** community investment partners with ongoing or preceding commitments will be engaged before and during the temporary closure period to discuss and determine if or how the partner has the potential to be affected.

6.7.5 Community Partnerships and Agreements

Newmont structures its agreements to include considerations that account for a temporary closure event. The contents of these agreements are confidential.

6.7.6 Socio-economic Monitoring and Evaluation During Temporary Closure Period

Socio-economic monitoring during a temporary closure period will focus on a limited number of topics:

- Number of trespass events and potential safety-related issues
- Number and types of complaints received through an established feedback mechanism regarding the management of temporary closure.

7.0 FINAL RECLAMATION AND CLOSURE MEASURES

This section of the RCP describes the specific final reclamation and closure measures that will be implemented for mine components during the Closure Phase, additional requirements for waste management, maintenance, monitoring, and reporting anticipated for the Closure and Post-closure Phases, socio-economic aspects related to the Closure and Post-closure Phases, and how performance uncertainty and risks will be managed during the Closure Phase.

The closure activities that are anticipated to occur within each Project phase are described below. The Project will advance to the Post-mining Closure Phase once mining activities cease, and recirculation of the HLF for rinsing and final gold recovery is initiated. The site will progress from the Post-mining Closure Phase to the Active Closure Phase once the on-site water quality is determined to have achieved applicable standards allowing for operational water management infrastructure decommissioning activities to commence. The Post-closure Phase will be initiated once water management and required site access infrastructure has been decommissioned, and post-closure monitoring and maintenance activities commence.

During the Closure Phase, numerous personnel will be on site year-round as required, as the key activities for each Project phase will include:

- Operation Phase (Year-1 to Year 9):
  - Implementation of the reclamation research program.
  - Continuous salvage and stockpile of reclamation material.
  - Progressive reclamation of areas no longer required for operations.
  - Progressive regrading of the HLF.
  - Progressive regarding of the WRSF.
  - Progressive closure of haul and mine site roads no longer required to support operations.
  - Reclamation of exploration areas.
  - Regular removal of recyclable / salvageable material and equipment.
  - Progressive complete backfill of Kona and Double Double Pits.
  - Partial backfill of Latte and Supremo Pits.
  - Installation of water treatment facility at the Plant Site and commencement of water treatment of surplus water.
- Post-mining Closure Phase (Year 10 to Year 15):
  - HLF recirculation for rinsing and final gold recovery.
  - Cover construction and revegetation of rinsed areas of the heap.
  - Continued water treatment of draindown rinse water from HLF stages.
  - Reclamation of disturbed areas within the Mine Site footprint that are no longer required to support closure activities, including the crusher system and ROM stockpile area, using overburden salvaged and stockpiled during mine site development and operations.
  - Equipment removed from service, cleaned, and demobilized from site, or landfilled if material is included on the approved landfill item list when no longer required to support closure and reclamation activities.

- Closure of Latte Pit and Supremo Pit by allowing them to flood and placing boulder fences at the pit rims.
- Reclamation of the soil stockpile area footprint(s) once stockpiled materials have been used.
- Reclamation of the frozen soil storage area footprint once stockpiled materials have been used.
- Reclamation of the ROM stockpile area.
- Contaminated sites investigation within the areas of fuel storage and transfer, equipment laydowns, and the bulk explosives storage area to determine the presence and/or extent of soil contamination.
- Excavation of any contaminated soil followed by either on-site treatment or temporary storage and removal off-site.
- If required, construction and commissioning of passive water treatment system for the HLF.
- Continue routine monthly, annual, and event-driven monitoring at conveyance structures and sedimentation ponds and their dams for stability, signs of seepage, blockage due to ice or foreign debris and significant erosion, or damage to any geosynthetic components.
- Continued operation of water conveyance structures and sedimentation ponds until water quality in the ponds have stabilized.
- Continue monitoring of surface water quality and infrastructure in accordance with conditions of the WUL and QML.

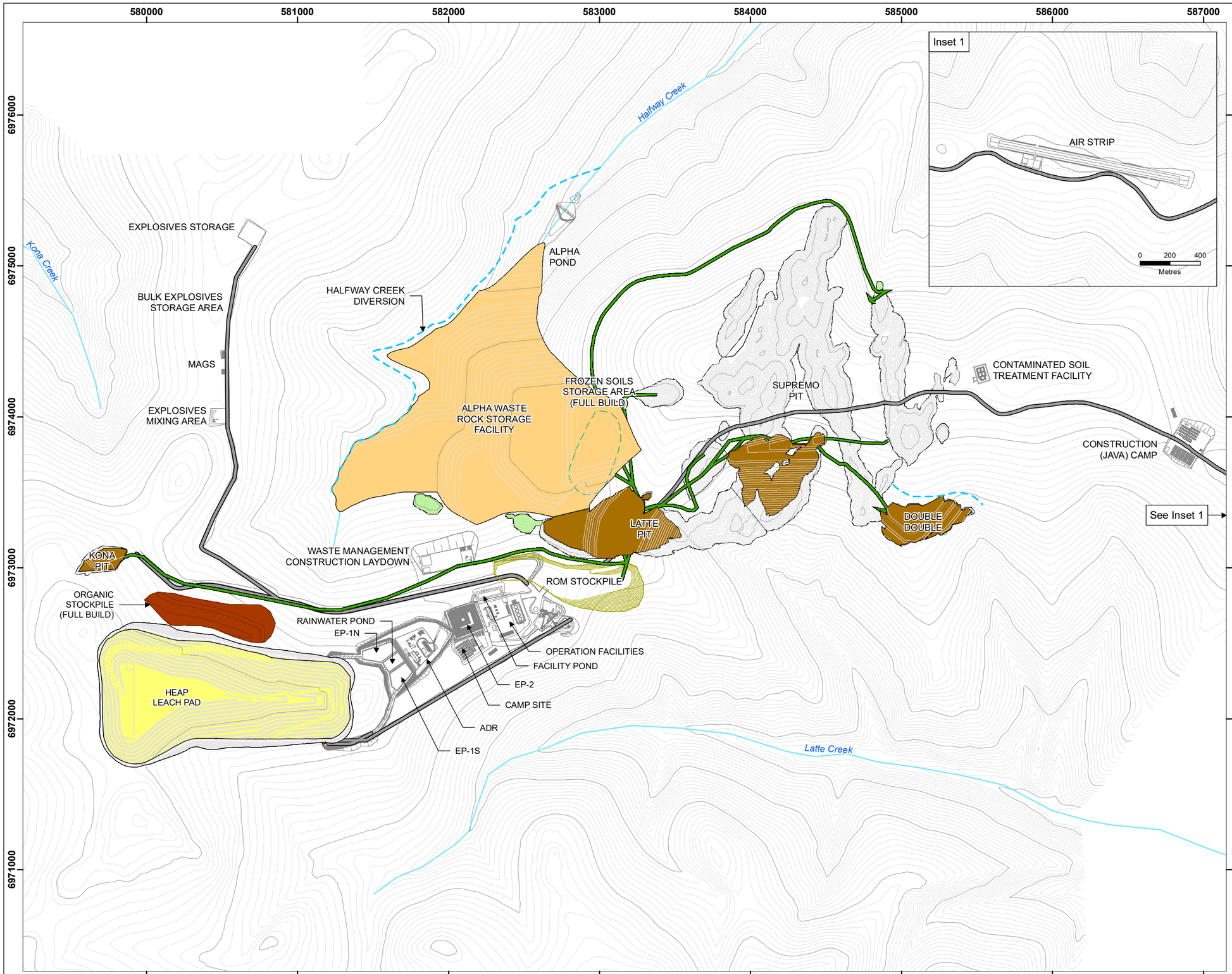
- Active Closure Phase (Year 16 to Year 21);
  - If draindown rinse water from HLF requires passive treatment, continue active water treatment during passive water treatment system commissioning and until HLF water quality has been sufficiently treated to qualify for passive treatment.
    - Once water quality in the sedimentation ponds has stabilized: Decommissioning of water conveyance structures
    - Decommissioning of the Facility Pond
    - Decommissioning of the Alpha Dam/Pond by breaching the dam and constructing a drainage pathway through the footprint of the former dam.
  - Re-grading the West Diversion Ditch to slope and re-establishing drainage patterns to match pre-mining conditions to the extent practical.
  - Dismantling process plant, reagent storage area, laboratory, truck shop and warehouse building, and bulk fuel storage and LNG storage facility infrastructure at the Plant site, as well as decommissioning of the bulk explosives storage area and water management infrastructure that is no longer needed.
  - Dismantling and removal of dormitories and kitchen, dining, mudroom, and recreation complex buildings, emergency response team building, mine dry and office complex, fresh (potable) water and fire water systems, sewage treatment plant, and waste management building at the Camp Site. This work will be done progressively to support reclamation activities, with a section of the Project camp remaining in place until final demolition and demobilization.
  - Dismantling final reclamation infrastructure including active water treatment plant and power plant once no longer required.
  - Decommissioning and reclamation of new road sections along the NAR, barge landings, the On-site Access Road, Mine Site roads, and the Project airstrip.

  - Dismantling of the Java Camp.
  - Continue monitoring of surface water quality and infrastructure in accordance with conditions of the WUL and QML.
- Post-closure Phase (Year 21 onward);
  - Passive water treatment, if required.
  - Post-closure monitoring and site maintenance.

The general arrangement of Project components within the Mine Site area at the commencement (Year 10) and end (Year 21) of the Closure Phase are shown in Figure 7-1 and Figure 7-2, respectively. Details pertaining to all Project and ancillary components, as well as the extent of disturbance occurring at the start of Year 10, are provided in Section 5.

COFFEE GOLD MINE

Mine General Arrangement at Beginning of Closure Phase (Year 10)



Legend

- Site Feature
- Access Road
- Watercourse
- Diversion Berm
- Haul Road
- Active Pit
- Pit Footprint
- Waste Rock Storage Facility
- Pit Backfill
- Heap Stack

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory

N

1:25,000

0 200 400 600 800 1,000

Metres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

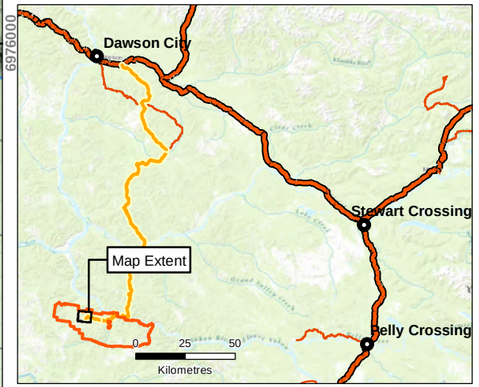
Figure 7-1	Date: Aug 23, 2023	Drawn by: AS	Reviewed: KP

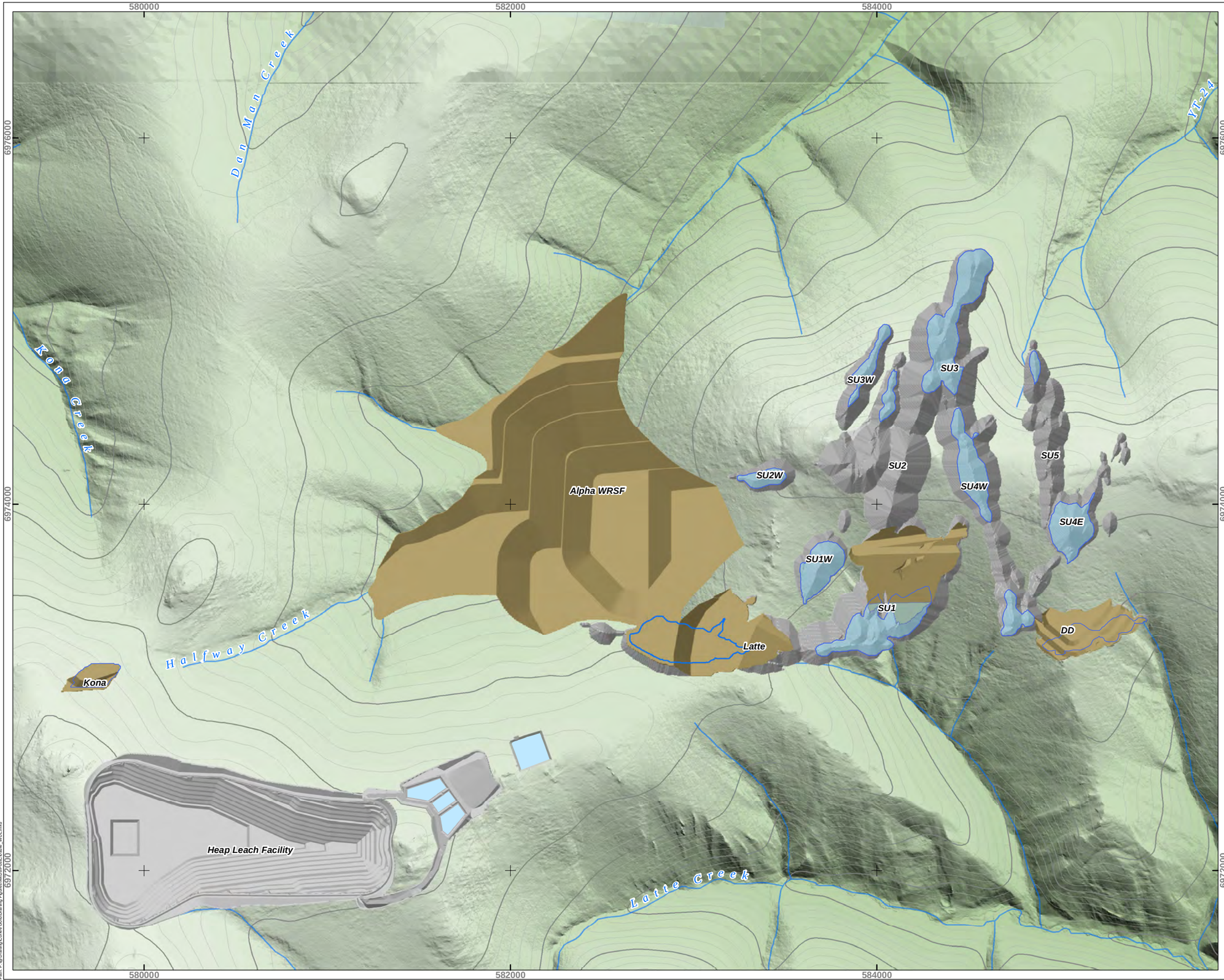
Newmont COFFEE

Path: S:\Geomatics\Projects\10362\2d\mxd\MPM\ROMP\Fig3_103862_03_Life_of_Mine_230609.mxd

COFFEE GOLD MINE

Location of Open Pit Lakes Post-Closure





Legend

- Municipalities
- Waterbody
- Watercourse

N

1:20,000

0 400 800 1,200

Meters

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 7-2	Date: Aug 10, 2022	Drawn by: AL	Reviewed: SJ/DF

Newmont COFFEE

Path: P:\@Drafting\Coffee Gold\Drafting Figures\MxD\Post Closure_WUL.mxd

7.1 Open Pits

For open pits, the YWB and EMR (2013) performance targets for closure are to meet water management objectives, protect humans and wildlife from topographic hazards, and prevent subsidence. In general, the information that is required shall demonstrate expected performance and/or management measures pertaining to pit stability, backfilling, surface water management and sediment control, and minimizing safety risks while meeting the requirements of the Yukon *Workplace Health and Safety Regulations*. In addition, pit water quality predictions and long-term predictions of loading to receiving waters (including interactions between pits and local groundwater) is required, as well as descriptions of pits being used to support site water management/treatment activities.

Since Kona and Double Double Pits are completely backfilled during the Operation Phase, this section presents information primarily for the Latte and Supremo Pits, which at the start of the Closure Phase in Year 10, will have been partially backfilled to support mine operations. Additional backfilling during closure of these pits is not currently proposed; however, further evaluations as the mine plan advances may require modifications to the proposed base case closure design. Pit design details and the results of stability analyses are provided in Section 5.3.1. Pit instability risks during the Closure and Post-closure Phases will be minimized by adhering to pit closure designs.

7.1.1 Pit Lakes and Water Quality Predictions

A total of nine pit lakes are predicted to develop once mining activities ceases, as shown on Figure 7-2. The generalized flow paths of pit spill directions and general groundwater catchments during the Post-closure Phase are shown on Figure 7-3. Figure 7-4 illustrates the anticipated timelines for pit development and management activities (i.e., dewatering during mining), and the duration of pit filling to the spill or decant elevation.

Table 7-1 presents the water volume capacity in each pit (assuming no additional backfill is placed in the pits post-mining), the spill elevation, and the approximate year (or range of years) that spilling is projected to occur. The elevation is in metres above sea level (masl). Pits Latte East, SU1, SU2W, SU3W, SU4W and SU5 are predicted to reach the spill elevation near the end of the Operation Phase due to their small size and timing of development. Although a lake will not form in the Double Double Pit or the Kona Pit as they will be backfilled, meteoric water will collect in the pore spaces. Surface runoff from the Double Double Pit backfill will report to Latte Creek, and runoff from the Kona Pit backfill will report to Halfway Creek via the Alpha WRSF rock drain.

Pit water quality predictions from the Water Quality Model (WQM) are presented for Base Case conditions and for Upper Case conditions in the Water Quality Model Report (Lorax 2023b). Predictions of downstream water quality at receiving environment are also provided in the Water Quality Model Report (Lorax 2023b). Predictions are provided for sulphate, nutrients (ammonia, nitrite, nitrate, total phosphorus), weak acid dissociable (WAD) cyanide, dissolved aluminum, and total metals.

Based on the pit lake and receiving environment water quality predictions, water treatment is not predicted to be required for any pit.

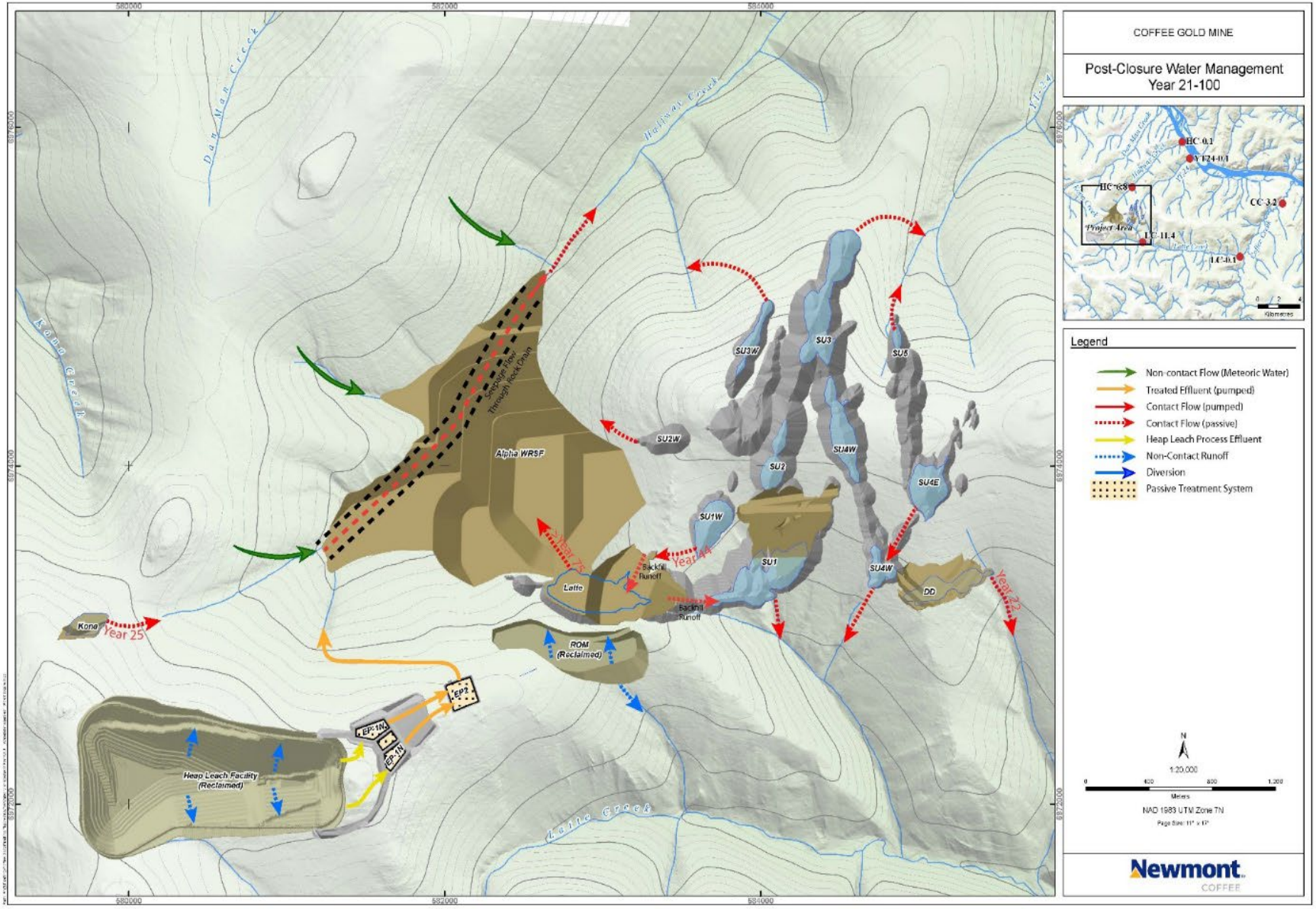
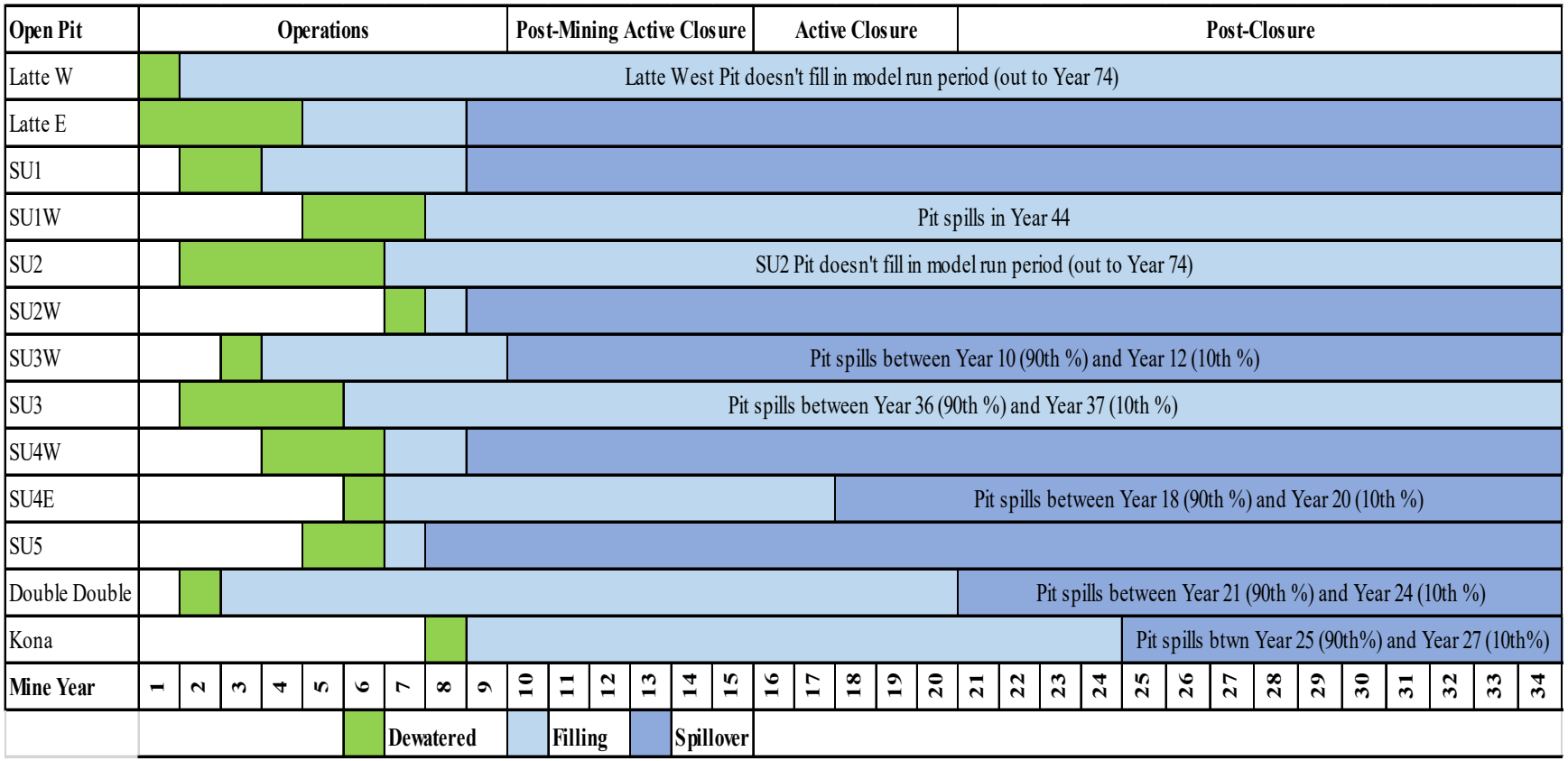


Figure 7-3 Pit Lake Schematic for Post-closure Phase



Percentile ranges for predicted spill dates are provided where this is not predicted to occur in the same year by all model iterations

Figure 7-4 Open Pit Dewatering Schedule and Predicted Years to Spillover Elevation

Table 7-1 Water Volume Capacity, Spill Elevation, and Predicted Spill Date for Pits Post-Mining

Pit Name	Pit Water Capacity (m^3) to Spill Elevation[1]	Spill Elevation (masl)	Predicted Spill Date[2]
Latte East[3]	1,416,400	954	Year 9
Latte West	1,160,000	1,030	>Year 2100
SU1[3]	1,416,400	954	Year 9
SU1W	2,200,000	1,090	Year 44
SU2	1,360,751	1,130	>Year 2100
SU2W (no lake)[4]	NA	NA	Year 9
SU3	502,898	1,090	Year 36 to 37
SU3W	168,729	1,190	Year 10 to 12
SU4W	255,800	1,044	Year 9
SU4E	306,780	1,147	Year 18 to 20
SU5	88,416	1,204	Year 8
Double Double (no lake)	399,390	1,044	Year 21 to 24
Kona (no lake)	249,417	1,230	Year 25 to 27

[1] Total pit shell volume including backfill pore space
[2] Range of predicted spill dates based on the 10th and 90th percentile model outputs
[3] Latte East and SU1 form a combined pit lake
[4] SU2W has no pit void below the spill elevation, therefore a pit lake does not form in this pit

7.1.2 Surface Discharge from Pit Lakes

Discharge rates from the pit lakes, as well as from the backfilled Kona and Double Double Pits are outlined in this section. Discharge rates for both surface and groundwater flows are provided in litres/second, and the range of predicted surface flows are summarized for the average, 10th and 90th percentiles from the multi-iteration model outputs. Note that because the Base Case model assumes that the baseline site climate regime is altered by climate change (i.e., the RCP6.0 scenario), the monthly flow distributions presented here are shifted earlier in the year by the projected warmer spring temperatures later in this century.

7.1.2.1 Latte East and West

The Latte West Pit is not predicted to fill to the spill elevation over the course of the model run (*i.e.*, out to calendar year 2100; Figure 7-5). The Latte East Pit is predicted to fill to the spill elevation by Year 5 (2031; Table 7-1; Figure 7-5), with average monthly predicted surface flows ranging from 0.25 L/s in November to 13.25 L/s in April (Table 7-2 and Figure 7-6).

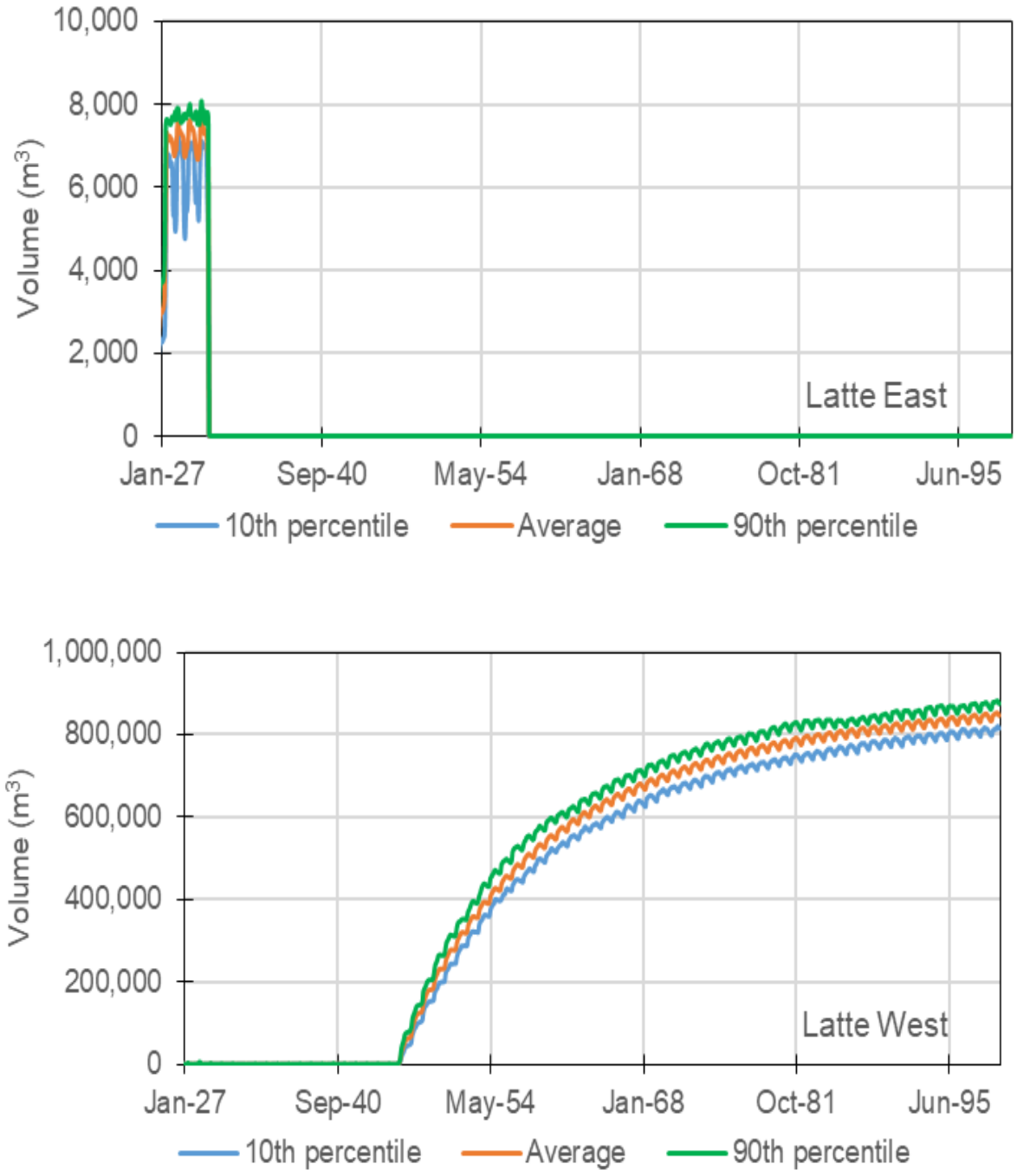


Figure 7-5 Latte East and Latte West Pit Lake Volumes

Table 7-2 Latte East Pit Lake Surface Discharge Rates (L/s)

Month	10th %	Average	90th %
Jan	0.03	0.83	2.35
Feb	0.02	0.55	1.35
Mar	0.03	2.20	6.13
Apr	5.66	13.25	23.15
May	3.01	7.04	11.41
Jun	2.15	6.15	10.29
Jul	1.58	6.87	12.91
Aug	2.47	6.27	9.81
Sep	1.58	4.03	6.67
Oct	0.91	3.46	7.08
Nov	0.04	0.25	0.60
Dec	0.02	0.39	1.07

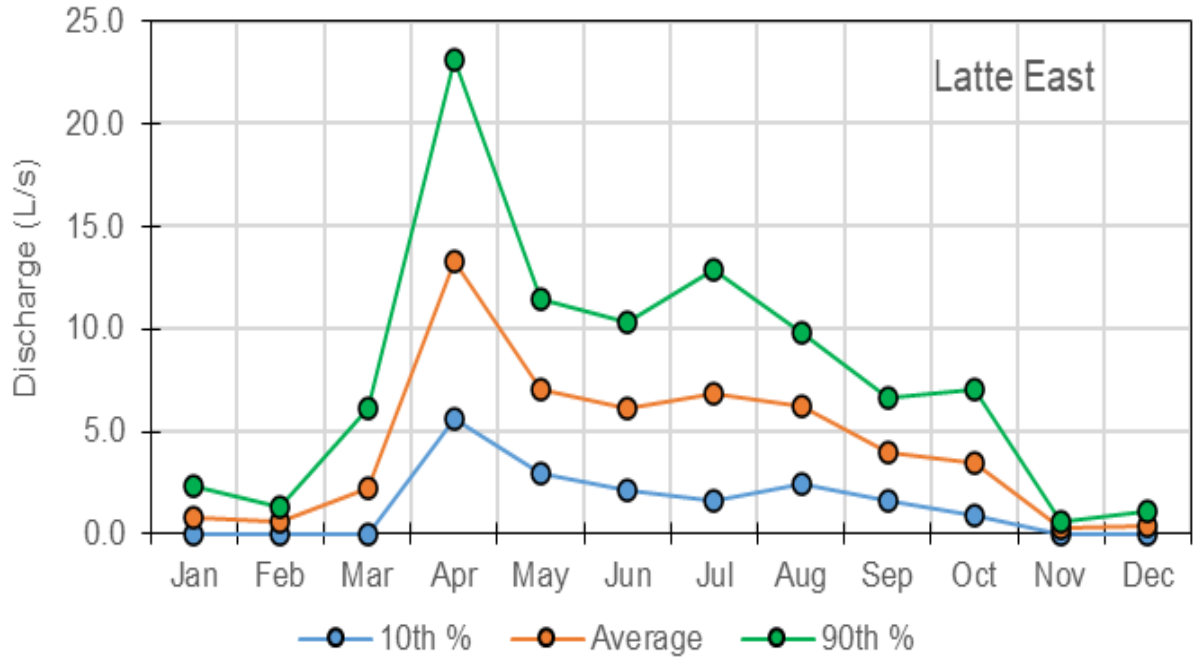


Figure 7-6 Latte East Pit Lake Surface Discharge Rates

7.1.2.2 Supremo

For the eight Supremo pit lakes, information is provided below on expected dates of pit lake spilling, discharge rates to surface waters, and flow routing to receiving streams.

SU1 and SU1W Pit Lakes

The SU1 pit lake, situated in the topographic low of the Supremo Pit complex, will receive runoff from non-contact and contact areas (including SU1W, SU2, in pit WRSF infiltration, and seepage from the Latte East Pit Lake). This pit lake will spill directly to Latte Creek.

The SU1 pit lake is predicted to reach the spill elevation in Year 8 (2034), while the SU1W pit lake is expected to reach the spill elevation in Year 44 (2070; Figure 7-7). Average monthly surface discharges from these pit lakes are predicted to range from 0.45 to 33.4 L/s, and 0.17 to 6.7 L/s, for the SU1 and SU1W Pits, respectively (Table 7-3 and Figure 7-8).

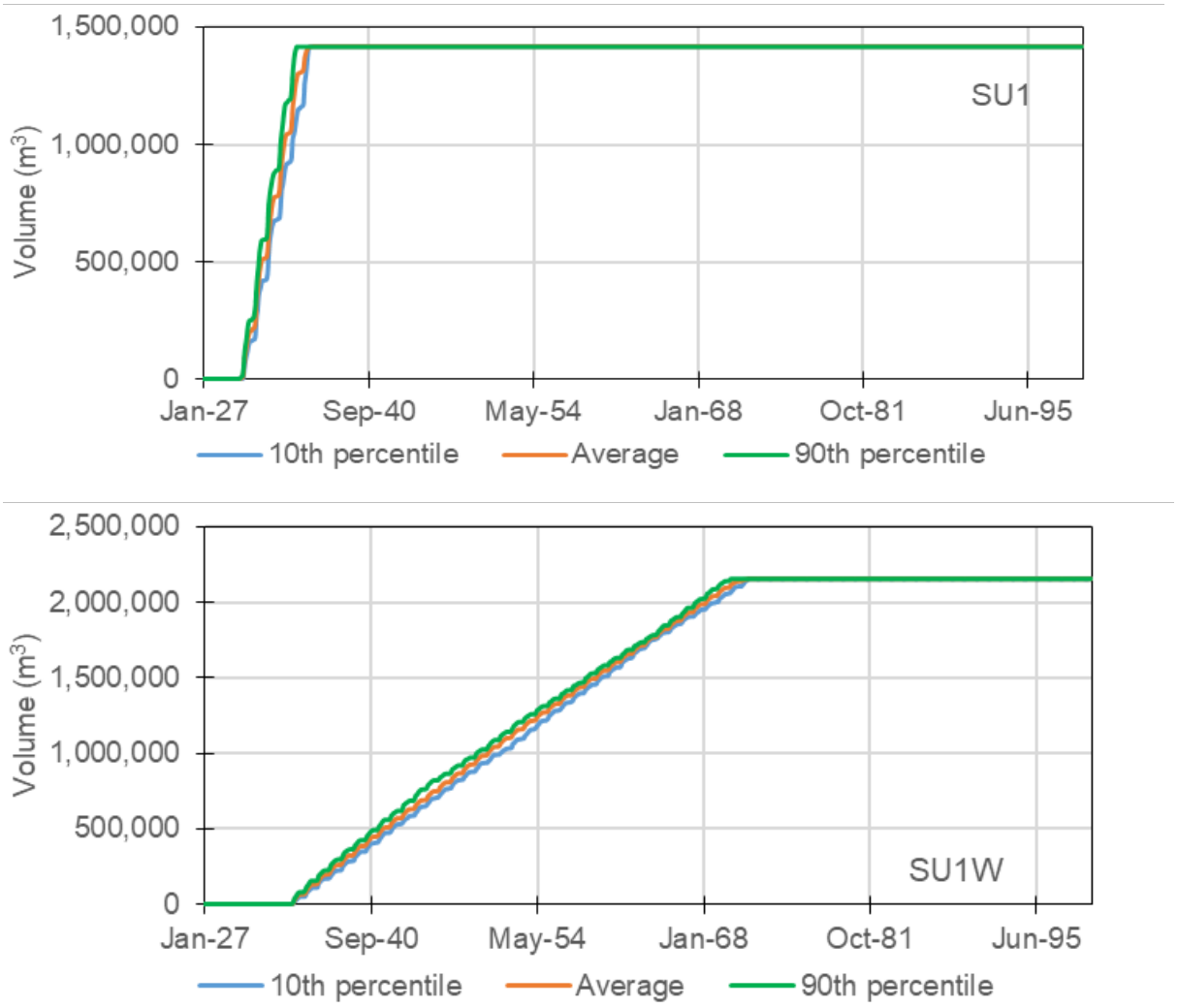


Figure 7-7 SU1 (top) and SU1W (bottom) Pit Lake Volumes

Table 7-3 SU1 and SU1W Pit Lake Surface Discharge Rates (L/s)

Open Pit	SU1			SU1W		
Statistic	10th %	Average	90th %	10th %	Average	90th %
Jan	0.00	2.62	7.71	0.01	0.53	1.81
Feb	0.00	1.84	4.52	0.00	0.34	0.80
Mar	0.00	6.80	16.26	0.00	1.27	3.36
Apr	18.80	33.44	50.46	1.43	6.69	10.92
May	11.17	20.20	30.64	0.24	1.95	3.60
Jun	7.01	15.65	24.84	0.00	1.74	3.77
Jul	5.51	16.73	30.52	0.00	2.15	6.41
Aug	7.44	15.57	25.39	0.00	2.04	4.79
Sep	5.68	10.53	16.67	0.00	1.47	2.98
Oct	3.43	8.74	15.88	0.28	1.68	3.53
Nov	0.00	0.45	1.17	0.00	0.17	0.55
Dec	0.00	0.83	2.15	0.02	0.28	0.64

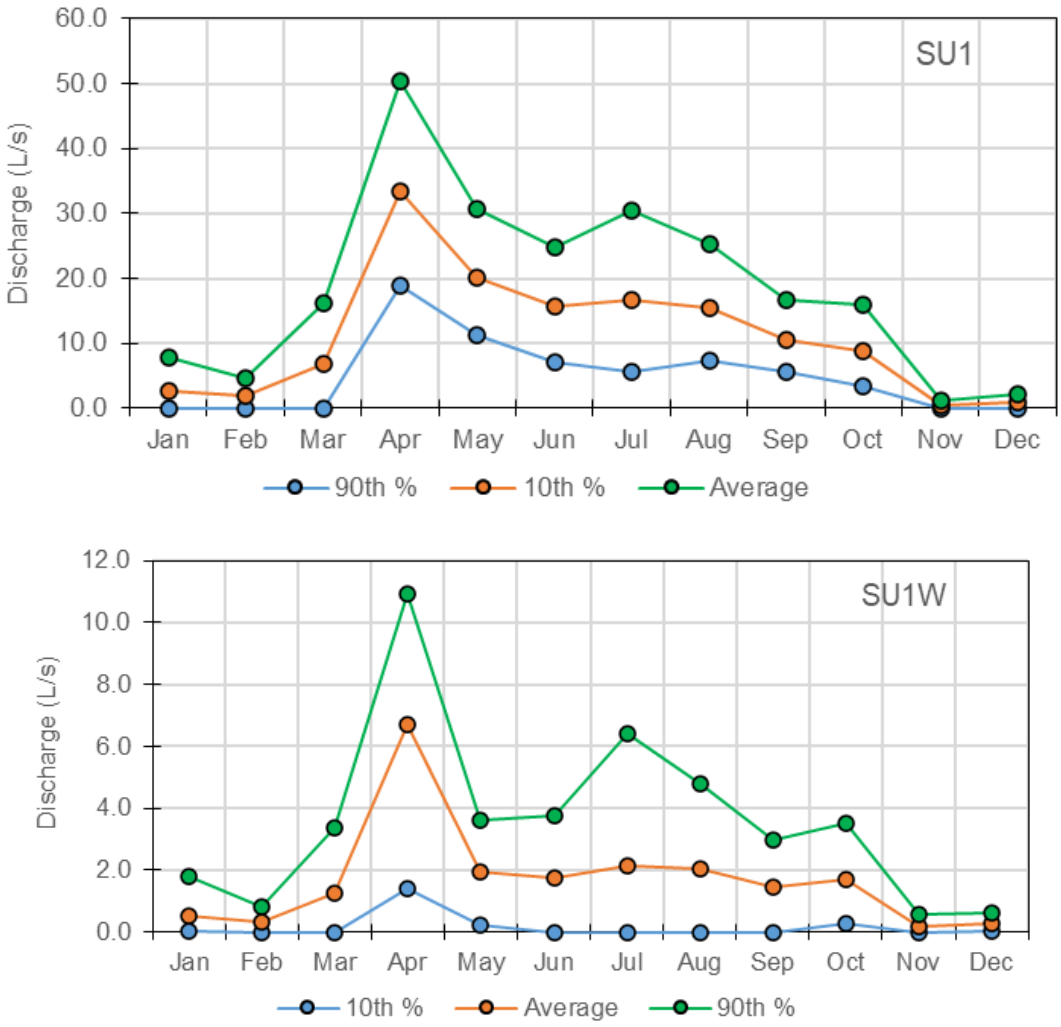


Figure 7-8 SU1 (top) and SU1W (bottom) Pit Lake Surface Discharge Rates

SU2 Pit Lake

The SU2 pit lake sits in the topographic high of the Latte catchment and Base Case WBM predictions indicate that it is not expected discharge via surface until after Year 74 (2100; Figure 7-9). Once full, the SU2 pit lake will discharge via surface through the Supremo backfill causeway to SU1. Note that the SU2W Pit does not form a lake, as its cross-sectional profile does not support a void volume below the spill elevation. Runoff from this pit shell will report to the Alpha WRSF rock drain, and monthly average discharge rates are predicted to range from 0.01 L/s in November to 0.74 L/s in April (Table 7-4 and Figure 7-10).

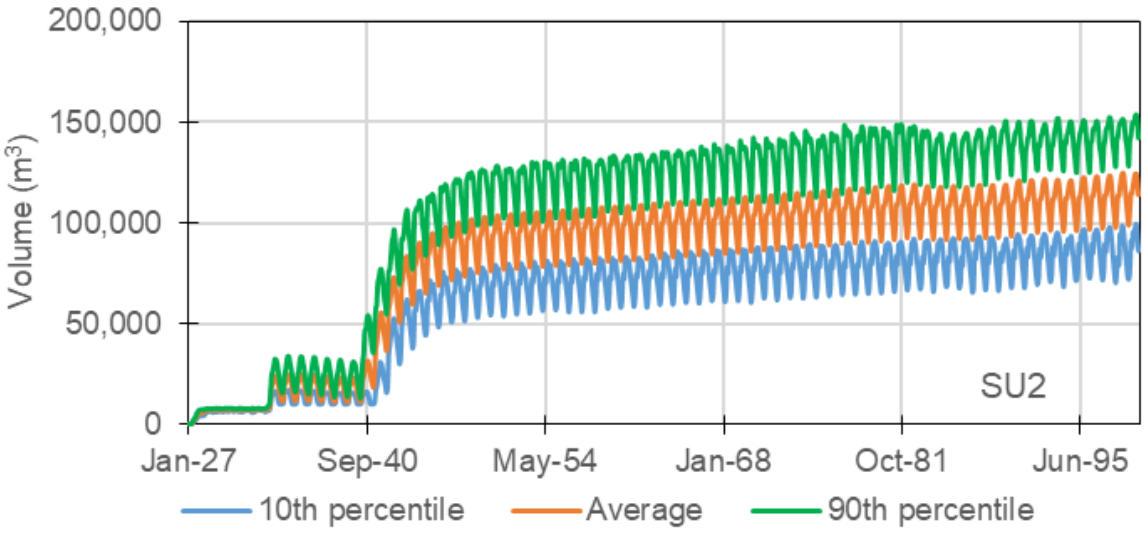


Figure 7-9 SU2 Pit Lake Volume

Table 7-4 SU2W Pit Surface Discharge Rates (L/s)

Statistic	10th %	Average	90th %
Jan	0.00	0.05	0.18
Feb	0.00	0.04	0.09
Mar	0.00	0.15	0.36
Apr	0.27	0.74	1.13
May	0.11	0.33	0.60
Jun	0.16	0.41	0.71
Jul	0.12	0.48	0.91
Aug	0.19	0.42	0.68
Sep	0.10	0.26	0.44
Oct	0.02	0.20	0.40
Nov	0.00	0.01	0.05
Dec	0.00	0.03	0.07

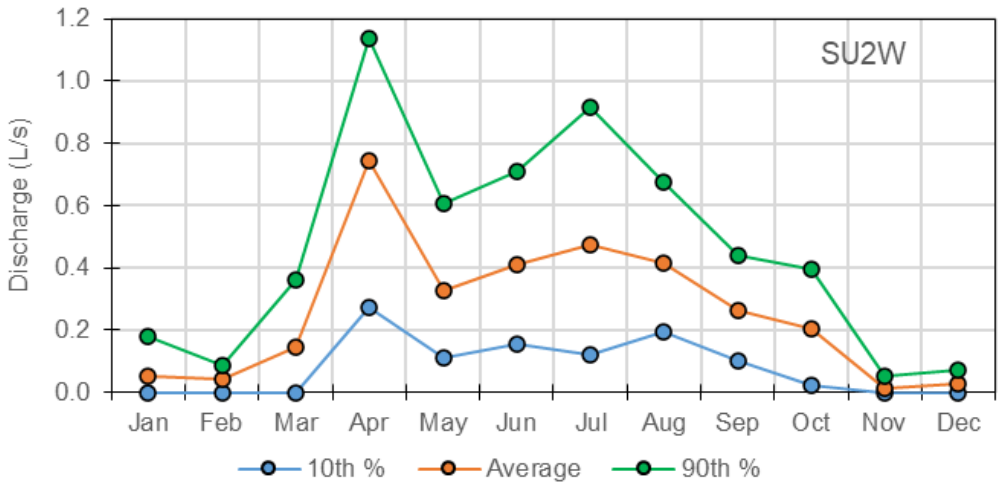


Figure 7-10 SU2W Pit Surface Discharge Rates

SU3W and SU3 Pit Lakes

The SU3W pit lake is located west of the SU3 Pit, and both drain to the YT24 catchment. The SU3W pit lake is predicted to spill by Year 10 to Year 12 (2036 to 2038) and report to YT-24 (Figure 7-11). Monthly average surface flow rates from this pit lake are predicted to range from 0.04 L/s in November to 2.08 L/s in April (Table 7-5 and Figure 7-12). The SU3 pit lake is predicted to reach the spill elevation between Year 36 to Year 37 (2062 to 2063; Figure 7-11). Monthly average surface flow rates from this pit lake are predicted to range from 0.1 L/s in November to 65.7 L/s in April, reporting to YT-24 (Table 7-5 and Figure 7-12).

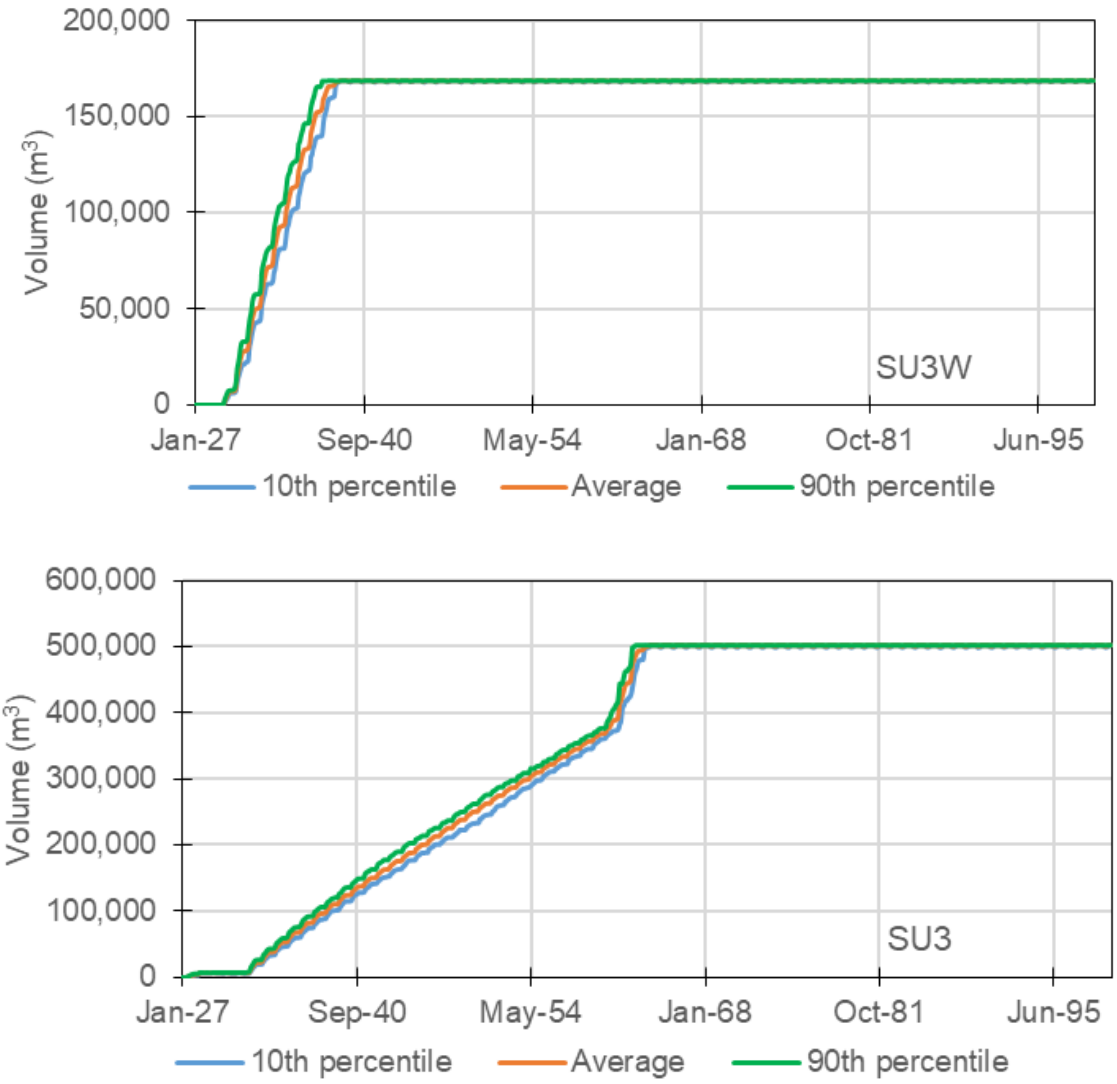


Figure 7-11 SU3W (top) and SU3 (bottom) Pit Lake Volumes

Table 7-5 SU3W and SU3 Pit Lake Surface Discharge Rates (L/s)

Open Pit	SU3W			SU3		
Statistic	10th %	Average	90th %	10th %	Average	90th %
Jan	0.00	0.16	0.61	0.00	0.37	1.48
Feb	0.00	0.12	0.27	0.00	0.27	0.74
Mar	0.00	0.41	1.09	0.00	1.07	3.23
Apr	0.06	2.08	3.55	0.00	5.65	13.44
May	0.00	0.63	1.61	0.00	0.96	2.84
Jun	0.00	0.70	1.55	0.00	1.12	3.52
Jul	0.00	0.90	2.42	0.00	1.66	5.60
Aug	0.00	0.82	1.86	0.00	1.53	5.36
Sep	0.00	0.62	1.26	0.00	1.23	3.43
Oct	0.00	0.56	1.25	0.00	1.35	4.51
Nov	0.00	0.04	0.17	0.00	0.09	0.37
Dec	0.00	0.08	0.24	0.00	0.19	0.46

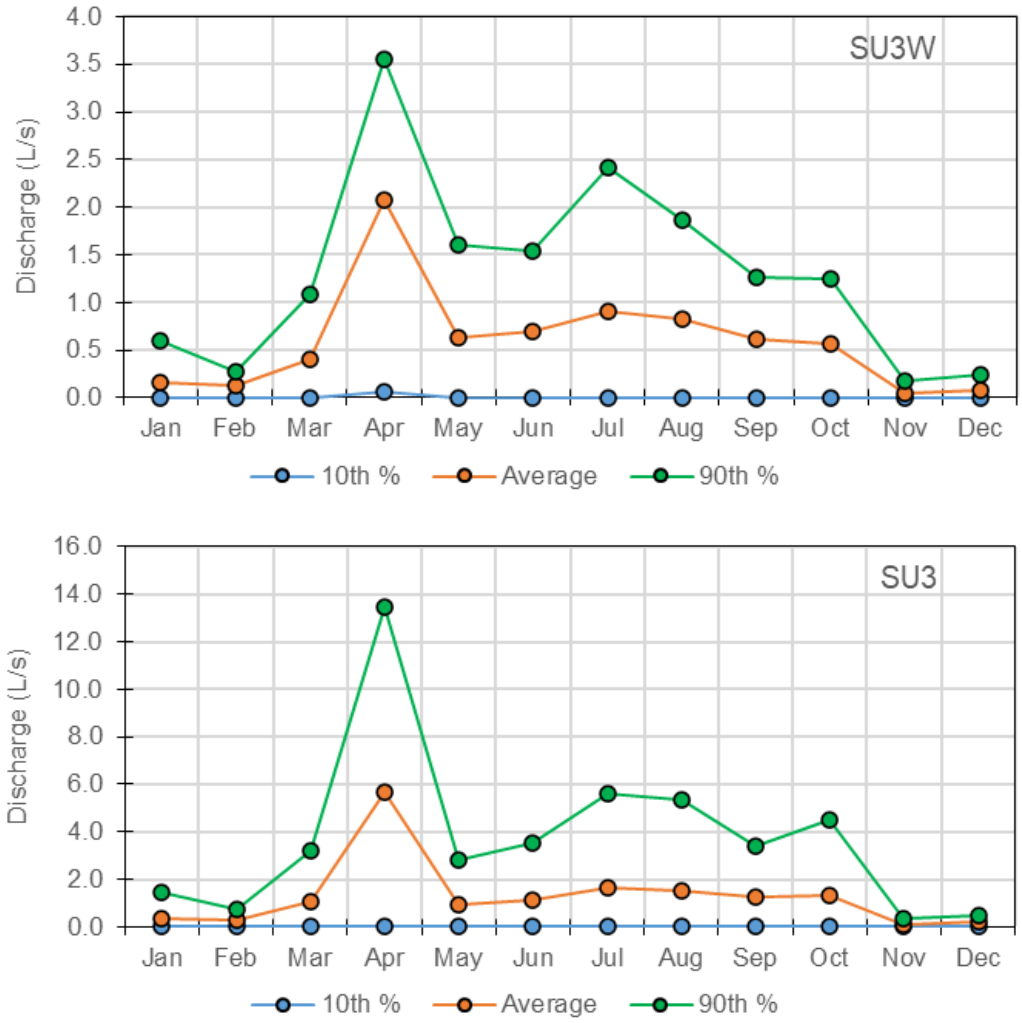


Figure 7-12 SU3W (top) and SU3 (bottom) Pit Lake Surface Discharge Rates

SU4E and SU4W Pit Lakes

The SU4E pit lake, located north of the backfilled Double Double Pit, is predicted to spill by Year 18 to Year 20 (2044 to 2046) and report to the interception ditch that flanks Double Double and drains into the SU1 Pit, and ultimately to Latte Creek (Figure 7-13). Monthly average surface flow rates from this pit lake are predicted to range from 0.04 L/s in November to 2.65 L/s in April (Table 7-6 and Figure 7-14).

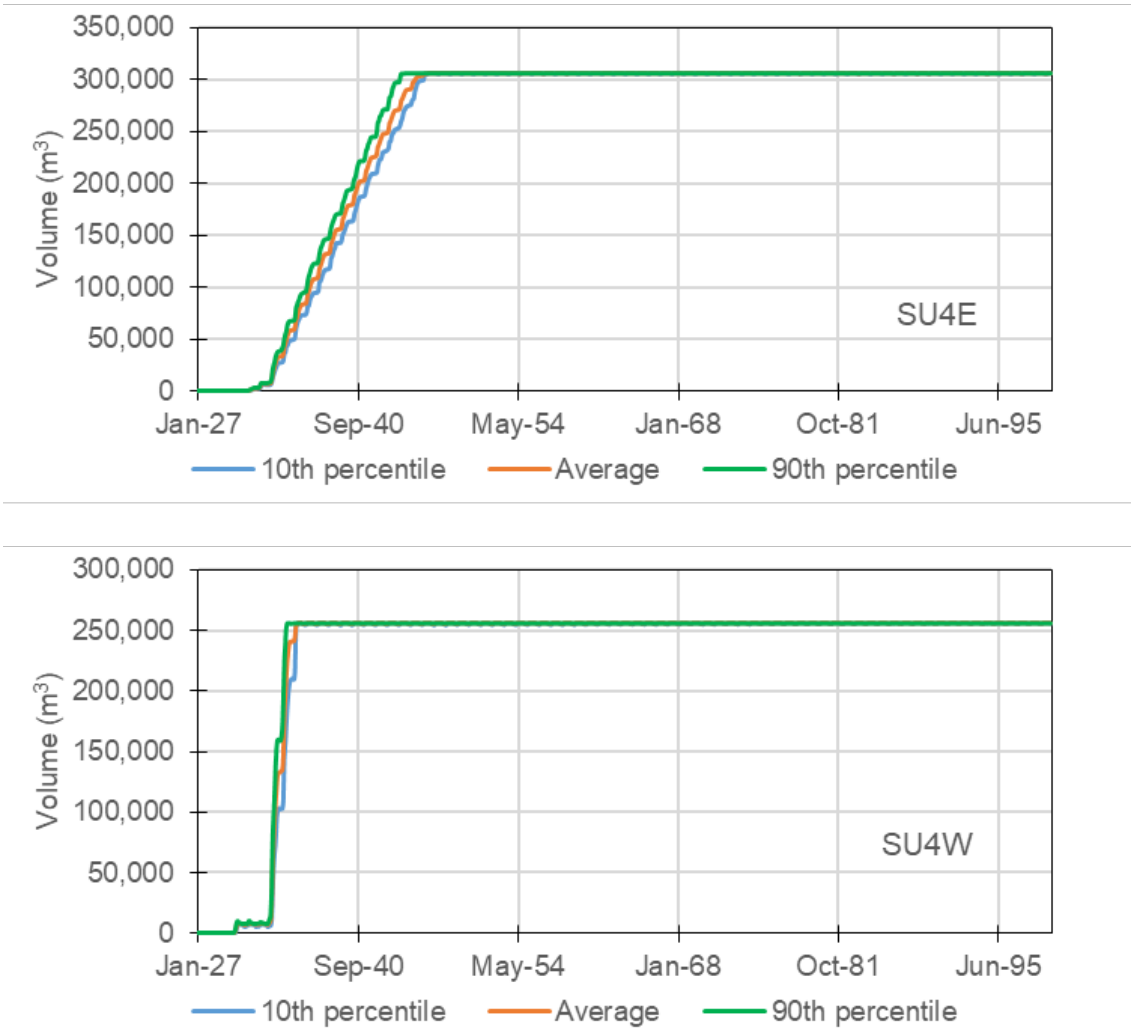


Figure 7-13 SU4E (top) and SU4W (bottom) Pit Lake Volumes

Table 7-6 SU4E and SU4W Pit Lake Surface Discharge Rates (L/s)

Open Pit	SU4E			SU4W		
Statistic	10th %	Average	90th %	10th %	Average	90th %
Jan	0.00	0.18	0.64	0.00	0.81	2.76
Feb	0.00	0.12	0.27	0.00	0.57	1.41
Mar	0.00	0.48	1.25	0.00	2.50	6.61
Apr	0.61	2.65	4.38	5.81	15.21	23.64
May	0.00	0.69	1.56	2.57	7.18	13.13
Jun	0.00	0.87	1.89	1.79	6.86	12.08
Jul	0.00	1.14	2.99	1.00	7.98	17.16
Aug	0.01	1.02	2.22	2.38	7.26	13.19
Sep	0.14	0.77	1.47	1.65	4.50	7.97
Oct	0.04	0.69	1.44	0.70	3.84	7.72
Nov	0.00	0.04	0.16	0.00	0.20	0.71
Dec	0.00	0.09	0.26	0.00	0.36	1.08

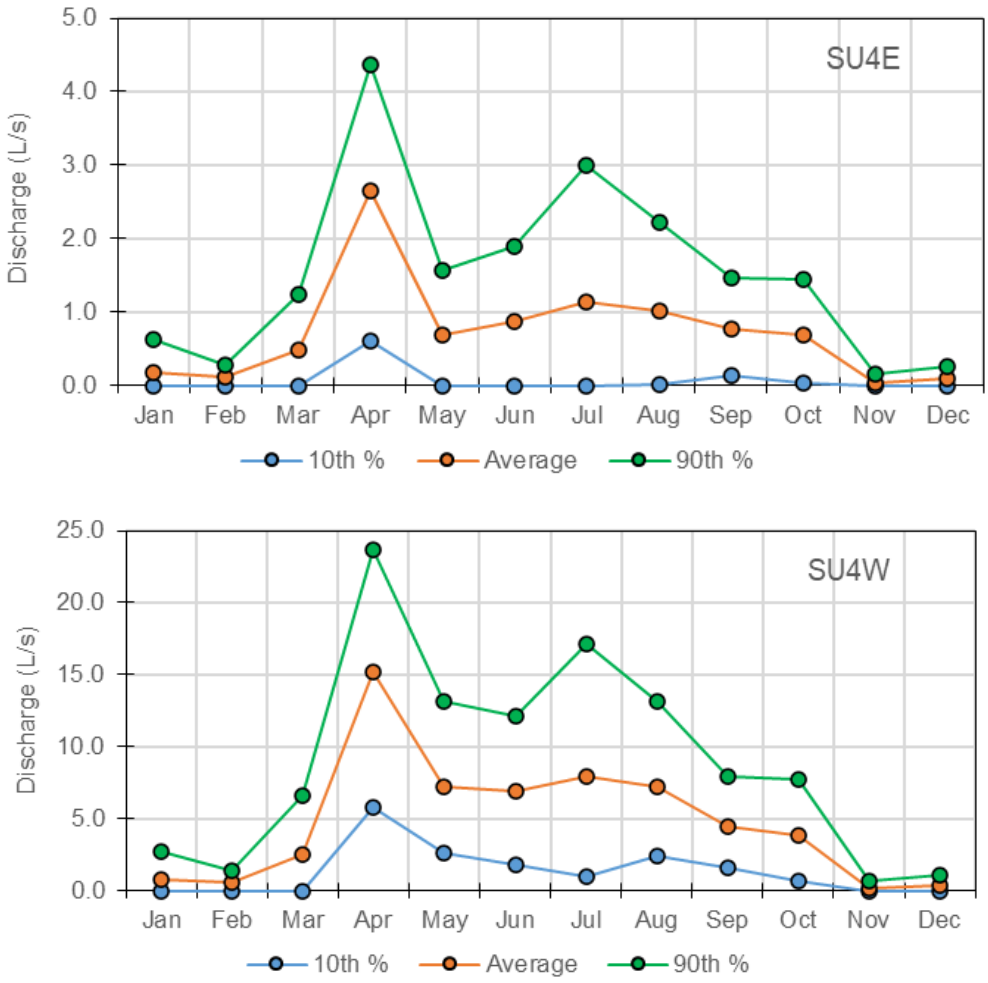


Figure 7-14 SU4E (top) and SU4W (bottom) Pit Lake Surface Discharge Rates

At the SU4W Pit, once the lake is at the spill elevation of 1,105 masl, water will drain passively to the Latte Creek catchment (Figure 7-13). Monthly average surface flow rates from this pit lake are predicted to range from 0.2 L/s in November to 15.2 L/s in April (Table 7-6 and Figure 7-14).

SU5 Pit Lake

The SU5 pit lake is predicted to reach the spill elevation in Year 8 (2034), and surface discharge from this pit lake will to YT-24 (Figure 7-13). Monthly average surface flow rates from this pit lake are predicted to range from 0.07 L/s in November to 3.7 L/s in April (Table 7-7 and Figure 7-16).

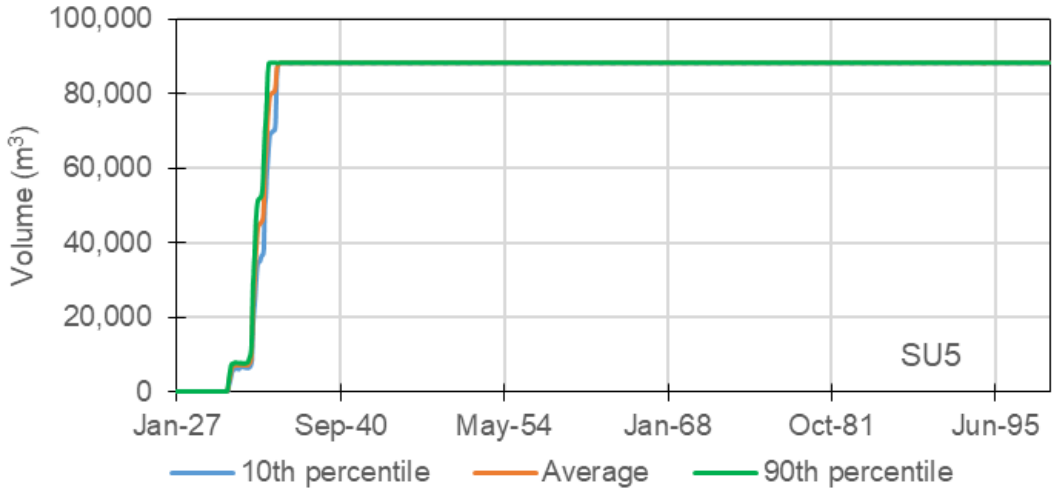


Figure 7-15 SU5 Pit Lake Volumes

Table 7-7 SU5 Pit Lake Surface Discharge Rates (L/s)

Statistic	10th %	Average	90th %
Jan	0.00	0.28	0.97
Feb	0.00	0.21	0.45
Mar	0.00	0.73	1.86
Apr	1.09	3.74	5.90
May	0.21	1.43	2.98
Jun	0.41	1.78	3.30
Jul	0.20	2.12	4.57
Aug	0.58	1.91	3.39
Sep	0.30	1.25	2.22
Oct	0.10	1.05	2.09
Nov	0.00	0.07	0.29
Dec	0.00	0.15	0.39

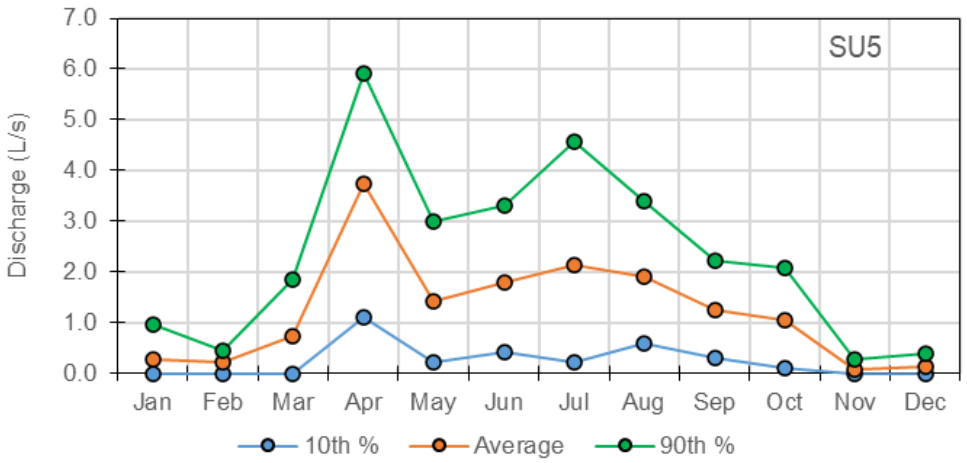


Figure 7-16 SU5 Pit Lake Surface Discharge Rates

7.1.2.3 Backfilled Double Double Pit

The backfilled Double Double Pit will begin to fill with meteoric water during the Operation Phase. By Year 24 near the beginning of the Post-Closure Phase, the pore space within the backfilled waste rock is expected to have filled with water to the 1,044 masl spill point elevation (Figure 7-17) and will passively discharge to the Latte Creek catchment at average monthly rates of 0.01 L/s in December to 2.4 L/s in May (Table 7-8 and Figure 7-18).

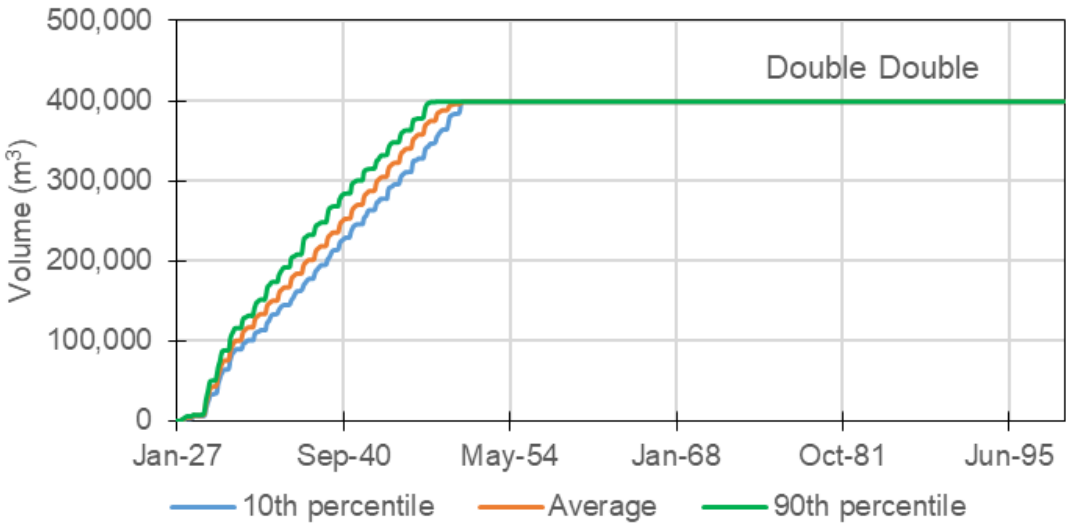


Figure 7-17 Backfilled Double Double Pit Water Volumes

Table 7-8 Backfilled Double Double Pit Surface Discharge Rates (L/s)

Statistic	10th %	Average	90th %
Jan	0.00	0.04	0.13
Feb	0.00	0.02	0.04
Mar	0.00	0.14	0.34
Apr	0.50	1.92	3.34
May	1.00	2.35	4.38
Jun	0.01	0.56	1.41
Jul	0.02	0.41	1.14
Aug	0.05	0.54	1.26
Sep	0.15	0.50	0.86
Oct	0.11	0.48	0.96
Nov	0.00	0.02	0.07
Dec	0.00	0.01	0.03

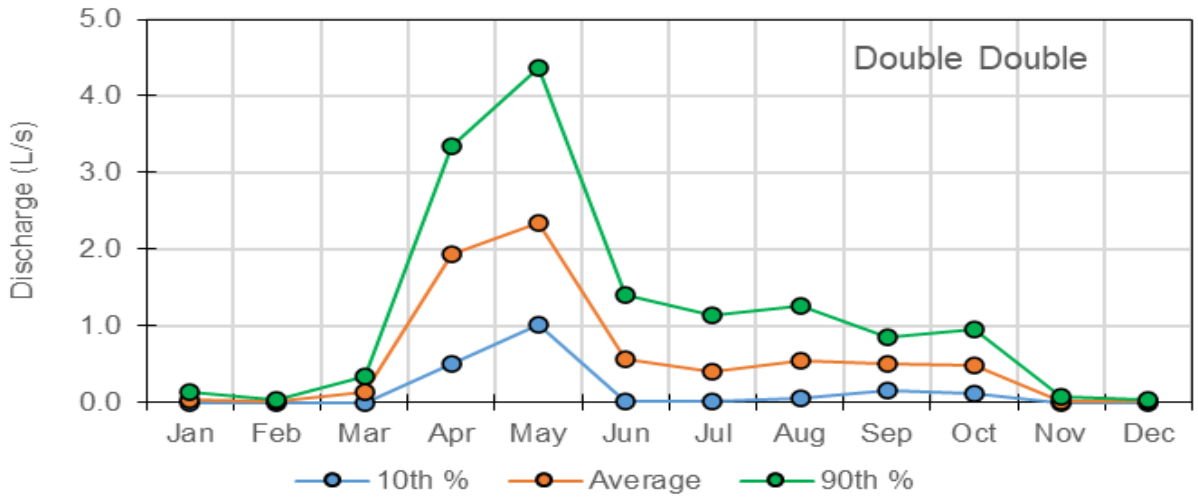


Figure 7-18 Backfilled Double Double Pit Surface Discharge Rates Backfilled Kona Pit

The backfilled Kona Pit will begin to fill with meteoric water during the Operation Phase. By Year 25 to 27, near the beginning of the Post-Closure Phase, the pore space within the backfilled waste rock is expected to have filled with water to the 1,230 masl spill point elevation (Figure 7-19) and will passively discharge to the Halfway Creek catchment via the Alpha WRSF rock drain. The backfilled Kona Pit will discharge at average monthly rates of 0.04 L/s in November to 1.1 L/s in May (Table 7-9 and Figure 7-20). Groundwater discharge is not expected from this backfilled pit.

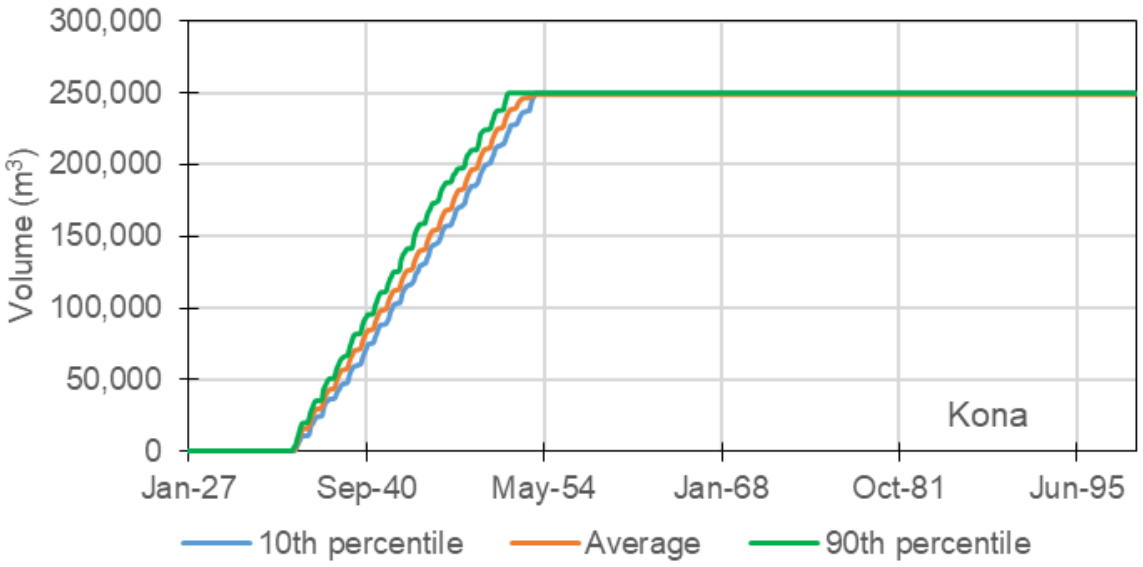


Figure 7-19 Backfilled Kona Pit Water Volumes

Table 7-9 Backfilled Kona Pit Surface Discharge Rates (L/s)

Statistic	10th %	Average	90th %
Jan	0.00	0.17	0.51
Feb	0.00	0.09	0.21
Mar	0.00	0.24	0.56
Apr	0.37	0.98	1.71
May	0.56	1.07	1.75
Jun	0.21	0.70	1.29
Jul	0.12	0.69	1.39
Aug	0.21	0.67	1.23
Sep	0.24	0.50	0.84
Oct	0.11	0.44	0.83
Nov	0.00	0.04	0.13
Dec	0.00	0.07	0.16

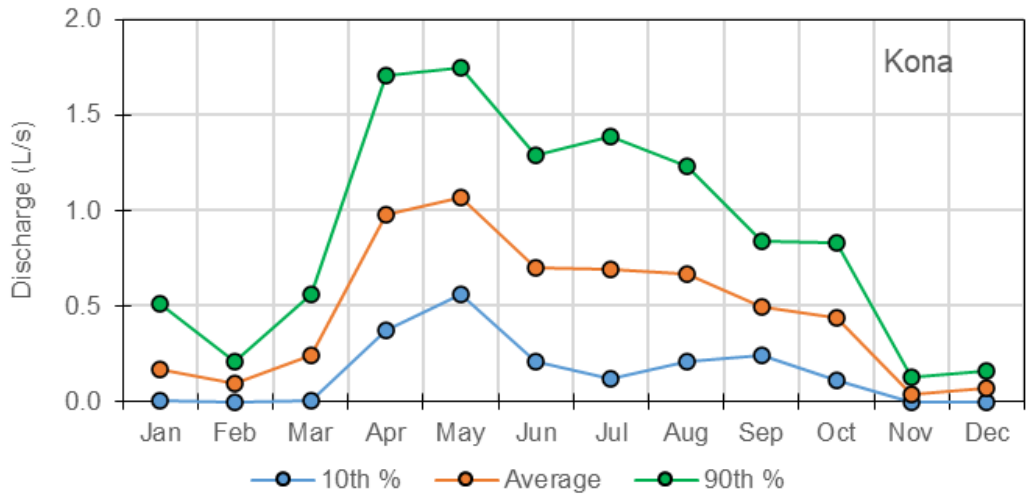


Figure 7-20 Backfilled Kona Pit Surface Discharge Rates

7.1.3 Groundwater Leakage from Pit Lakes

Pit lake leakage from the pit lakes to the local groundwater system is dependent on the water level, and therefore driving head, in the pit lakes. GW leakage rates from the pit lakes are expected to be minimal. The Latte West and SU2 pit lakes are predicted to leak at rates of 1.7 L/s and 0.6 L/s, respectively, to Halfway Creek, and at rates of 1.0 L/s and 2.4 L/s, respectively, to Latte Creek. The SU1 and SU4W pit lakes are predicted to leak at 0.02 L/s and 0.36 L/s, respectively, to Latte Creek. None of the pit lakes are predicted to develop measurable groundwater flow pathways to YT-24 (Table 7-10).

Table 7-10 Predicted Groundwater Leakage Rates from Pit Lakes to Receiving Catchments

Pit Lake	Leakage (L/s)		
	Halfway Creek	YT-24	Latte Creek
Latte West	1.73	0	1.02
Latte East	0	0	0
SU1	0	0	0.02
SU1W	0	0	0
SU2	0.61	0	2.4
SU2W	NA	NA	NA
SU3W	0	0	0
SU3	0	0	0
SU4W	0	0	0.36
SU4E	0	0	0
SU5	0	0	0
Double Double	0	0	0
Kona	0	0	0

7.1.4 Closure Measures

The Kona and Double Double Pits will be backfilled during the Operation Phase, therefore open pit closure measures described in the proceeding paragraphs pertain to the Latte and Supremo Pits which will have been partially backfilled during operations. Additional backfilling of the Latte and Supremo Pits during the Closure Phase is not currently planned.

Once mining operations in the open pit have ceased, the pit sump pumps and pipelines will be removed using excavators and labour support. Pipelines will be drained fully prior to dismantling. Pumps, pipelines, and fittings will be reused or salvaged, when possible, otherwise they will be placed in the designated landfill if the material is included on the approved landfill item list.

With respect to protecting humans and wildlife from topographic hazards, egress points will be maintained to minimize potential wildlife entrapment within the pits. Boulder fences will be placed, where required, around each open pit as it is mined out. Boulders would be placed with a set-back from the final pit crest to provide a visual warning to indicate a change in landscape for both humans and large mammals. The boulders would be strategically placed to ensure egress from the pit is maintained in the event that wildlife enters the pit. The placement of boulders is not intended to prevent access. Guidance will be sought from the Project's wildlife biologist on strategic placement of boulders, if required. Specific safety requirements for open pit closure will be determined once the pits have been constructed. Open pit closure measures will fulfill the requirements set out in the *Workers' Safety and Compensation Act* and Regulations.

Erosion and sediment control measures will be undertaken in the areas adjacent to the pit perimeters and near the spill points of the pit lake. With respect to surface water management and runoff, engineered spillway channels will be constructed where deemed necessary to prevent erosion at the pit lake spill points and subsequent sedimentation downstream. Processed material may be required to be used for spillway channels, produced using the on-site crushing equipment, immediately following the Operation Phase. Roadside ditches and diversions that were constructed in the Operation Phase will be used as necessary to assist in achieving WQO until such a time that they can be decommissioned. When decommissioned, ditches and diversions will be graded to blend into the surrounding landscape. Built-up sediment in sediment control structures will be excavated and placed within a closure landform, away from running surface water.

Prevention of subsidence will be accomplished by adhering to pit designs that either meet or exceed the acceptable safety factor of 1.3 (additional details on pit stability analyses are provided in Section 5.3.1).

7.1.5 Reclamation Activities

Reclamation activities proposed in areas adjacent to the pit perimeters and near the spill points of pit lakes will focus on erosion and sediment control. As such, once closure measures are completed, disturbed areas will be seeded and/or planted to establish ground cover as soon as possible. Revegetation research programs are currently underway to refine the site-specific revegetation prescriptions as described in Section 2.3.1. No additional reclamation activities for the backfilled and partially backfilled pits are currently proposed.

7.1.6 Remaining Issues and Investigations

Although the waste rock from the Kona Pit is non-PAG (low sulphur granitic rock), it is expected that a small area of ore exposed in the completed pit wall has weak potentially acid generating tendencies. In order to

limit exposure of this ore seam to potential oxidation, the current closure strategy is for the Kona Pit to be backfilled with waste rock from Supremo Pit during winter in order to re-establish permafrost to depth prior to the Closure Phase. With changing climate conditions in the future, it is anticipated that eventually (i.e., in more than 100 years) the backfilled pit could fill with meteoric water and spill to the Halfway Creek catchment. The potential issue that arises with this is that saturated Kona pit-derived granite may be source of arsenic.

The water balance water quality model indicates that the backfilled Kona Pit will fill with meteoric water over an approximately 18-year period from completion of backfill (e.g., Year 9 to Year 27) (Lorax 2023b). The purpose of the backfill with higher neutralization potential gneiss waste rock from Supremo is to limit the potential for acid generation from remaining ore seams on pit walls in Kona. Both the backfilling and eventual saturated conditions will effectively eliminate the ARD potential. However, metal leaching and in particular, arsenic mobility is anticipated due to reductive dissolution of arsenic in the granitic ore material. This process has been accounted for in the geochemical source terms and reflected in the output of the water quality model. Figure 7-21 below illustrates that As concentrations in the Kona Pit backfill are modeled to discharge to Halfway Creek at approximately 0.28 mg/L. This compares to Double Double saturated backfill, which does not contain elevated As or granite material with elevated As, where the predicted concentration of As in Double Double overflow is an order of magnitude lower at approximately 0.02 mg/L (Figure 7-22).

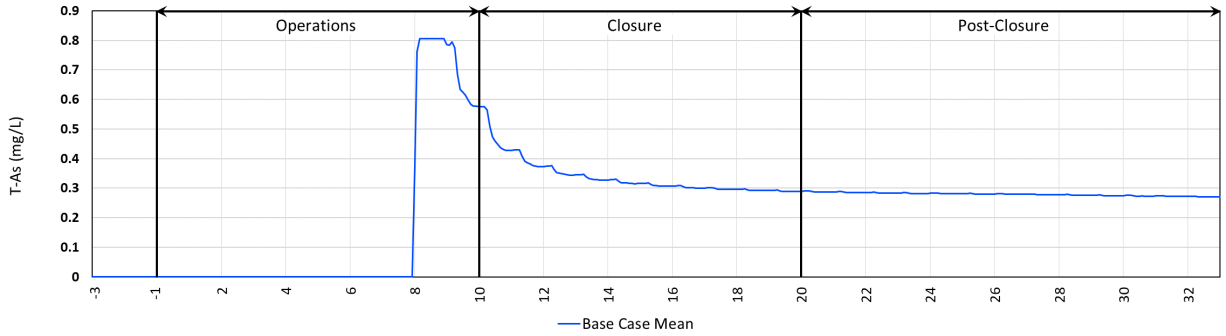


Figure 7-21 Time Series of Predicted Kona Pit Water Quality. Passive Spilling of the Backfill Pit Water is projected to Occur in Year 27

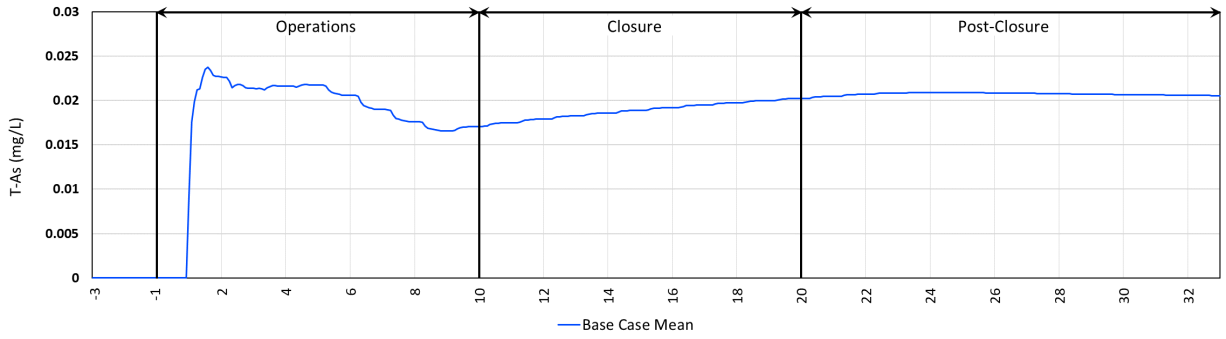


Figure 7-22 Time series of Predicted Double Double Pit Water Quality. Passive Spilling of the Backfill Pit Water is Projected to Occur in Year 24

While elevated As in the Kona backfill porewater is anticipated, the water quality model does not predict exceedances of the As Use-Protection objective in Halfway Creek at HC-1.0 (Figure 7-23). The predicted As concentrations following passive spilling of the Kona Pit in Year 27 show seasonal peaks of just over 0.003 mg/L and below the objective of 0.005 mg/L.

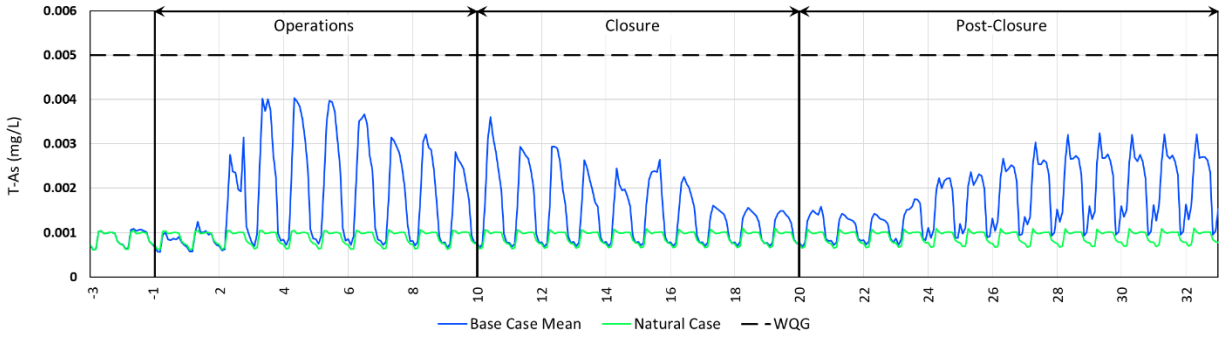


Figure 7-23 Time Series of Predicted As Concentrations in Halfway Creek at Attainment Location HC-1.0

These results notwithstanding, attention will be given to the pit wall exposures in Kona once mining is completed to ensure that backfilling plans minimize any exposure of granite ore material which can generate elevated As concentrations.

With respect to achieving the post-mine vision of returning the site to pre-mining conditions to the extent practical (outlined in Section 3.1.1), an alternatives assessment for pit backfilling was carried out as described in Section 2.3.4. Evaluations were conducted to assess the feasibility of placing additional waste rock in Latte and/or portions of Supremo Pits after they are mined out, using waste rock derived from active mining in other pits. This ultimately determined that it was not feasible to completely backfill Latte and Supremo Pits. Throughout the Operation Phase, in-pit drilling program results will ultimately inform decisions regarding the extraction of additional ore, as well as the timing (either progressively or at the end of mine life) and amount of backfilling to occur in each pit. By Year 6 of mining, a potential plan for additional backfill will be re-evaluated.

7.2 Waste Rock Storage Facilities and Stockpiles

For the Alpha WRSF and stockpiles, the performance targets for closure are to ensure physical stability, avoid unacceptable release of contaminants to the receiving environment, and avoid risks to humans and wildlife (YWB and EMR 2013). In general, these guidelines require information that demonstrates expected performance and/or management measures pertaining to physical and chemical stability, water quality and quantity conditions (including porewater, seepage, and runoff), surface water management and sediment control, and potential safety risks.

As outlined in Sections 5.3.1 and 5.3.2, waste rock will be permanently stored in the Alpha WRSF and in pits. Material contained in the soil stockpiles will be used during the reclamation of other disturbed areas, and ice-rich material placed in the FSSA will be managed depending on its acceptability of use in reclamation. General reclamation and closure measures for the stockpile pad areas are outlined in

Section 7.2.2. Additional information regarding the WRSF and stockpile designs and management are provided in the Waste Rock and Overburden Management Plan.

7.2.1 Alpha WRSF – Closure Measures

The Alpha WRSF will be constructed according to design criteria with progressive re-sloping during the Operation Phase to achieve final slope angles of 3:1 in closure. Operational plans will be developed to manage the placement of material within the Alpha WRSF so that the final surface of the facility contains waste rock with low arsenic concentrations (at or below 60 mg/kg). Once waste rock dumping ceases in Year 9, minor re-sloping may be completed to achieve long-term physical stability criteria and appropriate water conveyance for closure.

It is currently proposed that ice-rich material contained within the FSSA which is not suitable for use in other reclamation activities will be removed and placed in horizontal lifts within the Alpha WRSF progressively throughout operations.

At this time, no additional closure, safety, or reclamation measures are proposed. Based on this closure strategy, predicted water infiltration and seepage rates from the Alpha WRSF and downstream water quality is provided below.

7.2.1.1 Infiltration and Seepage Rates and Water Quality

Based on the current base case closure design of no cover for the Alpha WRSF, infiltration and seepage rates are expected to reach a steady state relative to annual precipitation during the latter part of the Operation Phase (Figure 7-21 and Figure 7-11). On a sub-annual time-scale, the Alpha WRSF is assumed to attenuate streamflow locally, as the high pore space volume and higher than natural proportion of fines acts to slow runoff generation as meteoric water infiltrates the facility, leading to attenuated peak flows and enhanced summer low flows. This process is evident in the monthly distribution of basal seepage, which shows a freshet peak flow condition that extends later in the year, into May and June – relative to the pit lake spill signature. Note that the potential effects of climate change have been incorporated into the site-wide water balance and water quality model (Lorax 2023b), and average annual precipitation is predicted to only marginally increase as the Post-closure Phase progresses (for more information refer to Section 4.1.1).

The Base Case source terms for the Alpha WRSF at closure are presented in Appendix 7-A.

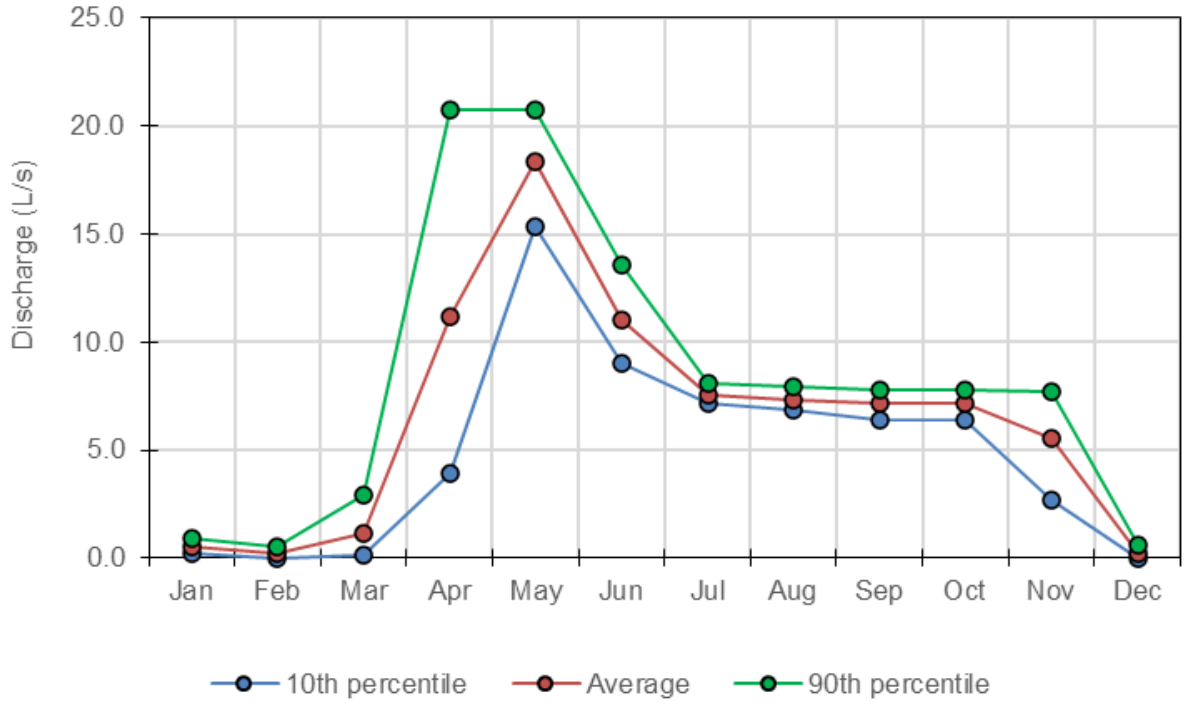


Figure 7-24 Alpha Waste Rock Storage Facility Basal Seepage Rates

Table 7-11 Alpha Waste Rock Storage Facility Basal Seepage Rates (L/s)

Statistic	10th %	Average	90th %
Jan	0.24	0.56	0.91
Feb	0.00	0.22	0.50
Mar	0.13	1.12	2.89
Apr	3.97	11.20	20.74
May	15.32	18.36	20.73
Jun	9.02	11.03	13.57
Jul	7.13	7.55	8.07
Aug	6.88	7.35	7.94
Sep	6.43	7.17	7.79
Oct	6.43	7.17	7.79
Nov	2.72	5.55	7.71
Dec	0.00	0.21	0.63

7.2.2 Stockpile Pads – General Closure Measures

Prior to commencing closure works for the stockpile pads, erosion and sediment control measures will be installed at the toes and low points of each stockpile area to minimize sediment-laden runoff outside of the disturbed area. Erosion and sediment control measures will be removed once no longer required.

Once the stockpiled material is depleted during the Post-mining Closure Phase, the disturbance footprint of the soil stockpiles will be scarified, if necessary, and seeded and/or planted to establish ground cover as soon as possible. Site-specific prescription will be developed in the future based on the outcomes of reclamation research that will be advanced during the Construction and Operation Phases as described in Section 2.3.1. Water management infrastructure associated with the pad areas will remain operational until closure WQO are achieved. This supporting infrastructure will then be decommissioned, as outlined in Section 7.7.

7.2.3 Reclamation Activities

Due to uncertainty related to available cover material volume and suitability, no additional active reclamation measures for the Alpha WRSF are currently proposed. The revegetation strategy for the Alpha WRSF is to allow the facility to naturally revegetate. This strategy will be actively researched through the reclamation research program during the Operation Phase to assess its feasibility to meet end land use planning objectives. The revegetation strategy for the Alpha WRSF may be re-evaluated based on the outcomes of the reclamation research and obligation to meet site specific closure objectives refined through end land use planning.

7.2.4 Remaining Issues and Investigations

As part of the alternatives assessment for closure options at the Project (Section 2.3.4), Newmont evaluated cover options for the Alpha WRSF, including conducting a material balance assessment and material prioritization evaluation. The reclamation material prioritization evaluation is included in the 2022 Coffee Mine Heap Leach Facility Cover Design Summary Report (Appendix 7-B). The current material balance identified sufficient suitable material for a WRSF cover; however, the evaluation is preliminary, and an updated material balance will be carried out during the Construction and Operation Phases to confirm that material is available for use as a WRSF cover. If adequate reclamation material is identified throughout construction and operation, a cover system will be designed and constructed for the WRSF based on volume and quality of reclamation material available as well as on end land use planning. The water quality model will then be updated based on the proposed cover design for the WRSF.

Ultimately, the Alpha WRSF reclamation and closure strategy design will focus on achieving the Project-specific closure objectives described in Section 3.1 to the extent practicable. This strategy may evolve as more information becomes available through Construction and Operation Phases (including an updated material balance), as well as from the outcomes of reclamation research.

7.3 Heap Leach Facility and Process Ponds

7.3.1 Heap Leach Pad Closure Measures

Concurrent reclamation of the HLF will occur progressively starting in Year 10 as described in the Heap Leach Facility Engineering Report for Licensing (Forte 2023), and will include the following:

- **Recirculation (rinsing):** recirculation of the leached ore will be carried out using barren solution, which will continue until the chemistry of the heap effluent reaches approximate equilibrium with the rinse solution (estimated timeline: 200 days, actual time driven by water quality measurements). The other determining factor for recirculation durations will be to ensure that CN_{WAD} concentrations have decreased to below 0.5 mg/L in heap effluent. Minor gold recovery will occur during this time.
- **Controlled draindown:** upon completion of recirculation, the HLF solution flow will be reduced to zero until meteoric water inputs become the sole water source to the HLF. Draindown solutions will be actively treated and discharged until all solution within the HLF system is meteoric (estimated timeline for draindown of the HLF: 5 months after the completion of the of recirculation).
- **Passive draindown and cover placement:** Following final rinsing and once heap draindown is complete, a cover system designed to limit meteoric infiltration will be installed on the heap (the cover will be placed progressively over areas as recirculation is completed and will take an estimated 3 months for each recirculation area to be covered). Appropriate water management features to safely convey runoff from the heap cover will also be installed as part of the cover design.

For additional details regarding the HLF design and stability analysis see the Heap Leach Pad Engineering Report for Licensing (Forte 2023).

Progressive regrading will occur near the end of operations to maintain the base case closure design of 2.5H:1V or flatter overall slope, and to prepare the side slopes for a primary leach cycle to recover residual metals. Closure of the heap leach pad will occur progressively during the Closure Phase with preliminary rinsing commencing in Year 10. The recirculation will be carried out progressively in 10 recirculation areas that are sized for optimal recirculation based on flow and application rate of recirculation solution. It is expected that each of the 10 areas will be rinsed with recirculation solution for approximately 200 days but will ultimately be driven by water quality measurements. Progressive closure of HLF will reduce length of time that HLF is at its maximum footprint size.

The final rinse area is expected to be completed in Year 15. Water treatment of surplus recirculation solution and heap seepage will continue during the heap draindown period after active recirculation rinsing has ceased in the Post-mining Closure Phase. Details on the proposed water treatment system are provided in the Heap Leach and Process Facilities Plan and Appendix 5-C of this plan. A sampling program will be developed specifically to determine the success of heap leach recirculation rinsing, which may include physical sampling of the heap. Details of the heap leach rinse sampling program will be provided in future iterations of the RCP.

The cover system will be installed on each rinsed area of the heap once rinsing is complete (starting in Year 11). A plan view of the HLF and cover system is shown on Figure 7-25.

Closure cover designs for the HLF were evaluated through the alternatives assessment (Section 2.3.4) to determine the preferred closure alternative for the HLF. The evaluations included an analytical water balance, numerical water balance, water quality model, slope stability evaluations of the cover material, sediment and erosion stability evaluations, and a trade-off study. In addition, potential failure modes for the HLF alternatives were identified and discussed during an FMEA workshop held in February 2022. Based on outcomes of the assessment and FMEA workshop, the proposed closure cover strategy was selected as the base case closure option for the HLF. Details of the alternative selection process and outcomes of the FMEA are discussed in Section 2.3.4.

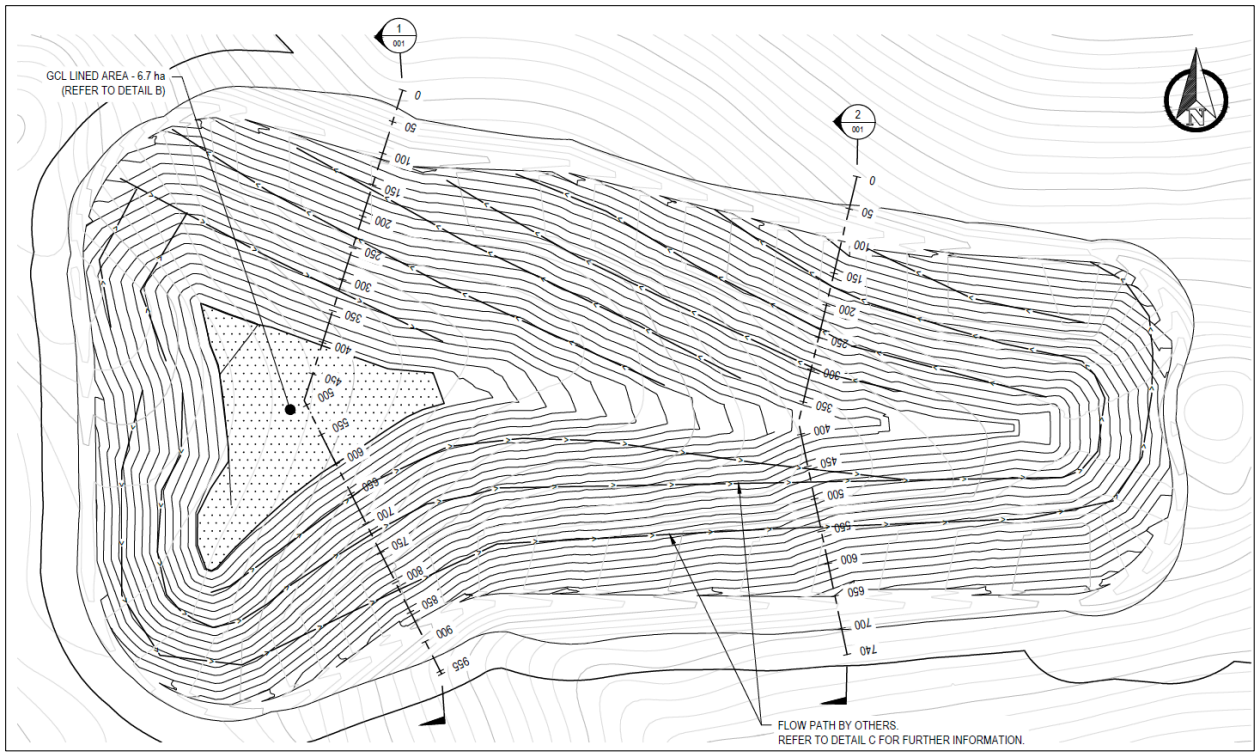


Figure 7-25 Plan View of HLF and Cover System

The closure cover strategy for the HLF includes overall 2.5:1 slopes, store and release cover on the slopes of the HLF and a GCL and store and release cover on the flat surfaces. A surface water drainage system to route runoff water from the cover system is also included in the closure concept for the HLF, as shown in Figure 7-25. Upon completion of active leaching operations, solution management will be maintained until the closure cover is established, and clean runoff is diverted off the facility. Side sloping of the heap during progressive reclamation may need to be scheduled for the warmer months due to freezing. Soils and rock placement will generally be done between May and December. GCL will only be installed immediately before the rock or soil cover is to be installed. GCL installation in May, July, and August will be limited to dry periods. The cover as described in the Heap Leach Facility Cover Design Report (Appendix 7-B) is expected to be completed in Year 16.

The goals of the cover system are as follows:

- Provide for physical stability of the heap, including stable slopes and erosion resistance through development of cover system material specifications to meet erosion criteria, as well as vegetation establishment
- Provide for positive drainage to minimize the creation of saturated zones
- Route runoff away from the heap and into the nearby natural drainage channels in a manner that prevents erosion or other ill effects
- Reduce net infiltration into the HLF from precipitation to approximately 22% of mean annual precipitation (MAP).

From bottom to top, the installation of the cover system on flat areas will entail:

- Compacting the rinsed ore to provide a firm, non-yielding base
- Placing a GCL, compacted low permeability soil, an integral GCL/geomembrane product, or equivalent low permeability infiltration barrier over the compacted base
- Placing a drainage layer (gravel, geonet, or equivalent) over the GCL
- Adding a 0.5 m storage layer comprised of finely-graded waste rock (i.e., confirmed to be of limited metal leaching potential), soil or other suitable material over the drainage layer
- Signage will be placed around the HLF to provide notice to public not to dig or excavate cover material without authorization by Newmont.

For both flat and sloped areas, a revegetation strategy will be developed based on site-specific testing to be performed during the Operation Phase as HLP stages are being progressively reclaimed.

The GCL will be installed by a specialized contractor, using their equipment, ensuring that the layers are keyed-in appropriately at the specified locations. Prior to installation of the GCL, the subgrade will be final graded to fill major voids or cracks. The GCL will be placed on top of the subgrade so that the ends of the panels cover the entire anchor trench floor. The minimum overlap of the GCL panels, as required by the manufacturer specifications and design, will exist at all seam locations. A protective cover will be spread over the GCL with low ground pressure equipment to the minimum cover thickness as indicated by the HLF cover conceptual design.

Groundwater and surface water quality monitoring will be carried out at locations near the HLF as described in Section 7.11.2. Should monitoring results indicate a leak after the facility has been decommissioned, Newmont will conduct a cause-and-effect study of the leakage and perform corrective actions as determined by the study. An example of corrective actions that may be taken include groundwater interception for active remediation.

7.3.2 Heap Leach Facility Pond Closure Measures

Closure of the four HLF ponds are anticipated to be completed in two ways. If deemed feasible and necessary for passive treatment (based on outcomes of future studies), two or three of the ponds will be converted to be part of the PRB system. The remaining pond(s) will be used for the duration of the water treatment period (up to Year 20) for disposal of the likely small volumes of sludge from the water treatment plant. The pond(s) will then be closed by folding down the liner over the sludge, then filling the depression (containing the encapsulated sludge) with suitable material.

7.3.3 Reclamation Activities

Areas that do not require engineered cover systems, such as at the closed HLF ponds, will be seeded and/or planted once closure measures are completed to establish ground cover as soon as possible. Site-specific prescriptions will be developed in the future for the HLF as a whole, based on the outcomes of engineering studies for the HLP, stability analyses, and reclamation research.

7.3.4 Remaining Issues and Investigations

Investigations that will be conducted once the HLF is in operation include a revegetation field trial program and HLF cover systems optimization study.

The requirement for passive treatment following reclamation activities for the HLF will be determined by the water quantities and quality exiting as seepage from the HLF. In the water balance and water quality model (Lorax 2023b), net infiltration into the heap was modeled using the results from the 1D numerical modeling of the combined GCL and store and release cover system as described in Appendix 7-B (i.e., total infiltration of roughly 22% of MAP). Using these cover performance assumptions, the water balance and water quality model was used to estimate effluent quality standards for heap leach seepage in the Post-closure period (e.g., Year 21 onwards). Specifically, the model was used to back-calculate the maximum allowable concentrations of key parameters in heap leach seepage waters that would maintain water quality objectives in Halfway Creek at HC-1.0 under all open water (e.g., April to October) flow conditions.

The back-calculated allowable concentrations were then compared to Upper Case geochemical estimates of late phase heap leach process solutions to provide an indication of which parameters may require treatment through a passive treatment system prior to discharge to Halfway Creek. The comparison was also used to derive passive treatment system (PTS) water quality model input values for estimating long-term water quality in the receiving environment. As illustrated in Table 7-12, there are only five parameters that may require additional passive treatment (e.g., NO_3, NO_2, CN_{WAD}, As and Sb) with the most likely being limited to NO_3 and As given the more significant differences between predicted HLF solution chemistry relative to the respective allowable concentration. Water quality modeling in the Post-Closure period at HC-1.0 for NO_3 and As illustrates that the proposed PTS discharge limits are appropriate for maintaining acceptable water quality in Halfway Creek (Figure 7-26).

Table 7-12 Comparison of Upper Case Late Phase HLF Solution Prediction to Back-Calculated Allowable Concentration in PTS Discharge

Parameter	Units	Upper Case Late Phase HLF Solution	Back-Calculated Allowable Concentration	Value Used for PTS Solution in WQM
$N\text{-}NH_3$	mg/L	0.06	41.3	0.06
$N\text{-}NO_3$	mg/L	307	221	220
$N\text{-}NO_2$	mg/L	1.9	0.45	0.45
Cl	mg/L	123	3000	123
Sulphate	mg/L	2516	3120	2500
WAD-CN	mg/L	0.2	0.11	0.1
Al	mg/L	0.2	6.0	0.2
Ag	mg/L	0.00125	0.00675	0.0012
As	mg/L	2.0	0.075	0.075
Ca	mg/L	350	NM	350
Cd	mg/L	0.00013	0.0053	0.00013
Co	Mg/L	0.8	0.105	0.1
Cu	mg/L	0.014	0.053	0.014
Fe	mg/L	0.5	22.5	0.5
Hg	mg/L	0.00026	0.00045	0.00026

Parameter	Units	Upper Case Late Phase HLF Solution	Back-Calculated Allowable Concentration	Value Used for PTS Solution in WQM
Mg	mg/L	155	NM	155
Mn	mg/L	0.06	0.2	0.06
Mo	mg/L	0.105	1.87	0.1
Na	mg/L	1168	NM	1170
K	mg/L	11	NM	11
Ni	mg/L	0.006	1.87	0.006
Pb	mg/L	0.0013	0.045	0.0013
Sb	mg/L	0.5	0.225	0.225
Se	mg/L	0.005	0.053	0.005
U	mg/L	0.685	1.5	0.685
Zn	mg/L	0.052	0.563	0.052

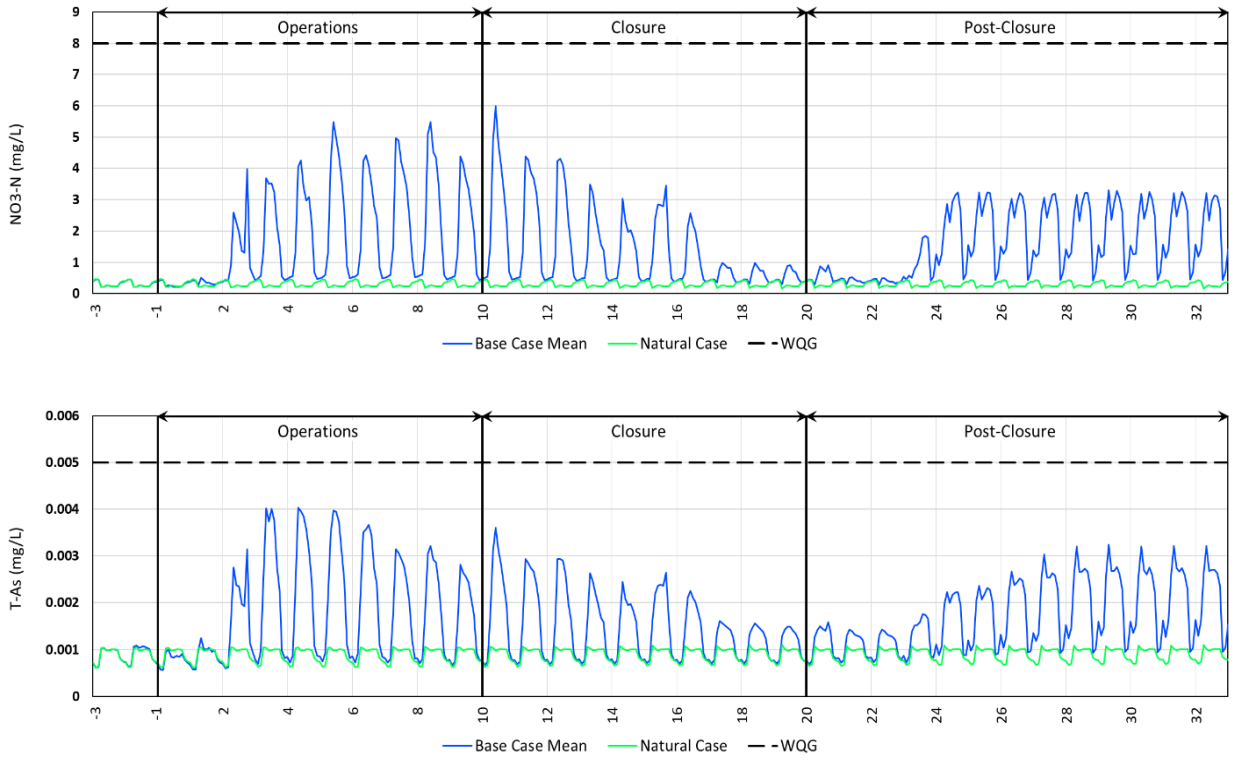


Figure 7-26 Time-series of NO_3 and As Water Quality Predictions at HC-1.0 for all Mine Phases and into Post-Closure Relative to Use Protection Objectives

As noted, nitrate (NO_3^-) and arsenic (As) represent the primary parameters of potential environmental concern from the HLF at closure. Nitrate represents a residual product of cyanide degradation, while As represents leached components from the ore. The use of a passive treatment systems (PTS) employing biological reactors (BR) and permeable reactive barrier (PRB) technology have been a successful passive

treatment technology for treating mine waste solutions and has been considered for this contingency option. All forms of BRs rely on the passage of flow through a permeable matrix (e.g., gravel) amended with materials designed to promote contaminant removal. Common forms of reactive amendments include various sources of organic matter (e.g., hay, sawdust, compost, and peat) and zero valent iron (ZVI). Within the reactive zone, favourable reactions promoted are denitrification and sorption with ZVI corrosion products, most notably for As (Benner et al., 1997; Blowes et al., 2000).

Given that flow paths in BRs are contained below ground, they are influenced to a lower degree by atmospheric conditions in comparison to surface wetlands and have been shown to function well in cold-interior climates (e.g., Benner et al., 1997).

Initial testwork to evaluate this type of semi-passive treatment system was conducted in 2021 at Yukon University and the results are presented in Appendix 2-G.

As Project engineering and closure planning continue and advance, and Project performance is better understood during operations, revisions to water treatment technologies and approaches may be considered.

If the site moves into closure prior to the construction of the active water treatment plant, Newmont will characterize heap seepage, implement appropriate pilot trials to inform water treatment plant design, complete detailed plant design with proof-of-concept, and construct the water treatment plant. Until the water treatment plant is constructed and commissioned, Newmont will manage the HLF seepage water through Event Pond storage and dynamic storage through recirculation of process solution in the heap as described in Section 6.5.2.

7.4 Ore Crushing Facilities

Performance targets for closing ore crushing facilities include ensuring physical stability, removing potential threats to public health and safety, and providing for appropriate future land use (YWB and EMR 2013). This section describes the closure measures that will be implemented to achieve these performance targets and Project-specific closure objectives.

A salvage program will be implemented to reduce the amount of equipment, materials, and items that will require disposal in the on-site landfill. In addition, all equipment, materials, and items will need to be screened and approved for disposal in the onsite landfill prior to disposal. The salvage program will pertain to ore crushing equipment, as well as other equipment and buildings at the Plant Site, Camp Site, bulk explosives storage area, waste management areas, and airstrip. Non-hazardous materials will be separated into three categories:

- Salvageable: materials or items that can be put to use by others as they retain a value equal to or higher than the cost of decommissioning and delivery to the point of sale
- Recyclable: Where materials can’t be salvaged, materials or items can be delivered to a recycling depot, for subsequent processing for use again
- Landfill: inert non-hazardous equipment, items, or materials that have no salvage or recycle value that are on the approved landfill item list will be disposed of in the on-site landfill
- Offsite disposal of non-approved items: equipment, materials or items that are not on the approved items list will be removed from site and landfilled at other approved sites.

7.4.1 Crusher System and Crushed Ore Stockpile Area Closure Measures

At the commencement of the Post-mining Closure Phase, and after any specified processed material for closure has been produced, the two-stage crushing system, overland conveyors, and radial stackers will be dismantled. Additionally, all pad areas (now depleted of materials) will be reclaimed, including the crushed ore stockpile pad and the ROM stockpile pads. Specific activities for each of these components are described below.

The crusher system infrastructure and equipment, except for what can be salvaged or recycled, will be dismantled and disposed of in the landfill if the material is included on the approved landfill item list, or removed from site. Concrete foundations will be demolished to just below ground level while concrete pads will be broken up to allow water infiltration, but otherwise will be left in place. Demolition rubble will be disposed of in the landfill, if approved, and covered with suitable material, based on the priority cover material placement sequence outlined in Appendix 7-B, for subsequent revegetation.

Buried piping and dead electrical cables within the area will be removed to approximately 1 m below grade at surface terminations and ends will be capped. Buried fuel and glycol lines will be flushed with clean water to remove hydrocarbons/glycol prior to capping the ends, or removed entirely and disposed of in the landfill, if approved, or removed from site. Surface piping will be flushed, if necessary, with clean water and removed and disposed of in the landfill, if approved, or removed from site. Surface cables will also be removed and landfilled, if approved, or recycled. Any hazardous wastes and contaminated soils will be managed as per the procedures described in Section 7.9.3.

7.4.2 ROM Stockpile Area Closure Measures

The pad of the ROM stockpile, constructed of waste rock, will remain in place. Prior to reclaiming the pad surface, the pad will be inspected by a qualified person and tested if necessary to ensure that all ore has been removed. Any remaining ore material will be removed and placed in the HLF. The ROM stockpile pad will be sloped to drain pad runoff towards Halfway Creek.

7.4.3 Reclamation Activities

Once closure measures in the ore crushing and stockpile areas are underway, compacted surfaces will be scarified and areas contoured to match adjacent topography. Disturbed areas will be covered with material from the soil stockpiles, based on the priority cover material placement sequence outlined in Appendix 7-B, and seeded and/or planted in order to establish ground cover as soon as possible. Revegetation research programs are currently underway to refine the site-specific revegetation prescriptions. The ore crushing and stockpile areas are anticipated to be revegetated as part of the larger disturbed area (i.e., including the Plant Site, crusher system, stockpile footprints, and areas in between).

7.4.4 Remaining Issues and Investigations

A regrading plan including engineer designs will be developed to outline the activities that will be carried out for closure of the crusher system and crushed ore stockpile area footprints. The regrading plan will include the site-specific revegetation prescriptions as determined through the reclamation research program and will be provided in future iterations of the RCP.

7.5 Plant Site Closure Measures

Performance targets for closure of the Plant Site include ensuring physical stability, removing potential threats to public health and safety, and providing for appropriate future land use (YWB and EMR 2013). This section describes the closure measures that will be implemented to achieve these performance targets and Project-specific closure objectives.

Construction and as-built records (reports, drawings, survey data, etc.) will be kept by Newmont in a secure location electronically and backed up, being available to project team members throughout the operating life of the mine and during closure. These as-built records will be essential for decommissioning, dismantling, demolition, remediation, and reclamation of site infrastructure.

The Plant Site area will be closed during the Active Closure Phase by removing all equipment, buildings, infrastructure, and other materials from the area. Specific measures are as follows:

- Hazardous wastes will be handled and removed from site for offsite disposal, and areas of suspected soil contamination will be assessed and managed as per the procedures described in Section 7.9.3.
- As applicable, utilities and services (air, glycol, power, and water) will be shut off, de-energized, and/or drained to permit safe dismantling and demolition of infrastructure within the Plant Site.
- Equipment, including the modular power plant, will be removed from the area and either transported offsite if it has salvage or recycle value or landfilled on-site if non-hazardous and approved to landfill on site. All contractor-owned equipment will be removed from site by the contractor. At this time, it is premature to indicate which equipment will have resale or salvage value, but equipment (and materials) will be salvaged or recycled to the extent practicable (as outlined in Section 7.4). All equipment will be cleaned thoroughly and drained / flushed of all hydrocarbons using clean water prior to landfilling.
- Storage tanks that support Plant Site processes will be decommissioned and any contents will be drained and placed into suitable drums. The contents will be consumed during closure activities, if practicable. Tanks will be cleaned and decontaminated by a specialized contractor.
- Buildings and structures will be demolished with the resulting steel being recycled or landfilled if the material is included on the approved landfill item list, and other non-hazardous demolition debris landfilled on-site, if approved.
- Concrete foundations will be demolished to just below ground level and concrete pads will be broken up to allow water infiltration but otherwise will be left in place. Demolition rubble from the foundations will be hauled to the on-site landfill, if approved.
- Buried piping or electrical cables within the area will be removed to approximately 1 m below grade at surface terminations and ends will be capped. Buried fuel and glycol lines will be flushed with clean water prior to capping the ends or will be removed entirely and disposed of in the landfill, if approved, or removed from site. At this time, the level of design does not allow for the development of detailed maps showing all buried foundations, equipment or infrastructure that will remain on site (once mine reclamation activities are complete).
- Surface piping will be flushed with clean water, if necessary, removed, and disposed of in the landfill, if on the approved landfill list, or re-purposed for water management use during closure.

- Powerlines and poles will be cut at ground level or removed. Power poles and lines will be shipped off-site if salvageable or not approved for on-site landfill. Otherwise, power poles and lines will be disposed of on-site in the landfill.
- Below-grade depressions (e.g., sump or secondary containment areas) will be backfilled with non-PAG waste rock or other suitable fill to re-establish a level surface. These areas may be contoured with the surrounding topography.

The proposed closure measures for the Plant Site may be altered and/or refined once designs are advanced to show the buried foundations, equipment, and/or infrastructure to remain on-site post-reclamation.

7.5.1 Bulk Fuel and LNG Storage Areas

Remaining fuel will be withdrawn from the fuel storage tanks during the Post-mining Closure Phase. Once empty, large tanks will be cut apart to facilitate their removal. Steel plate sections and distribution system components will be flushed / washed with clean water to remove any hydrocarbons. Wash water will be contained and directed to the oil-water separator used for the truck shop wash bay. Steel will be salvaged or recycled, when possible, removed from site if not approved for on-site landfilling or disposed of in the landfill site, if approved.

The tank farm earthen containment berms will be flattened, and liner materials will be removed and disposed of in the landfill, if approved, or removed from site. Materials underlying the liner will be tested for hydrocarbon contamination. Any contaminated materials encountered will be managed as per the established processes described under Section 7.9.3.1. Depressions within the storage areas will be filled with non-PAG waste rock or other suitable fill material to re-establish a level surface, and the area contoured to blend with surrounding topography.

To support the implementation of final closure measures in other areas after the fuel storage tanks have been removed from the Plant Site, appropriately-sized portable fuel storage tanks will be used to store diesel for equipment and power generation. Lined containment areas will be established for these portable fuel storage tanks as required.

7.5.2 Reclamation Activities

The footprint of the Plant Site will be covered with stockpiled material, based on the priority cover material placement sequence outlined in Appendix 7-B, and seeded and/or planted in order to establish ground cover as soon as possible. Revegetation research programs are currently underway to refine the site-specific revegetation prescriptions. It is anticipated that cover and revegetation plans will be developed considering the larger disturbed area (i.e., including the Plant Site, crusher system, stockpile footprints, and areas in between).

7.5.3 Remaining Issues and Investigations

A regrading plan including engineer designs will be developed to outline the activities that will be carried out for closure of the Plant Site area footprint. The regrading plan will include the site-specific revegetation prescriptions as determined through the reclamation research program and will be provided in future iterations of the RCP.

7.6 Camp Site Closure Measures

The performance targets and general closure measures outlined for the Plant Site are applicable to the Camp Site (see Section 7.5). Once decommissioning of buildings and supporting infrastructure is underway at the Camp Site, the Java camp will be used to house personnel throughout the Post-mining and Active Closure Phases to support closure works and monitoring activities. The Java camp will be decommissioned towards the end of the Active Closure Phase, at which time the Coffee exploration camp may be used. In addition to the closure measures outlined above for the Plant Site, additional measures required to close the Camp Site include decommissioning of the sewage treatment plant and closure of the effluent disposal field.

Prior to decommissioning of the sewage treatment plant, the effluent/treatment tanks and piping will be flushed with clean water to remove residual sludge. Residual sludge will be disposed of in accordance with the procedures established under the Operation Phase. The plant will be disconnected from service connections and transported off-site, where it will either be re-purposed or dismantled and components that cannot be re-purposed either recycled or landfilled (on-site, if on the approved landfill list, or off-site).

Buried piping within the area (including effluent disposal field) will be flushed with clean water, and piping will either be removed to approximately 1 m below grade at surface terminations and ends capped, or removed entirely and disposed of in the landfill, if on the approved landfill list. At this time, the level of design does not allow for development of detailed maps showing buried infrastructure that will remain on site (once mine reclamation activities are complete). Surface electrical cables and surface piping (flushed with clean water, if necessary, prior to removal) will be transported to the landfill, if approved, or off site for disposal.

7.6.1 Reclamation Activities

The footprint of the Camp Site will be covered with stockpiled material, based on the priority cover material placement sequence outlined in Appendix 7-B, and seeded and/or planted in order to establish ground cover as soon as possible. Revegetation research programs are currently underway to refine the site-specific revegetation prescriptions.

7.6.2 Remaining Issues and Investigations

A regrading plan including engineer designs will be developed to outline the activities that will be carried out for closure of the Camp Site footprints. The regrading plan will include the site-specific revegetation prescriptions as determined through the reclamation research program and will be provided in future iterations of the RCP.

7.7 Site Water Management Infrastructure

The end of the Post-mining Closure Phase is primarily dictated by the completion of the HLF recirculation. The water management infrastructure that will be in place at the beginning and end of the Post-mining Closure Phase is shown in Figure 7-2. The water management infrastructure remaining at the end of the Active Closure Phase includes the semi-passive water treatment system (if required), the pit lakes, pit lake outlet structures.

Sedimentation (Facility Pond and Alpha Pond) ponds and water conveyance structures will continue to be operated and monitored during the Closure Phase similar to the Operation Phase. Once pond water quality

has stabilized, decommissioning activities can occur. Stabilization of the water quality within the Alpha Pond is defined as:

- No notable upward trends in the parameters of potential concern (POPCs)
- Sustained reduction in inter-annual variability in POPC concentrations from Operation Phase conditions
- Discharge concentrations for all POPCs are consistently at levels that allow WQOs to be achieved in Halfway Creek.

Decommissioning of the sedimentation ponds will be accomplished by draining the ponds. Sediment that has accumulated in the ponds will be removed and disposed of in dedicated disposal areas in the Alpha WRSF. The base of each pond will be covered with a coarse gravel and revegetated as determined through the reclamation research program, and the base of the Alpha Pond will be reshaped to establish a natural streambed. The sedimentation pond dams may remain in-place to control sediment release during the Active Closure Phase, then will be breached to the pre-mining ground elevations. The plunge pool downstream of Alpha Pond will be left in place to capture sediment following the dam breach. Additional information regarding the design and stability analysis of water management infrastructure can be found in the Water Management Design Basis Report (SRK 2023).

Most of the excavated dam material will be temporarily placed upstream of the dams. Excavated dam materials will be used to backfill pond excavations (if present), to cover the inundation footprint of the ponds, and/or to construct a post-closure drainage pathway through the footprint of the former dam and pond.

The decommissioning of water conveyance structures that are not required in the Post-closure Phase will involve the re-establishment of drainage patterns as determined through the end land use planning for the site. This will be accomplished by breaching diversion and collections ditches in strategic areas to support permafrost protection or at other appropriate locations. Culverts will be removed and ditches and areas where culverts were removed will be re-graded to blend into the surrounding topography.

Closure of the Alpha Dam was evaluated through the alternatives assessment process described in Section 2.3.4, which determined partial decommissioning of the Alpha Dam and construction of a drainage channel as the base case closure measure for this infrastructure. Closure of the West Diversion Ditch was also evaluated through the alternatives assessment process, which determined complete decommissioning (re-grading to slope) as the base case closure measure for this infrastructure.

7.7.1 Reclamation Activities

Where water management infrastructure has been removed, disturbed areas will be covered with stockpiled material, based on the priority cover material placement sequence outlined in Appendix 7-B, and seeded and/or planted in order to establish ground cover as soon as possible. Revegetation research programs are currently underway to refine the site-specific revegetation prescriptions.

7.7.2 Remaining Issues and Investigations

Evaluation and design work will continue on water management structures that are likely to be operational through the Post-closure Phase, such as the Alpha WRSF rock underdrain, the pit lake spillway channels,

and other channels that may be required in the long-term to ensure Project-specific closure objectives are achieved to the extent practicable.

A reclamation research program is currently underway to determine the site-specific revegetation prescriptions and inform the revegetation strategy for the former water management infrastructure areas.

7.8 Mine Site Roads and Other Components

For roads and airstrips, the performance targets for closure are to establish conditions that support future land use objectives, ensure public safety, and eliminate risks to wildlife while providing for long-term operations, monitoring, and maintenance requirements (YWB and EMR 2013). Closure measures and reclamation activities are described below for haul roads and Mine Site roads, the NAR and On-site Access Road, the Project airstrip, laydown areas, and the bulk explosives storage facility. The Coffee exploration camp and airstrip will continue to be used in the Post-closure Phase to support monitoring activities; hence, reclamation and closure measures are not proposed.

7.8.1 Haul Roads and Mine Site Roads

Progressive closure of haul and Mine Site roads will occur throughout the Operation Phase as roads are no longer required to support operations. Roads used for closure works will generally undergo closure in the later portion of the Active Closure Phase when the majority of infrastructure has been decommissioned and key areas have been closed.

The running surfaces of the compacted roads will be scarified, re-graded as per landscape designs, and seeded and/or planted to establish ground cover as soon as possible. It is anticipated the water management infrastructure associated with roads (i.e., ditches and culverts) will be decommissioned at the same time as the road itself is decommissioned. These areas will be re-graded to blend into the surrounding landscape. To minimize the potential of sediment-laden runoff outside of the disturbed footprint, erosion, and sediment control measures (e.g., silt fences) may be temporarily required to minimize sedimentation downslope. Any temporary measures will be removed once monitoring results indicate that water management and revegetation in the area is meeting performance targets.

Revegetation research programs are currently underway to refine the site-specific revegetation prescriptions. Road corridor areas are anticipated to be revegetated as part of the prescribed reclamation for areas that they connect with to blend in with these surrounding areas.

7.8.2 NAR and On-site Access Road

The NAR and On-site Access Road will be operational throughout most of the Active Closure Phase to support closure operations including the transport of equipment, fuel, and consumables to the Mine Site, and the removal of hazardous materials and other wastes and equipment from the Mine Site (further described in Section 8.4). When it is decided that the NAR and On-site Access Road are no longer required for operations in the Closure or Post-closure phases, the On-site Access Road and new sections of the NAR will be decommissioned.

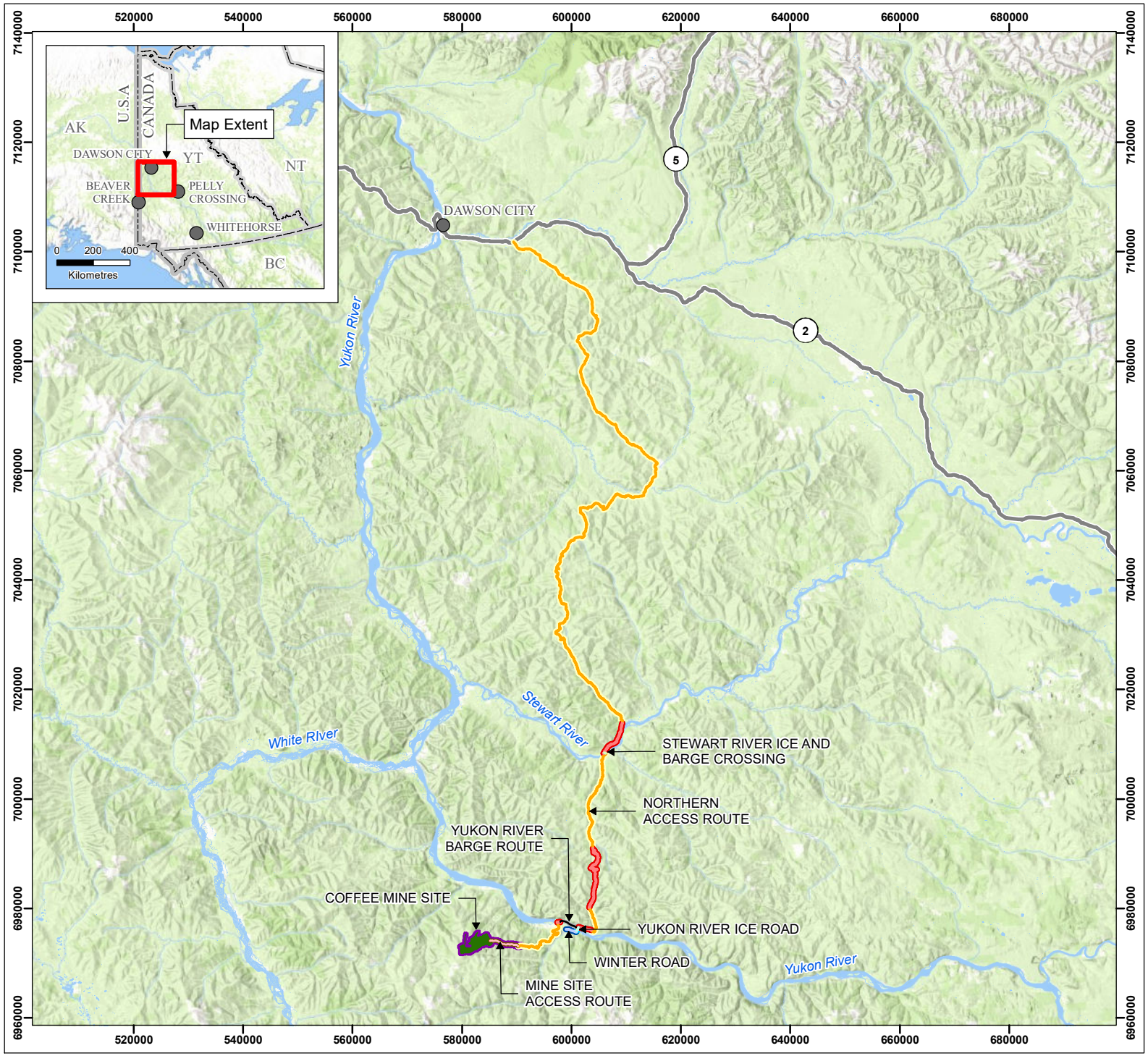
Options for closure of the NAR were evaluated through the alternatives assessment process as described in Section 2.3.4, which determined decommissioning new sections of the NAR constructed to support the Project as the base case closure option. New sections of the NAR and the On-site Access Road will be

decommissioned by removing culverts and bridges to re-establish pre-construction surface drainage patterns, removing the barge landings, scarifying the road surfaces to promote water infiltration and vegetation re-establishment, and contouring of the road surfaces and cut and fill slopes in accordance with landscape designs. Re-contouring works will target minimizing potential hazards for area users and wildlife. Site-specific prescriptions will be developed based on the outcomes of reclamation research. The section of the NAR that are planned for reclamation are shows on Figure 7-27. Newmont will continue to work with Yukon government and placer claim holders (if infrastructure falls within placer claims) on long term maintenance activities for existing sections of the NAR.

The closure measures for decommissioning and reclaiming the new sections of the NAR include:

- Restricting access to areas undergoing decommissioning and reclamation
- All materials installed for the construction of fords, culverts, bridges and barge landings will be removed
- On the road smaller cuts, fills and ditches will be filled in
- Banks will be stabilized and restored to original shape, where practical
- Pre-construction surface drainage patterns at disturbed areas will be established
- Excess rip rap or erosion control structures will be removed
- Re-contouring surfaces, road surfaces, and other disturbed areas (targeted to minimize potential hazards for humans and wildlife
- Scarifying disturbed areas to promote natural revegetation
- Scarifying road surfaces to promote natural revegetation
- Where warranted, temporary erosion protection measures may be used until vegetation is established
- Stabilizing and re-contouring remaining borrow sources
- Stabilizing and scarifying spoil sites
- Revegetation of disturbed areas for erosion protection and reintroduction of native species
- Restoration of shoreline habitat in riparian areas affected by the barge landings
- Specific revegetation methods and vegetation species will be developed based on the reclamation research program for the Mine Site.

Newmont is committed to developing a decommissioning program prior to decommissioning of the NAR. The NAR decommissioning program will be developed in collaboration with affected First Nations. Once the NAR and on-site access roads have been decommissioned, consumables and materials required to support activities conducted in the latter part of the Active Closure Phase and monitoring activities in the Post-closure Phase will be transported to site by air or barge campaigns on the Yukon River.



COFFEE GOLD MINE

Northern Access Route Reclaimed Section

Legend

- Proposed Reclaimed Road
- Stewart River Ice and Barge Crossing
- Yukon River Barge Route
- Yukon River Ice Road
- Winter Road
- Mine Site Access Route
- Northern Access Route
- Project Area
- Project Footprint
- Highway
- Waterbody

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Topographic Map
4. Inset Basemap: ESRI World Topographic Map

N

1:1,000,000

0 5 10 15 20 25

Kilometres

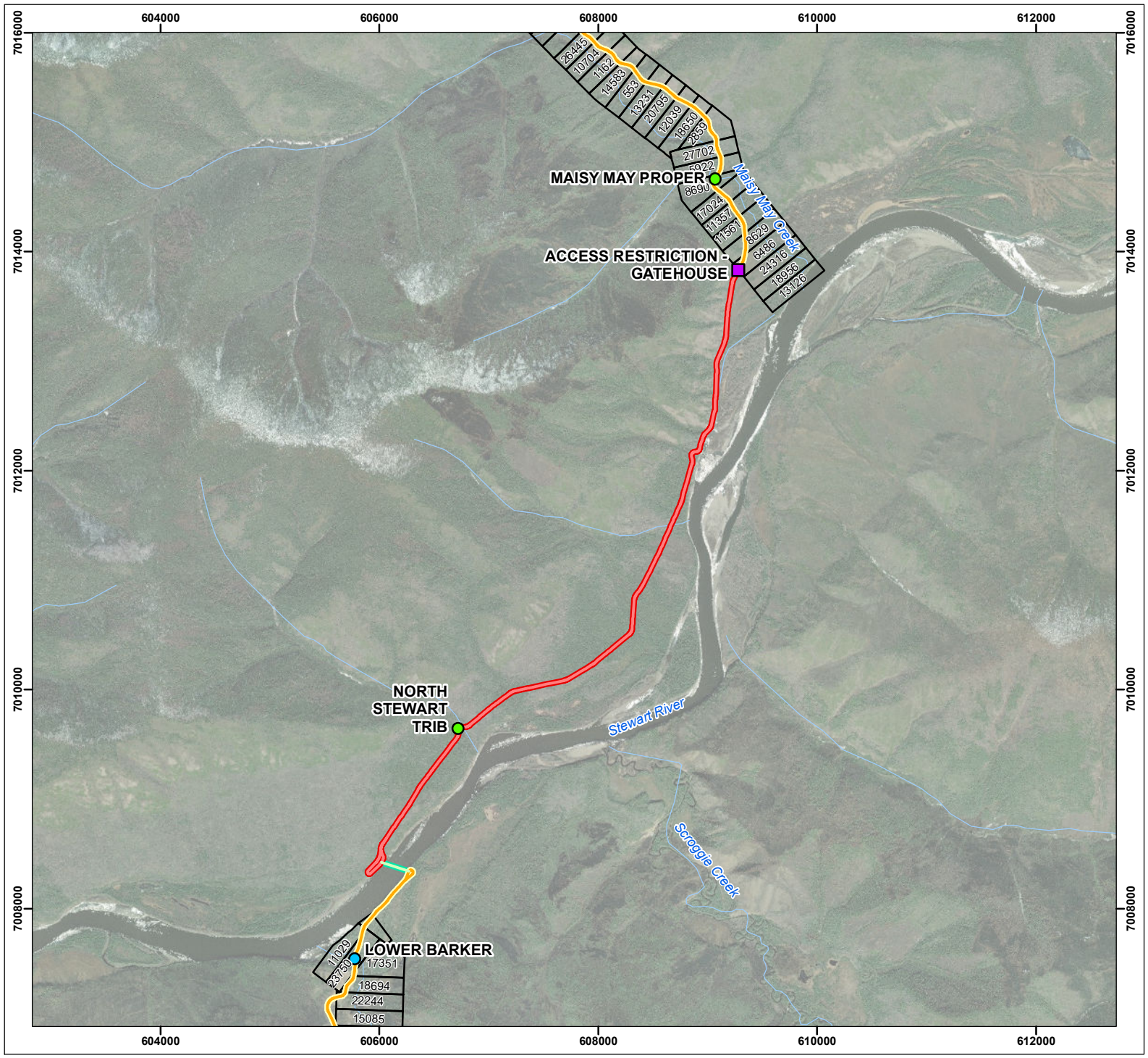
NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 7-27a	Date: Mar 2, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MP\PRCP\Fig7x_103862_03_NAR_reclaimed_road_overview_23302.mxd



COFFEE GOLD MINE

Northern Access Route Reclaimed Section



Legend

- Proposed Reclaimed Road
- Stewart River Ice and Barge Crossing
- Northern Access
- Active Placer Claim
- Access Restriction - Gatehouse
- Ford
- No Existing Watercourse Crossing
- Watercourse

Notes

1. Placer claim data downloaded from GeoYukon on July 6, 2022.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Imagery
4. Inset Map: ESRI World Topographic Map

N

1:50,000

0 0.2 0.4 0.6 0.8 1
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 7-27b	Date: Mar 2, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MP\PRCP\Fig\X_103862_03_NAR_reclaimed_road_mapbook_230302.mxd



COFFEE GOLD MINE

Northern Access Route Reclaimed Section



Legend

- Proposed Reclaimed Road
- Northern Access
- Active Placer Claim
- No Existing Watercourse Crossing
- Watercourse

Notes

1. Placer claim data downloaded from GeoYukon on July 6, 2022.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Imagery
4. Inset Map: ESRI World Topographic Map

N

1:50,000

0 0.2 0.4 0.6 0.8 1
Kilometres

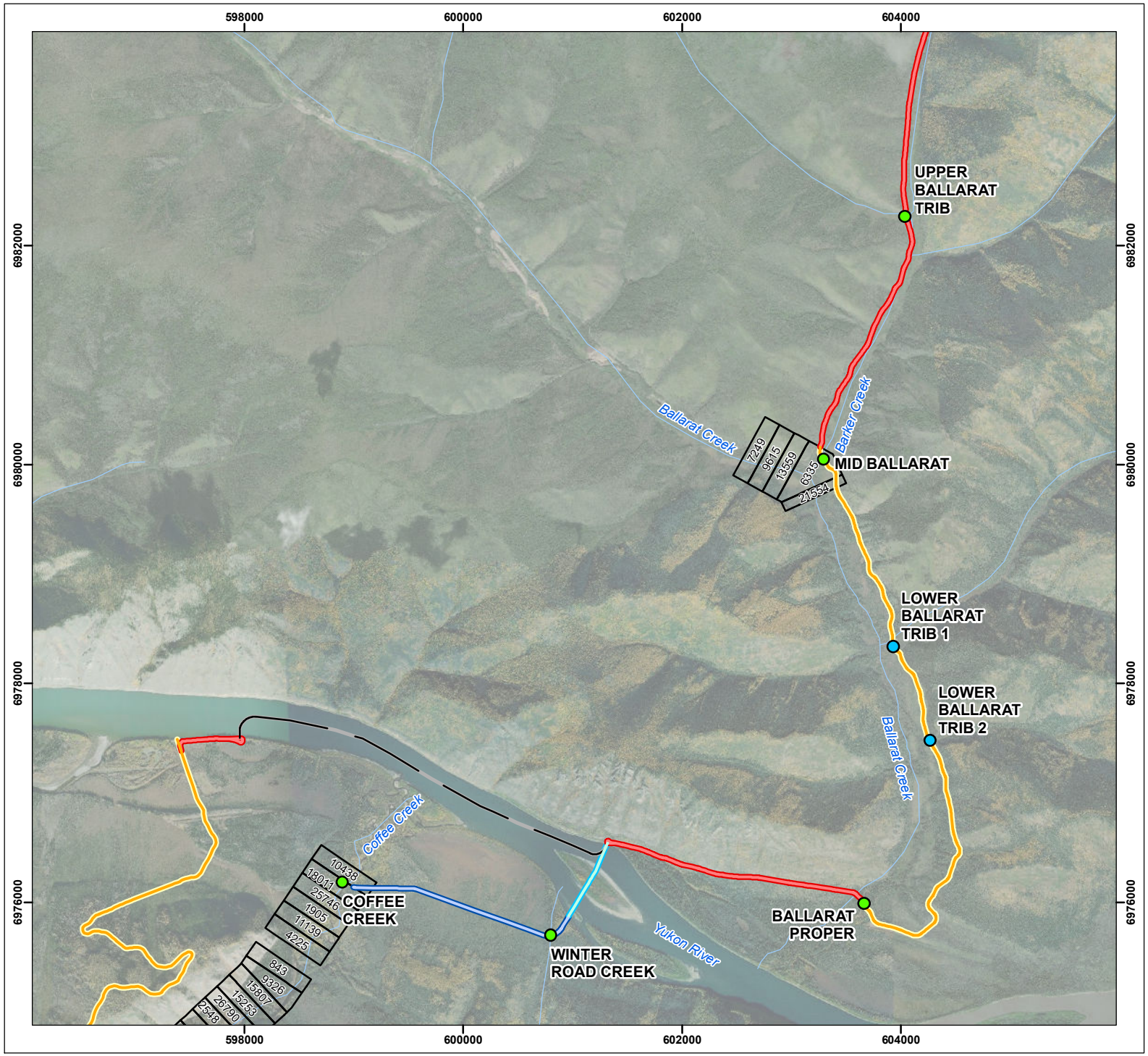
NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 7-27c	Date: Mar 2, 2023	Drawn by: AS	Reviewed: KP

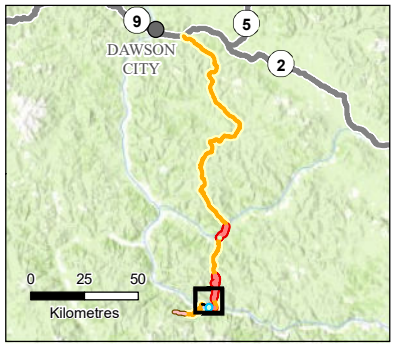
Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MP\RCP\Fig\X_103862_03_NAR_reclaimed_rcd_mapbook_230302.mxd



COFFEE GOLD MINE

Northern Access Route
Reclaimed Section



Legend

- Proposed Reclaimed Road
- Yukon River Barge Route
- Yukon River Ice Road
- Winter Road
- Northern Access Route
- Active Placer Claim
- Ford
- No Existing Watercourse Crossing
- Watercourse

Notes

1. Placer claim data downloaded from GeoYukon on July 6, 2022.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Imagery
4. Inset Map: ESRI World Topographic Map

N

1:50,000

0 0.2 0.4 0.6 0.8 1
Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 7-27d	Date: Mar 2, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MPR\CPF\gX_103862_03_NAR_reclaimed_rcad_mapbook_230302.mxd

7.8.3 Project Airstrip

The Project airstrip will be operational during most of the Active Closure Phase to permit the transport of personnel and resupply of consumables to the Mine Site. Upon decision to decommission, reclamation will include removal of lighting, navigation equipment, and water management infrastructure. The compacted runway and apron surfaces will be scarified to promote water infiltration and vegetation re-establishment. Contouring of the surface and cut and fill slopes will be done in accordance with landscape designs, which will consider factors such as minimizing potential hazards for area users and wildlife. Once the Project airstrip is reclaimed, the existing airstrip at the Coffee exploration camp will be used instead.

Once the Coffee exploration airstrip is no longer needed to support Post-closure monitoring activities, reclamation will be undertaken and will involve contouring, scarifying, top-soiling, and seeding.

7.8.4 Laydown Areas

Materials and equipment stored within laydown areas will be consumed prior to reclamation of these areas, shipped offsite, or disposed in the landfill if the material is included on the approved landfill item list. Areas of suspected soil contamination will be assessed and managed as per established processes outlined in Section 7.9.3.1. Upon remediation of any contaminated soils, the laydown areas will be graded in accordance with landscape designs. As per other areas of the Mine Site, it is anticipated that laydown areas will be revegetated to blend in with these surrounding areas. The landfill will be decommissioned following completion of the demolition of site infrastructure. The landfill will be closed as per requirements provided in future *Environment Act* permits for waste management.

7.8.5 Bulk Explosive Storage Area

The inventory of explosives, comprising ammonium nitrate and emulsion product, remaining at the end of mining will either be returned to the supplier or transferred to another licensed user. Areas of suspected soil contamination will be assessed and managed as per established processes outlined in Section 7.9.3.1. Once any contaminated soils have been remediated, the areas will be graded in accordance with landscape designs. Site-specific revegetation prescriptions will be developed based on the outcomes of reclamation research.

7.9 Environmental Management

7.9.1 Air Quality and Dust

Throughout remediation and closure works, dust resulting from earthworks, heavy vehicle traffic, and site light vehicle traffic will be managed using a water truck. The application of water to dry construction surfaces will limit the creation and conveyance of dust particles. Dust management will be the responsibility of Newmont if the work is self-performed, or the Prime Contractor on site.

7.9.2 Spill Management

Spill management on site will begin with good housekeeping. All works areas, laydowns, and maintenance areas will be kept clean and well-organized. Secondary containment will be provided for all fuel storage tanks. Drip trays will be placed under all equipment not in use. Spill kits will be kept on all equipment and

in all work areas as per applicable regulations. Fueling and lubing will only occur in designated areas. All construction waste and waste oil will be disposed of as per the applicable regulations.

In the event of a spill, it will be compulsory to be reported to site management immediately. Personnel will be trained in spill management and reporting procedures. Spill response procedures to be followed during closure are described in the Spill Contingency Plan.

7.9.3 Hazardous Materials Management

As indicated above, hazardous materials will be removed from areas in advance of decommissioning activities occurring, such as demolition or dismantling activities. Evaluations will be conducted early in the Post-mining Closure Phase to determine the type and quantities of hazardous materials that will either need to be consumed during the Closure Phase (e.g., such as during heap leaching or rinsing or water treatment processes, or mobile equipment lubricants), transported to an offsite facility licensed to dispose of such waste materials, or managed on-site (i.e., such as hydrocarbon contaminated soils). Hazardous waste handling and offsite transfer procedures will be conducted according to the Waste and Hazardous Materials Management Plan, which will be updated, if required, prior to the onset of the Post-mining Closure Phase to reflect site conditions at that time.

7.9.3.1 Land Treatment Facility

The locations and extent of hydrocarbon-contaminated soils (or snow) will be determined through a contaminated site investigation early in the Post-mining Closure Phase. Any contaminated soils will be excavated and either treated on site to an acceptable standard or transported off-site for disposal, depending on the volume of material, level of contamination, and anticipated time to remediate such soils.

Prior to closure of the facility, Soils that have successfully undergone bioremediation and have met criteria outlined in the *Contaminated Sites Regulations* numerical soil standards for industrial sites will be removed from the land treatment facility for use as cover material in the landfill or elsewhere on the Mine Site where acceptable. Naturally occurring elevated metals in the material will be considered when placing remediated soils. Once all remediated soil and bedding material have been removed, the HDPE liner will be disposed of in the landfill (if approved and the landfill is still operational) or shipped off-site for disposal. Disturbed areas will be seeded and/or planted to establish ground cover as soon as possible (site-specific prescription will be developed based on the outcomes of reclamation research).

7.9.4 Erosion and Sediment Control

Erosion and sediment control during reclamation and closure works will be the responsibility of Newmont if the work is self-performed, or the Prime Contractor on site. These measures will be implemented prior to and during construction to minimize erosion and sediment discharge into surrounding areas. These measures reduce the potential for erosion by stabilizing exposed soil or by reducing surface runoff and flow velocities. The site will be assessed before and during construction activities to determine the need for various erosion and sediment control provisions. Best practices such as diversion ditches, straw bales, sediment traps, and silt fences will be field-fit with approval from the engineering team. The Erosion and Sediment Control Plan developed for Construction and Operation Phases will be used to guide sediment and erosion control during the Closure Phase.

7.9.5 Revegetation

Construction during reclamation and closure works will generally occur within areas which were disturbed during operations in order to limit the required re-establishment of a natural vegetative cover. Re-vegetation following closure of specific mine components is generally described in the above paragraphs. Disturbed areas will generally be graded to reduce erosion and promote positive surface water drainage. A specified seed mix of native plants will be spread using equipment or by hand over the graded areas. If any areas require quick vegetation growth to achieve erosion control, hydroseeding will be considered. Revegetation research programs are currently underway to refine the site-specific revegetation prescriptions as described in Section 2.3.1.

7.9.6 Soil Salvage

Continuous salvage and stockpiling of reclamation material will be carried out throughout the Construction and Operation Phases to provide reclamation material for the site components that are planned to be covered with material in closure. Effective soil salvage will provide suitable material to restore ecosystems and reduce infiltration. Newmont will develop soil stockpile and salvage guidelines for the Project that will be optimized throughout operations based on material volumes and quantities. The guidelines will include strategic stockpile placement based on source and use locations to reduce costs associated with long haul distances and re-handling, and will also contain the following details:

- Segregate organics rich overburden from mineral overburden to the extent practical. Segregation will be informed by thickness of the organic rich horizon:
  - if greater than 30 cm, can be segregated from mineral overburden below
  - if less than 30 cm, segregation may not be practical using equipment available at the site.
- To not bury soil resources if they can be safely salvaged
- Salvage all salvageable soil as defined in Section 5.3.3.2 and act on opportunities to increase salvage volumes as they arise
- To consider progressive reclamation opportunities, cost-effective handling options, minimizing soil loss, degradation, or contamination
- Progressively update the soil stockpile and salvage guidelines concurrent with updates to the RCP and mine development
- Qualified personnel will be on-site during site preparation activities to guide material segregation and management. Stockpiles may be segregated in multiple lifts if overburden material conditions allow. Maintenance measures to reduce erosion of the stockpiles will be implemented as described in the Erosion and Sediment Control Plan.

7.10 Material Balance

Material balance estimates were prepared in 2018 and 2019 to determine the approximate quantity of material that would be moved during the construction activities for the Project. Overall estimates of available reclamation material range from 2.6 Mm^3 to 2.8 Mm^3 depending on the suitability of the material below the HLF. Overburden is classified as organics, silt layer, gravel layer, and weathered bedrock. Suitable overburden for use as reclamation material includes organics, silt, and the upper 20 cm of gravel, which will be managed to segregate the organics rich overburden from the mineral overburden to the extent practical (Section 7.9.6). The overall volume (including material outside the HLF foundation), and suitability

of frozen material for use as reclamation material remains an uncertainty for the project given depth of refusal for test pitting programs.

7.10.1 Required Materials

A variety of cover system scenarios were evaluated as part of the HLF cover system design to determine reclamation material requirements based on potential cover system thicknesses. The assessment also investigated a variety of options for cover system application across the site to determine reclamation material requirements. A reclamation material priority evaluation was carried out to determine where cover would be established following closure of various site components. The priority list evaluation determined that the HLF including event ponds is the highest priority component to receive reclamation material, followed by the Alpha WRSF, Alpha Pond/Dam, Kona Pit, and the Double Double Pit as described in the Heap Leach Facility Cover Design Report (Appendix 7-B). The priority sequence for cover material application will be refined through collaboration with stakeholders and First Nations.

The base case cover design includes a 0.5 m store and release cover system, based on constructability and likely performance requirements. Figure 7-28 provides an overview of the material required for the base case cover design at the site and indicates sensitivities for the amount of inorganics that are suitable for reclamation. The material balance for the base case design indicates a surplus of suitable material available for reclamation activities.

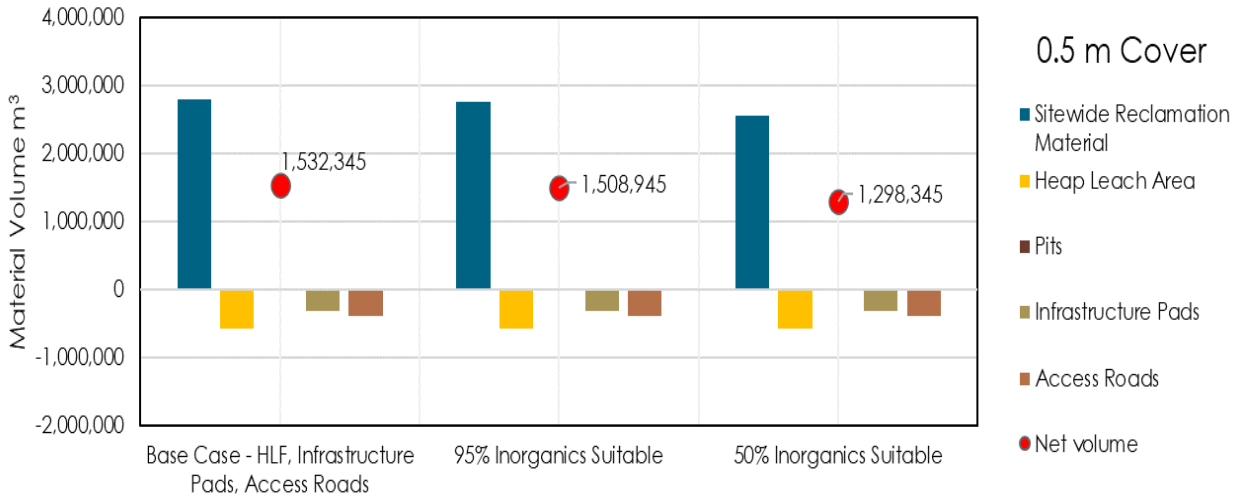


Figure 7-28 Base Case Cover System Material Requirements

7.10.2 Borrow Material and Locations

Table 7-13 shows reclamation material volumes by location and type based on the most recent design work. This represents the overburden material that is estimated to be removed during the Construction and Operation Phases. These volumes will be re-evaluated during construction and operations, and an updated material balance will be developed for confirmation of available reclamation materials. Additional information regarding the estimated material balance is provided in the Surface Material for Reclamation Report (JDS 2018), the Coffee Project Material Balance Report (Appendix 7-C), and the Heap Leach Facility Cover Design Report (Appendix 7-B).

Table 7-13 Reclamation Material Volume by Location and Type

Area	Material Type	Volume Available for Reclamation (m^3)
Plant Area & Crusher	Organics	82,709
	Silt	-
	Upper Gravel	-
	Weathered Bedrock	-
	Subtotal	**82,709**
Heap Leach Area & Event Ponds	Organics	339,030
	Silt	468,000
	Upper Gravel	
	Weathered Bedrock	-
	Subtotal	**807,030**
Kona Pit	Organics	18,866
	Silt	81,752
	Upper Gravel	12,577
	Weathered Bedrock	-
	Subtotal	**113,195**
Latte Pit	Organics	71,955
	Silt	71,955
	Upper Gravel	71,955
	Weathered Bedrock	-
	Subtotal	**215,864**
Supremo PH 1-4 Pit	Organics	321,019
	Silt	642,038
	Upper Gravel	256,815
	Weathered Bedrock	-
	Subtotal	**1,219,872**
Supremo PH5 Pit	Organics	27,177
	Silt	95,118
	Upper Gravel	27,177
	Weathered Bedrock	-
	Subtotal	**149,472**
Double Double Pit	Organics	24,129
	Silt	24,129
	Upper Gravel	-
	Weathered Bedrock	-
	Subtotal	**48,258**

Area	Material Type	Volume Available for Reclamation (m^3)
On-Site Development	Organics	154,278
	Silt	-
	Upper Gravel	-
	Weathered Bedrock	-
	Subtotal	**154,278**
Total		**2,790,679**
Material Type Summary	Organics	1,039,162
	Silt	914,993
	Upper Gravel	368,524
	HLF Silt and Upper Gravel	468,000
	Weathered Bedrock	

Source: Surface Material for Reclamation (JDS, 2018) and Coffee Project Material Balance Report (JDS 2019; Appendix 7-C).

7.11 Maintenance, Monitoring and Reporting Activities

This section describes the monitoring activities that are planned for the Closure Phase and, if relevant, the Post-Closure Phase to confirm the effectiveness of reclamation and closure measures (in accordance with Project-specific closure objectives outlined in Section 3.1.3) and inform adjustments for subsequent RCP iterations. The monitoring activities presented here are conceptual and will be refined as project planning advances. The key objectives that will be informed by monitoring results include:

- All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events.
- Protect and maintain the land, air, and water in a condition that provides for sustainable use.
- Ensure water remains substantially unaltered from pre-mining conditions to the extent practicable with respect to quantity, quality, and rate of flow, including seasonal rate of flow. Pre-mining conditions refers to the state of land, air, water, and resources prior to Project-related activities and disturbances associated with both exploration and mining.
- Protect health and safety of people and area wildlife using and accessing the site by emulating pre-mining conditions to the extent possible.
- Protect or enhance ecological processes and functions in order to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities, with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions.
- Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development. Sustainable Development, as defined in the Umbrella Final Agreement, means beneficial socio-economic change that does not undermine the ecological and social systems upon which communities and societies are dependent.

- Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable.
- To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources.
- Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land.
- Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks.

The objectives of environmental monitoring, surveillance, and reporting activities with respect to the eventual closure of the Project are to:

- Track the effects of the Project on the environment relative to predicted outcomes.
- Assess the effectiveness of mitigation measures and inform amendments to management and mitigation plans, as necessary.
- Assess the effectiveness of reclamation and closure measures.
- Inform reclamation and closure plan adjustments, as required.

Monitoring of the following environmental components is proposed in order to verify the achievement of the above objectives:

- Meteorology
- Aquatic Conditions
- Hydrology and Surface Water Quality
- Groundwater Quality
- Wildlife
- Vegetation
- Invasive plants
- Fish and Fish Habitat
- Benthic Invertebrate
- Periphyton
- Sediment Quality.

The conceptual monitoring requirements described in this section refer to the period from the commencement of the Post-mining Closure Phase to the end of the Post-closure Phase. The intensity of monitoring is likely to decrease with the progression of the Project into subsequent stages, and in general, monitoring programs will continue until predicted Project-related effects are confirmed or the success of reclamation efforts has been ascertained.

The details of these monitoring programs during the Operation Phase are provided in the EMAMP; however, a summary of the programs as they are to be implemented during the Closure and Post-closure phases is provided below.

7.11.1 Meteorological Monitoring

Meteorological monitoring refers to the collection of high-quality and site-specific climate data, including air temperature, precipitation, wind speed and direction, relative humidity, atmospheric pressure, solar radiation, snow depth, and snow water equivalent. The collection of meteorological data is closely tied to the monitoring of surface water hydrology, surface water quality, groundwater quantity and quality and air quality. The meteorological monitoring program is designed to capture temporal and spatial variability in key climate parameters at the site in such a way that these data can be robustly linked to the data collected by other monitoring programs. For example, short-term trends in water quality at a monitoring location may be caused by wetter or drier than average conditions, and not by changing geochemical factors.

The ongoing monitoring of site climate conditions will be used in the periodic updates of the site-wide water balance and water quality model (WB/WQM) and will aid in the interpretation of the monitoring results from other monitoring programs (e.g., water quality, aquatic biota, etc.).

The meteorological monitoring network consists of two climate stations with full instrument suites, and multiple snow courses situated at various elevations and aspects around the Project site. A Campbell Scientific automated weather station was installed in July 2012 and is located roughly 5 km to the east of the main Project infrastructure (i.e., heap leach, pits, waste rock storage areas) at elevation 975 masl (Table 7-14). This is referred to as the KM 11 climate station, and data is downloaded manually on a monthly basis. A second automated weather station was installed at high elevation (~1,340 masl) and adjacent to the proposed heap leach pad footprint (i.e., ~400 m to the northwest of the HLF) in October 2018. This station is referred to as the Kona climate station, and is equipped with a satellite transmitter, which uploads the climate data to a web server on an hourly basis. This will allow real-time assessment of station performance, battery health and upper elevation climate conditions in support of exploration and mining operations.

Snow courses were also established in 2012 at various elevations/aspects (i.e., low, mid and high elevation), oriented to discern effects of aspect on local snow accumulation and melt (Figure 7-29). Snow courses are surveyed at, or near, peak seasonal accumulation, over a 12-day window centred on Mar. 1 and Apr. 1, at ridgetop, climate station, mid-elevation and valley bottom sites (Figure 7-29).

Table 7-14 Meteorological Monitoring Station Locations

Station	Type	Parameters*	Latitude (°N)	Longitude (°W)	Elevation (m asl)	Sampling Frequency
IC-1.5_SS	Snow Course	SD, SWE, Density	62.915	-139.579	524	Monthly (Feb, Mar, Apr, May)
CC-EAST-1_SS	Snow Course	SD, SWE, Density	62.872	-139.394	1,220	Monthly (Feb, Mar, Apr, May)
KAM-WX_SS	Snow Course	SD, SWE, Density	62.873	-139.180	996	Monthly (Feb, Mar, Apr, May)
Mid-Elev-SS	Snow Course	SD, SWE, Density	62.894	-139.097	638	Monthly (Feb, Mar, Apr, May)
KM 11	Climate Station	TA, RH, WS, WD, BP, SR, PC	62.873	-139.180	975	15-minute, downloaded monthly
Kona	Climate Station	TA, RH, WS, WD, BP, SR, PC, SD	62.874	-139.434	1,340	15-minute, uploaded hourly via satellite

Notes:
TA = air temperature; RH = relative humidity; WS = wind speed; WD = wind direction; BP = barometric pressure; SR = solar radiation; PC = precipitation; SD = snow depth, SWE = snow water equivalent.

The climate stations have wind sensors mounted on the tower at 10 m above the ground surface, with the sensors for other instruments set at 2 m above ground surface. Observations are recorded to a central datalogger, complete with all-weather enclosure, battery pack, solar panel and voltage regulator. The following parameters are measured at 15-minute intervals by the two climate stations:

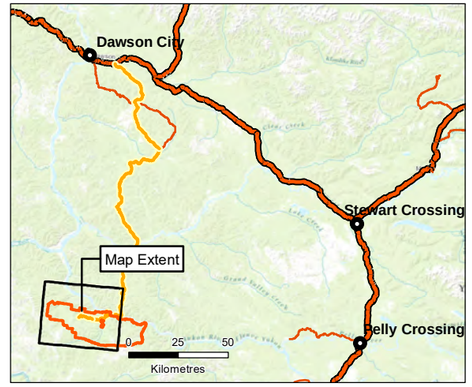
- Air temperature (◦C) and relative humidity (%) data
- Wind speed (m/s) and direction (0-360 degrees) measurements, including wind gust data
- Incoming solar radiation (W/m^2) and barometric pressure (mb) reading
- Snow depth (Kona station only)
- Measurements of precipitation (mm) at a tipping bucket gauge fitted with Alter shield and solid phase precipitation adaptor (Km 11 station), and a weighing cell all season precipitation gauge at the Kona station.

The full complement of climate monitoring and snow survey stations will be operated throughout the Closure Phase. During the Post-Closure phase, monitoring will likely be carried out remotely, or scaled back to a single climate station located near the HLF (Kona station) and co-located snow course.



COFFEE GOLD MINE

Weather Stations and Snow Course Locations, Coffee Gold Project



Legend

- Automated Weather Station
- Snow Course
- Tipping Bucket Rain Gauge
- Watercourse

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein..

N

1:125,000

0 2 4 6

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 7-29	Date: Dec 2, 2021	Drawn by: AL	Reviewed: SJ

Newmont COFFEE

Path: P:\@Drafting\Coffee Gold\Drafting Figures\MxD\Personal_20190627.mxd

7.11.2 Aquatic Conditions Monitoring

The program for water monitoring during the early part of the Closure Phase incorporates hydrology, surface water quality, and groundwater components (including groundwater quality and quantity). Water management activities will strive to separate contact from non-contact water to the extent practical, maximize the use of contact water for heap leach rinsing requirements, and suppress dust in disturbed areas, while the site is being reclaimed, as in the Operation Phase. These practices are expected to reduce both the volume of contact water that must be managed, and the potential of downstream effects on water quality and streamflow volumes.

The Closure Phase water monitoring program will be focused on:

- Meeting Environmental Effects Monitoring (EEM) requirements such that the Coffee Gold Mine becomes a “recognized closed mine” as defined in the Metal and Diamond Mine Effluent Regulations (MDMER)
- Meeting requirements pursuant to permits and approvals issued by the Yukon Government (as per the Quartz Mining License and Water Use Licence, and others that may apply)
- Conducting post-closure phase monitoring to verify that the site is stable.

The surface water and groundwater monitoring programs during the Closure and Post-Closure phases are structured to provide early indication of potential changes in flow sources and chemistry at the Mine Site, and potential effects down-gradient. Efforts will address three types of monitoring:

- **Mine Site** - monitor the quantity and quality of both surface and groundwater that may be potentially affected by the various mine facilities, to confirm that water management systems are effective.
- **Effluent** - monitor the quantity and quality of contact water that accumulates in sediment control ponds located downgradient of mine infrastructure and effluent from the water treatment plant to verify compliance for waters to be discharged to the environment (discharges will be subject to regulatory requirements).
- **Receiving Environment** - monitor the quantity and quality of surface water upstream and downstream of points of discharge in the receiving environment to confirm compliance with applicable regulatory requirements. A system of groundwater monitoring wells will be used to verify groundwater flow paths, and discharge rates and quality within these watersheds.

The surface water and groundwater monitoring programs for these components will be implemented in a systematic manner during the Closure Phase to obtain reliable and consistent data for comparison to previous results.

7.11.2.1 Earthworks Related Water Quality Monitoring

A water quality monitoring program will be implemented in closure to monitor for parameters associated with earthworks and construction activities, providing early warning about the onset of ARD or an increase in contaminant loading due to construction activities. The monitoring locations will focus on areas affected by construction, such as surface run-off over exposed slopes and water collected in temporary sumps and ditches. Construction water quality monitoring will consist of observations, testing, analysis, and recommendation on turbidity, total suspended solids (TSS), and contaminant loading.

Turbidity measuring equipment will be available for use by the Newmont or the contractor's environmental monitors, or as a contingency to be used by the field engineering team if the environmental monitor is not present. Water quality sampling bottles will be available to collect water samples for lab analysis of TSS if required. The senior environmental specialist will determine the specific needs for turbidity sampling equipment and water quality sampling bottles and analysis.

Event-based monitoring will be conducted by the environmental monitors during and/or following any naturally occurring or construction related discharge events that impact or have the potential to impact receiving waterbodies (e.g., if turbidity levels in the receiving environment exceed guidelines). These events include but are not limited to rainfall events, landslides, and failure of erosion and sediment control measures.

Corrective action will be implemented if there is change from background turbidity and/or TSS based on the Yukon water quality guidelines. The corrective action will be determined by the contractor with advice from the environmental monitors. The immediate response will be to identify the source of increased suspended sediment in the receiving waterbody. Corrective action will normally include stopping work and repairing or implementing additional mitigation measures. The environmental monitors will observe and document any non-conformance or environmental incident. If turbidity guidelines continue to be exceeded with the additional mitigation measures the environmental monitor will halt work in the area until turbidity levels meet guidelines.

In the event of failure of sediment or erosion control measures, increased frequency and timed intervals for turbidity sampling will be required. Sampling intervals and duration will vary with site conditions and the severity of the event; intervals may range from five minutes to one hour, with sampling normally terminated once levels have returned to baseline conditions.

7.11.2.2 Hydrology and Surface Water Quality Monitoring

Surface water monitoring is conducted within the area where the Project is reasonably expected to interact with streamflows and surface water quality, including all streams expected to receive effluent from the mine site, up to and including the Yukon River in the immediate vicinity of the confluence with Coffee Creek, YT-24, and Halfway Creek. Surface water monitoring consists of discharge and water quality monitoring at mine site locations (including effluent discharge points), and in the receiving watercourses (including reference sites) (Table 7-15 and Figure 7-30). Hydrometric monitoring includes streamflow and mine site effluent discharges, pond and pit lake levels and discharges (once the end-pit lake has reached the spillpoint elevation), and is directly linked to other aquatic ecosystem components, including surface water quality, groundwater quality and fish and fish habitat. This surface water monitoring program will serve two purposes. First, the data will be used to verify that flows and concentrations of POPCs from the mine site and in the receiving environment remain within the range of predicted outcomes made using the site-wide WB/WQM. Second, the data will allow calculation of loads (flow times measured concentrations for water quality parameters) should this become necessary as part of an investigation into an unanticipated occurrence with respect to surface water quality exceedances of licensed thresholds.

Table 7-15 Summary of Mine Site and Receiving Environment Surface Water Hydrology and Quality Monitoring Stations, Monitoring Parameters, and Frequency

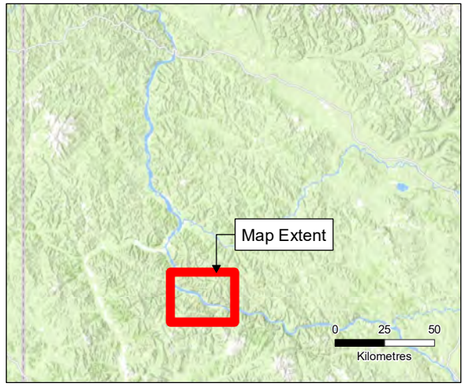
Catchment	Watercourse	Station ID	Rationale	Post-Mining Closure (Yr 10 to Yr 15)		Active Closure (Yr 16 to Yr 21)		Post-Closure Phase (Year 21+)	
				Flow/Level[2]	WQ[3]	Flow/Level[2]	WQ[3]	Flow/Level[2]	WQ[3]
Halfway Creek	Halfway Creek	M1	Alpha Pond (MDMER[1] EoP[2])	C/M	W[5]	C/M	M	A	A
		M2	HLF Event Pond (EP-2) and Passive Treatment Discharge (if needed)	C/M	M	C/M	M	A	A
		M3	HLF Water Treatment Plant (Influent and Discharge)	C/M	M	C/M	M	-	-
		M4	Facility Pond	C/M	M	C/M	M	-	-
		M5	Rainwater Pond	C/M	M	C/M	M	-	-
		M6	HLF Event Pond (EP-N1) and Passive Treatment System	C/M	M	C/M	M	A	A
		M7	HLF Event Pond (EP-S1) and Passive Treatment System	C/M	M	C/M	M	A	A
		M8	Downstream Alpha WRSF Toe Seepage	M	M	M	M	-	-
		M9	Kona Backfill Seepage, Upstream Alpha WRSF	M	M[5]	M	M[5]	A	A
		M10	SU3W Spill Point (provisional MDMER[1])[2]	M	M[5]	M	M[5]	A	A
		M16	SU2W Spill Point	M	M[5]	M	M[5]	A	A
		M20	Latte Pit West Backfill Spill Point	M	M[5]	M	M[5]	A	A
Coffee Creek	Latte Creek	M13	SU4W Spill Point (provisional MDMER[1])[2]	M	M[5]	M	M[5]	A	A
		M14	Double Double Backfill Spill Point (provisional MDMER[1])[2]	M	M[5]	M	M[5]	A	A
		M15	SU1 Spill Point (provisional MDMER[1])[2]	M	M[5]	M	M[5]	A	A
		M17	SU1W Pit Lake	M	M[5]	M	M[5]	A	A
		M18	SU4W Pit Lake	M	M[5]	M	M[5]	A	A
		M19	SU4E Pit Lake	M	M[5]	M	M[5]	A	A
YT-24	YT-24	M11	SU3 Spill Point (provisional MDMER[1])[2]	M	M[5]	M	M[5]	A	A
		M12	SU5 Spill Point (provisional MDMER[1])[2]	M	M[5]	M	M[5]	A	A
Receiving Environment									
Coffee Creek	Latte Creek	LC-15.5	Monitor Latte Creek below HLF	C/M	M	C/M	M	-	M[AM]
	Latte Creek Trib 20 (LTC20)	LCT20-0.1	Monitor Latte Creek Trib. below Supremo South discharge	C/M	M	C/M	M	-	M[AM]
	Latte Creek	LC-11.4	Proposed Use Protection WQO attainment point	C/M	M	C/M	M	-	M[AM]
		LC-0.2	Monitor Latte Creek above confluence with Coffee Creek	C/M	M	-	M	-	A
	Coffee Creek	CC-11.6	Monitor Background SWQ in Coffee Creek above confluence with Latte	C/M	M	-	M	-	A
		CC-10.9	Proposed non-degradation WQO attainment point	-	M	-	M	-	A
		CC-3.2	Far-field: Monitor Coffee Creek in important reach downstream of Latte confluence	-	M	C/M	M	-	M[AM]
	Yukon River	YUK-51.3	Far-field: Monitor in Yukon River above confluence	-	M	-	M		
		YUK-49.3	Proposed Non-degradation WQO attainment point	-	M	-	M		
YT-24	YT-24	YT24-0.1	Proposed Use Protection WQO attainment point	C/M	M	C/M	M	-	M[AM]
	Yukon River	YUK-38.9	Proposed Non-degradation WQO attainment point	-	M	-	M		
Halfway Creek	Halfway Creek	HC-1.0	Proposed Use Protection WQO attainment point	C/M	M	C/M	M	-	M[AM]
		HC-6.8	Downstream of Alpha WRSF; near-field monitoring	C/M	M	C/M	M	-	M[AM]
	Yukon River	YUK-37.6	Proposed Non-degradation WQO attainment point	-	M	-	M		
Independence Creek	Kona Tributary	KT-0.3	Far-field for Kona Pit	M[AM]	M[6]	-	M	AM	AM
Dan Man Creek	Dan Man Creek	DMC-2.0	Proposed new reference watershed	M	M[6]	-	M	-	A

Notes:

[1] Final Point of Discharge (FPoD)
[2] Pit lake levels monitored until pit spills, then pit lake decant will be monitored if water quality conditions require
[3] Water quality listed in Table 7-16, unless otherwise stated
[4] Heap Leach Facility (HLF) Event Ponds will be converted to passive treatment systems (PTS) in closure, and decant water quality and quantity from these treatment systems will be monitored
[5] Monitoring frequency of pits dependent on whether they are filling (*i.e.*, no discharge) or spilling (*i.e.*, final point of discharge)
M^{AM} = monitoring required monthly only if triggered by Surface Water Quality and Aquatic Life AMP
C / M = continuous and monthly manual flow measurements; M = Monthly (all months during open water season, where possible during winter season); Q = Quarterly; A = Annually; AM = only if triggered by Surface Water Quality and Aquatic Life AMP
WRSF - Waste Rock Storage Facility; WQO – Water Quality Objective
- Not Required

COFFEE GOLD MINE

RCP - Surface Water Quality Monitoring Stations



Legend

- Receiving Environment Station
- Pit Sump/Sediment Pond, not subject to MMER
- Provisional MDMER FPoD
- MDMER FPoD
- Watercourses
- Waterbodies
- Surface Contours (100m)

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein..

N

1:3,000,000

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 7-30	Date: Apr 16, 2024	Drawn by: AL	Reviewed By: SJ

Newmont COFFEE

Monitoring during the Post-mining and Closure Phase will be similar to the Operation Phase monitoring program, including the monitoring of the Alpha Pond and Facility Pond discharges. Continuous flow monitoring will be undertaken where continuous gauging data loggers are installed (Table 7-15) with gauging conducted monthly at stations with active discharges. While the open pits are filling with meteoric inputs, pit water levels will be surveyed to determine pit volumes and estimate a range of potential remaining time until the end pit lake reaches the spill point elevation. Pit lake water level surveys will be determined twice per year in June and October by a surveyor (with access to the water surface via pit ramps) to the end of the Closure Phase. Pit discharges to the receiving environment through the spill points (M10 through M16 and M20; Figure 7-30) will be monitored once pits are flooded and spilling by gravity drainage. In the receiving environment, continuous water levels are measured by level logger, and verified by manual gauging to maintain the rating curve for each receiving tributary. Where level loggers are not installed, flows and level are measured manually.

The Kona Tributary is included in the unlikely event that groundwater from the backfilled Kona Pit were to report into this catchment. This is not anticipated to occur, as permafrost is expected to aggrade into the backfilled Kona Pit, and this will be aided by placing waste rock into the pit in winter when the rock is frozen, limiting groundwater discharge to the near-surface active layer in summer and early autumn. The expectation is that any groundwater flow from the Kona Pit will report to the Halfway Creek catchment.

Facilities that will be decommissioned in the Closure Phase are shown as grey boxes in Table 7-15. The Facility Pond and HLF Event and Rainwater Ponds will no longer be required once the plant site and other facilities up-gradient are decommissioned and dismantled, unless deemed necessary during the Operation Phase as required for passive water treatment, and the area reclaimed as described in Section 7.3.2. The HLF will not be fully reclaimed until drain-down is completed. Excess water will be treated to remove residual cyanide, nitrogen, metalloids, and metal concentrations to acceptable concentrations.

The treatment system will make use of the HLF Ponds. Treated water of acceptable quality from the WTP will be released to the Halfway Creek drainage during the Operation Phase and into the Active Closure Phase. Upon cessation of active water treatment, the water treatment plant will be decommissioned and if required, the HLF seepage water will be directed through the HLF ponds that have been converted to passive treatment cells and ultimately into Latte Pit.

All receiving watercourse hydrometric stations are fully instrumented (i.e., staff gauge, stilling well, continuous water level recorder). Hydrologic monitoring will be undertaken on a monthly basis (dataloggers downloaded where they have been installed, and spot flow measurements taken at all stations) in the open water season (May through October). Monitoring will be discontinued in winter, and instrumentation will be removed for the winter months.

The Operation Phase surface water quality monitoring program will be maintained, with the following exceptions:

- Discharge from the Alpha Pond and Facility Pond will continue to be sampled weekly, and annual toxicity testing undertaken, according to the Water Use Licence (WUL) and Quartz Mine Licence (QML) conditions. These ponds will be decommissioned during the Active Closure Phase once water quality has stabilized, and these water management features are no longer required.

- Similarly, pit lake monitoring, including level surveys and water quality sampling, discharge flows and concentrations may be terminated if water quality conditions within the pit lakes stabilize such that there is no anticipated negative residual effect on receiving watercourse water quality.
- Monitoring may be terminated at a small number of receiving environment stations, recognizing that downstream monitoring will not be relevant if water quality is at background concentrations and/or consistently below the applicable water quality guidelines for the protection of aquatic life at stations closer to the mine, and/or higher up in a given catchment.

Surface water quality monitoring will continue at sites downstream of discharge points as per the requirements of the WUL and QML (Table 7-15) but will be discontinued once the site is deemed a "recognized closed mine". Samples will be shipped to an accredited laboratory and are analyzed for physical parameters, major ions, nutrients, total and dissolved organic carbon, weak acid dissociable (WAD) cyanide, and total and dissolved metals. The full list of parameters that are analyzed, and detection limits, are provided in Table 7-16.

Table 7-16 Analytical Parameter List and Reportable Detection Limits

Analysis		Reportable Detection Limit
Physical Parameters	**Unit**	
Conductivity	µS/cm	1.0
Hardness (as $CaCO_3$)	mg/L	0.5
pH	pH	0.01 unit
Total Suspended Solids (TSS)	mg/L	1.0
Total Dissolved Solids (TDS)	mg/L	10.0
Turbidity	NTU	0.1
Major Ions and Nutrients		
$Alkalinity_{Total}$ (as $CaCO_3$)	mg/L	0.5
$Alkalinity_{PP}$ (as $CaCO_3$)	mg/L	0.5
Bicarbonate (HCO_3)	mg/L	0.5
Carbonate (CO_3)	mg/L	0.5
Chloride (Cl)	mg/L	0. 5
Sulphate (SO_4)	mg/L	0.5
Fluoride (F)	mg/L	0.01
Nitrate (as N)	mg/L	0.002
Nitrite (as N)	mg/L	0.002
Total Ammonia (as N)	mg/L	0.005
Nitrate plus Nitrite (as N)	mg/L	0.002
Total Phosphorus as P	µg/L	0.002
Cyanide		
Weak acid dissociable cyanide (CN_{WAD})	mg/L	0.0005
Organic Carbon		
Total Organic Carbon (TOC)	mg/L	0.5
Dissolved Organic Carbon (DOC)	mg/L	0.5
Total and Dissolved Metals		
Aluminum (Al)	µg/L	0.5

Analysis		Reportable Detection Limit
Physical Parameters	**Unit**	
Antimony (Sb)	µg/L	0.02
Arsenic (As)	µg/L	0.02
Barium (Ba)	µg/L	0.02
Beryllium (Be)	µg/L	0.02
Bismuth (Bi)	µg/L	0.01
Boron (B)	µg/L	10
Cadmium (Cd)	µg/L	0.005
Calcium (Ca)	mg/L	0.05
Chromium (Cr)	µg/L	0.1
Cobalt (Co)	µg/L	0.005
Copper (Cu)	µg/L	0.05
Iron (Fe)	µg/L	1.0
Lead (Pb)	µg/L	0.005
Lithium (Li)	µg/L	0.5
Magnesium (Mg)	mg/L	0.05
Manganese (Mn)	µg/L	0.05
Mercury (Hg)	µg/L	0.002
Molybdenum (Mo)	µg/L	0.5
Nickel (Ni)	µg/L	0.02
Potassium (K)	mg/L	0.05
Selenium (Se)	µg/L	0.04
Silicon (Si)	mg/L	50
Silver (Ag)	µg/L	0.005
Sodium (Na)	mg/L	0.05
Strontium (Sr)	µg/L	0.05
Thallium (Tl)	µg/L	0.002
Tin (Sn)	µg/L	0.2
Titanium (Ti)	µg/L	0.5
Uranium (U)	µg/L	0.002
Vanadium (V)	µg/L	0.2
Zinc (Zn)	µg/L	0.1

7.11.2.3 Groundwater Quality Monitoring

Both groundwater flows and groundwater quality will be monitored during the Post-mining Closure, Active Closure, and Post-closure phases to detect any changes in groundwater pressure (i.e., water table elevations), or groundwater quality that may be caused by mine operation and closure activities.

The groundwater monitoring network includes the following instrumentation:

- Westbay® multi-level monitoring installations to monitor groundwater levels and groundwater quality on a discrete basis

- Vibrating wire piezometers (VWPs) to measure groundwater levels and temperature on a continuous basis
- Shallow and deep conventional groundwater monitoring wells to monitor groundwater levels on a continuous basis and groundwater quality on a discrete basis.

Groundwater monitoring station locations and monitoring frequencies are provided in Table 7-17 and shown on Figure 7-31. Locations were chosen to provide data adjacent to the mine facilities and in down-gradient locations along groundwater flowpaths to surface water surface receptors.

During the Post-mining Closure Phase (Year 10-15), most monitoring wells and Westbay systems will be sampled for water quality on a quarterly basis. The exception is the nested well pair MW14-03A/B, which will be monitored for water levels only as this well pair is not optimally located to detect seepage from the Latte Pit. In its place, a new monitoring station, MW-02WB (well or Westbay, to be determined) will be monitored for water quality. MW-02B will be initiated during operations and will be better positioned to detect seepage from Latte Pit.

During the Post-mining Closure Phase (Year 10-15), a new thermistor will be installed in the backfilled Kona Pit to monitor ground temperatures. This station, plus, other VWP/thermistor stations and conventional monitoring wells equipped with loggers will be downloaded on a quarterly basis.

During the Active Closure Phase (Year 16-20), groundwater quality sampling will decrease in frequency to twice per year, with loggers at monitoring wells and VWP/thermistor installations downloaded during the sampling events. The number and location of monitoring stations will remain consistent with those identified for the Post-mining Closure Phase (Year 10-15).

The Post-closure monitoring program is designed to focus on the receiving environment rather than focus on the areas immediately adjacent to mine facilities. It is assumed that monitoring conducted during Post-mining and Active Closure Phases will establish trends at these facilities. Draindown and progressive reclamation of the HLF is expected to eliminate the need for continued groundwater monitoring adjacent to the facility.

During Post-closure (Year 21+), the monitoring frequency is reduced to one event per year, with the number of monitoring locations streamlined to six sentinel stations located in the four project drainages (Halfway Creek, Latte Creek, YT-24, and Kona Tributary):

- MW15-01WB and MW15-02AZ: the Westbay well and shallow conventional well in overburden will be used to monitor the groundwater flowpath from Supremo and Double Double Pits towards Latte Creek
- MW15-04WB: this Westbay well will monitor groundwater draining Supremo Pit and Alpha WRSF downgradient of the Alpha Pond in Halfway Creek
- MW-05WB: this Westbay well will monitor groundwater potentially draining from the backfilled Kona Pit towards Independence Creek via the Kona Tributary
- MW15-01WB: this Westbay well will monitor groundwater draining from the Supremo Pit towards YT-24.

These monitoring locations listed above are co-located with VWP/thermistor installations. It is suggested that these VWPs continue to be downloaded while they are operational, however, the VWPs need not be replaced if they become non-operational as the adjacent Westbay will provide water level data.

The extensive groundwater monitoring program prescribed in the Construction, Operations, Post-mining Closure, and Active Closure Phases will serve to bolster the groundwater model calibration for the site, which in turn will be used evaluate the appropriateness of the monitoring network through all stages of mine life, including the Post-closure Phase. Alternative or additional Post-closure groundwater monitoring stations may be contemplated should groundwater quality monitoring or groundwater modeling outcomes suggest they are warranted.

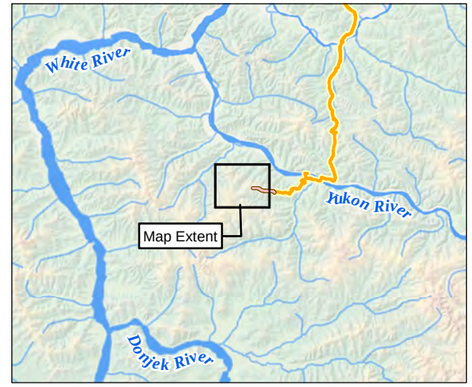
Table 7-17 Groundwater Monitoring Well, Thermistor and Vibrating Wire Stations and Monitoring Frequency

Groundwater Catchment Area	Mine Facility	Monitoring Station ID	Easting[1]	Northing[1]	Installation type[2]	Post-mining Closure (Year 10 – Year 15)[3]			Active Closure (Year 16 – Year 20)[3]			Post-Closure Phase (Yr 21+)[3]		
						Temp	GWL	GWQ	Temp	GWL	GWQ	Temp	GWL	GWQ[4]
Halfway Creek	Latte Pit	*MW-02WB*	*582,626*	*6,973,232*	Westbay or Conventional Well		Q	Q		BA	BA			
	Latte Pit	MW14-03A	582,401	6,973,191	Conventional Well		C							
	Latte Pit	MW14-03B	582,388	6,973,197	Conventional Well		C							
	Supremo Pit	MW15-06WB	584,090	6,975,003	Westbay		Q	Q		BA	BA			
	Alpha WRSF	MW15-04T	584,027	6,976,568	Thermistor/ VWP	C	C		C			O	O	
	Alpha WRSF	MW15-04WB	584,024	6,976,566	Westbay		Q	Q		BA	BA		A	A
	Kona Backfill	*MW-03T*	*579,689*	*6,973,046*	Thermistor	C			C			C		
	Heap Leach	MW16-01T	580,988	6,972,503	Thermistor/ VWP	C	C		C	C		O	O	
	Heap Leach	MW16-01WB	580,971	6,972,510	Westbay		Q	Q		BA	BA		A	A
Latte Creek	Latte	*MW-01WB*	*583,475*	*6,973,048*	Westbay or Conventional Well		Q	Q		BA	BA			
	Supremo/Latte/Double Double	*MW-04*	*584,734*	*6,972,200*	Conventional Well		C	Q		BA	BA			
	Supremo/Latte/Double Double	SRK-15D-09T	584,734	6,972,215	Thermistor/ VWP	C	C							
	Supremo/Latte/Double Double	MW15-02T	584,855	6,971,756	Thermistor/ VWP	C	C					O	O	
	Supremo/Latte/Double Double	MW15-02WB	584,858	6,971,758	Westbay		Q	Q		BA	BA		A	A
	Supremo/Latte/Double Double	MW15-02AZ	584,858	6,971,754	Conventional Well		C	Q		BA	BA		C	A
	Heap Leach	MW14-07T	580,832	6,971,365	Thermistor/ VWP	C	C		C	C				
	Heap Leach	MW15-05T	581,406	6,971,083	Thermistor/ VWP	C	C		C	C		O	O	
	Heap Leach	MW15-05WB	581,402	6,971,084	Westbay		Q	Q		BA	BA		A	A
Kona Creek	Kona Pit	MW17-01T	579,737	6,973,195	Thermistor/VWP	C	C		C	C				
	Kona Pit	*MW-05T*	*579,674*	*6,974,244*	Thermistor/VWP	C	C		C	C		O	O	
	Kona Pit	MW-05WB	583,475*	6,973,048*	Westbay		Q	Q		BA	BA		A	A
YT-24	Supremo	MW15-07T	585,198	6,974,583	Thermistor/VWP	C	C		C	C				
	Supremo	MW15-01T	585,826	6,976,210	Thermistor/VWP	C	C		C	C		O	O	
	Supremo	MW15-01WB	585,829	6,976,212	Westbay		Q	Q			BA		A	A

Notes:
D/S = downstream
1 Measured by real time kinematic (RTK). *Italics* indicate new monitoring station with co-ordinates being approximate and subject to refinement pending future groundwater model updates during Operations.
2 Westbay = multi-level groundwater well, VWP = vibrating wire piezometer
3 Frequency: C = continuous; Q = quarterly; BA = biannually (2x per year), A = annually,: O = download opportunistically while the adjacent Westbay is sampled, however station need not be replaced if damaged or malfunctioning.
4 Water quality listed in Table 7-8, unless otherwise stated

COFFEE GOLD MINE

Groundwater Monitoring Stations



Legend

- Approximate Location of Additional GW Monitoring — *WB = Westbay*, *T = Thermistor String*
- Monitoring Well — AZ = Active Zone, WB = Westbay, A = Deep Conventional (200+m), B = Shallow Coventional (150+m), T = Thermistor String
- SWQ Monitoring Station
- Thermistor/VWP
- Vibrating Wire Piezometer (VWP)
- Mine Site Access Route
- Northern Access Route

Proposed Infrastructure

- WRSF/Backfill
- Pit
- Diversion
- Seepage Monitoring Locations

N

1:40,000

0 500 1,000 1,500 2,000 2,500

Meters

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 7-31	Date: Jul 14, 2023	Drawn by: (A.L.)	Reviewed: (L.F.)

Newmont COFFEE

Path: P:\@Drafting\Coffee Gold\Drafting Figures\Mxd\Baseline Report\Fig 2-1_GW Monitoring Plans_20230715_Operations.mxd

7.11.3 Wildlife Monitoring

All project personnel will be responsible wildlife awareness and reporting wildlife encounters. Wildlife monitoring will be conducted under the supervision of the environmental monitor, and a wildlife encounter log will be maintained. All project personnel will be trained on wildlife encounter procedures as per the site-specific safety plan. The environmental surveillance and monitoring programs that will be carried out to monitor the occurrence of wildlife during the Closure Phase include the following:

- Wildlife Observation Monitoring
- Project-related Wildlife Mortality Monitoring.

Table 7-18 and Table 7-19 summarize the wildlife monitoring programs that will be carried out in closure. Based on results of the monitoring programs that are implemented during the Construction and Operation Phases as described in the EMAMP, the monitoring programs in closure may be expanded to include additional monitoring for Project-related effects on wildlife. Details for the wildlife closure monitoring programs will be advanced throughout mine operations and will be provided in future RCP iterations. Outcomes of the closure wildlife monitoring program will inform potential mitigative or adaptive management actions to minimize project-related effects on wildlife.

Table 7-18 Overview of Wildlife Observation Monitoring Program

Monitoring Component	Description
Indicator	Wildlife presence – all species
Monitoring Category	Environmental surveillance
Design	Observational
Measurable Parameter	Occurrence of wildlife use
Key Project Interactions	The Project may result in habitat loss, sensory disturbance, and increased mortality risk for wildlife.
Threshold	N/A - Data will be used to support other monitoring programs and inform adaptive management where applicable.
Objective	To document wildlife presence in the Project area, including interactions with personnel and facilities.
Scope of Monitoring Work	All wildlife sightings within the Project LSA will be documented in the Wildlife Log. Monitoring will be ongoing throughout the life of the Project.
Monitoring Frequency	Wildlife observation monitoring will be ongoing throughout the life of the Project, including through the Closure Phase and the Post-closure Phase. It will be conducted on an opportunistic basis as wildlife are observed by Project personnel on site.

Table 7-19 Overview of Project-related Wildlife Mortality Monitoring Program

Monitoring Component	Description
Indicator	Wildlife mortality – all species
Monitoring Category	Environmental surveillance
Design	Observational
Measurable Parameter	Occurrence of Project-related wildlife mortality
Key Project Interactions	The Project has the potential to increase mortality risk for wildlife directly through vehicle collisions and interaction with mine site infrastructure.
Threshold	Every Project-related mortality involving an ungulate or large carnivore will be reviewed to determine if further action is needed. Other mortalities will be dealt with on a species-by-species basis.
Objective	To document wildlife mortality and determine cause to reduce the risk of similar wildlife mortality in the future.
Scope of Monitoring Work	All Project-related wildlife mortalities within the Project LSA will be documented. Monitoring will be ongoing throughout the life of the Project as mortality occurs.
Monitoring Frequency	All Project-related wildlife mortalities within the Project LSA will be documented. Monitoring will be ongoing throughout the life of the Project as mortality occurs, including during the Closure Phase and the Post-Closure Phase.

7.11.4 Vegetation Monitoring

The vegetation monitoring program that will be implemented during the Closure Phase includes the Habitat Loss/Habitat Reclaimed Monitoring Program and will be an extension of the program that will be implemented during the Construction and Operation Phases. Table 7-20 provides an overview of the closure Habitat Loss/Habitat Reclaimed monitoring program.

In addition to the program described below, closure monitoring for metals uptake in vegetation that has established on bare waste rock will be carried out through an extension of the revegetation reclamation research program as described in Section 2.3.1. Details for the vegetation closure monitoring programs will be advanced throughout mine operations and as results from vegetation monitoring during the Operation Phase are made available. Outcomes of the closure vegetation monitoring program will inform potential mitigative or adaptive management actions to minimize project-related effects on vegetation.

Table 7-20 Overview of Habitat Loss/Habitat Reclaimed Monitoring Program

Monitoring Component	Description
Indicator	Ecological Communities
Monitoring Category	Environmental Effects
Design	Project footprint survey with focus on the mine area and new quarry/borrow sites along the NAR.
Measurable Parameters	Size of the footprint (comparison of proposed footprint and actual area disturbed; ha)
Key Project Interactions	Direct habitat loss in the mine area footprint (either temporary or permanent). Project activities will result in direct loss of ecological communities including wetland habitats, traditional and medicinal plants, and rare plants.
Goal	The Project will not exceed the extent of the proposed footprint; progressive reclamation will take place during operations.
Objective	Ensure that the Project footprint within area of new disturbance (i.e., the mine area and new quarry/borrow sites along the NAR) is within the proposed limit; quantify the amount of habitat loss and habitat reclaimed.
Threshold	Exceedance of proposed mine area footprint
Scope of Monitoring Work	Habitat loss/habitat reclaimed monitoring will be conducted along the boundary of the mine area footprint at the mine area which encompasses the proposed mine site, mine access route, and airstrip up to the boundary of the NAR. It will also be conducted at new quarry/borrow sites along the NAR. Monitoring will be conducted using the most appropriate technology available, (which may include aerial mapping, surveys, handheld GPS or drone) to measure the extent of the mine area footprint by walking the perimeter of the footprint where surface disturbance is observed. Similar methodology will be used to measure the extent of progressive reclamation in the areas. The size of the footprint (ha) will be compared between actual area disturbed and the proposed footprint.
Frequency	The Habitat Loss/Habitat Reclaimed monitoring will be completed during construction, operations, and reclamation and closure. During construction and operations, monitoring will be conducted once annually to capture the direct loss of vegetation from clearing activities and to track locations that are progressively reclaimed. During reclamation and closure, monitoring will be conducted every three years, or as determined by reclamation efforts, to capture on going revegetation activities.

7.11.4.1 Invasive Plant Monitoring

Invasive plants are those that are introduced by humans to areas outside of their natural range of distribution, where they become established and disperse, generating a negative impact on the economy, environment, and social realms (IUCN 2011). Potential Project-related effects include changes to plant composition and possible loss of native plant species, due to the introduction and spread of invasive plants in the Project area through physical disturbance and vehicle transport. Newmont will implement mitigation measures for invasive plant species across the Project area and will actively manage for invasive plants to prevent invasive species spread south of the Yukon River throughout the Project. In addition, Newmont will quantify the presence and abundance of invasive plant species within and adjacent to the Project footprint south of the Stewart River.

The invasive plant closure monitoring program will be a continuation of the invasive plant monitoring program that will be implemented during the Construction and Operation Phases as described in the EMAMP. The results of invasive plant monitoring will be used to:

- Guide the targeted removal of any Rank 1 invasive species identified in the Project area south of the Yukon River (refer to the Vegetation Protection Plan for further details on the methods for invasive plant removal
- Monitor and document any spread of invasive plant species along the southern sections of the NAR (i.e., between the Stewart and Yukon Rivers).
- Document the effectiveness of Project mitigation measures for invasive plants and, if necessary, inform adjustments to mitigation practices.

Table 7-21 provides an overview of the invasive plant monitoring program that will be implemented in during the Closure Phase. Monitoring will be carried out annually in closure, with reduced monitoring frequency as the Project enters advanced stages of closure, which will be determined by results of previous monitoring activities, consideration of adaptive management, or incidental observations. Sample site selection will consider potential entry points and locations where there is a high volume of humans, vehicles, and equipment entering or leaving the mine area footprint south of the Yukon River, including mine infrastructure, laydown areas, access roads, airstrip, and camp facilities. The invasive plant monitoring areas are provided on (Figure 7-32).

Monitoring methods will include roadside driving and walking surveys, as well as observations during other environmental monitoring programs and routine monitoring tasks within the Project footprint. Further details regarding invasive plant species monitoring methods are provided in the EMAMP.

Table 7-21 Overview of Invasive Plant Monitoring

Monitoring Component	Description
Indicator	Invasive plant species
Monitoring Category	Environmental Effects
Design	Project footprint survey; presence and absence sampling
Measurable Parameter	Occurrence of invasive plants in the Project footprint south of the Stewart River; density distribution class
Key Project Interactions	Introduction of invasive plant species causing habitat loss for native plant species and possible change of plant composition
Goal	The Project minimizes the potential introduction and spread of invasive plant species
Objective	1) To quantify the presence and abundance of invasive plant species within and adjacent to the Project footprint south of the Yukon River to aid in the management of invasive plants 2) To document any spread of invasive plant species along the southern sections of the NAR between the Stewart River and the Yukon River.
Threshold	No introduction of invasive plant species within and adjacent to the Project footprint south of the Yukon River as a result of Project activities
Scope of Monitoring Work	Invasive plant monitoring will be conducted in the Project footprint south of the Stewart River. Monitoring will be conducted using presence and absence sampling methods to determine abundance and density distribution of invasive species. A combination of roadside driving at slow speeds in a vehicle or UTV averaging 20 km/hr and walking surveys will be used to monitor linear and non-linear (localized) features. Invasive plant monitoring will be completed annually during construction and operation.

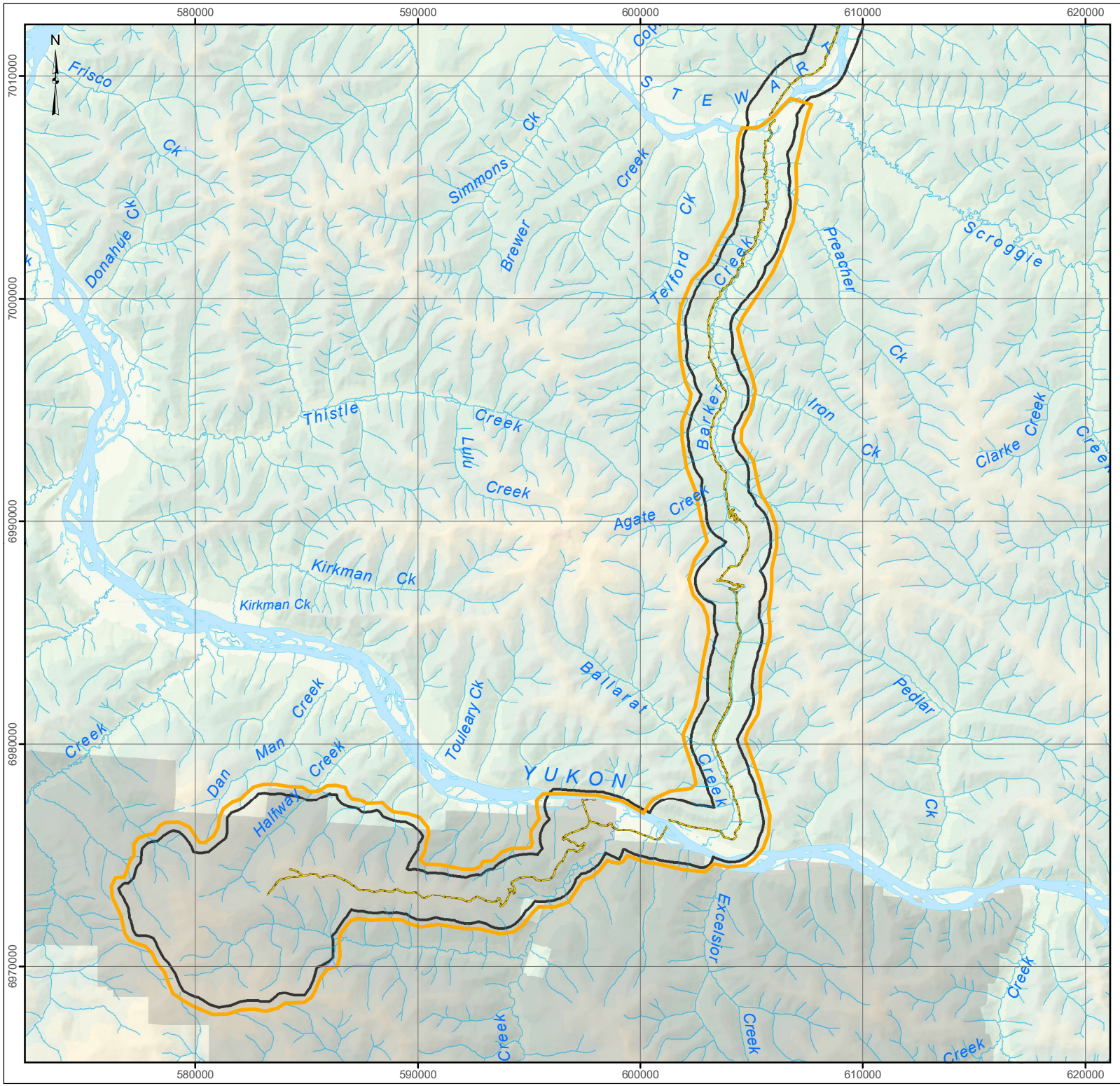
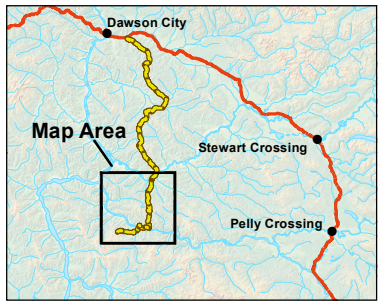


Figure 7-32. Invasive Plant Monitoring Areas

Legend

- Northern Access Route
- Coffee Property
- Local Study Area
- Invasive Plant Monitoring Areas



0 2,000 4,000 6,000 8,000 10,000
Meters

Map Scale: 1:150,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change. Project data displayed is site specific.

Drawn: OL/AR	Checked: AA	Date: 2023-08-09

Newmont EDI

Path: L:\PROJECTS\Kaminak_CoffeeCk\Mapping\21Y0136_CoffeePermitting\Reporting\Vegetation MAMP\Fig5_1_InvasivePlantMonitoring_20220512.mxd

7.11.5 Fish and Aquatic Life Monitoring

7.11.5.1 Fish and Fish Habitat Monitoring

Closure of the Project has the potential to affect the fish and fish habitat VC and/or the periphyton and benthic invertebrates IC by physical disturbance, flow alteration, toxicity, and productivity alteration. The objective of fish and fish habitat monitoring is to assess the key Project interactions and predicted residual effects in comparison to baseline and reference conditions in a quantitative and statistically robust manner (where possible), and to also comprehensively monitor aquatic environments that could potentially be influenced by Project activities. The following Fish and Fish Habitat components will be monitored:

- Fish community (general abundance/diversity)
- Fish condition
- Fish habitat.

Fish community sampling includes assessing fish species diversity, condition, and general catch per unit effort (CPUE) results through sampling efforts[13]. Sampling methods will include electrofishing (open site), minnow trapping, and beach seining, where appropriate.

The fish and fish habitat monitoring program will focus on measurements of fish habitat attributes within fish-bearing locations downstream of the mine infrastructure index areas for each stream. Specifically, stream habitat units (i.e., riffles, pools, and glides) will be delineated and measured (width, length, and depth) and bed materials within each unit will be documented. Wolman Pebble Counts and hourly water temperature data will also be collected. The monitoring locations and timing will be consistent with fish sampling efforts. An overview of the monitoring program for fish community and condition as well as fish habitat quality are provided in Table 7-22.

Monitoring for fish community, condition, and habitat will be at stations on Latte, YT-24, Halfway and Coffee Creeks, with reference sites on upper Carlisle, Independence and an unnamed stream south of YT-24 (SYT; Figure 7-33). During mine operations and during the Closure Phase of the Project, fish and fish habitat monitoring will be conducted at all the same stations as during the construction phase. Fish and fish habitat monitoring locations and frequency throughout the Construction, Operation, and Closure Phases are provided in Table 7-23.

Post-closure, fish and fish habitat monitoring will only be conducted in the event that site-specific water quality objectives are not maintained or if identified thresholds were recently exceeded and monitoring of adaptive management actions are required. Further details regarding fish and fish habitat monitoring are provided in the EMAMP.

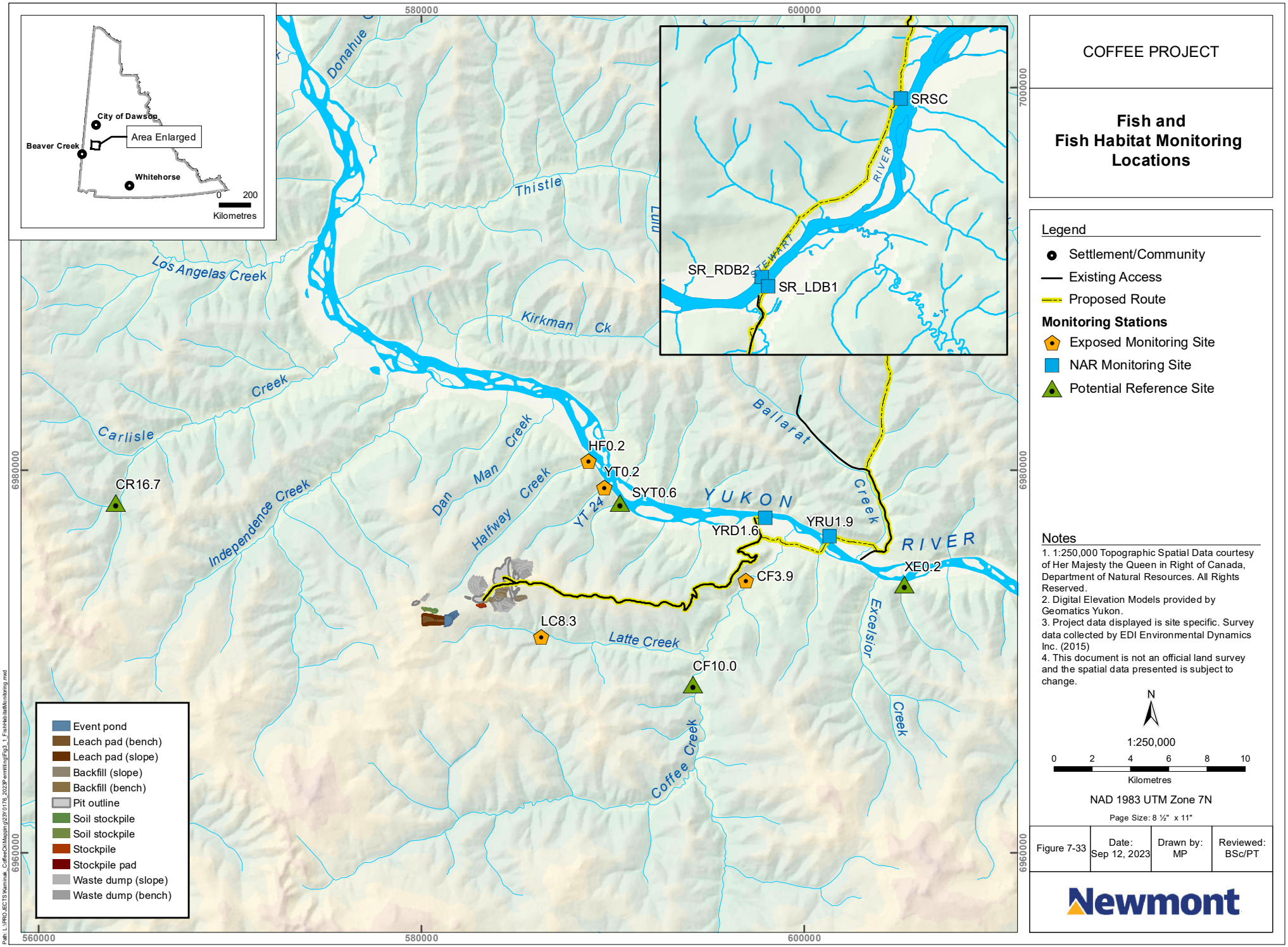
13 As reported in EDI (2018), low fish densities in receiving waters do not allow for statistical confidence when evaluating CPUE data.

Table 7-22: Overview of Fish Community, Condition and Habitat Monitoring

Monitoring Component	Description	
	Fish Community Sampling and Fish Condition	Fish Habitat Quality
Monitoring Category	Environmental Effects	Environmental Effects
Design	Before-After-Control-Impact (BACI)	Before-After-Control-Impact (BACI)
Measurable Parameters	Fish CPUE, fish species diversity, Fulton's condition factor, presence of various stages/ages (based on length/weight data).	Number and depth of pools; channel width.
Key Project Interactions	Changes in water quality/quantity, changes in prey item availability and habitat primary productivity.	Changes in water quality (sediment mobilization/deposition) and quantity (erosion).
Goal	The Project will not have a significant adverse effect on fish populations, including community structure or fish condition.	The Project will not have a significant adverse effect on fish habitat when compared to control/reference areas.
Objective	Evaluate how the Project may influence fish use and fish condition in habitat downstream of the Project.	Evaluate how the Project may influence habitat in fish-bearing streams downstream of the Project.
Scope of Monitoring Work	Fish sampling in receiving watersheds, including Latte, Halfway, and YT-24 Creeks and reference sites via electrofishing. Sampling will also be conducted in Coffee Creek via beach seining, electrofishing, and minnow trapping. Monitoring to be conducted annually during Construction and then every three years during Operation, Reclamation and Closure.	Detailed habitat assessment in receiving watersheds, including Halfway, Latte, YT-24, and Coffee Creeks (at fish-bearing monitoring stations) and a matched reference area. Monitoring to be conducted annually during Construction and then every three years during Operation, and Reclamation and Closure.
Mitigation Measures	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to prevent or reduce changes in the downstream aquatic environment.	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to prevent/reduce changes in the downstream aquatic environment.
Project Terms and Conditions	To be determined following YESAA and Yukon Water Board process	To be determined following YESAA and Water Board processes

Table 7-23 Fish and Fish Habitat Monitoring Stations and Sampling Frequency

Station	Location	Coordinates (UTM Zone 7)		Rationale for Inclusion	Frequency		
		Easting	Northing		Construction	Operation	Reclamation and Closure
Coffee Creek Watershed							
CF3.9	Coffee Creek below Latte Creek	596860	6974237	Downstream of confluence	Annually	Every 2 years	Every 3 years
CF10.0	Coffee Creek above Latte Creek	594191	6968831	Reference site for fish habitat	Annually	Every 2 years	Every 3 years
Latte Creek Watershed							
LC8.3	Lower Latte Creek	591817	6970662	Downstream of influence	Annually	Every 2 years	Every 3 years
Halfway Creek							
HF0.2	Lower Halfway Creek	588716	6980472	Downstream of influence	Annually	Every 2 years	Every 3 years
YT-24 Watershed							
YT0.2	Lower YT-24	589575	6979154	Downstream of influence	Annually	Every 2 years	Every 3 years
Carlisle Creek Watershed							
CR16.7	Upper Carlisle Creek	564251	6976963	Reference Area	Annually	Every 2 years	Every 3 years
Unnamed Watersheds							
SYT0.6	Unnamed Creek	590011	6978135	Reference Area	Annually	Every 2 years	Every 3 years
XE0.2	Unnamed Creek	605159	6973987	Reference Area	Annually	Every 2 years	Every 3 years



COFFEE PROJECT

Fish and Fish Habitat Monitoring Locations

Legend

- Settlement/Community
- Existing Access
- Proposed Route

Monitoring Stations

- Exposed Monitoring Site
- NAR Monitoring Site
- Potential Reference Site

Notes

1. 1:250,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
2. Digital Elevation Models provided by Geomatics Yukon.
3. Project data displayed is site specific. Survey data collected by EDI Environmental Dynamics Inc. (2015)
4. This document is not an official land survey and the spatial data presented is subject to change.

N

1:250,000

0 2 4 6 8 10

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 7-33	Date: Sep 12, 2023	Drawn by: MP	Reviewed: BSc/PT

Newmont

Path: L:\PROJECTS\Newmont_Coffee\GIS\Mapping\23Y\0176_2023\Permitting\Fig3_1_FishHabitatMonitoring.mxd

7.11.5.2 Benthic Invertebrate Monitoring

The benthic invertebrate monitoring program includes benthic invertebrate productivity, benthic invertebrate community, and benthic invertebrate tissue quality. Benthic invertebrate monitoring is focused on Halfway Creek, YT-24 Creek, Latte Creek, and Coffee Creek, with sampling areas located in the upper reaches (considered to be most sensitive to potential Project-related changes due to highest potential for mine-related change) and the lower reaches which are occupied by fish (Figure 7-34). An overview of the benthic invertebrate monitoring program is provided in Table 7-24.

Benthic invertebrate monitoring will be completed through construction, operations, and reclamation and closure, as summarized in Table 7-25. During the Closure Phase of the Project, the benthic invertebrate monitoring program will be conducted every two years (subject to adaptive management). Post-closure, monitoring will only be conducted in the event that site-specific water quality objectives are not maintained or if identified thresholds were recently exceeded and monitoring of adaptive management actions are required. Additional details on benthic invertebrate monitoring are provided in the EMAMP.

Table 7-24 Overview of Benthic Invertebrate Monitoring

Monitoring Component	Description
Indicators	Benthic Invertebrate Productivity, Community Structure, and Tissue Quality
Monitoring Category	Environmental Effects
Design	Multiple Control-Impact Approach (MCI) and Before-After/Control-Impact (BACI)
Measurable Parameters	Biomass (dry weight/m^2), density (organisms/m^2), taxon richness, %EPT[1], %mayflies, %HPG[1], %FFG[1], metal concentrations in composite samples
Key Project Interactions	Changes in surface water hydrology and surface water quality
Goal	The Project will not have a significant adverse effect on benthic invertebrates when compared to baseline and/or reference conditions
Objective	Evaluate how the Project may influence benthic invertebrates
Scope of Monitoring Work	Benthic invertebrate community samples will be collected at five stations per area by Hess sampler (3-grab composites, 500 µm mesh, lowest practical level taxonomy) and analyzed following guidance for MDMER-EEM. Sampling areas will include upper areas on Halfway Creek, YT-24, and Latte Creek and two matched reference creeks. Lower areas on the same creeks (with Coffee Creek replacing Latte Creek) will also be evaluated using a similar design (with separate lower reference creeks). Monitoring of upper creek areas will be conducted at least once during Construction, annually in upper creek stations for the first three years of Operation, and every two years for subsequent years of Operation and during Reclamation and Closure. Monitoring of lower creek areas will be the same as for upper Creek areas, except for every 2 years through all years of Operation. Monitoring will be subject to Surface Water Quality and Aquatic Life AMP triggers for higher frequency based on Fish and Aquatic Life Monitoring Plan (FALMP) findings.
Mitigation Measures	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to avoid/reduce changes to the downstream aquatic environment.
Project Terms and Conditions	To be determined following YESAA and *Yukon Waters Act* licencing processes

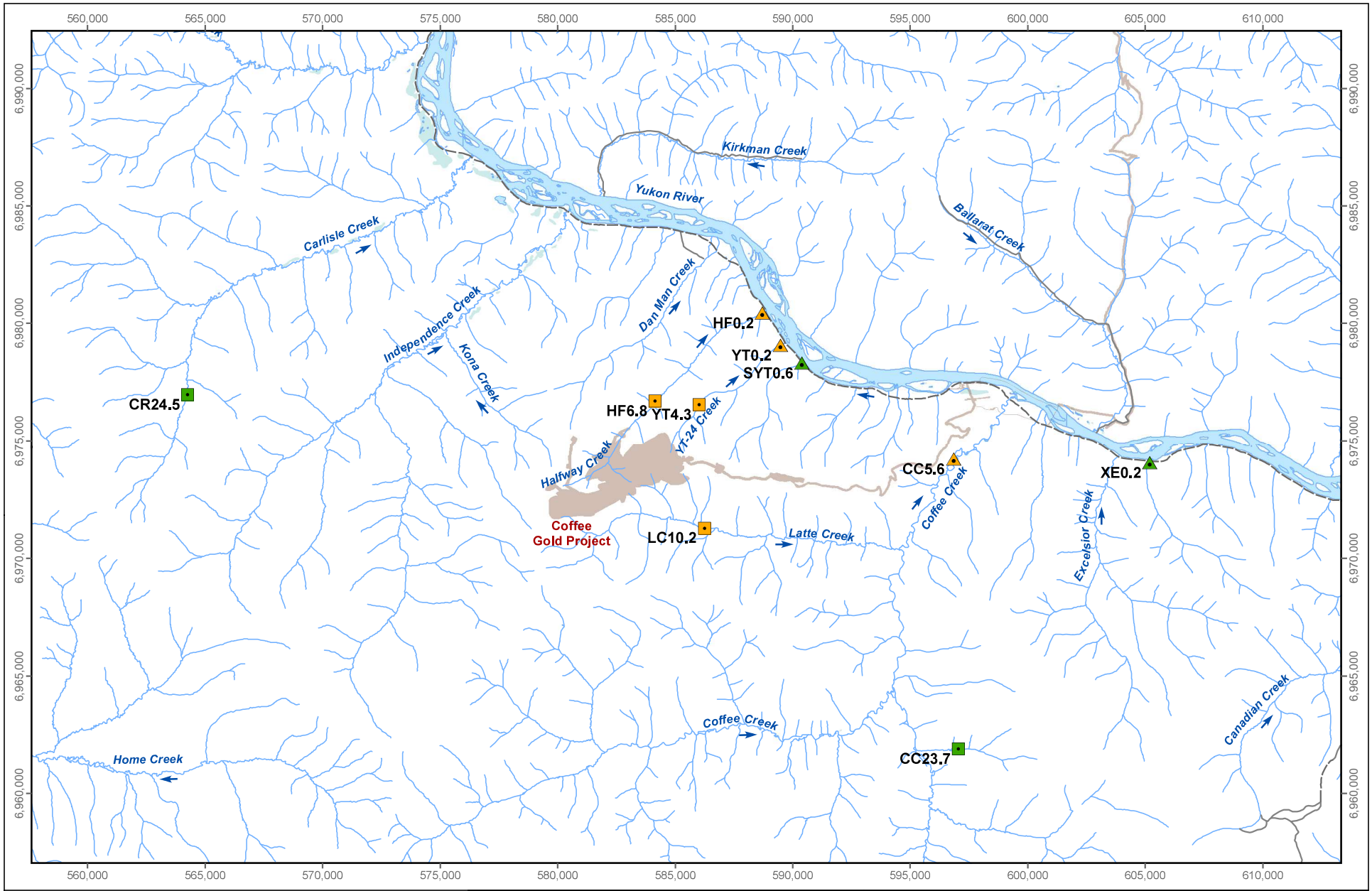
[1]EPT = ephemeroptera, plecoptera, trichoptera (mayflies, stoneflies, and caddisflies); HPG = habit preference group; FFG = functional feeding group

[2] Where a significant change is a statistically significant difference of greater than two standard deviations of the reference mean.

Table 7-25 Benthic Invertebrate Monitoring Areas and Frequency

Station	Area	Mean* Coordinates (UTM Zone 7)		Rationale for Inclusion	Frequency		
		Easting	Northing		Construction	Operation	Reclamation and Closure
Halfway Creek Watershed							
HF6.8	Upper Halfway Creek	584040	6976554	Downstream of influence	Once	Annually**	Every 2 Years
HF0.2	Lower Halfway Creek	588708	6980454	Downstream of influence	Once	Every 2 Years	Every 2 Years
Latte Creek Watershed							
LC10.2	Upper Latte Creek	586245	6971292	Downstream of influence	Once	Annually**	Every 2 Years
Coffee Creek Watershed							
CF5.6	Coffee Creek	596860	6974237	Downstream of influence	Once	Every 2 Years	Every 2 Years
YT-24 Watershed							
YT4.3	Upper YT-24 Creek	607645	6976556	Downstream of influence	Once	Annually**	Every 2 Years
YT0.2	Lower YT-24 Creek	589471	6979077	Downstream of influence	Once	Every 2 Years	Every 2 Years
Upstream Reference Area 1							
CR24.5	Upper Carlisle Creek	564251	6976963	Reference Area	Once	Annually**	Every 2 Years
Upstream Reference Area 2							
CF23.7	Coffee Creek	597045	6961892	Reference Area	Once	Annually**	Every 2 Years
Downstream Reference Area 1							
XE0.2	Creek East of Excelsior	605198	6974086	Reference Area	Once	Every 2 Years	Every 2 Years
Downstream Reference Area 2							
SYT0.6	Stream South of YT-24 Creek	590395	6978316	Reference Area	Once	Every 2 Years	Every 2 Years

*Mean of n = 5 stations per area
**Sampling will be conducted annually for first three years of the Operation phase. Sampling will be conducted every two years after year three pending findings and application of the Surface Water Quality and Aquatic Life AMP. Annual frequency is the maximum recommended for temporal comparison and both annual and bi-annual frequencies are appropriate to detect potential changes and meet or exceed standard recommended frequencies AEMP and/or EEM biological studies.



LEGEND

Sampling Location

- Upper "Future" Exposure
- Lower "Future" Exposure
- Upper Reference
- Lower Reference

- Mine Footprint
- Limited-use road
- Trail

0 2.5 5 10
km

N
W E
S

Projection: North American Datum 1983 UTM Zone 8
Reproduced under licence from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Benthic Invertebrate and Periphyton Monitoring Areas, Coffee Project FALMP

Date: March 2022
Project 217202.0040

minnow environmental inc.

Figure 7-34

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Newmont - 217202.0040 - Coffee AEMP and Permitting 2020\D - GIS\AEMP Design\21-40 Figure 4-1 BI and Periphyton Monitoring Areas, Coffee Project FALMP.mxd

7.11.5.3 Periphyton Monitoring

Periphyton represents an important component of aquatic food webs in creeks and consists of a complex matrix of organisms. Periphyton generally includes algae, fungi, bacteria, and protozoa attached to submerged substrate, and are an indicator of primary productivity in creeks. Key Project interactions with periphyton include predicted residual changes in surface water hydrology (flow reductions or increases with changes to the seasonal distribution of low and high flows) and changes in surface water quality (some localized increases in concentrations of sulphate, nitrate, arsenic, and/or aluminum) in Latte Creek, YT-24 Creek, and/or Halfway Creek. The design of the periphyton monitoring program is similar to that for benthic invertebrates and includes periphyton productivity and periphyton community. As with benthic invertebrate monitoring, periphyton monitoring is focused on Halfway Creek, YT-24 Creek, Latte Creek, and Coffee Creek (Figure 7-34). An overview of the periphyton monitoring program is provide in Table 7-26.

Periphyton monitoring will be completed through construction, operations, and reclamation and closure, as summarized in Table 7-27. During the Closure Phase of the Project, the periphyton monitoring program will be conducted every two years. Post-closure, monitoring will only be conducted in the event that site-specific water quality objectives are not maintained or if identified thresholds were recently exceeded and monitoring of adaptive management actions are required. Further details regarding periphyton monitoring are provided in the EMAMP.

Table 7-26 Overview of Periphyton Monitoring

Monitoring Component	Description
Indicators	Periphyton Productivity and Community Structure
Monitoring Category	Environmental Effects
Design	Multiple Control-Impact Approach (MCI) and Before-After/Control-Impact
Measurable Parameters	Biomass (ash free dry mass/m^2), chlorophyll-a (mg/m^2), taxon richness, %green algae, %blue-green algae, %diatoms
Key Project Interactions	Changes in surface water hydrology and surface water quality
Goal	The Project will not have a significant adverse effect on periphyton when compared to baseline and/or reference conditions
Objective	Evaluate how the Project may influence periphyton
Scope of Monitoring Work	Periphyton samples will be collected at five stations per area by scraping carefully recorded surface areas to provide three samples, one for ash free dry mass, one for chlorophyll-a, and one for taxonomy. Sampling areas will include upper areas on Halfway Creek, YT-24, and Latte Creek and two matched reference creeks. Lower areas on the same creeks (with Coffee Creek replacing Latte Creek) will also be evaluated using a similar design (with separate lower reference creeks). Monitoring of upper creek areas will be conducted at least once during Construction, annually in upper creek stations for the first three years of Operation, and every two years for subsequent years of Operation and during Reclamation and Closure. Monitoring of lower creek areas will be the same as for the upper Creek areas except that it will be every 2 years throughout Operation.
Mitigation Measures	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to avoid/reduce changes to the downstream aquatic environment.
Project Terms and Conditions	To be determined following YESAA and *Yukon Waters Act* licencing processes.

Table 7-27: Periphyton Monitoring Areas and Frequency

Station	Area	Mean* Coordinates (UTM Zone 7)		Rationale for Inclusion	Frequency		
		Easting	Northing		Construction	Operation	Reclamation and Closure
Halfway Creek Watershed							
HF6.8	Upper Halfway Creek	584040	6976554	Downstream of influence	Annually	Annually**	Every 2 Years
HF0.2	Lower Halfway Creek	588708	6980454	Downstream of influence	Annually	Every 2 Years	Every 2 Years
Latte Creek Watershed							
LC10.2	Upper Latte Creek	586245	6971292	Downstream of influence	Annually	Annually**	Every 2 Years
Coffee Creek Watershed							
CF5.6	Coffee Creek	596860	6974237	Downstream of influence	Annually	Every 2 Years	Every 2 Years
YT-24 Watershed							
YT4.3	Upper YT-24 Creek	607645	6976556	Downstream of influence	Annually	Annually**	Every 2 Years
YT0.2	Lower YT-24 Creek	589471	6979077	Downstream of influence	Annually	Every 2 Years	Every 2 Years
Upstream Reference Area 1							
CR24.5	Upper Carlisle Creek	564251	6976963	Reference Area	Annually	Annually**	Every 2 Years
Upstream Reference Area 2							
CF23.7	Coffee Creek	597045	6961892	Reference Area	Annually	Annually**	Every 2 Years
Downstream Reference Area 1							
XE0.2	Creek East of Excelsior	605198	6974086	Reference Area	Annually	Every 2 Years	Every 2 Years
Downstream Reference Area 2							
SYT0.6	Stream South of YT-24 Creek	590395	6978316	Reference Area	Annually	Every 2 Years	Every 2 Years

*Mean of n = 5 stations per area
**Sampling will be conducted annually for first three years of the Operation phase. Sampling will be conducted every two years after year three if that change in sampling effort is deemed appropriate. Annual frequency is the maximum recommended for temporal comparison and both annual and bi-annual frequencies are appropriate to detect potential changes and meet or exceed standard recommended frequencies AEMP and/or EEM biological studies.

7.11.5.4 Sediment Quality Monitoring

Key Project interactions with sediment include predicted residual changes in surface water hydrology (flow reductions or increases with associated changes to the seasonal distribution of low and high flows that can affect levels of suspended solids) and changes in surface water quality (some localized increases in concentrations of sulphate, nitrate, arsenic, and/or aluminum that could affect sediment quality) in Latte Creek, YT-24 Creek, and/or Halfway Creek. The objectives of stream sediment quality monitoring are to assess the key Project interactions in comparison to baseline and reference conditions and sediment quality guidelines for the protection of aquatic life (CCME 2000b). Sediment quality monitoring is an independent monitor of potential Project-related influence and provides supporting data for the interpretation of benthic invertebrate monitoring data.

An overview of the sediment monitoring program is provided in Table 7-28. The design of the monitoring program includes physical characteristics (particle size distribution and organic carbon content) and chemical characteristics (nutrients and metal concentrations). Sediment quality monitoring will be completed through construction, operations, and reclamation and closure as summarized in Table 7-29.

During the Operation Phase and during the Closure Phase, sediment quality monitoring will be conducted every two years. Post-closure, sediment quality monitoring will only be conducted in the event that water quality objectives are not maintained or if identified thresholds were recently exceeded and monitoring of adaptive management actions are required. Sediment quality monitoring will be undertaken in the late summer to ensure comparability over time. To simplify monitoring logistics and to facilitate linkages among monitoring components, sediment monitoring will be completed at the same time as benthic invertebrate and periphyton monitoring, although the actual location of the stations will differ to accommodate the requirement for in-creek sediment deposition. Stream quality monitoring locations are shown on Figure 7-34. Further details regarding the sediment monitoring program are provided in the EMAMP.

Table 7-28 Overview of Sediment Monitoring

Monitoring Component	Description
Indicator	Sediment Quality
Monitoring Category	Environmental Effects
Design	Before-After
Measurable Parameters	Particle size distribution, total organic carbon content, total nitrogen, total metals scan (ICP-MS[1] on < 63 µm fraction)
Key Project Interactions	Changes in surface water hydrology and surface water quality
Goal	The Project will not have a significant adverse effect on sediment quality when compared to baseline conditions
Objective	Evaluate how the Project may influence sediment quality
Scope of Monitoring Work	Sediment samples will be collected at five stations per area. Sampling areas will include locations of sediment deposition on Latte Creek, Coffee Creek, lower YT-24 Creek, and Halfway Creek. No sampling will be undertaken at reference areas. Monitoring will be conducted at least once during Construction and every two years during Operation and during Reclamation and Closure
Mitigation Measures	Erosion and sediment control within the footprint of the Mine Site. Water management within the footprint of the Mine Site to avoid/reduce changes to the downstream aquatic environment
Project Terms and Conditions	To be determined following YESAA and *Yukon Waters Act* licencing processes

[1] ICP-MS = inductively couple plasma - mass spectrometry

Table 7-29 Sediment Quality Monitoring Areas and Frequencies

Station	Area	Mean* Coordinates (UTM Zone 7)		Rationale for Inclusion	Frequency**		
		Easting	Northing		Construction	Operation	Reclamation and Closure
Halfway Creek Watershed							
HF0.2	Lower Halfway Creek	588708	6980454	Downstream of influence	Once	Every 2 Years	Every 2 Years
Latte Creek Watershed							
LC10.2	Upper Latte Creek	586245	6971292	Downstream of influence	Once	Every 2 Years	Every 2 Years
Coffee Creek Watershed							
CF5.6	Coffee Creek	596860	6974237	Downstream of influence	Once	Every 2 Years	Every 2 Years
YT-24 Watershed							
YT0.2	Lower YT-24 Creek	589471	6979077	Downstream of influence	Once	Every 2 Years	Every 2 Years

*Mean of n = 5 stations per area
**Annual frequency is considered appropriate to detect potential change over time

7.11.6 Physical Inspections

Annual physical inspections of remaining infrastructure and facilities in closure will be carried out by a qualified engineer licensed to practice in Yukon. An annual review of the physical monitoring program results (including inspections and instrumentation data) by a qualified engineer will be conducted in accordance with Project permits and licences. Table 7-30 provides a summary of the physical inspection program that will be implemented early in the Closure Phase.

The frequency of inspections is likely to decrease with the progression of the Project into subsequent Closure Phases until determined to be no longer required, or until the success of reclamation efforts has been ascertained. The closure physical monitoring program will be advanced through detailed project planning stages.

Table 7-30 Closure Physical Inspection Program

Mine Component	Type of Inspection	Frequency			Responsible Party	Deliverable
		Post-mining Closure Phase	Active Closure Phase	Post-closure Phase		
Open Pits	Water Level and General Visual Inspection	Quarterly until reaches spillway then annually	Quarterly until reaches spillway then annually	Every two years for first ten years then as recommended	Care and Maintenance Personnel	Weekly Log, included in Monthly and Annual Reports
Heap Leach Facility	Geotechnical / Detailed	Annual	Annual	Every two years for first ten years then as recommended	Geotechnical Engineer (Yukon P.Eng)	Inspection Report
Facility and Alpha Ponds	Water Samples	As per permitting requirements	As per permitting requirements	N/A	Environmental Monitors	Daily Log, included in Monthly and Annual Reports
Waste Rock Storage Facility	Geotechnical	Every two years	Every two years	Every two years for first ten years then as recommended	Geotechnical Engineer (Yukon P.Eng)	Inspection Report
Water Management Infrastructure	Inspection of Ice, Blockages	Annual, prior to freshet	Annual, prior to freshet	Every two years for first ten years then as recommended	Care and Maintenance Personnel	Inspection Report
	Water Samples	As per permitting requirements	As per permitting requirements	As per monitoring plan	Environmental Monitors	Daily Log, included in Monthly and Annual Reports
Site Roads (including the NAR)	General Visual Inspection	Quarterly	Quarterly	N/A	Care and Maintenance Personnel	Inspection Reports
Pumps / Pipelines	Confirmation of Operation	Daily for operating pumps	Daily for operating pumps	N/A	Care and Maintenance Personnel	N/A
	Check for Flow and Absence Leaks	Weekly for operating pipelines	Weekly for operating pipelines	N/A	Care and Maintenance Personnel	N/A

7.11.7 Reporting

Reporting will be conducted in accordance with Project permit and license conditions. At a minimum, Newmont anticipates the submission of an annual interpretive report to satisfy regulatory requirements. The annual report will include:

- Summaries of Project activities completed, and mitigation measures implemented within the previous calendar year
- Results of monitoring programs and interpretation of findings related to the inspection and monitoring programs outlined above
- Details of any additional investigations that were conducted and any corrective actions taken
- A summary of engagement with regulators, Project-related working groups, First Nations, or Project stakeholders regarding that status of monitoring programs
- A description of any proposed changes to mitigation and monitoring plans.

Every three years, or as appropriate based on data collection, Newmont will review the results of annual monitoring and develop a detailed report that evaluates monitoring indicator trends. This interpretive report will include a retrospective analysis of monitoring data from baseline to current conditions to assess trends and compliance with Project-specific objectives and thresholds. Statistical analysis of the monitoring results will be performed where appropriate.

7.12 Socio-Economic Aspects of Permanent Closure

This section describes closure aspects for socio-economic components. Because the socio-economic environment is dynamic and interconnected, some closure-related measures described below may include components of, or references to, other reclamation and closure measures. As part of monitoring associated with the SEMP, Newmont will manage and monitor the implementation of socio-economic mitigation measures throughout the Construction and Operation phases and iteratively revise these measures as needed based on community feedback and other influencing factors. Results of the SEMP will be incorporated into the RCP to accurately reflect the socio-economic conditions of the community through the Closure and Post-closure Phases. These updates will include potential Project-related impacts that may be observed through the SEMP as well as through community consultation, and a social closure impact assessment and plan will be developed to present and guide mitigation of these impacts. The SEMP will be updated as the Project advances and will describe the socio-economic monitoring program that will be carried out in the Closure and Post-closure Phases. A key objective informed by results of the closure and post-closure socio-economic monitoring program includes protecting the quality and diversity of the traditional economy, including the health and viability of country foods (e.g., fish, wildlife, plants) and other harvestable resources (e.g., furs, medicinal plants).

Socio-economic measures to address potential effects on socio-economic valued component described in Section 4.3 are presented below and will become more prescriptive as the Project advances.

7.12.1 Education and Training Measures

Preparing for the Closure and Post-closure Phases, Newmont is committed to:

- Supporting information sharing with local education institutions to plan for a decrease in student enrollment numbers associated with families or workers leaving the area

- Providing appropriate training opportunities that align with transferrable skills to support workers and the local/regional economy toward a post-mining transition.

Table 7-31 summarizes the proposed education and training measures that will be implemented during the Closure and Post-closure Phases, expected timeframe for the start of implementation, and the anticipated roles and responsibilities for involved parties or groups in their implementation.

Table 7-31 Education and Training Measures Associated with Closure

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
Support local elementary and secondary educational institutions to plan for changes in student enrollment numbers			
Engage with Yukon Education and local elementary and secondary schools to communicate anticipated population-driven changes in enrollment.	**Newmont**: Responsible for communicating workforce and corresponding population decreases anticipated during the Closure and Post-closure Phases. **Yukon Department of Education**: Responsible for broad communication across all Yukon schools, including Whitehorse, and ensuring local schools have support to manage potential changes to enrollment. **Robert Service School (City of Dawson), Eliza Van Bibber School (Pelly Crossing), J.V. Clark School (Mayo), and Nelnah Bessie John School (Beaver Creek)**: Responsible for communicating changes in enrollment to Yukon Department of Education.	Initiate engagement specific to closure approximately Project Year 8	**SEMP:** Describes measures to be implemented during Construction and Operations to manage potential Project related effects on educational services (primary, secondary and post-secondary) and community-based training, including on-going engagement with local education and training institutions. On-going SEMP monitoring will inform Closure and Reclamation Strategy.
Provide appropriate training opportunities that are available and focus on skills transferrable to the local and regional economy			
Engage with local education and training organizations and institutions to discuss how transferrable skills and other closure-supporting activities will be included in Newmont and partners training programs.	**Newmont**: Responsible for engaging with local education/training institutions on necessary education and/or training requirements for all identified positions required for each Project Phase, including specific training opportunities associated with reclamation and closure, and working with partners to identify training needs that prepare for closure. **Yukon University and other training providers**: Responsible for providing feedback to Newmont regarding available training programs and/or needs to develop new training programs. **TH Human Resources & Education Department, SFN Citizen Development Department, WRFN Employment and Training Department, and FNNND Education and Training Department**: Responsible for providing feedback to Newmont regarding available training programs and/or needs to develop new training programs.	Design training initiatives that may begin during Construction and Operation phases to consider skills that are relevant post-mining. Initiate engagement on job transition training specific to closure at approximately Year 8.	**Engagement Plan(s) Newmont will engage with relevant training or education organizations**

7.12.2 Local Employment, Procurement, and Economic Measures

Newmont is committed to:

- Supporting education, training, and career development opportunities through a Workforce Transition Strategy
- Supporting career planning, financial management, and financial literacy training through an Employee Assistance Program that plans for post-Project careers for the Project's workforce
- Supporting supply chain changes by communicating proactively with suppliers with respect to the Project schedule and future supply requirements for the Closure Phase
- Supporting local governments to absorb potential changes to communities by communicating proactively on the Project schedule
- Supporting financially sustainable partnerships and agreements
- Establishing and contributing to investment opportunities through Community Investment planning that anticipates closure.

Table 7-32 summarizes the proposed measures associated with local employment, procurement, and the economy to be implemented to address closure-related Project effects, along with the expected timeframe for the start of implementation, and the potential roles and responsibilities for other involved parties or groups.

Table 7-32 Local Employment, Procurement, and Economic Measures Associated with Closure

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
Supporting education, training, and career development opportunities through a Workforce Transition Strategy			
Reduce potential adverse economic effects of closure by exploring options to reduce the Project's direct workforce gradually and retain local staff as long as possible.	**Newmont:** Prioritize current employees for reclamation and closure positions, where possible, and facilitate training, if necessary. Work with key suppliers and contractors to define possibilities for staging a reduction of the workforce in preparation for closure. Provide management/leadership training and career advancement for employees who have a demonstrated interest and aptitude. Consider employees for corporate positions locally if available, or at other mine/development sites, where possible.	Initiate during Operation phase. More focused recruitment beginning approximately Year 8	**Human Resources plans and documents**
Fulfill all obligations identified in employment contracts	**Newmont:** Fulfill all conditions for terminations as defined in employment contracts, including severance payments. The Proponent will offer an Employee Assistance Program to support employees during transition to permanent closure. Identify and provide a local workforce transition contact to respond to questions and concerns regarding temporary or permanent closure status, schedule, and activities.	Initiate pre-Construction, carries forward through Construction, Operation and Closure Transition Contact identified approximately Year 12	**Human Resources plans and documents**
Focus on transferrable skills and career opportunities that are relevant to workers and the economy post-closure	**Newmont**: Convene a planning process toward the Workforce Transition Strategy that includes up-to-date information on Newmont's commercial plans and workforce needs. Emphasize transferable skills for on- and off-the-job training opportunities to maximize workers' "job-ready" status for potential positions in other mining projects and industries. Connect workers with relevant jobs that are local, where possible. Define approach to incentivizing retention of existing staff, to avoid a "brain drain" near the end of mine life. Engage with First Nations and other parties to gather input for the Workforce Transition Strategy **The Project's direct workforce:** Provide input into the Workforce Transition Strategy, as requested.	Initiate engagement with external groups specific to closure at approximately Year 8. Define approach to retention incentives (approximately Year 8)	**Workforce Transition Plan; Workforce Mobilization Plan**

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
	Other mining firms in Yukon: Contribute information about their potential workforce needs, to maximize the transfer of jobs and skills to current and future mines and mining projects in Yukon. **Yukon Government Department of Energy and Mineral Resources:** Contribute information about potential industry needs and plans that connect to workforce and skills demand. **Yukon Bureau of Statistics:** Contribute data on jobs and skills to support a Workforce Transition Strategy. **Yukon University:** Participate in identifying up-to-date training needs and opportunities that bridge the Project's workforce with other career opportunities. **Other groups or organizations that may have partnered with Newmont on education, training, and career development:** Contribute information, insights, or identification of opportunities to bridge the Project's workforce into new career opportunities.		
Supporting career planning, financial management, and financial literacy training through an Employee Assistance Program that plans for post-Project careers			
Support the Project's direct workforce in their long-term careers and financial outcomes over the post-Project transition period	**Newmont**: Design workforce training initiatives to focus on long-term (Post-closure) career and financial planning. Provide resources and initiatives focused on career transitioning such as financial planning, job-search techniques, career fairs, and others under the Employee Assistance Program. **Project's direct workforce:** Participate in Employee Assistance Program initiatives, as desired. **Newmont's key suppliers:** Share information related to the Employee Assistance Program, and how it could implement something similar for their own workers (the Project's indirect workforce). **Other partners TBD**: Contribute information, insights, or identification of opportunities to bridge the Project's workforce into new careers and/or income sources.	Refresh career and financial planning initiatives at approximately Year 8	**Education and Training Strategy** **Employee Assistance Program**

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
Supporting supply chain changes by planning proactively with suppliers on Project timeframes, including Closure			
Engage key suppliers and contractors about Project timeframes (including Closure), to inform and support their businesses' long-term planning Share information with the business community at large that may be interested in the secondary effects of Project-related changes to purchasing	**Newmont**: Convene a planning process for and with key contractors that focuses on planning for closure. Provide updates on Project timeframes. **Suppliers:** Participate in a planning process. Share information with Newmont and peers, as desired. Raise questions and concerns for Newmont's awareness and response, as needed. **Chambers of Commerce (e.g., Dawson, Whitehorse, Yukon First Nation Chamber of Commerce, Yukon Chamber of Mines):** Participate in closure-related supply chain planning and/or receive informed on Project timeframes. Share information on Project timeframes with Chamber membership, if appropriate. **Other groups or organizations that may have partnered with Newmont on business development:** Contribute information, insights, or identification of opportunities to bridge the Project's supply chain into new economic opportunities.	Initiate engagement specific to closure at approximately Year 8	**Local Contracting and Procurement Strategy, Engagement Plan**
Supporting local governments to absorb potential changes to communities by communicating proactively on Project timeframes			
Share information with local municipal and Indigenous government to allow them to plan for post-Project futures	**Newmont**: Initiate information-sharing with local governments related to Closure and overall Project timeframes. Remain engaged with governments and contribute actively to their revenue planning. Engage regularly on a determined schedule to develop strategies that will support communities through the period of revenue change once closure dates confirmed. **Local governments in Dawson, Pelly Crossing, Mayo, Beaver Creek, Whitehorse**: Share information on Project timeframes to their communities (i.e., available on website, community offices, project events, etc.). Raise questions and concerns for Newmont's awareness and response, as needed.	Information sharing, government engagement, and engagement reporting will occur throughout Project Revenue change engagement will occur at approximately Year 10	**Engagement Plan**

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
Supporting financially sustainable partnerships and agreements			
Support First Nations and/or other partners with whom Newmont has financially-based partnerships and agreements in transitioning beyond the Project's LOM (and revenue stream)	**Newmont**: Engage First Nations partners in conversations about Project timeframes and how these affect agreements. **First Nations with whom Newmont has signed agreements that include revenue or other financial components:** Raise questions or concerns related to long-term financial sustainability of partnerships, if desired. **Other supports or resources, as requested:** Provide advice or services on long-term financial planning, if needed.	Design and/or renew agreements so that Project timeframes such as Closure are considered, if this is appropriate and mutually agreeable to Newmont and First Nations partners. Initiate engagement specific to closure at approximately Year 8	**Impact-Benefit Agreements**
Establishing and contributing to investment opportunities through Community Investment planning that anticipate Closure			
Support Newmont's Community Investment partners in transitioning beyond the Project's LOM (and revenue stream)	**Newmont**: Include exit and/or financial sustainability strategies in Community Investment commitment decisions that Newmont makes during Construction and Operations. Prefer Community Investment opportunities in which Newmont is not the only financial contributor. Communicate financial sustainability objectives with Community Investment partners when commitments are made. Engage Community Investment partners to clarify and update exit/sustainability strategies. **Community Investment Partners:** Share information during the detailed closure-planning process. Raise questions and concerns, if desired.	Exit strategies determined and communicated as Community Investment decisions are made during Construction and Operation phases. Initiate engagement specific to closure at approximately Year 8	**Community Investment Protocol**

7.12.3 Community Infrastructure and Services Measures

Newmont is committed to:

- Supporting users of the Northern Access Road in understanding changes in access and/or maintenance of the road post-Closure
- Supporting local governments and service providers in understanding potential changes in demand for municipal and social services related to Closure.

Table 7-33 summarizes the proposed measures associated with community infrastructure and services to be implemented to address closure-related Project effects, along with the expected timeframe for the start of implementation, and the potential roles and responsibilities for other involved parties or groups.

Table 7-33 Community Infrastructure and Services Measures Associated with Closure

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
Support road users in understanding access to the NAR post-Closure			
Engage users of the NAR on long-term use post-Closure	**Newmont**: Engage with road users and governments. Describe options for road access post-Closure. Incorporate feedback and concerns, as appropriate. **TH and SFN governments:** Participate actively in conversations about road access post-Closure. Share information on traditional use and other interests related to the road. **Other road users**: Participate in conversations about road access. **Yukon Government Department of Public Works and Highways, and EMR:** Participate in conversations with road users, as needed.	Initiate engagement specific to closure at approximately Project Year 10	**NAR management agreements and/or governance instruments (leases, permits, closure objectives, etc.)**
Support governments and providers of long-term and short-term accommodations in Whitehorse in a transition toward lower demand for accommodation post-Closure			
Engage property market players to contribute to their plans for sustainable long-term housing options	**Newmont**: Engage members of affected communities. Communicate Project timelines and describe the potential to affect the property market. Share information about workforce planning, including closure timeframes. **Property market players in Dawson**: Contribute information, insights, or identification of opportunities to bridge the Project's accommodation supply into new opportunities. **Yukon Bureau of Statistics, Canada Mortgage and Housing Corporation, Statistics Canada**: Contribute data and reporting on housing demand, prices, and other factors related to housing supply at the time of closure. **City of Dawson, Pelly Crossing, Mayo, Beaver Creek, City of Whitehorse:** Participate in conversations with Newmont about long-term sustainable housing options. **Direct project workforce**: Actively contribute to closure planning by sharing information about where they plan to live post-Closure.	Initiate engagement specific to closure at approximately Project Year 8	**SEMP:** Includes the Community Infrastructure and Services Management Strategy, which describes measures to be implemented during Construction and Operations to manage potential Project related effects on housing. On-going SEMP monitoring will inform Closure and Reclamation

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
Support local governments and service providers in responding to changes in demand for municipal and social services related to closure			
Engage local governments and service providers on Project timeframes, to contribute to their long-term plans	**Newmont**: Share information about timeframes for closure, including workforce transitions. Brief local governments and service providers about any workforce well-being-related topics that may have arisen during Construction and Operation Phases that may be relevant to Closure. **City of Dawson, Pelly Crossing, Mayo, Beaver Creek, City of Whitehorse:** Participate in conversations with Newmont related to Closure. Identify specific local government departments or other partners who may be incorporated into Closure-related conversations related to services. **Service providers in Dawson, Pelly, Mayo, Beaver Creek, and Whitehorse, as needed:** Participate in conversations with Newmont related to Closure. Ask clarifying questions and request data from Newmont, if needed, to allow service providers to adapt to closure-related changes. Troubleshoot solutions, as needed.	Initiate engagement specific to closure at approximately Year 8	**SEMP** **Engagement Plans**

7.12.4 Traditional Knowledge and Lands and Resource Use Measures

Newmont is committed to:

- Communicating the results of post-mining environmental monitoring to increase confidence in safely consuming traditional and non-traditional foods from the Project area and to support the traditional economy
- Communicating areas that will be open to (or excluded from) traditional and non-traditional use activities
- Ensure that First Nations have an opportunity to participate in end land-use planning for the site that are consistent with traditional land use values for the area, including future uses.

Table 7-34 summarizes the proposed measures associated with traditional knowledge and lands and resources use to be implemented to address closure-related Project effects, along with the expected timeframe for the start of implementation, and the potential roles and responsibilities for other involved parties or groups.

Table 7-34 Traditional Knowledge and Lands and Resource Use Measures Associated with Closure

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
Support traditional land use activities within the project area to the extent possible and perception of safe land and resource use			
Engage with key users of land and resources post-closure on environmental monitoring results to maximize confidence in the Project's environmental management measures. Communicate areas that will be open to (or excluded from) traditional and non-traditional use activities. Maintain legacy hiking trails.	**Newmont**: Convene a process that builds on initiatives established by Newmont during construction and operations (see SEMP) so that First Nations and key land and resource users can continue to feel comfortable and confident in the environmental quality parameters post-Closure. Establish a feedback process so that information can be shared transparently on agreed environmental quality parameters (physical and biophysical environments) and quality or harvesting resources. Respond to questions and concerns in a forthright and timely fashion. Consider input from First Nations and other land users into reclamation programs (e.g., use of traditional plans for revegetation) and in the definition of end land use planning for the site. **First Nations lands departments and technical experts on environmental quality topics**: Represent their respective Nations in participating in conversations and problem-solving around closure-related environmental quality. Represent the interests of land and resource users through providing technical information and First Nations governance support. **Hunters, gatherers, other land and resource users, users of legacy hiking trails:** Provide key information on expected and actual land and resource use post-closure.	Construction, Operation, and Closure	**Engagement Plan(s)** **Environmental monitoring programs during Construction, Operation, and Closure Phases**

7.12.5 Community Health and Well-Being Measures

Newmont is committed to:

- Engaging with service providers (YG, municipalities, hospitals, and clinics) on changes in demand for health services, including the potential for additional requirements and changes in demand for mental health supports
- Engaging with local RCMP regarding changes in workforce and/or scheduled layoffs
- Including in the Workforce Transition Strategy connections to social support services, information on food security, and health and well-being information.

Table 7-35 summarizes the proposed measures associated with community health and well-being to be implemented to address closure-related Project effects, along with the expected timeframe for the start of implementation, and the potential roles and responsibilities for other involved parties or groups.

Table 7-35 Community Health and Well-Being Measures Associated with Closure

Action	Role(s) &/or Responsibilities	Timeframe	Link to Other Newmont Plans or Initiatives
Engagement with service providers (Yukon Government, municipalities, hospitals, and clinics) on changes in demand for health services, including additional requirements and mental health			
Support service providers in anticipating, planning for, and responding to potential changes in demand for services related to closure.	**Newmont**: Share information about timeframes for closure, including workforce transitions to support service delivery planning. Brief local governments and service providers about any workforce well-being-related topics that may have arisen during Construction and Operation Phases that may be relevant to Closure. **City of Dawson, Pelly Crossing, Mayo, Beaver Creek, City of Whitehorse, Yukon Government:** Participate in conversations with Newmont related to Closure. Identify specific local government departments or other partners who may be incorporated into Closure-related conversations related to services. **Hospitals, clinics, and mental health service providers, addictions support providers:** Participate in conversations with Newmont related to Closure. Ask clarifying questions and request data from Newmont, if needed, to allow service providers to adapt to closure-related changes.	Initiate engagement specific to closure at approximately Project Year 8	**Engagement Plan(s)**
Including in the Workforce Transition Strategy connections to social support services, information on food security, and health and well-being information			
Connecting the Project's direct workforce with social, health, and well-being supports to ease the transition into post-Closure life and work	**Newmont**: Share information about timeframes for closure, including workforce transitions. Brief local governments and service providers about any workforce well-being-related topics that may have arisen during Construction and Operation Phases that may be relevant to Closure. Provide information and training to employees on resources available to them regarding social support and services through extended health and public health. **Social support service providers**: Participate in conversations with Newmont related to Closure. Ask clarifying questions and request data from Newmont, if needed, to allow service providers to adapt to closure-related changes. **Direct Project workforce:** Engage with Newmont on social, health, and well-being issues for inclusion in the Workforce Transition Strategy, as needed. **Newmont's key suppliers:** Adopt Newmont's approaches to social, health, and well-being topics at the time of workforce transition, as needed.	Initiate engagement specific to closure at approximately Project Year 8	**Engagement Plan(s)**

7.12.6 Heritage Resources

During reclamation and closure activities, it is not anticipated that there will be increases in the potential to affect tangible heritage resources (i.e., archaeological, and historical resources, as well as paleontological resources). Nevertheless, should additional ground disturbance occur to support reclamation and closure activities, mitigation to be implement in areas of new ground disturbances would involve the same measures in place for the Construction and Operation phases of the Project, including:

- Completing a Heritage Resources Impact Assessment (HRIA) for any areas of new disturbance not previously assessed
- Consulting on appropriate mitigation measures
- Avoiding known archaeological and historical resources
- Conducting systematic data recovery
- Implementing Project-specific Heritage Resources Protection Plan, including a Chance Find Procedure (CFP)
- Following monitoring plans
- Implementing Project-specific Heritage Resources Protection Plan, including a CFP.

Regardless of new ground disturbances, Newmont will implement the following measures during the Closure Phase to restore historical features:

- Consult with First Nations on the preferred approach to historical features restoration
- Cover disturbed areas to the extent practicable with materials from areas already disturbed
- Restore the character of the Coffee Creek camp area for cultural gatherings
- Maintain and restore historical cabins and features
- Revegetate with native vegetation including berry producing shrubs, medicinal plants, etc.

7.13 Performance Uncertainty and Risk Management

Project-related risks will continue to be assessed as the Project advances. Once the site has ready steady-state operating conditions, it will be possible to re-evaluate closure-related risks, based on lessons learned during early operations, as especially those learned from progressive reclamation measures that have been implemented. Management and monitoring plans will continue to evolve as the Project advances and continual refinements and improvements will reduce uncertainties associated with perceived or potential risks. As the Project will gradually transition from operations to closure (i.e., operating activities such as heap rinsing and water treatment will start in the Operation Phase and continue into the Closure Phase), there will be further opportunity to refine plans and incorporate changing site conditions when relevant.

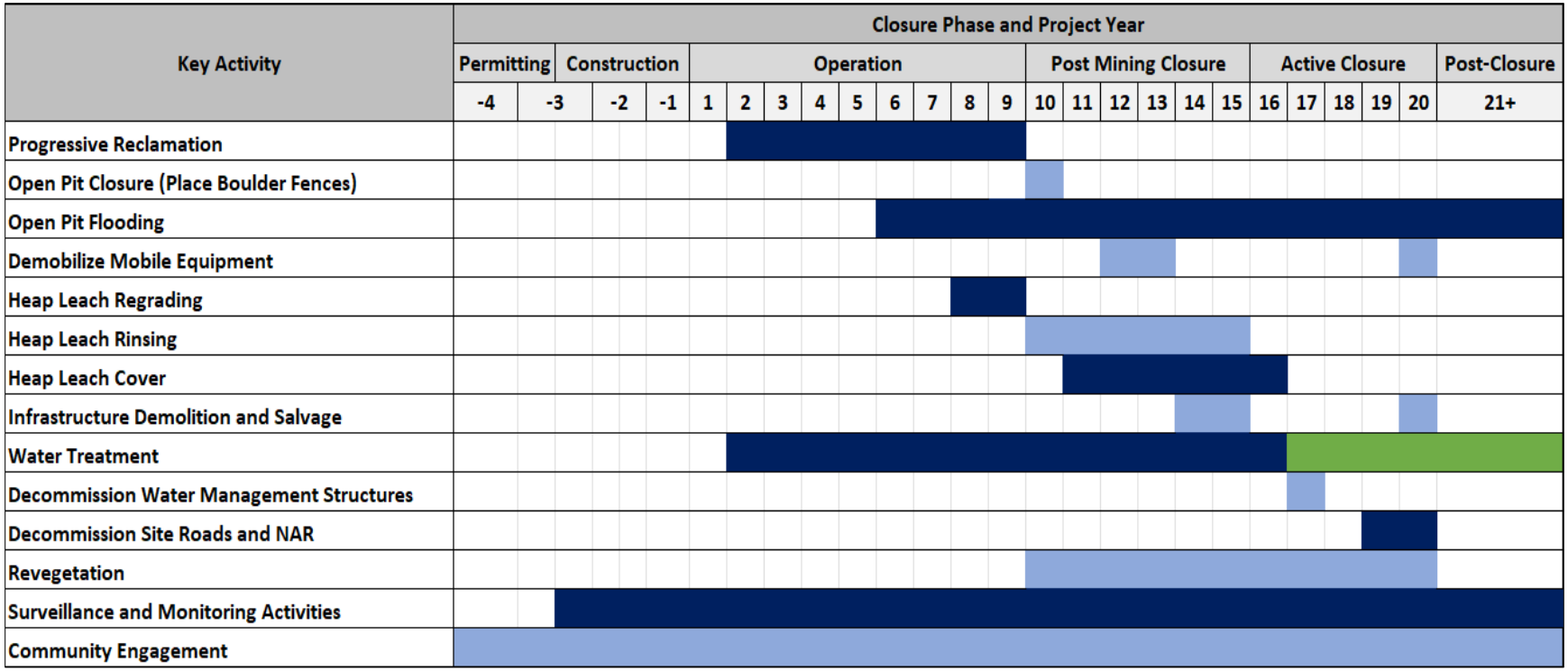
Risks will also be managed adaptively, as outlined in Section 5.8.2. An AMP for the Closure Phase will be developed during the Operation Phase, and it is expected that the approach will largely follow the plan implemented for the Operation Phase. The Operation Phase plan would have been tested under actual conditions and/or refined throughout this period in response to gaining a better understanding of actual site conditions.

8.0 RECLAMATION AND CLOSURE SCHEDULE AND EXECUTION STRATEGY

8.1 Schedule Overview

Throughout the Operation Phase, closure activities will be undertaken in a progressive manner from Year 2 to the end of Year 9 when open pits, the Alpha WRSF and FSSA, and stages of the HLF are no longer required to support mine operations. Activities planned during the Operation Phase are detailed in Section 2.3.2.

The Closure Phase will commence at the start of Year 10 and is projected to end at the end of Year 21. The Closure Phase is categorized into Post-mining Closure (Year 10 – 15) and Active Closure (Year 16 - 21) Phases based on site water quality associated with the HLF draindown and rinsing. Activities within the Post-mining Closure Phase are focused on water treatment, as well as decommissioning and reclamation of site areas that are no long in use and are not required for closure. Activities within the Active Closure Phase are focused on decommissioning water management infrastructure as well as site components that are not required for the Post-closure Phase. The Post-closure Phase activities include long-term monitoring and site maintenance, and passive water treatment, if determined to be required. Figure 8-1 presents the estimated time period for key closure activities as they occur during each Project phase. The time period for the activities will be refined through further Project planning and evaluations.



*Green highlighted cells indicate years that passive water treatment will be in effect, if required.

Figure 8-1 Key Closure Activities Estimated Time Period

Certain tasks will be performed simultaneously or overlap preceding or subsequent tasks to ensure that closure works remain on schedule.

Routine monitoring in accordance with the conditions of the mine operating licenses and permits will be ongoing throughout the Operation Phase and Closure Phase as described in Section 7.11. Additionally, monitoring of reclaimed areas to observe progress towards achieving site-specific closure objectives will be ongoing throughout the Closure Phase.

8.2 Reclamation Execution Strategy

During the Closure Phase, reclamation of disturbed areas within the Mine Site footprint will be undertaken when those areas are no longer required to support closure activities. The following items will be considered when planning and executing final closure:

- Reclamation activities will incorporate suitable surface preparation techniques that will contribute to long-term stability, reduced erosion, and success of revegetation. A combination of re-grading, scarification, and rough and loose surfacing will be utilized. Based on reclamation research during operations and from other analogous sites, landscaping such as the creation of hummocks or mounds may be utilized.
- Stockpile management during operations and closure will be imperative to ensure that suitable reclamation material is available. Strategic stockpile placement will reduce also costs associated with long haul distances and reduce requirements to re-handle material.
- Overburden materials used for reclamation will be sourced from stockpile locations proximal to the area to be reclaimed, unless direct placement opportunities exist (direct dozing).
- Proper construction and maintenance of water management structures (channels, ditches, berms, settling basis, etc.) during reclamation and closure activities will be important to ensure success. Water management and erosion and sediment control around reclaimed areas will be carefully planned to maximize reclamation success, limit the need for future disturbance, and divert clean water away from areas still being used.
- The mining fleet will be used to support progressive reclamation during operations and will be available during the beginning of the closure period to support final reclamation and closure activities. Utilizing the remaining mining fleet to support reclamation, specifically those activities that require large amounts of material movement will contribute to operational efficiencies and lower costs.
- Site infrastructure will be decommissioned, and sites will be reclaimed as the closure phase progresses and the infrastructure is no longer required to support closure activities. The infrastructure that will remain on-site to support closure activities includes the Exploration Camp, site office and labs, emergency response building, fuel storage tanks, waste management facility, land treatment facility, truck shop and warehouse, and power plant. This infrastructure will be decommissioned by the end of the Active Closure Phase once they are no longer required.
- Post closure monitoring will be completed as per the schedule provided in Section 7.0 using helicopter access and third-party consultants. Post closure maintenance will occur on as needed basis based on outcomes of monitoring and recommendations of qualified professionals. Post closure maintenance may require mobilization of equipment and supplies using barges and will be carried out by a third-party contractor.

8.3 Equipment Fleet

The anticipated mining equipment on-site prior to the Closure Phase includes the following:

Table 8-1 Major Mining, Support, and Ancillary Equipment Count by Year (Start, Peak, LOM)

Major Equipment List[1]	End of Construction	Peak of Operation Phase	End of LOM
Komatsu - PC3000 - Shovel	3	4	4
Komatsu - WA900 - FEL	1	2	2
Sandvik - D55SP - Production Drill	3	4	3
Sandvik - DX800 - Presplit Drill	1	2	2
Komatsu - D275 - Track Dozer	5	6	5
Komatsu - WD500 - Wheel Dozer	2	3	3
Komatsu - GD825 - Grader	3	3	3
Komatsu - HD785 - Water Truck	2	2	2
Komatsu - D275 - Track Dozer - ROM STK	1	1	1
Komatsu - HD1500 - Haul Truck	12	27	12
Total Units Required	34	54	37
Ancillary Equipment List[1]	**End of Construction**	**Peak of Operation Phase**	**End of LOM**
Drilling			
Caterpillar - 236D - Skid Steer	2	2	2
Loading & Hauling			
Caterpillar - 415 - Backhoe	1	1	1
Caterpillar - 236D - Skid Steer	2	2	2
Komatsu - HD785 - Rock Spreader	1	1	1
Service / Materials			
Lowboy - TowHaul - Trailer (100t Float)	1	1	1
Komatsu - HD785 for Lowboy Trailer (100t Float)	1	1	1
Hyster - 700HD - Tire Manipulator	2	2	2
Western Star - 6900 - Fuel / Lube Truck	2	2	2
Ford - F550 Custom - Explosives Box Truck	1	1	1
Ford - F550 Custom - Mechanic Truck	2	2	2
Lifting			
Gehl - D12-40 - Fork Lift Zoom-Boom (5t)	2	2	2
Grove - Rough Terrain Crane (65t)	1	1	1
Personnel Transport			
Ford - F350 - Light Vehicles	10	10	10
Freightliner - Custom - Passenger Bus (44 ppl)	1	1	1
Crew Van	1	1	1
Fixed			
Pit Dewatering Pumps (Diesel)	4	4	4
Noram - LTN20WL - Portable Light Plants (Diesel)	11	12	8
Mobile Wash Car	1	1	1
Dispatch Equipment	1	1	1

Source: Stantec (2019)

[1] Equipment brand is subject to change; however, the equipment listed in the table is the anticipated size to be available post mining.

It is anticipated that contractor equipment will be required to be mobilized to support the existing fleet of mining equipment to be used for reclamation and closure activities. The following equipment is anticipated to be required. This equipment list may be updated or modified based on required capacity.

- Pickups & Vans (x 4)
- Telehandlers
- 345 Excavator
- 330 Excavator
- 40T Articulating Trucks (x 4)
- D6T Dozer
- D8 Dozer
- 140M Grader
- 992K Loader
- 980 Loader
- Small roller compactor
- Rubber-tired backhoe (for GCL installation only)
- Cranes
- Manlifts (x 2).

It is not anticipated at this time that a portable crushing spread consisting of a jaw crusher, cone crusher, screen deck(s), and a wash plant will be required for the Closure Phase. If processed material is required for reclamation and closure activities, it is preferred to produce it using on-site stationary equipment immediately following the Operation Phase.

8.4 Site Access and Haul Roads

Site access during the Closure Phase will be achieved via the NAR. The NAR and on-site access road, including barge crossings, will be kept in place to support Closure including Operation Phase equipment demobilization, infrastructure demobilization as appropriate, and mobilization of supplementary equipment for closure activities. Site access control, access road requirements, and security will be maintained to the same level as during operations, as described in Access Route Operation Management Plan, until NAR access is no longer required.

Progressive closure of haul and Mine Site roads will occur throughout the Operation Phase as roads are no longer required to support operations. Roads used for closure works will generally undergo closure in the later portion of the Closure Phase. Light vehicle roads will be maintained to support monitoring activities as required, although the preference will be to use small vehicles such as snowmobiles and ATVs to support monitoring.

8.5 Site Security

Site security will be maintained at all times throughout the Closure Phase as per the procedures set up during operations. Security will be tailored to protect equipment and assets on site and operations security requirements associated with gold production may be reduced / removed. Site security and traffic management responsibilities will be shared by security personnel.

Security personnel will maintain a logbook of all site visitors, including check-in and check-out times, name, company, vehicle details. Security personnel will utilize radio communication to assist with access control, safety, incident command, and traffic management as required.

8.6 Site Infrastructure

8.6.1 Site Camp

Once the Mine Camp has been decommissioned in the Post-mining Closure Phase, the Exploration Camp will be utilized to house mine site personnel to support closure works and monitoring activities throughout the Post-mining and Active Closure Phases. The capacity of the Exploration Camp will be 245 persons and will include single rooms with shared washrooms. The camp will contain five dorm wings, which contains eight 3.4 x 18 m trailers. In addition to the dorms, the camp will include a kitchen, diner, and recreation hall. The construction camp will be powered by a generator. The Exploration Camp will be decommissioned towards the end of the Active Closure Phase, at which time the Coffee Exploration Camp may be used.

8.6.2 Site Offices and Labs

The site office complex and site laboratory will be utilized during the Closure Phase. The office complex will include a large open office area, private offices, a main boardroom, and a meeting room. Construction management, administrative, and QA/QC personnel will be headquartered in these offices, which will be equipped with high-speed internet. The offices will also serve as a location for site visitors to report to and to receive site orientations.

8.6.3 Emergency Response Team Building

The emergency response building located adjacent to the mine dry and office complex will house an ambulance and fire truck throughout the Closure Phase. An emergency medical responder will be on site 24 hours a day to provide emergency care. For additional information regarding emergency response infrastructure and equipment, refer to the Emergency Response Plan.

8.6.4 Bulk Fuel Storage

Four 4-million litre fuel tanks with dispensing systems will be constructed in Year -2 and are planned for use during the initial portion of the Closure Phase. The bulk fuel storage is planned to be located at least 30 m away from any water bodies, and in an area where it can be frequently supervised. The construction plans for the bulk storage area include a geomembrane liner covered by aggregate materials to ensure any spills are contained at the source. Emergency response equipment will be available at the bulk storage area.

To support the implementation of final closure measures in other areas after the bulk fuel and LNG storage areas have been decommissioned and the fuel storage tanks have been removed from the Plant Site,

appropriately sized portable fuel storage tanks will be used to store diesel for equipment and power generation. Lined containment areas will be established for these portable fuel storage tanks as required.

8.6.5 Waste Management

The waste management facility, non-hazardous waste landfill within the waste management area, and the land treatment facility for storage and treatment of hydrocarbon-contaminated soil and snow located east of the Supremo Pit will continue to be used for waste management throughout the Closure Phase. All work will adhere to site waste management procedures which will be procured for the Operation Phase. At this time, no additional waste streams not accounted for during the Operation Phase will be generated. Washcars will be pumped at least once a week by a septic truck.

8.6.6 Maintenance Areas and Laydowns

The truck shop and warehouse will be utilized for maintenance and repairs to site vehicles and equipment until demolished. It is then anticipated that a fabric structure building would be used as a maintenance shop for contractor equipment. Existing laydowns will be used selectively until reclaimed. When the final laydown areas are due to be reclaimed, the final equipment on site will be staged / parked on tertiary roads to ensure that laydowns can be appropriately reclaimed.

8.6.7 Power Generation

The power plant utilized throughout the Operation Phase will be utilized as the power source throughout the Closure Phase. The power plant will be able to generate 9 megawatts (MW) of peak gross electrical power. Further details on the construction and capacity of the power plant are provided in Section 5.3.6.4.

8.7 Labour Requirements

Table 8-2 shows the anticipated labour requirements during the Closure Phase. Equipment operator and supervision requirements will increase and decrease according to the amount and size of reclamation and closure activities being completed on site. The following table shows the manpower required to conduct earthworks reclamation activities with some supplementary demolition activities but does not include specialized subcontractors such as the decommissioning crew. Post closure monitoring and maintenance activities will be completed using applicable consultants and contractors.

Table 8-2 Personnel Required for Closure Phase

Position	Total Compliment	Shift Rotation (Weeks in x Weeks out)
Administration		
Site Manager	1	4x3 (days)
Health and Safety Officer	2	2x2
General Administrator	2	2x2
Environmental		
Environmental Superintendent	1	4x3 (days)
Environmental Monitors	2	2x2
Environmental Technician	2	2x2
Operations / Maintenance		
Surface Foreman	2	2x2
Demolition Foreman	2	2x2
Electrician	2	2x2
Facilities Maintenance - Tradesman	2	2x2
Mobile Equipment Operator	24	2x2
Labourers/Apprentices/ADR Operators	4	2x2
Survey	2	2x2
QA/QC	4	2x2
Operations Foreman	1	2x2
Power Plant Operator	2	2x2
Millwright	2	2x2
Barge or ice bridge	4	2x2
Camp Support Services		
Camp Manager	1	4x3 (days)
Catering	6	2x2
Housekeeping	6	2x2
Nurse / Paramedic	2	2x2
Total Closure Staff	76	

9.0 RECLAMATION AND CLOSURE LIABILITY

9.1 Basis of Estimate

Based on Newmont internal policies, the Standard Reclamation Cost Estimator (SRCE) Version 2.0 was used to develop both the Two Year Forward and Life of Mine Reclamation Liability Cost Estimates. Third party rates were used to simulate a contractor performing reclamation activities. Third party rates were established by increasing standard Newmont Nevada equipment and labour rates for third party contractors by 25%. These rates were checked against standard contractor rates in Yukon and BC to ensure continuity. This approach is in alignment with previous reclamation liability cost estimates developed for the Coffee Project. A cost model summary is provided in Appendix 9-A. The complete SRCE cost model is provided as a supplementary information package.

Using SRCE, indirect and overhead costs were added directly to the estimate following buildup of direct costs.

The following percentages were used for indirect and overhead costs:

- Engineering, Design and Construction Plan 5.0%
- Contingency 15.0%
- Contractor Overhead and Profit 13.0%
- Contract Administration 2.0%

Both cost estimates consider the costs of closure activities over a period of 50 years following operations. A discount rate of 4.0% is used to calculate the NPV in 2023 dollars. In the absence of prescriptions for Yukon, this discount rate is in alignment with BC guidance for major mines. An inflation rate of 2.1% was used, representing the 10-year average of Yukon CPI increase between 2013 and 2022. The difference between discount rate and inflation rate (1.9%), was used as the actual SRCE input “Discount Rate”. Furthermore, Active Closure activities were not discounted when reporting the total NPV in 2023 dollars. Therefore, the aggregate discount rate of 1.9% was only applied to long-term monitoring and maintenance costs.

9.2 SRCE Model

The closure cost estimates for the Site were developed using the SRCE model, a tool which was developed to improve the consistency and accuracy of reclamation and closure cost estimates. The model standardizes user input requirements, productivity calculations, and volume and area calculations in a consistent format while allowing flexibility to incorporate site-specific conditions. Since its development in 2006, the model has been accepted and is currently used in world-wide applications to develop costs for Financial Assurance (FA), Life of Mine (LOM), and Asset Retirement Obligation (ARO) cost estimates for countless mines through North and South America, and Asia.

Equipment productivities used by the model are derived from readily available published resources such as CAT Handbook or RS Means, which compare against actual field conditions. The model includes rates based on published sources for equipment and labor crews to complete reclamation activities, but also allows incorporation of site-specific contractor rates and fuel costs.

Descriptions of calculation methods and assumptions on which calculations found in the model are based on are presented in the SRCE User's Guide available on the web at NVbond.org.

9.3 Two Years Forward Liability Estimate

The Two Years Forward Liability Estimate assumes a closure scenario immediately following Construction. In this scenario, metal prices, or other market factors would push the mine into temporary closure and then final closure.

The estimate considers a two-year interim care and maintenance period following Construction. This can also be thought of as temporary closure and would include re-circulation of the heap leach solution.

This two-year interim care and maintenance period consists of $10,601,602 of undiscounted costs, broken down into the following:

- Road Maintenance $ 1,162,483
- Monitoring $ 1,420,000
- Site Management $ 881,906
- Closure Planning $ 431,346
- G&A $ 3,957,303
- Engineering, Design and Construction Plan $ 392,652
- Contingency $ 1,177,956
- Contractor Overhead and Profit $ 1,020,895
- Contract Administration $ 157,061

If the mine moves to final closure, as simulated in this scenario, a three-year period of active closure would follow, which would include one year of heap leach rinsing followed by covering of the heap leach facility. Other reclamation activities carried out in this scenario include regrading, scarifying, and revegetating the Alpha WSRF, partial removal of the Alpha Dam, open pit closure of any pits developed during construction (anticipated at this time to be Latte and Supremo), demolition of infrastructure and buildings, reclamation of laydowns, pads, and roads, and revegetation of disturbed areas.

Active water treatment is required for heap leach rinsing. As the active water treatment plant has not been constructed by this time, the capital and operating costs are included in this estimate.

Capital costs of $13,377,500 are considered to retrofit the ADR plant into an active Water Treatment Plant (WTP) capable of treating the HLF drain-down. An operating cost of $10.09/$m^3$ is considered.

Activities conducted during Post-Closure are limited to surveillance and monitoring.

Table 9-1 Two Years Forward Closure - Undiscounted Costs

Total Cost	
CA$	
Waste Rock Dumps	806,257
Heap Leach	541,606
Solution Mgmt	16,577,318

Total Cost	
CA$	
Pits	18,567
Roads	6,335,651
Process Ponds	1,959,996
Yards, etc.	1,801,506
Landfills	1,015,008
Foundations & Buildings	12,320,351
Other Demo & Equip Removal	168,720
Sediment & Drainage Control	366,634
Waste Disposal	783,718
Monitoring	5,970,000
Reclamation Maintenance	378,805
Construction Management	2,204,766
Closure Planning	678,965
G & A	10,037,058
Subtotal – Direct Costs	**61,964,925**

Engineering, Design and Construction Plan	**3,098,246**
Contingency	**9,294,739**
Contractor OH and Profit	**8,055,440**
Contract Administration	**1,239,299**
Total – Undiscounted Costs	**83,652,649**

The NPV (2024) of the Two Years Forward Liability Estimate is CDN $92,902,637.

9.4 Life of Mine Liability Estimate

The Life of Mine Liability Estimate assumes a closure scenario in line with the mine plan and current regulatory submissions.

This scenario considers a six-year period of “Post-Mining Closure” following Operations. This is followed by a five-year period of “Active Closure” before “Post-Closure”.

Activities conducted during Post-Mining Closure include open pit closure, demobilization of any mobile equipment not required for closure, heap leach closure, demolition of infrastructure and buildings, and active water treatment.

Heap leach closure consists of regrading, rinsing, and progressive covering over a total period of nine years. Active water treatment is required during Post-Mining Closure and heap leach closure, however the active water treatment plant is already built in this scenario, so only operating costs are considered in the liability estimate.

As Post-Mining Closure moves to Active Closure, water treatment is transitioned from Active to Passive. The capital and sustaining capital costs for passive water treatment are considered during Active Closure and Post-Closure.

An operating cost of $10.09/m^3 is considered for the Active WTP. Capital costs of $5,200,000 are considered to construct the passive water treatment facility. Sustaining capital costs of $17,533,773 over a period of 44 years (to the end of the closure duration estimated) are considered for replacement of the passive water treatment media.

Activities completed during Active Closure include construction of the passive water treatment facility, decommissioning of water management structures, decommissioning of site roads and the NAR, and final revegetation of disturbed areas.

Activities conducted during Post-Closure are maintenance of the passive water treatment facility and surveillance and monitoring of the site.

Table 9-2 Life of Mine Closure - Undiscounted Costs

Total Cost	
CA$	
Waste Rock Dumps	262,229
Heap Leach	2,282,078
Solution Management	61,131,590
Pits	121,015
Roads	9,213,420
Process Ponds	2,047,448
Yards, etc.	1,881,520
Landfills	477,259
Foundations & Buildings	11,694,297
Other Demo & Equip Removal	168,720
Sediment & Drainage Control	385,447
Waste Disposal	783,718
Monitoring	10,170,000
Construction Management	3,527,626
Closure Planning	678,965
G & A	21,500,407
Subtotal – Direct Costs	**126,325,738**
Engineering, Design and Construction Plan	**6,316,287**
Contingency	**18,948,861**
Contractor OH and Profit	**16,422,346**
Contract Administration	**2,526,515**
Total – Undiscounted Costs	**170,539,747**

The NPV (2024) of the Life of Mine Liability Estimate is CDN $209,852,847.

10.0 REFERENCES

Aboriginal Children in Care Working Group. 2015. Aboriginal Children in Care: report to Canada's Premiers. Accessed: March 29, 2016.

Access Consulting Group (ACG). 2014. Memorandum: Kaminak Coffee 2013 Fisheries Summary Report. Prepared for Kaminak Gold Corporation, May 30, 2014.

Arriagada, P. 2016. Aboriginal peoples: fact sheet for Yukon. Statistics Canada: Social and Aboriginal Statistics Division. March 29, 2016. Available at: http://www.statcan.gc.ca/pub/89-656-x/89-656-x2016012-eng.pdf Accessed: April 2016.

Bates, P. and DeRoy, S. 2014. White River First Nation Knowledge and Use Study. Prepared by The Firelight Group, with White River First Nation. Prepared for Kaminak Gold Corporation.

B.C. Ministry of Environment (BC MOE). 2014. Ambient Water Quality Guidelines for Selenium, Technical Report, Update, April 2014.

B.C. Oil and Gas Commission (BC OGC). 2009. British Columbia Noise Control Best Practices Guideline. March 2009.

Belik, V. 2013. Shakin' all over: Earthquakes in the Yukon. Yukon News11 January 2013. Whitehorse, YT. Available at http://yukon-news.com/letters-opinions/shakin-all-over-earthquakes-in-the-yukon. Accessed April 2016.

Benner S.G., Blowes, D.W., Ptacek, C.J. 1997. A full-scale porous reactive wall for prevention of acid mine drainage. Ground Water Monit. 17(99-107).

Blowes, D.W., Ptacek, C.J., Benner, S.G., McRae, C.W.T., Bennett, T.A., Puls, R.W. 2000. Treatment of inorganic contaminants using permeable reactive barriers. J Contam Hydrol.45(1-2):123–37.

British Columbia Mine Waste Rock Pile Research Committee. 1991. Investigation and Design of Mine Dumps: Interim Guidelines. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/permitting/geotechnical-information/1991-05-00_minedrockoverburdenpile_investigationdesignmanual.pdf.

Calliou Group. 2012a. Letter Report: Mini Project Specific Traditional Land Use Study White River First Nation for the Tarsis Resources White River Property ("Project"). June 15, 2012.

Calliou Group. 2012b. White River First Nation Baseline Community Harvest Study 2011-2012. Prepared for Foothills (TransCanada) Pipe Lines: Alaska Highway Pipeline Project on behalf of White River First Nation (August 2012).

Canadian Council of Ministers of the Environment (CCME). 2000a. Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota: Methylmercury. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. Accessed at: http://st-ts.ccme.ca/en/index.html on March 20, 2016.

Canadian Council of Ministers of the Environment (CCME). 2000b. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. Accessed at: http://stts.ccme.ca/en/index.html on March 20, 2016.

Castillo, V.E. 2012. Fort Selkirk: Early Contact Period Interaction between the Northern Tutchone and the Hudson's Bay Company in Yukon. Occasional Papers in Archaeology 17:257. Hude Hudan Series.

CBC News. 2022. How Yukon's booming economy and rapid population growth has led to a housing crisis, 2022. Available at https://www.cbc.ca/news/canada/north/yukon-census-2022-population-growth-housing-crisis-1.6349010. Accessed June 2022.

City of Dawson. 2016. Getting here. Available at: https://dawsoncity.ca/plan-your-trip/getting/. Accessed May 2016.

City of Dawson. 2022a. Solid Waste Diversion. Available at https://www.cityofdawson.ca/p/solid-waste-diversion.

City of Dawson. 2022b. Water & Wastewater Services. Available at https://www.cityofdawson.ca/p/water-wastewater-services.

City of Dawson and Tr'ondëk Hwëch'in. (TH) n.d. After the Gold Rush: The Integrated Community Sustainability Plan, Volume I: The City of Dawson and Tr'ondëk Hwëch'in Community Vision. Available at: http://www.infrastructure.gov.yk.ca/pdf/icsp_dawson.pdf. Accessed April 2016.

City of Whitehorse. 2013. 2010 Official Community Plan. Available at: http://www.whitehorse.ca/home/showdocument?id=728. Accessed April 2016.

City of Whitehorse. 2022. Whitehorse 2040: Draft Official Community Plan. Available at https://www.whitehorse.ca/home/showpublisheddocument/16825/637892411951630000.

Dawson Forest Management Planning Team (FRMP). 2013. Dawson Forest Resources Management Plan. Available at http://www.emr.gov.yk.ca/forestry/pdf/dawson_frmp_web.pdf. Accessed October 2015.

Dawson Indian Band. 1988. Han Indians: People of the River. Dan Sha Productions. Pp. 1–15.

Dawson Regional Planning Commission (DRPC). 2013. Dawson Planning Region Resource Assessment Report- Appendix C: Tr'ondëk Hwëch'in Resource Report for the Dawson Regional Planning Process. City of Dawson, Yukon, Canada.

Development, Planning, Research & Analysis Ltd. Canada (DPRA) 2010. Eagle Gold Project Socio-economic Baseline Report, Final Report. Prepared for Victoria Gold Corporation.

Dobrowolsky, D. 2014. Compilation of information relating to Coffee Creek/White River Areas (January 2014). Prepared for Kaminak Gold Corporation, Tr'ondëk Hwëchin First Nation, White River First Nation.

Dobrowolsky, H. and Hammer, T.J. 2001. Tr'ochëk: The Archaeology and History of a Hän Fish Camp. Tr'ondëk Hwëch'in: Canada. Available at http://www.tc.gov.yk.ca/publications/trochek_2001.pdf. Accessed February 2016.

Duk-Rodkin, A. 1999. Glacial Limits Map of Yukon. Indian & Northern Affairs Canada/Department of Indian & Northern Development: Exploration & Geological Services Division, Geoscience Map 1999-2.

Easton, N.A., Kennedy, D., and Bouchard, R. 2013. WRFN: Consideration of the Northern Boundary (09 September 2013 Draft Report).

Ecofor. 2012. Appendix 31: Socio-economic Assessment, Brewery Creek Property. Prepared for Golden Predator Corp.

Environmental Dynamics Inc. (EDI). 2017. Coffee Gold Mine. Fisheries & Aquatic Resource Baseline Update – 2016. Prepared for Kaminak Gold Corporation. March 2017.

EDI. 2018a. Coffee Gold Project: 2017 Bird and Wildlife Studies. Prepared for Goldcorp Kaminak Ltd., Vancouver, BC by EDI, Whitehorse, YT. April 2018

EDI. 2018b. Coffee Gold Project. Fish and Aquatic Resources Studies – 2017. Prepared for Goldcorp Kaminak Ltd. April 2018.

EDI. 2019. Coffee Gold Project: Fish and Aquatic Resources Studies – 2018. Prepared for Newmont Goldcorp Corporation. July 2019.

EDI. 2020a. Coffee Gold Project: 2019 Fish and Aquatic Resources Studies. Prepared for Newmont Corporation. April 2020.

EDI. 2020b. Summer 2020 – Stewart River Back Channel Fieldwork. Prepared for Newmont Corporation. December 2020.

EDI. 2021. 2021 Halfway Creek Fish Investigations. Prepared for Newmont Corporation. November 2021.

First Nation of Na-Cho Nyäk Dun (FNNND). 2008. Tan Sothan – A Good Path: Integrated Community Sustainability Plan (May 2008).

First Nation Nacho Nyak Dun (FNNND). 2022. https://www.nndfn.com/history/ Accessed June 2016.

Forte Dynamics, Inc. (Forte). 2023. Coffee Gold Project. Heap Leach Engineering Report for Licensing. Document #123017-51010-CV-EDR-2001. July 2023.

Goh, J., Pfeffer, J., and Zenios, S. 2015. Workplace Stressors and Health Outcomes: Health Policy for the Workplace. Behavior Science and Policy. Available at https://behavioralpolicy.org/article/workplace-stressors-health-outcomes/. Accessed February 2017.

Golder Associates. 2011. Guidance Document on Water and Mass Balance Models for the Mining Industry. Prepared for Yukon Environment. Available at: http://www.env.gov.yk.ca/publications-maps/documents/mine_water_balance.pdf. Accessed November 2017.

Government of Canada. 2012. Canadian Environmental Assessment Act, 2012. (S.C. 2012, c. 19, s. 52). Available at: https://laws-lois.justice.gc.ca/PDF/C-15.21.pdf. Accessed November 2021.Government of Canada. 2015. Operational Policy Statement: Addressing “Purpose of” and “Alternative Means” under Canadian Environmental Assessment Act 2012 (OPS). Available at: https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/addressing-purpose-alternative-means-under-canadian-environmental-assessment-act-2012.html. Accessed April 2022.

Government of Canada. 2021a. Environmental Scan - Northwest Territories, Nunavut and Yukon: 2020-2021. Available at https://www.jobbank.gc.ca/trend-analysis/job-market-reports/nunavut/environmental-scan.

Government of Canada. 2021b. Indigenous and Northern Affairs Canada, Communications Branch. First nation profiles. Available at: https://fnp-ppn.aadnc-aandc.gc.ca/fnp/Main/Search/SearchFN.aspx?lang=eng. Accessed April 2022.

Government of Canada, the Council for Yukon Indians, and the Government of Yukon. 1993. Umbrella Final Agreement. Available at: http://publications.gc.ca/collections/Collection/R34-5-1-1993E.pdf. Accessed June 2018.

Government of Canada, Selkirk First Nation, and the Government of Yukon. 1997. Selkirk First Nation Final Agreement. Available at: https://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-HQ/STAGING/texte-text/al_ldc_ccl_fagr_ykn_selk_sfa_1330098787524_eng.pdf. Accessed June 2018.

Government of Canada, Tr'ondëk Hwëch'in, and the Government of Yukon. 1998. Tr'ondëk Hwëch'in Final Agreement. Available at: http://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-HQ/STAGING/texte-text/al_ldc_ccl_fagr_ykn_tro_thfa_1330369623386_eng.pdf. Accessed June 2018.

Government of Yukon. 2013. Health and Social Services. Yukon Communicable Disease Control. Available at: http://www.hss.gov.yk.ca/ycdc.php. Accessed July 2016.

Government of Yukon. 2014. City of Whitehorse. Available at http://www.infrastructure.gov.yk.ca/201.html. Accessed April 2016.

Government of Yukon. 2015a. Health and Social Services; Family and Children’s Services. March 12, 2015. Available at: http://www.hss.gov.yk.ca/family_children.php Accessed: April 26, 2016.

Government of Yukon. 2015b. Health and Social Services; Family and Children’s Services; Child Protection. May 25, 2015. Available at: http://www.hss.gov.yk.ca/childprotection.php Accessed: April 26, 2016.

Government of Yukon. 2016. Harvest data for big game and furbearers. Provided by Environment Yukon, 19 February 2016.

Government of Yukon 2019. Preferred Practices for Works Affecting Yukon Waters. Water Resources Branch – Environment Yukon. Available at http://www.env.gov.yk.ca/publications-maps/documents/bestpractes_water.pdf. Accessed May 2018.

Government of Yukon. 2020. Putting People First – The final report of the comprehensive review of Yukon's health and social programs and services. Available at https://yukon.ca/sites/yukon.ca/files/hss/hss-imgs/yg_-_hss_-_taking_the_pulse_-_final_report_-_en_fnl5_screen.pdf.

Government of Yukon. 2021a. 2021–22 Fiscal and economic outlook. Available at https://yukon.ca/sites/yukon.ca/files/fin/fin-2021-22-fiscal-and-economic-outlook.pdf.

Government of Yukon. 2021b. Public School Enrolment. Available at http://www.sewp.gov.yk.ca/subject.

Hawley, M. and Cunning, J. 2017. Guidelines for Mine Waste Dump and Stockpile Design. CRC Press. May 2017.

Independent Author. 2021. Mental Health Services in Rural Yukon—Department of Health and Social Services. Available at https://www.oag-bvg.gc.ca/internet/docs/yuk_202106_43846_e.pdf.

Independent Author. 2022. 2022 Report of the Auditor General of Canada to the Yukon Legislative Assembly. Available at https://www.oag-bvg.gc.ca/internet/docs/yuk_202205_e.pdf.

InterGroup Consultants Ltd. 2009. Socio-Economic Setting for the Proposed Mayo Hydro Enhancement Project (Mayo B). Submitted to Yukon Energy (February 2009).

International Council on Mining and Metals (ICMM). 2008. Planning for Integrated Mine Closure: Toolkit. Available at: https://www.icmm.com/website/publications/pdfs/mine-closure/310.pdf. Accessed January 2018.

International Council on Mining and Metals (ICMM). 2019. Integrated Mine Closure. Good Practice Guide, 2nd Edition. Available at: https://www.icmm.com/website/publications/pdfs/environmental-stewardship/2019/guidance_integrated-mine-closure.pdf. Accessed January 2022.

International Union for Conservation of Nature (IUCN). 2011. Invasive Species. Available from: http://www.iucn.org/about/union/secretariat/offices/iucnmed/iucn_med_programme/species/invasive_species/ [Accessed October 26, 2015].

Interview 2, February 8, 2016. Anonymous Contributor. Yukon College, City of Dawson, Yukon.

Interview 4, Gerberding, L., Lancaster, J., Regimbal, J. February 8, 2016. Building Maintenance, Public Works Lead Head, Fire Chief, City of Dawson Public Works Department, Dawson City Fire Department, City of Dawson, Yukon.

Interview 7. Olesh, M. February, 9 2016. Development Officer, Community Development and Planning

Interview 8, February 9, 2016. Anonymous Contributors, TH Housing and Infrastructure Department, Dawson City, Yukon.

Interview 11. February 10, 2016. President, Vice-President, Board Member, Conservation Klondike Society (CKS), Dawson City, Yukon.

Interview 13. February 12, 2016. Manager, Conservation Officer Services, City of Dawson, Yukon.

Interview 14. 2016. Anonymous Contributor — Trapping Concession Holders. Coffee Gold Mine Socio Economic Interview #14, Dawson City, Yukon. Dated 10 February 2016.

Interview 15. 2016. One of the Trapping Concession Holders #58. Coffee Gold Mine Socio-Economic Interview #15, Dawson City, Yukon. Dated 11 February 2016.

Interview 20, February 12, 2016. Anonymous Contributor. Klondike Development Organization (KDO), Dawson City, Yukon.

Interview 21, February 17, 2016. Realtor, Coldwell Banker Redwood Realty, Dawson City, Yukon.

Interview 22. February 29, 2016. Registered Trapping Concession #54, City of Dawson, Yukon.

Interview 28, March 4, 2016. Project Manager, Klondike Development Organization (KDO), Dawson City, Yukon.

JDS Energy and Mining Inc. (JDS). 2016. Feasibility Study Report for the Coffee Gold Project, Yukon Territory, Canada. Prepared for Kaminak Gold Corporation. February 2016.

JDS Energy & Mining Ltd. (JDS). 2018. Surface Material for Reclamation – Coffee Mine.

Klohn Crippen Berger (KCB). 2013. Minto Explorations Ltd. Minto Phase V/VI Socio-economic Study. Prepared for Minto Explorations Ltd.

Klondike Development Organization (KDO). 2011a. Klondike Development Organization Strategic Plan 2011-2015. Available at: http://www.klondikedevelopment.com/wp-content/uploads/2011/03/forum_1strategicplan.pdf. Accessed October 6, 2015.

Klondike Development Organization (KDO). 2011b. Klondike Housing Market Research: Demand Survey Results. Available at: https://www.klondikedevelopment.com/wp-content/uploads/2011/05/demandsurveyresults.pdf.

Lambe, L., McIver, T., Kim, S., Mayne, K., Craig, W., King, M. 2019. Health and Health-related Behaviours Among Young People in Yukon. Available at https://yukon.ca/sites/yukon.ca/files/hss/hss-imgs/hbsc_yukon_report_2018_final.pdf.

Local Business Focus Group, February 9, 2016. Dawson City Curling Club, Dawson City, Yukon.

Lorax Environmental Services (Lorax). 2021. Coffee Gold Project – Proposed Site-Specific Water Quality Objectives for Primary Receiving Environments. Prepared for Newmont, November 2, 2021.

Lorax. 2023a. Coffee Mine Project Geochemical Source Term Report. Prepared for Newmont Corporation. January 1, 2023.

Lorax. 2023b. Coffee Mine Project Water Balance and Water Quality Model. Prepared for Newmont Corporation. January 13, 2023.

MacIntosh, J., Wouest, J., Bulman, D. 2014. Sustaining men's sense of self after workplace bullying. NZJHRM Volume 14(2).

March TH TWG Meeting, Pers. Comm. 2016.

Meister, K. 2016. Northern Region Supervisor, Conservation Officer Services, Dawson City, Yukon. Coffee Gold Mine Socio-Economic Interview #13. Dated 12 February 2016.

Mishler, C. and Simeone, W.E. 2004. Han: Hän Hwëch'in people of the river. Fairbanks: University of Alaska Press.

Natural Resources Canada (NRC). 2016a. Seismic Zones in Western Canada. Available at http://earthquakescanada.nrcan.gc.ca/zones/westcan-en.php#StElias. Accessed April 2016.

Natural Resources Canada (NRC). 2016b. Seismograph Stations, Monitoring, Data Collection and Data Products. Available at http://earthquakescanada.nrcan.gc.ca/stndon/index-en.php. Accessed April 2016.

Natural Resources Canada (NRC). 2016c. Earthquake Database. Available at http://earthquakescanada.nrcan.gc.ca/stndon/NEDB-BNDS/bull-en.php. Accessed April 2016.

Natural Resources Canada (NRC). 2016d. Hazard Calculator: Seismic Design Tools for Engineers. Available at http://earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index-en.php. Accessed April 2016.

Northwest Territories Mine Health and Safety Regulations (15.95) (SNWT (1995). Mine Health and Safety Act. S.N.W.T. 1994,c.25. In force December 15, 1995; SI-014-95. Accessed from https://www.canlii.org/en/nt/laws/stat/snwt-1994-c-25/latest/part-1/snwt-1994-c-25-part-1.pdf

O'Donoghue, M., Suitor, M., Bellmore, J., Kienzler, M., and Westover, S. 2013. Moose survey: lower Stewart River west – White Gold area, early-winter 2012 Yukon Fish and Wildlife Branch Report TR-13-03. Whitehorse, Yukon.

Palmer Environmental Consulting Group Inc. (Palmer). 2017. Coffee Gold Project. Fish and Aquatic Resources Baseline Report. Prepared for Kaminak Gold Corporation. February 20, 2017.

Pearse, T.D., and Weinstein, M. 1988. Opening the land: a study of the impacts of the Casino trail on the northern Tutchone of Pelly Crossing and Carmacks, Yukon Territory.

Popadynec, R. 2007. Finding a Medicine Tree. First Nation of No-Cho Nyak Dun, in collaboration with the Yukon Department of Education.

Popadynec, R. 2009. (First Nation of Na-Cho Nyak Dun). A time of Bear Roots.

Public Health Agency of Canada (PHAC). 2008. Report on Sexually Transmitted Infections in Canada: 2008. March 9, 2010. Available at http://www.phac-aspc.gc.ca/std-mts/report/sti-its2008/03-eng.php Accessed April 2016.

Public Health Agency of Canada (PHAC). 2011. Diabetes in Canada: Facts and figures from a public health perspective. December 15, 2011. Available at:http://www.phac-aspc.gc.ca/cd-mc/publications/diabetes-diabete/facts-figures-faits-chiffres-2011/highlights-saillants-eng.php Accessed April 4, 2016.

Rea, R.V., Hodder, D.P., and Child, K.N. 2004. Considerations for natural mineral licks used by moose in land use planning and development. Alces 40: 161-167.

Selkirk First Nation (SFN). 2022. Our People. Available at http://www.selkirkfn.com/government/about/our-people/. Accessed June 2022.

Social Economy Research Network of Northern Canada (SERNNoCa). 2012. Northern Social Economy Organizations. Available at: http://yukonresearch.yukoncollege.yk.ca/sern/resources/organizations. Accessed June 7, 2016.

SRK Consulting (U.S.), Inc. (SRK). 2016. 2015 Geotechnical Field Investigation. Coffee Gold Project. Yukon Territory, Canada. Prepared for Kaminak Gold Corporation. January 4, 2016.

SRK Consulting (Canada), Inc. (SRK). 2023. Coffee Gold Project – Water Management Design Basis Report. Prepared for Newmont Goldcorp. February 2023.

Statistics Canada. 2003. 2001 Census Data. Catalogue no. 93F0053XIE. Available at: http://www12.statcan.gc.ca/english/census01/Products/standard/themes/DataProducts.cfm?S=1. Accessed March 2016.

Statistics Canada. 2013. NHS Profile, 2011. Catalogue no. 99-004-X. Available at: http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E. Accessed October 9, 2014

Statistics Canada. 2015a. Volunteer rate by province or territory, population aged 15 and over, 2007 and 2010. Available at: http://www.statcan.gc.ca/pub/11-008-x/2012001/c-g/11638/c-g06-eng.htm. Accessed June 7, 2016.

Statistics Canada. 2015b. Canadian Vital Statistics, Birth and Death Databases and Appendix II of the Publication. Mortality Summary List of Causes. Catalogue number 84F0209XIE. Table 102-0552 - Deaths and mortality rate, by selected grouped causes and sex, Canada, provinces and territories, annual. December 10, 2015. Available at http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1020552. Accessed March 2016.

Statistics Canada. 2016a. Canadian government finance statistics (CGFS), statement of operations and balance sheet for the provincial and territorial governments, annual (dollars), CANSIM (database) Table 385-0034. Accessed April 2016.

Statistics Canada. 2016b. Health indicator profile, annual estimates, by age group and sex, Canada, provinces, territories, health regions (2013 boundaries) and peer groups, occasional. CANSIM (database). Table 105-0501. March 7, 2016. Available at http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1050501. Accessed March 2016.

Statistics Canada. 2017. Census Profile. Available at https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E.

Statistics Canada. 2021. Family Violence in Canada: A statistical profile, 2019. Available at https://www150.statcan.gc.ca/n1/en/daily-quotidien/210302/dq210302d-eng.pdf?st=xyG7QLbM.

Statistics Canada. 2022. Population and dwelling counts: Canada, provinces and territories. Table: 98-10-0001-01. Available at https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810000101.

Tetra Tech EBA Inc. (Tetra Tech). 2016. Environmental Baseline Report, Mine Site Study Area: Surficial Geology, Permafrost, and Terrain Stability. Presented to Kaminak Gold Corporation. May 2, 2016.

Tetra Tech. 2017. Summer 2017 Geotechnical Investigation Data Report, Coffee Mine Site. Coffee Gold Project. Presented to JDS Energy & Mining Inc. November 30, 2017.

Tetra Tech. 2023. Ground Temperature Monitoring Update, Coffee Mine Project, Technical Memorandum. Prepared for Newmont Corporation. August 16, 2023.

Tetra Tech and SRK. 2017. Fall 2016 Geotechnical Investigation Data Report, Coffee Mine Site – Coffee Gold Project. March 2017.

Tr'ondëk Hwëch'in (TH). 2012a. Coffee Creek Traditional Knowledge Survey, Final Report. Prepared for Kaminak Gold Corporation. December 2012

Tr'ondëk Hwëch'in (TH). 2012b. Tr'ondëk Hwëch'in resource report, submitted to the Dawson Regional Land Use Planning Commission (May 2012) in: 'Appendix C' of the Dawson planning region resource assessment report (DRAFT), November 2012. Available: http://dawson.planyukon.ca/index.php/the-dawson-region/resource-assessmentreport/appendices/186-appendix-c-tr-ondek-hwechin-in-resource-report/file. Accessed 1 February 2016.

Tr'ondëk Hwëch'in (TH). 2016. Traditional Foods and Traditional Economy Focus Group, March 1, 2016. TH Community Hall, Dawson City, Yukon.

Tr'ondëk Hwëch'in (TH). 2022.Website: home page. Available at http://www.trondek.ca/. Accessed June 2022.

Transport Canada (TC). 2020. Canadian Motor Vehicle Traffic Collision Statistics: 2020. Available at: https://tc.canada.ca/en/road-transportation/statistics-data/canadian-motor-vehicle-traffic-collision-statistics-2020. Accessed Feb 2022.

Transportation Safety Board of Canada (TSB). 2014a. Statistical Summary – Aviation Occurrences 2012. Available at: http://www.tsb.qc.ca/eng/stats/aviation/2012/ss12.asp Accessed May 25, 2016.

Transportation Safety Board of Canada (TSB). 2014b. Statistical Summary - Aviation Occurrences 2013. November 12, 2014. Available at: http://www.bst-tsb.gc.ca/eng/stats/aviation/2013/ssea-ssao-2013.asp Accessed: April 4, 2016.

United States Environmental Protection Agency (US EPA). 2015. Draft Aquatic Life Ambient Water Quality Criterion for Selenium (Freshwater) 2015. EPA 822-P-15-001.

United States Geological Survey (USGS). 2011. ShakeMap Scientific Background. Available at http://earthquake.usgs.gov/earthquakes/shakemap/background.php. Accessed April 2016.

Usher, P.J., and Staples, L. 1988. Subsistence in the Yukon. Prepared for the Economic Development Department, and Council for Yukon Indians.

WesTech Engineering Inc. (WesTech). 2023. Contingency Water Treatment Plan. Prepared for Newmont. April 28, 2023.

Windeyer, C. 2015. Dawson City daycare crunch means choice between work and kids. CBC News. Available at: http://www.cbc.ca/news/canada/north/dawson-city-daycare-crunch-means-choice-between-work-and-kids-1.3129642. Accessed April 2016.

Yukon Bureau of Statistics (YBS). 2020. GDP by Industry (at basic prices). Available at https://yukon.ca/sites/yukon.ca/files/ybs/fin-gross-domestic-product-industry-2020.pdf.

Yukon Bureau of Statistics (YBS). 2021. Police-reported Crime Statistics in Yukon 2020. Available at https://yukon.ca/sites/yukon.ca/files/ybs/crime_2020.pdf.

Yukon Bureau of Statistics (YBS). 2022a. Labour Force Survey, April 2022. Available at https://yukon.ca/sites/yukon.ca/files/ybs/fin-yukon-employment-april-2022.pdf.

Yukon Bureau of Statistics (YBS). 2022b. Population Report Fourth Quarter, 2021. Available at https://yukon.ca/sites/yukon.ca/files/ybs/fin-population-report-q4-2021.pdf.

Yukon Bureau of Statistics (YBS). 2022c. Yukon Employment Annual Review, 2021. Available at https://yukon.ca/sites/yukon.ca/files/ybs/fin-yukon-employment-annual-review-2021.pdf.

Yukon College. 2016. Statistics. Available at https://yukoncollege.yk.ca/about/pages/fast_facts Accessed January 2017.

Yukon Department of Energy, Mines and Resources (EMR). 2006. Yukon Mine Site Reclamation and Closure Policy. Available at: https://yukon.ca/sites/yukon.ca/files/emr/emr-forms/emr-yukon-mine-site-reclamation-closure-policy.pdf. Accessed November 2021.

Yukon Department of Energy, Mines and Resources (EMR). 2010. *Quartz Mining License Application Guide* – February 2010. Available at: http://www.emr.gov.yk.ca/mining/pdf/qm_license_application_guide.pdf. Accessed October 2017.

Yukon Department of Energy, Mines and Resources (EMR). 2013. Yukon Mine Site and Reclamation Closure Policy. Financial and Technical Guidelines. September 20143. Available at: https://yukon.ca/sites/yukon.ca/files/emr/emr-forms/emr-yukon-mine-site-reclamation-closure-policy-financial-technical-guidelines.pdf. Accessed January 2022.

Yukon Department of Energy, Mines and Resources (EMR). 2014. Yukon Mine Site Reclamation and Closure Policy. Financial Guidelines. Available at: https://yukon.ca/sites/yukon.ca/files/emr/emr-forms/emr-yukon-mine-site-reclamation-closure-policy-financial-guidelines-april2014_0.pdf. Accessed December 2021.

Yukon Department of Tourism and Culture 2015.Yukon Tourism Indicators Year-end Report 2014. Available at: http://www.tc.gov.yk.ca/pdf/2014_TourismIndicators_YearEndReport.pdf

Yukon Environmental and Socio-economic Assessment Board (YESAB). 2012. Designated Office Evaluation Report: White River – Quartz Exploration Project Number: 2012-0080.

Yukon Environmental and Socio-economic Assessment Board (YESAB) and Yukon Environment. 2012. Dam Guide: Design Expectations and Required Information. Available at: http://www.env.gov.yk.ca/publications-maps/documents/env_yk_dam_guide_2012.pdf.

Yukon Geological Survey (YGS). 2015. Yukon Exploration and Geology Overview. K.E. MacFarlane and M.G. Nordling (eds.), 2016. 80 p. Available at: http://ygsftp.gov.yk.ca/publications/yeg/yeg15/YEG_Overview2015.pdf . Accessed April 2016.

Yukon Government Health and Social Services (YGHSS). 2013. Yukon 2012 Health Status Report. Whitehorse, YK: Government of Yukon. http://www.hss.gov.yk.ca/pdf/health_status_report_2012.pdf Accessed April 2016.

Yukon Housing Corporation (YHC). 2013. Comprehensive Review and Assessment of Housing Issues in Yukon. Available at http://www.housing.yk.ca/pdf/comprehensive_analysis_yhc_issues_2013.pdf.

Yukon Land Use Planning Council (YLUPC). 2015. About us. Available at: http://www.planyukon.ca/index.php/about-us-2. Accessed April 2016.

Yukon River Commercial Fishing Association, and Tr'ondëk Hwëch'in (TH). 1997. Summary of Streams in the Tr'ondëk Hwëch'in Traditional Area: A Search for Candidate Streams to Support a Program based on a Klondike Area Central Incubation/Outplanting Facility.

Yukon School of Visual Arts. n.d. What is SOVA? Available at http://yukonsova.ca/blog/?page_id=302. Accessed February 2017.

Yukon Water Board (YWB). 2012. Type A and B Quartz Mining Undertakings - Information Package for Applicants. Available at: http://www.yukonwaterboard.ca/forms/quartz/FINAL%20YWB%20Quartz%20Application%20Pkg%20Feb%202012.pdf. Accessed October 2017.

Yukon Water Board and Yukon Department of Energy, Mines and Resources (YWB and EMR). 2013. Reclamation and Closure Planning for Quartz Mining Projects. Available at: http://www.emr.gov.yk.ca/mining/pdf/mml_reclamation_closure_planning_quartz_mining_projects_aug2013.pdf.

APPENDIX 1-A

Reclamation and Closure Plan
YWB and EMR Table of Concordance

Table of Concordance for RCP Sections – YWB and EMR (2013) Reclamation and Closure Planning for Quartz Mining Projects: Annex 1 – Annotated Outline for Reclamation and Closure Plans

YWB and EMR (2013) Annex 1 Annotated Outline for Reclamation and Closure Plan		RCP Section(s)
1.0 INTRODUCTION		
Provide a brief project summary including the closure philosophy and guiding principles for the reclamation and closure plan (RCP).		1.1, 1.2
Summarize the project schedule from the current status through to completion of reclamation and closure.		1.1.1
2.0 RECLAMATION AND CLOSURE PLANNING		
Summarize the processes and approaches used to develop the RCP.		2.0
Describe the sequence and phases of reclamation and closure planning for the mine, and where this RCP fits in a continuum of reclamation and closure planning.		2.2
Identify the extent of additional research, planning and design required to complete a final, detailed plan ready for construction.		2.3
Describe processes for integrating reclamation and closure planning into development and operational decision-making.		1.2, 2.3
Summarize reclamation research completed to date. Include results from reclamation research programs as appendices if appropriate. Provide a summary of any plans for additional reclamation research. Include a detailed reclamation research plan as an appendix if appropriate.		2.3.1, Appendices 2-B to 2-J
Summarize community (e.g., governments, local communities, regulatory agencies, and non-government organizations) engagement activities undertaken to support the development of the RCP.		2.1, Appendix 2-A
Describe methods used to identify, characterize, evaluate, and select closure alternatives. Include descriptions of specific tools like risk assessment, failure modes effects analysis, multi-attribute analysis, etc. that were applied, and why these approaches were selected.		2.3.4, Appendices 2-K to 2-M
3.0 CLOSURE OBJECTIVES AND DESIGN CRITERIA		
3.1 Reclamation and Closure Objectives	Describe specific reclamation and closure objectives, including objectives that meet or exceed the fundamental objectives described in Section 5.1 of the *Plan Requirements and Closure Costing Guidance (YWB and EMR (2013).* Describe any constraints to achieving the fundamental objectives.	3.1; Appendix 3-A
	Provide rationales for selection of specific objectives. Describe how the objectives address community (e.g., governments, local communities, regulatory agencies, and non-government organizations) expectations.	3.1
3.2 Design Criteria	Provide the design criteria that guide the design for the reclamation and closure activities, including project constraints, regulatory and guidance-based criteria and other criteria. These are the criteria that will define the effectiveness of the design.	3.3
	Identify and describe design criteria for all components of the project and RCP, recognizing that criteria may vary depending on risks associated with specific components or processes. Include rationales for selection of all criteria. Where criteria are developed in accordance with regulatory requirements or guidance documents, rationales must clearly demonstrate how the proposed criteria meet these requirements or guidance.	3.3
	Design criteria must be supported with data and analyses that quantify the criteria for the site. For example, summarize seismic analysis, flood-frequency analysis and site-specific water quality analysis. Provide detailed reports as appendices.	3.3; 5.3
4.0 ENVIRONMENT DESCRIPTION		
Summarize environmental conditions for areas that are, or will be, affected by the mine. This should include footprint areas as well as environmental components that will be affected (e.g., watersheds, airsheds – the geographical area affected by air from the mine site, wildlife ranges). Address both pre-disturbance and existing conditions and include descriptions of relevant reference areas. Provide references for supporting data and analyses that demonstrate a suitable understanding of site-specific environmental conditions.		4.1; 4.2
4.1 Climate	Describe climate conditions at the site, including but not limited to temperature, rainfall, snowfall, snow accumulation and evaporation. Describe the climate change scenarios that will be considered in designing closure features.	4.1.1
4.2 Surface Water	Describe the hydrology of the site including high, low and mean flows for various seasonal conditions. Describe the water quality in water courses affected by mining, including the seasonal variability. Identify contaminants of concern as well as any parameters that may be appropriate indicators.	4.1.6; 4.1.7
4.3 Groundwater	Describe the groundwater conditions at the site, including a summary of elevations, flow directions, permeabilities, water quality, and interactions with surface water.	4.1.8
4.4 Vegetation and Wildlife	Describe the vegetation and wildlife in the area. Characterize species distributions and habitats.	4.2.2; 4.2.3
4.5 Soil and Bedrock	Describe soil and bedrock conditions, including both surface and subsurface conditions. Summarize the site data from geotechnical testing, site investigation programs, and overburden investigations. Include a discussion of the geology of the area, including geomorphic features, bedrock composition and thermal conditions.	4.1.5
4.6 Seismicity	Summarize seismic hazard conditions for the project site.	4.1.2

YWB and EMR (2013) Annex 1 Annotated Outline for Reclamation and Closure Plan		RCP Section(s)
5.0 PROJECT DESCRIPTION		
Provide a description of the project that includes the project location, history of the site, mining activities, and the operational phases. Describe the facilities and features that have already been constructed and the activities that have been undertaken. Also describe facilities, features and activities that are proposed as part of the mine plan and provide a schedule for their completion. Descriptions of all facilities and features should include both narratives and design drawings showing plan views, layouts, cross-sections, and profiles. For the purpose of liability estimates, discrete descriptions are required for current, two-years forward, and end-of-mine conditions.		5.0
5.1 Mine Features, Facilities and Equipment	Provide detailed descriptions of mine features, facilities, and equipment for current, two years hence and end-of-mine conditions. This should include information on the quantity and size of all components with narrative descriptions and/or design drawings showing plan views, layouts, cross-sections and profiles. Descriptions require sufficient detail to estimate reclamation and closure liability for all mine components.	5.3, 5.4, 5.5, 5.6
	Provide maps and drawings, at appropriate scales and contours for the information displayed, showing all features and facilities identified in the mine plan, including related and off-site facilities that are associated with the mine plan or reclamation. The maps should include, or be accompanied by, information about each feature such as area, volume, tonnage, slope angles, and other dimensions as needed to quantify reclamation and closure tasks.	5.3
	Describe mine-related land disturbance in detail, to accompany and explain the information provided on maps and drawings. Describe any current or potential stability issues or other issues affecting on-site features and facilities.	5.4, 5.5, 5.6
5.2 Mining Operations	Describe the mining operations including rates, types of equipment, processing, metal recovery, material segregation, hauling, waste disposal, tailings disposal, heap leaching, concentrate storage, etc. Describe how mining activities and decisions have considered reclamation needs. Quantify mining activities that have occurred as well as those that are proposed within the next two years, and by the end-of-mine.	5.3.1; 5.5; 5.6; Mine Operations Plan; Waste Rock and Overburden Management Plan; Heap Leach and Process Facilities Plan
5.3 Water Management	Describe the current and proposed management of surface water and groundwater at the site. Include narratives and design drawings for all water management facilities and activities including diversions, ponds, intake structures, dams, storage facilities, pumps, water collection wells, sumps, pipelines, etc. Describe management of solutions used for processing or metal recovery. Address quantities, flow rates and paths, quality, storage requirements, groundwater/surface water interactions, etc.	5.3.12; Water Management Plan; Heap Leach and Process Facilities Plan
	Characterize geochemical effects associated with mining activities. Describe results from monitoring and testing programs. Provide predictions of geochemical loading and effects from mine-related sources, using appropriate modeling tools (e.g., water balance models, groundwater models, contaminant load models, conceptual site models). Modeling tools should be of sufficient granularity to evaluate seasonal conditions.	7.1; Water Management Plan
	Describe water treatment operations and facilities, including the types of processes used (physical, chemical, biological), nominal and maximum capacity, maintenance and availability requirements, and any unique or special operating features. If the water treatment system is currently operating, provide monitoring results to demonstrate performance. If the treatment system is proposed, describe the results of water treatment testing programs that demonstrate performance of the proposed treatment methods for site-specific water quality, flow rate, climate and receiving environment conditions.	2.3.1.2; 5.3.5.4; Heap Leach and Process Facilities Plan
5.4 Monitoring	Describe monitoring activities and results, including monitoring schedules and analytical requirements for surface water quality and flow, groundwater quality and flow, physical stability, vegetation, wildlife and air.	5.7
5.5 Risk Assessment, Contingency Planning and Adaptive Management	Describe any risk assessment or contingency planning processes undertaken to support decision making for mine development and operations. Include risk assessment results or contingency plans as appendices as appropriate.	5.8
	Provide details about any adaptive management plans that are being implemented to address uncertainties about mine development or operation.	5.8.2; Environmental Monitoring and Adaptive Management Plan
6.0 TEMPORARY CLOSURE		
The Temporary Closure Plan section of a RCP must describe the measures and activities that will be undertaken in the event of a temporary closure. During any temporary closure, facilities on site must remain substantially intact and maintained in good working order. Site maintenance and monitoring and reporting must continue uninterrupted throughout temporary closure.		6.0
In general, temporary closure plans must focus on ensuring public health and safety, protecting the environment, and managing risks associated with potential abandonment of a site. To demonstrate how these objectives will be achieved, each temporary closure plan must include at a minimum the following information.		6.0
6.1 Site Security, Monitoring and Maintenance	Describe the locations where equipment will be stored, storage methods for chemicals, reagents, and fuel, and how infrastructure will be maintained during temporary closure.	6.3
	Summarize the ongoing monitoring and maintenance activities that will be required and any processes that will be used to make decisions about these requirements. Provide an environmental monitoring, management and reporting plan that will be implemented to ensure that the site remains secure and stable, and to demonstrate that the site continues to meet performance expectations.	6.6
	Describe how site access will be restricted, the onsite security that will be in place, how access to open pits and underground working will be restricted, and how buildings and infrastructure will be secured.	6.3
	Describe how all landfills, waste management areas, tailings facilities, ore stockpiles, heap leach pads, and impoundments will be geochemically and physically stabilized and secured. Describe how increased durations of exposure during temporary closure may affect acid rock drainage or metal leaching predictions for ore or waste materials. Describe measures that will be taken to minimize exposure of susceptible materials.	6.4
	Quantify labour, materials, energy, and other requirements to conduct temporary closure activities and provide details that will be required to estimate costs of temporary closure activities.	6.2

YWB and EMR (2013) Annex 1 Annotated Outline for Reclamation and Closure Plan		RCP Section(s)
6.2 Interim Water and Solution Management Plan	Describe plans for the management of clean water, contaminated water, and process solutions during any temporary closure.	6.5
	Describe water and solution management processes, protocols and activities including managing water levels in open pits, underground workings, tailings impoundments, heap leach pads, pregnant and barren solution ponds, storm water ponds, or other water holding, conveyance or treatment facilities on-site. Include a description of ongoing water treatment processes and management of discharge streams.	6.5
	Include descriptions of the facilities and processes for conveyance of clean water through or around the site, including their maximum capacities. Address any special requirements for maintaining or operating these during temporary closures.	6.4.4
	Provide flow diagrams and drawings for water management programs including control or shut off switches for all tanks, pumps, pipelines, and ponds. Include an equipment list of essential fluid management system components and describe spare parts and backup systems that will be maintained on site.	5.3; 6.5
	Provide schedule of water management activities to be undertaken during periods of temporary closure. Describe inspections needed to ensure suitable water and solution management performance and outcomes.	6.5; 6.6
	Provide an emergency fluid management protocol that includes by-pass procedures if over-topping of water holding facilities may occur, and by-pass or containment procedures if water treatment facilities are damaged or unable to keep up with demand.	6.5.2
7.0 FINAL RECLAMATION AND CLOSURE MEASURES		
The Final Reclamation and Closure Measures section of the RCP should provide details on proposed reclamation and closure for all components of the mine site. Each section should describe the disturbance on site, the proposed closure methods, and alternative closure options associated with that closure aspect. Provide designs and detailed descriptions for reclamation and closure measures and activities that will be undertaken for all mine features and facilities.		2.3.4; 7.0
Describe what will be done to achieve the reclamation and closure objectives and meet the design criteria. Provide sufficient detail and supporting analyses to demonstrate how the proposed measures and activities will meet the performance expectations.		7.0
Also provide sufficient detail to support accurate estimates of reclamation and closure liabilities. A table that shows the total area of disturbance for all project components must be provided, addressing current, two-years forward, and end-of-mine conditions.		5.4; 5.5; 5.6
Identify and describe any alternatives that were considered for reclamation and closure of specific mine components or to address specific issues. Provide details about the characterization, evaluation, and selection of alternatives, including the use of tools like risk assessment, failure modes effects analysis, multi-attribute analysis, etc. Describe the benefits and drawbacks associated with the alternatives and provide rationale for the options selected.		2.3.4, Appendices 2-K to 2-M
7.1 Underground Workings and Openings to Surface	Describe how all surface openings to underground workings (raises, shafts, excavations, tunnels, chutes) will be blocked utilizing a suitable method as designed by a qualified professional engineer and capped to meet requirements specified in the Occupational Health and Safety Regulations of the *Occupational Health and Safety Act*.	N/A
	Where there is a demonstrated risk, and potentially significant consequence, that mine water pressures are likely to build to dangerous levels, describe how long-term drainage of excess mine water will be achieved.	
	Describe long-term water management for underground workings. Identify expected long-term water levels and describe any management requirements for discharge. Quantify any potential discharges including those to both surface and groundwater. Characterize interactions between underground workings and local groundwater. Provide predictions of underground water quality, based on monitoring data and geochemical analyses. Describe water treatment requirements associated with long-term drainage or water management from underground facilities. Identify any contingency treatment facilities to address uncertainty about water quality or underground water levels. Provide predictions of water quality, based on monitoring data and site-specific testing programs. Include predictions of loading to receiving water, using water quality and contaminant loading models.	
	Provide stability analyses for underground workings and demonstrate how workings are designed to minimize any surface expression of underground subsidence. Describe any underground support structures that are to remain in place to provide long-term structural stability. Provide analysis to demonstrate how the support structures will sustain anticipated loads for the long term, including static and dynamic loading. Stability calculations must be based on current standards and designs certified by qualified professional engineers must be provided.	
	Identify areas where safety issues may arise and describe how access to areas of unsafe drop-offs will be blocked and notices will be appropriately posted. Include measures to address requirements of the Workplace Health and Safety Regulations as set out in the *Occupational Health and Safety Act*.	
	If underground backfill will be used, describe how the mine workings will be backfilled, what materials will be used, and the timing of the backfill. Include a description of any material or equipment that will be left underground and how it will be decontaminated. Provide schematics of underground workings, including ramps, adits and other openings to surface and any remaining related structures, equipment or materials to be left in place.	
	Describe reclamation and re-vegetation activities that will be taken at any surface openings.	
7.2 Open Pits	Provide stability analyses for pits and describe any measures to stabilize open pits, including any re-sloping, grading, buttressing, etc. Provide designs to demonstrate expected performance. Stability analysis reports may be provided in appendices.	5.3.1.1; Appendix 5-A; Mine Operations Plan
	Describe any pit backfilling, including quantities and types of materials, handing and transportation methods, placement methods, and criteria for final fill. If pits will be left to fill with water, prepare a pit water balance that predicts pit filling conditions and timing.	5.3.1; 7.1.2; Waste Rock and Overburden Management Plan
	Identify areas where safety issues may arise and describe how access to areas of unsafe drop-offs will be blocked and posted appropriately. Include measures to address requirements of the Occupational Health and Safety Regulations as set out in the *Occupational Health and Safety Act*.	7.1.4
	Provide predictions of pit water quality based on monitoring data, operational uses of the pit and materials stored in pits. Address both transitional and long-term water quality. Provide a characterization of interactions between pits and local groundwater. Include groundwater model reports as appendices. Describe water treatment requirements associated with pit water, for both transitional and long-term conditions. Describe transitional and long-term management of pit water including both water levels and water quality based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance analysis and contaminant loading models. Address water storage requirements for both normal and emergency circumstances and identify conditions in which pit storage may be used for site water management. Quantify any potential discharges including those to both surface and groundwater.	7.1.2; 7.1.3; Water Management Plan
	Provide designs for surface water management and sediment control facilities at pits and infrastructure including layout, sizing, material and construction specifications, and erosion control.	5.3.12; Erosion and Sediment Control Plan
	Describe reclamation and re-vegetation activities for pit areas. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.	7.1.4

YWB and EMR (2013) Annex 1 Annotated Outline for Reclamation and Closure Plan		RCP Section(s)
7.3 Heap Leach Pads and Process Ponds	For heap leach pads and process ponds, RCPs should contain the following information.	
7.3.1 Detoxification, Rinsing and Solution Management	Describe proposed processes, sequences and scheduling for any residual leaching, rinsing, detoxification and/or neutralization of heap materials. The proposed processes should be supported by site-specific test work that demonstrates the effectiveness of proposed rinsing, detoxification, and neutralization methods.	7.3.1
	Provide a complete physical and chemical characterization of the residual heap leach materials, providing evidence that rinsing will be physically practical and can achieve neutralization. Include predictions of water quality from the heap leach pad, based on monitoring data, and/or site-specific testing programs. Include long-term predictions of loading to receiving water, using water quality and contaminant loading models.	5.3.5; 7.3.1; Heap Leach and Process Facilities Plan
	Identify water quality criteria that will be used to start and end rinsing, detoxification and/or neutralization activities.	7.3.1; Heap Leach and Process Facilities Plan
	Provide a solution management plan that describes expected flows, storage and handling of process and rinsing solutions. Describe the water balance for the heap leach facility, including leaching and rinsing sequences, areas and volumes of ore under leach/rinse, application rates, and percolation characteristics of the ore. Provide test results to demonstrate ore performance at the neutralization stage, considering multiple leach cycles and full heap depth. Describe the overall solution storage capacity, and how the capacity will be used during detoxification, rinsing and draindown. Include the sequence and plan for final draindown of the heap leach facility, considering the total quantity of solution, expected draindown rate, and the capacity of proposed water treatment systems. Provide designs for the pumping and piping facilities for conveying leach solution to and from the heap leach pad, including layout and sizing.	5.3.5; Heap Leach and Process Facilities Plan
	Describe water treatment processes that will be used during rinsing, detoxification, and post-closure. Provide as appendices the results of water treatment test programs that demonstrate expected performance of treatment systems. Provide designs for water treatment facilities including flow sheets, sizing, capacities, process controls, containment systems, reagent use and discharge conditions. Describe amounts and characteristics of any water treatment sludge and provide designs for containment facilities/approaches, both temporary and permanent. Describe scheduling for construction of water treatment facilities, including any variations or additions that may be required for specific closure phases.	5.3.5.4; Appendices 2-D to 2-G; Heap Leach and Process Facilities Plan
7.3.2 Physical Stability and Reclamation	Describe the results of stability analyses for the heap leach pad and any reclamation measures required to meet long-term stability requirements. Analyses must be supported by site-specific sampling and testing of materials, providing realistic and defensible material strengths and properties. Provide stability analyses and design reports as appendices.	Heap Leach and Process Facilities Plan; 7.3.1
	Provide designs for cover systems that will be used for heap leach pads. Include detailed descriptions and specifications for proposed covers and provide modeling to demonstrate how the proposed covers will achieve infiltration criteria, to support water balance and contaminant load modeling. Identify materials and sources for cover construction. Describe any proposed re-grading of heap surfaces.	7.3.1; Appendix 7-B
	Provide designs for surface water management and sediment control facilities and infrastructure for heap leach pads, including layout, sizing, material and construction specifications, and erosion control.	5.3.5.2; Erosion and Sediment Control Plan
	Describe how liner systems for heap leach pads and process ponds will be decommissioned. Demonstrate measures to ensure that liners do not remain as long term containment facilities unless designed for this purpose.	7.3.2
	Identify areas where safety issues may arise, and describe methods for addressing safety issues by reclamation, controlling access or posting notice.	7.3.3
	Describe reclamation and re-vegetation activities for heap leach pads and pond areas. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.	7.3; Appendix 7-B
7.4 Tailings Facility Areas	Describe the materials that will be contained in any tailings facilities on site, including sample selection, mineralogical analyses, static testing, and kinetic testing. Also describe the water quality and quantity conditions associated with the tailings, including porewater, seepage and runoff. Provide results of monitoring and site-specific testing programs. Include long-term predictions of loading to receiving water, using water quality and contaminant loading models. Describe the results of stability analyses for tailings facilities and any reclamation measures required to meet long-term stability requirements. Analyses must be supported by site-specific sampling and testing of materials, providing realistic and defensible material strengths and properties. Provide supporting reports for characterization of tailings conditions as appendices.	N/A
	Provide designs for covers that will be used to reclaim tailings surfaces. Include detailed descriptions and specifications for proposed covers and provide modeling to demonstrate how the proposed covers will achieve infiltration criteria, to support water balance and contaminant load modeling. Identify any requirements for water covers, saturation of tailings materials, or maintenance of dry tailings, and provide designs for achieving these outcomes.	
	Provide detailed designs for the closed tailings facility, along with management approaches for long-term maintenance and monitoring. Describe how the proposed closure measures will achieve the overall closure objectives. Identify specific design components and operational requirements that will affect or constrain closure options. Include the results of stability analyses for any proposed upgrades or changes to tailings facilities and any reclamation measures required to meet long-term stability requirements.	
	For any permanent structures that will remain as part of a tailings facility, describe long-term care and maintenance activities required to ensure the integrity of the tailings facility.	
	Describe any tailings relocation activities, including where the tailings will be placed, how they will be moved, and reclamation requirements for both existing and new storage locations. Identify any water management implications of tailings relocation and describe how these have been incorporated into water management strategies.	
	Describe water treatment requirements associated with tailings storage facilities and locations including surface water, seepage, and groundwater. Identify any contingency treatment facilities to address uncertainty related to tailings water quality or flows. Provide predictions of seepage, runoff and groundwater quality, based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance analysis and contaminant loading models.	
	Describe the requirements for surface water management for tailings areas including transitional and long-term surface water management and sediment control. Provide designs for surface water management and sediment control facilities and infrastructure, including layout, sizing, material and construction specifications, and erosion control. Include descriptions and diagrams of the pipelines, diversion ditches, spillways, and seepage recovery systems, including those that will be removed or decommissioned at closure and those that will remain permanently.	
	Identify areas where safety issues may arise, and describe methods for addressing safety issues by reclamation, controlling access or posting notice.	
	Describe reclamation and re-vegetation activities for tailings areas. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.	

YWB and EMR (2013) Annex 1 Annotated Outline for Reclamation and Closure Plan		RCP Section(s)
7.5 Waste Rock and Overburden Dumps	Describe the materials that will be contained in each waste rock and overburden storage facility on site, including sample selection, mineralogical analyses, and the results of other testing programs. Also describe the water quality and quantity conditions associated with the waste rock and overburden materials including porewater, seepage and runoff. Provide results of monitoring and site-specific testing programs. Include long-term predictions of loading to receiving water, using water quality and contaminant loading models.	5.3.2; 7.2.1.1; Waste Rock and Overburden Management Plan
	Describe the results of stability analyses for the waste rock and overburden dumps, and any reclamation measures required to meet long-term stability requirements. Analyses must be supported by site-specific sampling and testing of materials, providing realistic and defensible material strengths and properties.	5.3.2; Appendix 5-B; 7.2.1
	Describe proposed reclamation methods for waste rock and overburden dumps, including re-grading, covering and re-vegetation. Include figures and drawings that show plan views, layouts, cross-sections and profiles. Describe how the proposed closure measures will achieve the overall closure objectives. Also provide designs for covers that will be used for waste rock and overburden materials. To support water balance and contaminant load modeling, include detailed descriptions and specifications for proposed covers and provide modeling to demonstrate how the proposed covers will achieve infiltration criteria. Identify materials and sources for cover construction. Identify any requirements for water covers, saturation of waste materials, or maintenance of dry conditions, and provide designs for achieving these outcomes.	5.3.2; 7.2
	Describe any waste rock or overburden relocation activities, including where the materials will be placed, how they will be moved, and reclamation requirements for both existing and new storage locations. Identify any water management implications of waste relocation and describe how these have been incorporated into water management strategies, water balance and contaminant load predictions.	7.2; 7.9.6
	Describe water treatment requirements associated with waste rock and overburden storage facilities and locations, including surface water, seepage, and groundwater. Identify any contingency treatment facilities to address uncertainty related to waste rock and overburden water quality or flows. Provide predictions of seepage, runoff and groundwater quality, based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance analysis and contaminant loading models.	7.2.1.1
	Provide designs for any contaminated water collection and conveyance facilities, including details about how the designs have addressed foundation conditions and requirements for long-term performance if needed.	5.3.12; 7.7
	Describe the requirements for surface water management for waste rock and overburden areas including transitional and long-term surface water management and sediment control. Provide designs for surface water management and sediment control facilities and infrastructure including layout, sizing, material and construction specifications, and erosion control. Include descriptions and diagrams of the pipelines, diversion ditches, spillways, and seepage recovery systems, including those that will be removed or decommissioned at closure and those that will remain permanently.	7.7; 7.9.4; Water Management Plan
	Identify areas where safety issues may arise, and describe methods for addressing safety issues by reclamation, controlling access or posting notice.	7.2.1
	Describe reclamation and re-vegetation activities for waste rock and overburden areas. Provide details about landscape design, describing how the proposed design will provide long-term ecosystem services once mine activities are complete.	7.2.3
7.6 Ore Stockpiles and Pads	Describe the materials that will be contained in each ore stockpile or the remaining pads. Include details about sample selection, mineralogical analyses, and the results of other testing programs. Provide predictions of seepage, runoff and groundwater quality, based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance and contaminant loading models.	5.3.3.3; Waste Rock and Overburden Management Plan
	Describe any plans for milling of ores stockpiles and the costs associated with the milling activities. Provide test work that demonstrates feasibility of milling the materials.	5.3.4; Heap Leach and Process Facilities Plan
	Provide designs for any re-grading, covering and re-vegetation of ore stockpiles or pads. Include figures and drawings that show plan views, layouts, cross-sections and profiles. Describe how the proposed closure measures will achieve the overall closure objectives.	5.3.3; 7.4.2
	Provide designs for covers that will be used for ore stockpiles and pads. Include detailed descriptions and specifications for proposed covers and provide modeling to demonstrate how the proposed covers will achieve infiltration criteria. Identify materials and sources for cover construction. Performance of covers should be incorporated into water balance and water quality modeling, to predict long-term contaminant effects. Identify any requirements for water covers, saturation of ore materials, or maintenance of dry conditions, and provide designs for achieving these outcomes.	N/A
	Describe ore stockpile relocation activities, including where the materials will be placed, how they will be moved, and reclamation requirements for both existing and new storage locations. Identify any water management implications of stockpile relocation and describe how these have been incorporated into water management strategies.	5.3.3; 7.4.3
	Describe the requirements for surface water management for ore stockpile areas, including transitional and long-term surface water management and sediment control. Provide designs for surface water management and sediment control facilities and infrastructure including layout, sizing, material and construction specifications, and erosion control. Include descriptions and diagrams of the pipelines, diversion ditches, spillways, and seepage recovery systems, including those that will be removed or decommissioned at closure, and those that will remain permanently.	5.3.3.3; 7.9.4; Erosion and Sediment Control Plan
	Describe water treatment requirements associated with ore stockpiles and pads, including surface water, seepage, and groundwater. Identify any contingency treatment facilities to address uncertainty related to ore stockpiles water quality or flows. Provide predictions of seepage, runoff and groundwater quality based on monitoring data and site-specific testing programs. Include long-term prediction ns of loading to receiving water, using water balance analysis and contaminant loading models.	N/A
	Describe reclamation and re-vegetation activities for ore stockpile areas. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.	7.4.3

YWB and EMR (2013) Annex 1 Annotated Outline for Reclamation and Closure Plan		RCP Section(s)
7.7 Water Management Structures and Systems	Provide detailed geotechnical and hydraulic designs for all water management structures and facilities including dams, diversions, ponds, passive treatment systems, spillways, collection systems, etc. Include designs for any upgrades or changes required during reclamation and closure. Demonstrate how the proposed facilities meet the design criteria.	5.3.12; Water Management Plan
	Describe the results of stability analyses for the water management structures, and any reclamation measures required to meet long-term stability requirements. Analyses must be supported by site-specific sampling and testing of materials, providing realistic and defensible material strengths and properties. Analyses should also address permafrost conditions and long-term performance.	7.7; Water Management Plan
	Provide an overall water management plan that addresses surface water, groundwater and seepage, the management of clean water and contaminated water, water treatment requirements, and sediment and erosion control. This management plan must address regular conditions, flood events, and low-flow events. Provide description and diagrams of closure period water management processes and protocols. Include decision diagrams if relevant.	Water Management Plan
	Provide designs for any contaminated water collection and conveyance facilities, including the location and capacity of water collection wells, pumps, slurry walls, pipelines, etc. Describe how these facilities will operate in a variety of climatic and flow conditions.	Heap Leach and Process Facilities Plan; Water Management Plan
	Describe treatment systems that will be used during reclamation implementation or long-term closure to address contaminated water from all sources at the site. Provide results of water treatment test programs that demonstrate expected performance of treatment systems, whether passive or active. Provide designs for water treatment facilities, including flow sheets, sizing, capacities, process controls, containment systems, reagent use and discharge conditions. Describe amounts and characteristics of any water treatment sludge and provide designs for containment facilities/approaches, both temporary and permanent. Describe scheduling for construction of water treatment facilities, including any variations or additions that may be required for specific closure phases.	5.3.5.4; 2.3.1.2; Appendices 2-D to 2-G; Appendix 5-C
	Describe the requirements for overall site surface water management, including transitional and long-term surface water management and sediment control. Provide designs for surface water management and sediment control facilities and infrastructure including layout, sizing, material and construction specifications, and erosion control. Include descriptions and diagrams of the pipelines, diversion ditches, spillways, and seepage recovery systems, including those that will be removed or decommissioned at closure and those that will remain permanently.	5.3.12; Water Management Plan
	Describe long-term monitoring and maintenance requirements for water management structures that will remain on site (e.g., dams, diversions). Describe the role of professional engineers in the long-term management of these structures. If dams will be removed, provide detailed designs for dam removal. Dams that are to remain in place must meet the provisions of the Canadian Dam Safety Guidelines and must be certified by a qualified professional engineer with respect to their long-term physical and chemical stability.	7.11
	Describe proposed methods for reclaiming and closing any water storage, water treatment or process ponds on site. Characterize any sediments remaining in the ponds (e.g., ABA, ICP-MS, XRD, TCLP, SWEP, etc.). Describe relocation or reclamation of sediments contained in ponds. Address any water management implications associated with pond or sediment reclamation.	7.3.2; 7.7
	All aspects of the water management plan should be based on the results of water balance analyses and contaminant load modelling. Provide an overall site water balance with at least a monthly time step that incorporates water balances from all major site components and predicts water deficits and surpluses. Provide an overall site contaminant load balance that integrates source loading from all mine related sources and predicts interactions with local groundwater and surface water. Document or predict past, present or future predicted discharges from individual source facilities including location, volume, and water quality.	Water Management Plan
7.8 Mine Infrastructure	Describe how mill and processing buildings and facilities will be dismantled and how the foundation will be removed. Describe plans for revegetation. Include details for the removal of processing equipment, presses, crushing and ore handling facilities, concentrate storage sheds and any other ancillary structures that are used in the milling process.	7.4
	Describe how machinery, equipment, and storage tanks will be cleaned and removed from the mine site. Provide a list of all fixed and mobile equipment that will be removed from the site for sale or salvage.	7.4; 7.5
	Provide the proposed measures for reclamation and closure of buried support infrastructures (tanks, pipes, underground services, etc.). Provide detailed maps that show all buried foundations, equipment or infrastructure that will remain on site once mine reclamation activities are complete.	7.5; 7.6
	Describe how the camp will be dismantled, including how sewage treatment facilities, water supply wells, and pump houses will be decommissioned. Include the proposed measures for reclamation and closure of airstrips, power transmission lines, pipelines, and railways.	7.6
	Describe in detail how all landfills, land treatment facilities, and waste storage areas will be decommissioned and reclaimed. Provide a figure that shows the locations of all landfills and waste storage areas.	7.8.4; 7.9.3.1; Waste and Hazardous Materials Management Plan
	Describe how any power generation facilities, transmission towers and poles' right of way will be decommissioned and dismantled.	7.5
	Describe reclamation and re-vegetation activities for infrastructure sites. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.	7.5.2; 7.6.1
7.9 Hazardous Materials	Provide an inventory of hazardous materials on the site, including reagents, explosives, fuels, lubricants, etc. Include estimates of expected hazardous material quantities to be addressed during reclamation and closure and describe plans for completion of environmental site assessments to be conducted early in the reclamation and closure implementation phase to confirm quantities and types. Also provide estimates of hydrocarbon contaminated soils that will require reclamation and provide designs and operation plans for any contaminated soil treatment facilities.	7.9.3; Waste and Hazardous Materials Management Plan
	Describe how explosives, reagents and other hazardous materials will be removed from site and/or disposed of in an approved facility. Describe reclamation plans for operational storage areas and facilities.	7.8.5; 7.9.3
	Describe the investigation, reclamation and revegetation activities that will be required at all areas where fuel was stored. Include in this description how all waste fuel or unused fuel will be removed from the site.	7.5.1
7.10 Roads and Other Access	Describe access requirements for site operations, monitoring and maintenance, including any measures for control of access to the site during reclamation and closure, and the expected duration of any restrictions on access.	5.3.13.2; 5.3.13.3; 8.5
	Provide a detailed description of methods and timing for reclamation of access roads, site roads, airstrips and other access. Include methods and timing for removal of bridges, culverts and drainage ditches, including re-establishment of streambeds. Provide designs for long-term erosion and sediment control, demonstrating how the closed facilities will handle flood events.	7.7; 7.8; 7.9.4
	Describe scarification, re-grading, landscape design and re-vegetation activities, including areas where specific prescriptions will be applied. Identify any indicators that will be used to determine if revegetation is warranted.	7.7; 7.8; 7.9.4

YWB and EMR (2013) Annex 1 Annotated Outline for Reclamation and Closure Plan		RCP Section(s)
	Describe any measures to address specific requirements for reclamation of access that is subject to an easement, right of way or lease under the *Lands Act*. Also describe any specific reclamation requirements for access that is located on First Nation settlement land.	7.8
7.11 Borrow Materials Planning	Provide a site wide compilation of borrow requirements for the RCP, identifying quantities, material specifications, and proposed locations for use.	7.10
	Provide an inventory of available borrow materials (e.g., overburden, growth media, granular, rip-rap, low permeability), showing sources for the required borrow materials. Provide quantities and properties of available materials, including site-specific test work to demonstrate that the proposed sources will meet the required specifications and quantities. Provide detailed borrow source investigation reports as appendices.	7.10.2; Appendix 2-I
	Describe any measures that will be required to refine or amend borrow materials so that they will achieve specifications.	N/A
	Mining activities often produce materials that can be used for implementation of reclamation works – e.g., overburden for covers. If mined materials are needed for reclamation activities, describe how the mine plan will be implemented to segregate appropriate materials and place them in easily accessible locations.	7.9.6
7.12 Monitoring and Maintenance	Describe maintenance and monitoring programs that will be undertaken during reclamation and closure. Monitoring may include water quality, water quantity, vegetation performance, terrestrial contamination, wildlife usage, physical integrity, air quality, etc. Include detailed schedules that describe monitoring locations, parameters, frequencies and analytical requirements. Describe how schedules may change during different stages of reclamation and closure, including any monitoring triggers for adjustments to monitoring locations, parameters or frequencies. Describe the access requirements for operation, maintenance, and monitoring.	7.11
	Describe re-vegetation maintenance requirements and expectations. Fertilization, weed control, and replanting or additional planting schedules should be provided. Include cover repair activities and decision-making protocols for evaluating cover performance and making decisions about maintenance needs. Describe any constraints on expected cover life, especially for synthetic covers. Include measures and schedules for replacing or repairing covers.	2.3.1; 7.9.5; Appendix 7-B
	Describe expected life for passive or active water treatment facilities, and measures and schedules for replacing or repairing those facilities.	7.3.1; 8.1
	Describe other site maintenance requirements such as storm water conveyances, water storage facilities, passive treatment facilities, and dams.	7.11.6
7.13 Performance Uncertainty and Risk Management	The RCP should identify and characterize key risks and uncertainties, and provide measures for addressing them where possible, while recognizing the reclamation and closure principle that adaptive managements must not form the basis of the RCP.	5.8.2; 7.13
7.13.1 Risk Assessment	Describe processes undertaken to identify and characterize risks associated with the site and the reclamation and closure plan. Describe how these processes have incorporated perspectives of various parties with different perspectives about mine related risks. Provide results of these risk assessment processes.	2.3.4; 5.8
	Describe mitigation measures and contingency plans established to address risks identified in the risk assessment.	5.8.2; 7.13
7.13.2 Adaptive Management Plans	Describe any proposed adaptive management plans that are designed to address unexpected performance of the mine closure facilities and systems. Describe specific events associated with uncertain performance, identify appropriate indicators for measuring performance. Describe monitoring requirements, defining specific thresholds for responding to unexpected performance. Outline processes for evaluating monitoring results and comparing to thresholds and provide descriptions of specific actions that will be taken in response to the threshold exceedances. Decision diagrams should be included for adaptive management protocols.	5.8.2; 7.13
8.0 RECLAMATION AND CLOSURE SCHEDULE AND EXECUTION STRATEGY		
The Reclamation and Closure Schedule and Execution Strategy section of the RCP describes when and how the reclamation and closure measures will be conducted. The schedule should address all reclamation and closure activities from progressive reclamation through to long-term monitoring and maintenance. The execution strategy should identify how the reclamation and closure activities will be completed - who is expected to carry them out, and how they will be funded.		8.0
8.1 Reclamation and Closure Schedule	Provide a detailed reclamation and closure schedule, describing the timing, sequencing, and duration for all reclamation and closure activities.	7.0; 8.1
	Describe the current design status for the RCP and provide schedules for completion of remaining reclamation research and design activities required to prepare a for construction RCP.	2.3; 2.3.1.4; 8.1
	Describe any progressive reclamation activities that have been completed or are proposed.	2.3.2
8.2 Execution Strategy	Describe the human resource requirements for completion of the RCP. Provide a table which summarizes the number and type of personnel required to implement each of the reclamation and closure activities. Include personnel requirements for the initial (i.e., with active work underway) closure phase and the long-term post-closure phase.	8.7
	Describe any institutional controls necessary to protect human health and environment (e.g., prohibition on excavation into cap/cover, prohibition on use of ground water, closure of all open adits/shafts, limitation of site access to treatment process units and reclaimed area).	8.5
	Describe who will carry out each stage of reclamation and closure activities. Identify plans for conducting any long-term operations, maintenance and monitoring activities, including who will carry out these activities and how they will be funded.	8.2
9.0 RECLAMATION AND CLOSURE LIABILITY		
The RCP must summarize estimates of liability associated with completion of reclamation and closure measures and activities. Quantify liabilities for current conditions, two-years hence and end-of-mine. Describe the approach and assumptions for estimating liabilities, including demonstrating how the approaches have addressed the principles described in this guide. Details of costs estimation methods and models must be provided as appendices, in accordance with direction provided in Annex 2 of this guide.		9.0

APPENDIX 1-B

Reclamation and Closure Plan
Decision Document and Proponent Commitments
Table of Concordance

Decision Document Mitigation Measures				
Mitigation Number	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
		Wildlife and Wildlife Habitat		
1	The Proponent shall apply for a lease or another form of regulatory approval under the Territorial *Lands Act* that will provide the Proponent with the authority and ability to control access between Maisy May Creek and the Stewart River. The point of access control shall be the beginning of new road connecting the existing road network with the Stewart River barge landing. Access shall be restricted through means such as a gatehouse or equivalent access restriction until the road is decommissioned such that this section of new road not become a public road.	**Access Route Construction Management Plan** Section 2.0: Authorizations for Construction; Section 7.0: Access Tie-in, Access Control, and Staging Area	Construction / Operation	
		Access Route Operational Management Plan Section 3.1: Access Control		
		Wildlife Protection Plan Section 4.2.4.1: Access Management		
2	The Proponent shall restrict public access to the Coffee Creek barge landing and roads connected to the barge landing that it maintains. Access shall be restricted through means such as a gatehouse, as near the barge landing as possible, until such time the road network attached to the barge landing is decommissioned such that these roads not become public roads.	**Access Route Construction Management Plan** Section 7.0: Access Tie-in, Access Control, and Staging Area	Construction / Operation	Access restricted through operation of the barge landings and through a gatehouse located approximately 2.8 km northeast of the north Stewart River barge landing.
		Access Route Operational Management Plan Section 3.1: Access Control		Access restricted through operation of the barge landings and through a gatehouse located approximately 2.8 km northeast of the north Stewart River barge landing.
		Wildlife Protection Plan Section 4.2.4.1: Access Management		
2.1	The Proponent shall ensure that all new road sections do not become public roads and that all new road sections be decommissioned by the conclusion of project activities. New barge landings shall be obstructed in a manner to prevent unloading of vehicles by barge.	**Access Route Construction Management Plan** Section 9.13: Decommissioning and Reclamation	Closure	
		Access Route Operational Management Plan Section 3.1: Access Control	Construction / Operation / Closure	
		Reclamation and Closure Plan Section 7.8.2: NAR and On-site Access Road	Closure	
3	The Proponent shall not use the NAR, except for maintenance purposes, when caribou migrations are expected to intersect the NAR or caribou are persistently crossing the NAR over a period of three days. Normal road use shall not resume until caribou are considered to have cleared the road corridor.	**Access Route Operational Management Plan** Section 4.5: Interaction with Wildlife	Construction / Operation / Closure	
		Wildlife Protection Plan Section 4.3.1: Species Specific Mitigation: Caribou		Phased approach to caribou mitigation: Response Level 3.
4	Snowbanks along the Northern Access Route shall be maintained at a level of less than 50 cm above the roadbed. Flowthrough breaks should be included at appropriate intervals and locations along the Northern Access Road.	**Wildlife Protection Plan** Section 4.1: Project Design; Section 4.2.4: Manage Road Operations	Construction / Operation	Snowbanks will be managed and maintained to 0.5 m high where safe to do so and allowed by other design considerations and will include periodic breaks to allow wildlife to move across the road, spaced between 500 m and 1 km apart on alternating sides of the road.
		Access Route Operational Management Plan Section 4.3: Snow Removal and Snow Management		Snowbanks will be managed and maintained to 0.5 m high where safe to do so and allowed by other design considerations and will include periodic breaks to allow wildlife to move across the road, spaced between 500 m and 1 km apart on alternating sides of the road.
5	The proponent shall retain an individual qualified in caribou behavior who will, in consultation with Government of Yukon, implement design features to reduce the likelihood of entrapment within project infrastructure as well as design features that reduce noise, visual, and light stimuli in alpine and subalpine habitats of high importance to caribou that are within line of sight of the mine site's activities to assist in reducing stimuli that may cause an expansion of the zone of influence (ZOI) for the mine site.	**Noise Management Plan** Section 5.0: Environmental Protection Measures	Construction / Operation / Closure	
		Wildlife Protection Plan Section 4.0: Wildlife Protection Measures Framework; Section 4.2: General Wildlife Protection Measures		
		Access Route Construction Management Plan Section 7.0: Access Tie-in, Access Control, and Staging Area; Section 8.0: Borrow Sources		
6	Between May 1 and August 31, the minimum cruising altitude for project-related aircraft shall be 600m. This window will be extended as necessary based on seasonal caribou presence documented in the Wildlife Monitoring Plan and decision criteria in the Adaptive Management Plan.	**Wildlife Protection Plan** Section 4.2.5: Manage Aircraft Operations	Construction / Operation / Closure	

Decision Document Mitigation Measures				
Mitigation Number	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
		Water and Aquatic Resources		
7	In evaluating whether the non-degradation threshold for Coffee Creek is met, the Proponent shall be subject to performance evaluation criteria that incorporate a suitable method to determine if the Coffee Gold Project is the primary or most substantial cause of any exceedance of the non-degradation threshold. The Proponent's non-degradation thresholds shall be revised to require that the Project not be the primary or most substantial cause of any exceedance of a non-degradation threshold.	**Surface Water Quality and Aquatic Life Adaptive Management Plan** Section 2.3.2: Non-Degradation Water Quality Objectives - Coffee Creek and Yukon River	Construction / Operation / Closure	
8	The proponent shall revise water quality objectives prior to licensing, as necessary, dictated by the current relevant science and using the same level of protection assessed during the Screening. That is, use-protection objectives in Halfway, Latte and YT-24 creeks, and performance evaluations that reflect non-degradation objectives in Coffee Creek and the Yukon River downstream of Halfway, Latte and YT24 creeks.	**Water Management Plan** Section 1.4.2: Territorial Regulations	Construction / Operation / Closure	
9	Prior to licencing, the Proponent shall revise use-protection water quality objectives to ensure they incorporate the most recent toxicological information and guidance from CCME, Government of Canada, and BCMoE for the protection of freshwater aquatic life.	**Water Management Plan** Section 1.4.2: Territorial Regulations	Construction / Operation / Closure	
10	Reclamation and closure plans required under the Quartz Mining Act will include, at a minimum, the same use protection and non-degradation objectives as during operations. Water quality early warning triggers for reclamation and closure will be developed and applied for all watercourses as part of the Environmental Monitoring and Adaptive Management Plan.	**Reclamation and Closure Plan** Section 3.1.5: Water Quality Objectives **Reclamation and Closure Plan** Section 5.8.2: Contingency Planning and Adaptive Management Approach	Closure	
11	The Proponent shall develop water related adaptive management plans in accordance with Government of Yukon's 2021 guidance document, including any future revisions, "Guidelines for developing adaptive management plans in Yukon: water-related components of quartz mining projects".	**Environmental Monitoring and Adaptive Management Plan** Section 2.2: Adaptive Management Approach **Surface Water Quality and Aquatic Life Adaptive Management Plan**	Construction / Operation / Closure	
12	Ore shall not remain on the ROM ore pad at the end of operations, during scheduled or unscheduled closure, without prior confirmation of long-term attenuation capacity of the schist pad for the key COPIs, arsenic and uranium that has been reviewed and accepted by the relevant regulator.	**Reclamation and Closure Plan** Section 6.4.1: Heap Leach Facility and ROM Stockpile; Section 7.4.2: ROM Stockpile Area Closure Measures	Temporary Closure	
13	The proponent shall provide to the relevant regulator all iterative water balance and water quality model runs generated in support of future licensing applications based on project updates, additional water quality mitigation measures proposed during screening and licensing, and new information. During operations, the proponent shall provide results of monitoring data to allow comparison with predictions with relevant regulators and affected First Nations.	**Water Management Plan** Section 7.0: Reporting **Water Management Plan** Section 8.0: Annual Water Management Planning	Construction / Operation / Closure	
14	Prior to licensing, the proponent shall summarize the results of all test work completed for the development of the proposed bioreactor treatment system (EBR system), identify treatment performance objectives for the EBR, provide timelines to complete the remaining test work and develop the detailed design of the EBR system.	**Heap Leach and Process Facilities Plan** Section 4.5: Water Treatment of Heap Leach Solutions **Heap Leach and Process Facilities Plan** Appendix D: Coffee Mine Water Treatment Design for Permitting	Construction / Operation	
15	The overall timeline for development of the EBR system must meet the conditions evaluated during the Screening, such that detailed plans for the EBR are submitted, reviewed and accepted by the responsible regulator, and the EBR is operational prior to the HLF water balance reaching a threshold that requires discharge of treated excess water to Halfway Creek or the Latte Pit.	**Heap Leach and Process Facilities Plan** Section 4.4: Solution Management **Heap Leach and Process Facilities Plan** Section 4.5 Water Treatment of Heap Leach Solutions	Construction / Operation	
16	The proponent shall provide contingency plans contemplating scenarios where timelines or effluent quality objectives cannot be met prior to licensing. Contingency plans shall include a proof of concept, an estimated implementation time, and water quality early warning triggers which will be developed and applied for all affected watercourses as part of the Environmental Monitoring and Adaptive Management Plan.	**Water Management Plan** Section 4.3.8.1: Alpha Pond Performance Targets and Mitigation Measures **Water Management Plan** Appendix A: Coffee Gold Project Contingency Water Management Measures - Memo	Construction / Operation	
		Heap Leach and Process Facilities Plan Section 4.5.3.3 and Appendix E: Contingency Water Treatment Plan	Construction / Operation	
17	The proponent must define acceptable performance conditions for the Alpha Pond in terms of water quantity and quality for seepage from the Pond as part of the adaptive management for the Alpha Pond.	**Water Management Plan** Section 4.3.8.1: Alpha Pond Performance Targets and Mitigation Measures	Construction / Operation	
18	The proponent shall provide contingency plans contemplating scenarios where the management of surface effluent discharged from Alpha Pond fails to meet water quality objectives in Halfway Creek.	**Water Management Plan** Section 4.3.8.1: Alpha Pond Performance Targets and Mitigation Measures	Construction / Operation	

Decision Document Mitigation Measures				
Mitigation Number	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
Traditional Land Use and Heritage Resources				
18.1	The Noise Management Plan shall include the following measures to reduce the effects on traditional land uses: a) The plan shall include an objective to mitigate noise from a traditional land use perspective. b) In collaboration with affected First Nations, mitigations measures shall be identified that achieve the above objective. This may include reducing the timing and frequency of noise-related activities during critical times for traditional land use, such as fall harvesting. c) The Proponent shall develop a system for tracking, recording, and responding to complaints related to noise in collaboration with Environmental Health Services. Complaints are to be submitted to Environmental Health Services for recording purposes. d) The Proponent shall establish, in discussion with affected First Nations and communities, a means by which to communicate and inform individuals and communities who may be affected by Project-related noise in advance of any changes in sound levels that may occur, including when planned blasts are predicted to occur or deviations in the blasting plans. e) This aspect of the plan shall be adaptive and be based on inputs from the Noise Monitoring Plan and/or through the Socio-economic Management Plan undertaken in collaboration with affected First Nations.	a) **Noise Management Plan** Section 1.2: Scope and Objectives b) **Noise Management Plan** Section 5.0: Environmental Protection Measures c) **Noise Management Plan** Section 5.1.5: Noise Complaint Procedure d) **Noise Management Plan** Section 5.1.3: Blasting e) **Noise Management Plan** Section 5.2: Adaptive Management	Construction / Operation / Closure	
19	The Proponent shall facilitate and support traditional land use activities within the project area to the extent possible (that is, within the limits of safety and in areas under the control of the Proponent). Facilitation and support shall include, but not be limited to: a) Making all or a portion of the Coffee Creek camp available for traditional uses; b) Funding suitable infrastructure at the Coffee Creek camp for traditional uses; c) Funding and supporting culture camps for affected First Nations; d) Ensuring staff are provided with information regarding traditional land uses they may encounter.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Traditional Knowledge and Lands and Resource Use Management Strategy	Construction / Operation / Closure	
20	The Proponent shall establish an elder-in-residence program in order to better: a) improve cross cultural awareness; b) increase First Nations physical presence at the mine site; c) improve First Nation knowledge of project development, and improve the Proponent's understanding of First Nation perspectives regarding the Project's development; d) ensure First Nation workers can access elders at the mine site.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Cultural Awareness and Diversity Management Strategy	Construction / Operation / Closure	
21	The Proponent shall include the following in the scope of the Socio-Economic Management Plan: a) A management objective to continue to identify effects on each affected First Nation's Traditional Land Use in the Coffee Creek Area b) A commitment to carrying thorough effectiveness monitoring and adaptive management of measures intended to mitigate impacts from construction until post-closure; c) A commitment to ensure that all affected First Nations have an opportunity to participate in developing end land use objectives for the site that are consistent with traditional land use values for the area, including future uses. d) Development of a Terms of Reference with each affected First Nation for the methodology to undertake studies under the umbrella of the SEMP relating to effects to Traditional Land Use, including roles and responsibilities of Proponent and First Nation contributors; and e) Capacity funding to ensure the affected First Nations' full participation in the SEMP management and monitoring components that are relevant to the affected First Nations interests, if they so choose.	a) **Socio-economic Monitoring Plan** Section 6.0: Monitoring b) **Socio-economic Monitoring Plan** Section 6.0: Monitoring c) **Socio-economic Monitoring Plan** Section 1.6.2: Potentially Affected First Nations' Role and Responsibility d) **Socio-economic Monitoring Plan Section** 1.6.2: Potentially Affected First Nations' Role and Responsibility e) **Socio-economic Monitoring Plan** Section 1.6.2: Potentially Affected First Nations' Role and Responsibility	Construction / Operation / Closure	

Decision Document Mitigation Measures				
Mitigation Number	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
		Traditional Land Use and Heritage Resources		
22	The Proponent shall fund efforts of affected First Nations (TH, WRFN, SFN and FNNND) to collect traditional knowledge with respect to the Coffee Creek area for the purposes of supporting a First Nation-developed culture program aimed at transmitting knowledge about the area to future generations.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Traditional Knowledge and Lands and Resource Use Management Strategy	Construction / Operation / Closure	
23	The Proponent shall provide capacity funding for each affected First Nation to retain Indigenous Project Monitors, if they so choose, which shall have the following functions in relation to reducing effects to traditional land use; a) To identify, document and develop mechanisms to support resolution of potential conflict between mining activities and First Nation cultural values and practices in the Coffee Creek area. b) The monitors shall be involved in the collection of information on matters on-site related to harvestable resources in the project area and surrounding landscape and ways in the accessibility to those resources or quality of experience in harvesting those resources may be diminished. c) The monitors shall be on-site during mining activities but also be given means for community-based outreach work. This may include but not be limited to travel to First Nation primary communities and/or accommodating First Nation elders and land users at the site. d) The monitors shall also be involved in data collection for other culturally important land uses. Data collection shall include but not be limited to land user perceptions, regarding compatibility of traditional activities and adjacent industrial activities (e.g. user tolerance for noise, visual scarring, or other "sense of place" determinants). e) The Monitors shall be provided authority and resources to scope traditional knowledge and traditional use studies aimed at documenting mining / land use conflicts (actual or potential), and ways in which those conflicts could be mitigated. For greater clarity, this condition envisions that the Monitor may, from time to time, employ supporting staff of their choosing to support special projects. f) Funding for the Monitors shall be sufficient to enable the above functions, if so desired by each affected First Nation. The Indigenous Project Monitors act as a liaison between the affected First Nations and the Proponent and are a mechanism to implement the adaptive management framework outlined in the SEMP to address effects to traditional land uses. The Indigenous Project Monitors may act in conjunction with, or replace, the Environmental Monitors as committed to by the Proponent, depending on the needs and preferences of each affected First Nation. The Indigenous Project Monitors are intended to be independent of the Proponent and represent the interests of the affected First Nations.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Traditional Knowledge and Lands and Resource Use Management Strategy	Construction / Operation / Closure	
24	The proponent shall only landfill inert substances at the project site. The Proponent shall work with affected First Nations and regulatory agencies to develop an Approved Landfill Materials list and mechanism for establishing suitably low leachability risk for proposed landfill materials.	**Waste and Hazardous Materials Management Plan** Section 1.3: Incorporation of Traditional Knowledge and Consultation Feedback, Section 5.0 Waste Management and Appendix B: Waste Materials List	Construction / Operation	
		Health and Safety		
25	The Proponent shall develop mandatory, regular harassment prevention training, in consultation with a qualified expert, to be delivered to all the Proponent's employees, contractors and consultants working on the Project. The qualified expert must also be proficient in cross-cultural awareness training.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy **HR Policy**	Construction / Operation / Closure	
26	The Proponent shall ensure that human resource staff complete training to enable them to effectively support employees who disclose workplace harassment. In order to support reporting of sexual harassment and assault, human resource staff shall provide all new staff members with information about ways in which they can record and provide evidence of harassment or bullying, what happens after they make a disclosure, and how they will be protected from reprisals.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy **HR Policy**	Construction / Operation / Closure	
27	The Proponent shall ensure that all HR staff complete training to effectively support employees who disclose sexualized or gender-based violence, as well as harassment and discrimination against Indigenous people in their workplace or at home. It is recommended that a counsellor be available on site for support through this as well.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy **HR Policy**	Construction / Operation / Closure	

Decision Document Mitigation Measures				
Mitigation Number	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
		Health and Safety		
28	The Proponent shall create a mentor program for Yukon First Nation employees to achieve three goals: a) ensure that First Nation women have access to a mentor or supervisor who has the authority to and regularly checks in to address any negative experiences related to the male-dominated work environment, and who pays special attention to potential cases of abuse; b) develop a formal feedback process to ensure that enquiries are regularly made of First Nation employees to ensure that they are able to voice their concerns and address any negative experiences; and c) involve TH, SFN, FNNND and WRFN in further developing the program to ensure that it meets the needs of First Nation employees.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy	Construction / Operation / Closure	
29	The Proponent shall, in consultation with a qualified expert and with TH, SFN, FNNND and WRFN, develop gender appropriate and gender- and sexuality-specific policies and processes that promote a safe, respectful, and inclusive environment for women and gender and sexual minorities.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy **HR Policy**	Construction / Operation / Closure	
30	The Proponent shall ensure that HR staff administer confidential exit surveys with explicit questions about whether workplace harassment occurred, if disclosures were made, and what supports were provided. The proponent shall use this information to track trends and inform hiring, policy, and other initiatives at the mine site, and shall provide an annual report to Health and Social Services and the Women's Directorate detailing the Proponent's efforts to prevent workplace harassment as well as statistics on reported incidences of harassment, disclosures, etc.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy **HR Policy**	Construction / Operation / Closure	
31	The Proponent shall ensure that the on-site First Aid Technician or Emergency Medical Technician is trained in Mental Health First Aid and/or has formal mental health training to provide short-term or crisis support at the mine site and has referrals to other mental wellness supports or navigation to other systems.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy	Construction / Operation / Closure	
32	The Proponent shall ensure that on-site employees have the ability to utilize the Employee Assistance Plan (EAP) services available (i.e., make available a private phone line or Internet connection so employees can discreetly reach EAP services)	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy	Construction / Operation / Closure	
33	The Proponent shall retain professional services in the appropriate field to help their on-site mental health first aid staff develop the methods and tools that are appropriate to provide support to perpetrators of violence and harassment to help end cycles of abuse.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy	Construction / Operation / Closure	
34	The Proponent shall consider gender equity/diversity in hiring processes.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy **HR Policy**	Construction / Operation / Closure	
35	To address and mitigate impacts to employees who are or become victims of domestic abuse, the Proponent must create a policy that: a) outlines clear procedures for the workplace to deal with affected employees and provide appropriate resources and support; b) plans for and addresses the safety concerns of the affected employees while at work to ensure that all workers are safe from threats of domestic violence; and c) includes a personal safety plan for employees suffering from domestic violence.	**Code of Conduct**		Additional detail will not be provided
36	The Proponent shall provide access to the EAP for the eligible dependents of employees and inform all employees of this.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy **HR Policy**	Construction / Operation / Closure	

Decision Document Mitigation Measures				
Mitigation Number	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
		Health and Safety		
37	The Proponent shall develop clear standards for behaviour at work and codes of conduct against sexual harassment and gender-based violence on the job site and in the broader community, including standards/codes of conduct in relation to the sex trade, and shall distribute education and awareness campaign materials on gender-based violence. Refer to Unlocking Opportunities for Women and Business: Actions and Strategies for Oil, Gas and Mining Companies Tool Suite 4: Addressing Gender Based Violence in the Workforce (2018) for information and resources.	**Code of Conduct**		Additional detail will not be provided
38	The Proponent's Noise Management and Monitoring Plans submitted at licensing should incorporate all recommendations outlined in Appendix 10-A Noise Intermediate Component Analysis Report 2017, s.43.3. In addition, the Proponent must implement the following measures based on industry best-practice guidelines: a) Workers' living quarters shall be designed to limit noise, with mitigating features such as high-quality soundproofing for windows and seals on doors. b) Physical barriers shall be used to maximize shielding and reduce noise transmission. Physical barriers shall be of an appropriate height and thickness to break the line-of-sight between the project related noise sources and the dormitory and other sensitive receptors at the permanent camp, to reduce noise levels to lower than 30 dBA (Leq) indoors to be protective of sleep. c) Optimization of operations shall include notifying workers of the schedule for loud procedures or particularly annoying noise events. Periods of respite shall be provided in the case of unavoidable maximum noise level events.	a) **Noise Management Plan** Section 5.1.4: Design of Permanent Camp b) **Noise Management Plan** Section 5.1.1: Heavy Equipment c) **Noise Management Plan** Section 5.1.3: Blasting	Construction / Operation / Closure	
39	If thresholds under YAAQS are being approached at the sites of the monitoring stations, or where CACs have exceeded thresholds, activities involving sources of emission be reduced or have additional emission mitigations applied. In this way, air quality and adaptive management may reduce or prevent further increases in CACs, and reduce the risk to employees during non-working hours. The Proponent shall notify workers traversing areas that have elevated outdoor concentrations and require them to use appropriate PPE. Off-duty workers will be advised to reduce exposure by remaining indoors to the extent possible and closing windows in camp residences at times of peak emissions.	**Air Quality and Greenhouse Gas Monitoring Plan**	Construction / Operation / Closure	Emission sources determined to cause excursions of or approaches to CAC thresholds will be reduced, curtailed and/or have additional emission mitigations applied.
40	The Proponent shall incorporate an adaptive management plan in collaboration with First Nations and regulators, that establishes concrete actions for approaching and exceeding thresholds. The following adaptive management actions and corresponding triggering thresholds are to be used until such time as a detailed project specific approach is jointly developed to operationally target the reduction of CAC's and particulates and management of air quality at, and in proximity to, the Project site.	**Air Quality and Greenhouse Gas Monitoring Plan**	Construction / Operation / Closure	
41	The Proponent shall ensure that impacts on employee health (both on and off-duty, on-site) are considered in assessing the need for adaptive measures. The Proponent shall ensure that ambient air quality in camp buildings meets indoor air quality guidelines through various means including the use of adequate ventilation and air filtration systems, effective insultation, seals on windows and doors, bans on vehicles idling in the immediate vicinity. Indoor air monitoring will occur to ensure that emissions are not accumulating in indoor environments.	**Air Quality and Greenhouse Gas Management Plan** Section 7.1.4: Design of Camp Accommodations **Health and Safety Program**	Construction / Operation / Closure	
		Community and Economics		
42	The Proponent shall maintain a transition fund, as a component of the Workforce Transition Strategy, of an amount sufficient to ensure, in the event of unscheduled closure: a) the funding of programs and other financial commitments outlined in the Socio-Economic Monitoring Program for a period of 12 months, b) maintenance of the Employee Assistance Program for a minimum of 6 months.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Local Employment and Procurement Management Strategy	Construction / Operation / Closure	
43	The Proponent will promptly notify Health and Social Services of unscheduled closures, the supports and services the Proponent has in place for impacted employees and their families, and any forecasted implications beyond the scope of what the Proponent can address. Health and Social Services will assess the need to coordinate or deploy health and social resources to support impacted communities, in alignment with mandate(s) and scope.	**Reclamation and Closure Plan** Section 6.7.1: Management of Socio-economic Aspects of Temporary Closure	Temporary Closure	

Decision Document Mitigation Measures				
Mitigation Number	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
		Community and Economics		
44	The Proponent shall provide staff with access to online information and resources for money management and budgeting.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Local Employment and Procurement Management Strategy **EAP**	Construction / Operation / Closure	
45	Recruitment for care and maintenance positions shall follow the same process used for hiring mine employees, prioritizing local hire, with preference given to former qualified mine employees.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Local Employment and Procurement Management Strategy	Construction / Operation / Closure	
46	Security requirements shall take into consideration the potential for early unscheduled closure and the need for care and maintenance requirements to maintain environmental safeguards prior to decommissioning.	**Reclamation and Closure Plan** Section 9.0: Reclamation and Closure Liability	Closure	
47	The Proponent shall match the current Government of Yukon incentive for secondary suite renovation ($10,000). Residents in Dawson and its environs will be eligible, with the number of Proponent grants capped at 30 approved and matched incentives.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Infrastructure and Services Management Strategy	Construction / Operation / Closure	
48	The Government of Yukon shall work with the City of Dawson and Tr'ondëk Hwëch'in Government to identify and make available suitable lands for housing development.	**Yukon Government**		Additional detail will not be provided

Decision Document Monitoring Requirements				
Mitigation Letter	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
Wildlife and Wildlife Habitat				
A	The Government of Yukon shall implement a monitoring program for linear development (i.e. roads) and surface disturbance (i.e. mined areas) in the White Gold area in relation to effects to moose and other wildlife (i.e. caribou). The program shall be scoped with the following considerations: 1. Monitoring shall include past developments and disturbances as well as reclamation efforts. 2. Monitoring shall seek to consolidate the quantity and quality of data submitted by Proponents into a consistent format for intended use in this program. 3. The program shall aspire to define significant cumulative linear and surface disturbance thresholds in the White Gold area for moose and caribou prior to issuance of any new Quartz Mining Land Use approvals, or expansion by more than 5% of the disturbance area for existing approvals. 4. The program shall be developed collaboratively with First Nations with traditional territory overlapping the area. First Nation participation in the monitoring program shall be funded by Government of Yukon. 5. The program shall be guided by a Terms of Reference (ToR), developed by consensus with Government of Yukon and First Nation government representatives. The ToR shall define temporal and spatial scopes, roles and responsibilities, and overall mandate. 6. Monitoring shall reflect and complement priorities identified in and work undertaken for the Dawson Land Use Plan.	**Yukon Government**		
B	The Government of Yukon shall implement monitoring of the overall abundance of moose in the Dawson Gold Fields MMU using a variety of methods that allow for tracking of population abundance and spatial distribution, such as aerial surveys and tracking of licensed harvest data, and which are performed consistently throughout the Project's lifecycle. Surveys should be conducted in early winter, commencing prior to construction, with subsequent surveys at five-year intervals, where possible, and include involvement of monitors from affected First Nations. The subsequent effects monitoring shall be informed by survey results and annual monitoring of all licensed moose harvest in game management subzones adjacent to, and intersecting the Northern Access Route.	**Yukon Government**		
C	The Proponent shall, in coordination and consultation with Government of Yukon, undertake effects monitoring of moose populations for areas of direct overlap with mine infrastructure, including the Northern Access Route, and for areas determined to be in the ZOI for moose within the Dawson Gold Fields MMU, Lower Stewart MMU and White Gold MMU.			Newmont is currently in negotiations with Yukon Government regarding the effects monitoring program for wildlife. Program details will be provided when finalized as the negotiations are ongoing.
D	Within 5 years of commencing operations, Government of Yukon shall conduct regional surveys, focusing on the interactions between the Fortymile and Klaza caribou herds and the Project. These surveys shall be conducted for the purposes of understanding the direct effects of the Project as well as the effects of the Project's induced development on herd movements and populations, establishing adaptive management thresholds and determining if additional measures are required should the evidence indicate there are negative project-related effects on caribou, either directly or indirectly.	**Yukon Government**		

Decision Document Monitoring Requirements				
Mitigation Letter	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
Water and Aquatic Resources				
E	The proponent shall develop and implement a plan to monitor seepage quality downgradient of the ROM ore pad to serve enable detection of any arsenic or uranium breakthrough from the pad to the underlying groundwater. Monitoring data shall be compared to triggers developed under the proponent's Environmental Monitoring and Adaptive Management Plan.	**Groundwater Monitoring Plan** Section 2.3.5: Seepage Monitoring	Construction Operations Closure	GW Monitoring Plan includes a visual survey once a month during the non-frozen season to confirm the presence of persistent seepage around facility perimeters (ROM).
		Surface Water Quality and Aquatic Life Adaptive Management Plan Section 4.5.3: Indicators, Performance Thresholds and Responses		Latte Creek thresholds tied to completing an evaluation of the ROM stockpile pad seepage.
F	The proponent's Environmental Monitoring and Adaptive Management Plan (EMAMP) plan shall include: 1. Water management goals defined as use-protection in Halfway, Latte and YT-24 creeks, and non-degradation in Coffee Creek and the Yukon River downstream of Halfway, Latte and YT-24 creeks; 2. For the purpose of non-degradation performance evaluation for the Yukon River extend monitoring spatially to the Yukon River downstream of Halfway, YT-24 and Coffee creeks, in areas directly affected by each creek's plume. This is in addition to water quality for the purpose of non-degradation performance evaluation in the fully mixed areas of the Yukon River downstream of Coffee Creek. 3. The rationale for the scope of the monitoring programs; 4. Descriptions of how the Project effects assessments informed the development of the monitoring programs; and 5. Descriptions and rationales for which programs require an adaptive management component. 6. Include AMP events for Halfway Creek closer to the site than HC1.0, which is located in the lower reaches of Halfway Creek upstream of the Yukon River, where use-protection WQOs can be proposed; 7. Include annual assessments to confirm non-degradation of surface water quality in Coffee Creek downstream of Latte Creek and the Yukon River downstream of Halfway, Latte and YT-24 creeks; such assessments will include comparison to a reference watershed; 8. Thresholds for arsenic and uranium levels in downgradient seepage of the ROM ore pad and triggers for adaptive measures 9. And shall develop Adaptive Management initiatives to address areas of uncertainty relevant to: i. Performance of the Alpha Rock Drain; ii. Performance of the Alpha Pond(s) (water quality and seepage quantity and quality); iii. Performance of the bioreactor treatment system for HLF seepage (EBR system); and iv. NORM/TENORM for long-term storage of uranium-rich materials (EBR materials) 10. Define stabilization of water quality in the Alpha Pond (during the Closure phase, as a pre-condition for decommissioning of the Alpha Pond in Post-Closure) as: i. No notable upward trends in the COPIs ii. A sustained reduction in inter-annual variability in COPI concentrations from Operations phase conditions iii. Discharge concentrations for all COPIs are consistently at levels that allow WQOs to be achieved in Halfway Creek.	1) **Water Management Plan** Section 1.4.2: Territorial Regulations 1) **Surface Water Quality and Aquatic Life Adaptive Management Plan** Section 1.2: Adaptive Management Plan Objectives	Construction Operations Closure	
		2) **Surface Water Quality Monitoring Plan** Section 2.0: Monitoring Locations and Frequencies		
		3) **Environmental Monitoring and Adaptive Management Plan**		
		4) **Environmental Monitoring and Adaptive Management Plan** Section 2.0: Environmental Monitoring Approach		
		5) **Environmental Monitoring and Adaptive Management Plan** Section 2.2: Adaptive Management Approach		
		6) **Water Management Plan** Section 4.3.8.1: Alpha Pond Performance Targets and Mitigation Measures		
		7) **Surface Water Quality and Aquatic Life Adaptive Management Plan**		Will not include a comparison to a reference watershed.
		8) **Surface Water Quality and Aquatic Life Adaptive Management Plan** Section 4.5.3: Indicators, Performance Thresholds and Responses		Latte Creek thresholds tied to doing an evaluation of the ROM stockpile pad seepage.
		9i) **Water Management Plan** Section 4.3.7: Alpha Rock Drain		
		9ii) **Water Management Plan** Section 4.3.8.1: Alpha Pond Performance Targets and Mitigation Measures		
		9iii) **Heap Leach and Process Facilities Plan** Section 4.5.3.1: Process Descriptions 9iii) **Heap Leach and Process Facilities Plan** Section 4.5.3.3: Contingency Water Treatment Plan		
		9iv) **Heap Leach and Process Facilities Plan**, Section 4.5.3.1 Process Descriptions		
		10) **Reclamation and Closure Plan** Section 7.11.2: Aquatic Conditions Monitoring, Section 5.8.2 Contingency Planning and Adaptive Management Approach		

Decision Document Monitoring Requirements				
Mitigation Letter	**Proposed Mitigation**	**Management Plan**	**Project Phases**	**Notes**
		Health and Safety		
G	The Proponent shall include the following parties in the development of a monitoring program to ensure that the Project's effects on personal safety are adequately monitored: Government of Yukon, the Yukon Status of Women Council, and the Yukon Aboriginal Women's Council.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Health and Well-Being Management Strategy		
H	To position Government of Yukon with adequate information to act on recommendations and preparation of services within communities, data collected in the monitoring program must be shared and used by parties in the development of response and resources to address effects as they occur. To support that, information relating to the amount and percentage of workforce that is transient to the Yukon will be required. The Proponent shall provide a quarterly report detailing the numbers and percentage of workforce that is transient (i.e. fly-in/fly-out and non-resident to the Yukon) to the Government of Yukon.	**Socio-economic Monitoring Plan** Section 6.0: Monitoring **Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Infrastructure and Services Management Strategy and Community Health and Well-Being Management Strategy		
I	The Proponent shall develop an Air Quality and Dust Management and Monitoring Plan which incorporates the following: 1. Long-term Monitoring stations o Long-term monitoring stations will be operated throughout the phases of the Project. The long-term monitoring stations: o Shall be placed at the permanent camp facilities, mine dry and office complex); the truck shop/warehouse; and at the Yukon River foreshore, east of the existing Coffee Creek camp. These are sites of predicted exceedances and worker presence (including off-duty workers) and likely exposure. The aim of establishing these stations is to redress the insufficient number of monitoring stations suggested by the Proponent for the mine site area. o Employ continuous monitoring, as opposed to the periodic and volumetric monitoring currently proposed. 2. Apply the use of MicroPulse LiDAR technology to monitor and track dust and particulates throughout the Project and adjacent areas. 3. At the commencement of Project Operations, Government of Yukon (YG) shall develop a repository for the monitoring data collected by the Proponent under the Air Quality and Dust Management Plan, and which it will provide on a timely (quarterly) basis. This repository will be accessible to First Nations, industry parties, regulators and the general public. YG shall review repository data and ensure compliance with the Adaptive Management Measures outlined under Mitigations 40 and 41. 4. A system for implementing additional monitoring and/or mitigation measures in the event of: o Changes to overall air quality, particularly increases in particulates, dust and contaminant concentrations approaching thresholds; o Complaints o Such a plan is required for submission during the Quartz Mining Licence phase for the Project. 5. A system for tracking, recording and responding to complaints related to air quality in collaboration with Environmental Health Services. Complaints are to be submitted to Environmental Health Services for recording purposes.	1. **Air Quality and Greenhouse Gas Monitoring Plan** Section 2.0: Monitoring Locations, Section 3.0: Monitoring Methodology 2. **Air Quality and Greenhouse Gas Monitoring Plan** Section 4.0 Data Analysis and Interpretation; Yukon Government 3. **Air Quality and Greenhouse Gas Monitoring Plan** Section 6.0 Reporting and Annual Review 4. **Newmont Coffee Grievance Mechanism** 5. **Newmont Coffee Grievance Mechanism**	Construction Operations Closure	1. Continuous monitoring for PM10, PM2.5, NOx and SO2 and discrete monitoring for dustfall with metals analysis is proposed for the mine dry and office complex. Passive monitoring for dustfall fall with metals analysis and NOx and SO2 is proposed for the Yukon River Foreshore. The Yukon river foreshore location is only inhabited for part of the year and will likely have unreliable power, therefore, passive monitoring is proposed for this site. The truck shop/warehouse and the existing Coffee Creek Camp are not expected to produced statistically different results than the mine dry and office complex and may have reliable power and/or equipment interference effects. 2. MicroPulse LiDAR is not a currently available and accepted practice.
		Community and Economics		
J	A working group shall be formed consisting of Government of Yukon, City of Dawson, Tr'ondëk Hwëch'in Government and the Proponent. This working group will monitor project-induced population growth and housing demand across project life. Project monitoring must involve the collection of data on the population of Dawson, rental and homeownership rates, availability of rental and market housing and associated prices. The Proponent shall provide an annual report on workforce numbers and place of worker residence, made publicly available, to establish clear reporting of inmigration trends.	**Socio-economic Monitoring Plan** Appendix B: SEMP Management Strategies - Community Infrastructure and Services Management Strategy		

Proponent Commitments - Reclamation and Closure Plan

FSR Plan	Mitigation Name	Reference	Proponent Committed Mitigation	Management Plan	Commitment Incorporated	Section Location	Notes
Access Route Construction Management Plan (ARCMP)	ARCMP	SIR7-R7-4 (YOR 2017-0211-2174)	The NAR will be decommissioned at the end of the Post-mining closure stage, unless otherwise directed by First Nations or regulators. Decommissioning of the new portions of the NAR that are purpose-built for the Project will entail the removal of culverts and bridges to maintain pre-construction surface drainage, removal of the barge landings, and general grading of the road surface to promote runoff shedding. Once grading is complete, the road surface will be scarified. All culverts and bridges installed on currently undisturbed or unconstructed sections of the NAR are proposed to be removed unless Yukon Government or Yukon Water Board specifically authorizes otherwise during approval of the Project's Reclamation and Closure Plans (updated every two years during Project operation). As existing road falls on crown land, Newmont will continue to work with Yukon government and placer claim holders (if infrastructure falls within placer claims) on long term maintenance activities.	RCP	Yes	**RCP** Section 7.8.2: NAR and On-site Access Road	New sections of the NAR will be decommissioned near the end of the Active Closure Phase. All culverts and bridges installed on the new sections of road will be removed.
Access Route Construction Management Plan (ARCMP)	Project and Exploration Airstrip Access Management	SIR1-21.1-R281 (YOR 2017-0211-326-2)	• The Project airstrip will be reclaimed near the end of the Post-closure Phase, when lighting, navigation equipment, and culverts will be removed. Reclamation will involve contouring, scarifying, top-soiling, and seeding. Once the Project airstrip is reclaimed, the existing airstrip at the exploration camp will be used instead.	RCP	Yes	**RCP** Section 7.8.3: Project Airstrip	The project airstrip will be decommissioned near the end of the Active Closure Phase.
Access Route Construction Management Plan (ARCMP)	Project and Exploration Airstrip Access Management		Once the exploration airstrip is no longer needed to support Post-closure monitoring activities, reclamation will be undertaken and will involve contouring, scarifying, top-soiling, and seeding.	RCP	Yes	**RCP** Section 7.8.3: Project Airstrip	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP	PP Table 32-2 (YOR 2017-0211-027-1)	• Develop a detailed closure Adaptive Management Plan (AMP) to support Project licensing.	RCP	Yes	**RCP** Section: 5.8.2: Contingency Planning and Adaptive Management Approach	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Consult and work with communities for subsequent versions of the reclamation and closure plan, which will include mitigation measures activities related to socioeconomic aspects of closure (e.g., community contributions, partnerships).	RCP	Yes	**RCP** Section 2.1 : Consultation and Engagement Activities	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Salvage suitable soil material from areas that will be disturbed by the Project footprint where appropriate.	RCP	Yes	**RCP** Section 7.9.6: Soil Salvage	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Undertaken progressive reclamation and closure. Revegetate inactive areas as soon as practical.	RCP	Yes	**RCP** Section 2.3.2: Progressive Reclamation	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Implement erosion and sedimentation mitigation associated with reclamation and closure activities.	RCP	Yes	**RCP** Section 7.9.4: Erosion and Sediment Control	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Ensure that reclaimed ponds and conveyance structures are graded, as required, for proper drainage. Implement a care and maintenance program during seasonal closures or temporary closure.	RCP	Yes	**RCP** Section 6.4.4 Water Management Infrastructure - Diversion Ditches, Alpha and Facility Pond; Section 7.7: Site Water Management Infrastructure	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• During temporary closure, conduct regular inspections to confirm compliance with applicable permits and licenses.	RCP	Yes	**RCP** Section 6.6: Reporting and Monitoring Requirements	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Maintain an egress point out of Open Pits during Reclamation and Closure and Post-closure phases, to reduce potential wildlife entrapment.	RCP	Yes	**RCP** Section 7.1.4: Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Develop a Revegetation Reclamation Research Program where reclamation protocols will be developed and tested on-site. Apply the most successful treatments more broadly during the reclamation phase.	RCP	Yes	**RCP** Section 2.3.1.1: Revegetation Reclamation Research	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Decommission and close Project facilities as described in this plan.	RCP	Yes	**RCP** Section 7.0: Final Reclamation and Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Continue the Operation Phase monitoring programs until no longer required or have been adapted for closure.	RCP	Yes	**RCP** Section 5.7: Monitoring Activities	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP	SIR2-14-R2-73 (YOR 2017-0211-411-1)	• A Social Reclamation and Closure Plan will be developed as an effort to minimize potential negative effects to local communities and individuals.	RCP	Yes	**RCP** Section 2.3.3: Minimizing Project Effects	Socio-economic monitoring and mitigation measures to minimize potential negative effects to local communities and individuals will be described in the SEMP as well as in future iterations of the RCP.

Proponent Commitments - Reclamation and Closure Plan							
FSR Plan	**Mitigation Name**	**Reference**	**Proponent Committed Mitigation**	**Management Plan**	**Commitment Incorporated**	**Section Location**	**Notes**
Conceptual Reclamation and Closure Plan (CRCP)	CRCP	SIR1-2.12-R49 (YOR 2017-0211-323-1)	During the active Reclamation and Closure Phase, numerous personnel will be on site year-round as required, as key activities will include the following:	RCP	Yes	**RCP** Section 7: Final Reclamation and Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Continue water treatment until HLF effluent is of suitable quality for discharge.	RCP	Yes	**RCP** Section 7: Final Reclamation and Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Continue operation of conveyance structures and sedimentation ponds until water quality in the ponds meets discharge requirements.	RCP	Yes	**RCP** Section 7: Final Reclamation and Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Continue decommissioning of roads, pads, processing equipment, and other mine infrastructure, then decommissioning of water management infrastructure toward the end of the active Reclamation and Closure Phase.	RCP	Yes	**RCP** Section 7: Final Reclamation and Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Reclaim remaining disturbed areas within the Mine Site footprint.	RCP	Yes	**RCP** Section 7: Final Reclamation and Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Continue routine monthly, annual, and event-driven monitoring at conveyance structures and sedimentation ponds and their dams for stability, signs of seepage, blockage due to ice or foreign debris and significant erosion, or damage to any geosynthetic components.	RCP	Yes	**RCP** Section 7: Final Reclamation and Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		• Continue monitoring of surface water quality and infrastructure in accordance with conditions of mine licences and monitoring to observe progress toward the return of the Mine Site to pre- mining conditions.	RCP	Yes	**RCP** Section 7: Final Reclamation and Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		Annual physical inspections of engineered facilities will be carried out by a qualified engineer licensed to practice in Yukon. An annual review of the monitoring program results (including inspections and instrumentation data) by a qualified engineer will be a requirement of internal protocols and expected in Project licenses.	RCP	Yes	**RCP** Section 7.11.6: Physical Inspections	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP	SIR7-R7-16 (YOR 2017-0211-2174)	Certain components of the site will be buried in place at closure, this includes items that are not salvageable, (e.g., pond liners, concrete foundations, piping).	RCP	Yes	**RCP** Section 7.3.2: Heap Leach Facility Pond Closure Measures; Section 7.4.1: Crusher System and Crushed Ore Stockpile Area Closure Measures; Section 7.5: Plant Site Closure Measures; Section 7.6: Camp Site Closure Measures	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP	TH Proposed Conditions (March 2020) (YOR 2017-0211-3971)	Description of the approach for determining End Land Use objectives that explicitly considers; i. Pre- and post-mining traditional use; ii. Pre-mining ecosystems and habitats in comparison with the projected postmining landscape. iii. How affected communities and First Nations will be engaged in the development of the End Land Use objectives.	RCP	Yes	**RCP** Section 3.2: End Land Use Planning	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		Specific closure objectives for major mine components and analysis of cover options based on the closure objectives. These specific objectives must then be incorporated into a workplan clearly illustrating how the closure objectives are considered in the development of the closure concepts and detailed closure plans proposed for each of the major mine components.	RCP	Yes	**RCP** Section 3.1.4: Component-specific Closure Objectives	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		These objectives should include consideration of the following: i. Minimizing infiltration / contact water; ii. opportunities to mitigate pathways for metal uptake in vegetation and wildlife; and iii. supporting target ecosystems and habitats. iv. Measures to ensure arsenic concentrations within the top metre of waste rock storage locations will not exhibit an arsenic concentration greater than 60 mg/kg, on average.	RCP	Yes	**RCP** Section 3.1.4: Component-specific Closure Objectives	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		Description of continuous improvement measures or research to reduce loading of contaminants into the environment through ongoing evaluation and implementation of mine planning, mine development, mitigation, and remedial options in order to meet the long-term protection goals for waterbodies downstream of the mine components, including but not limited to enhancing the level of use-protection in Halfway Creek.	RCP	Yes	**RCP** Section 2.3.1: Reclamation Research	
Conceptual Reclamation and Closure Plan (CRCP)	CRCP		A reclamation research program that is designed to test proposed reclamation and closure activities in order to reduce uncertainty or answer specific questions in order to develop detailed reclamation and closure plans that support achieving closure objectives. This program must consider: i. Specific closure objectives of major mine components; ii. a detailed implementation schedule tied to life of mine milestones.	RCP	Yes	**RCP** Section 2.3.1: Reclamation Research; Section 2.3.1.4: Reclamation Research Implementation Schedule	
General Mine Development Plan (GMDP)	Failure Modes and Effects Analysis and Risk Register	SIR1-2.1-R1 (YOR 2017-0211-323-1)	The Failure Modes and Effects Analysis (FMEA) and associated Risk Register are to be updated and refined during Project design and planning, including during the development of the detailed Reclamation and Closure Plan (RCP) for Project licensing.	RCP	Yes	**RCP** Section 2.3.4.4: Step 4: Failure Modes and Effects Analysis	

Proponent Commitments - Reclamation and Closure Plan							
FSR Plan	**Mitigation Name**	**Reference**	**Proponent Committed Mitigation**	**Management Plan**	**Commitment Incorporated**	**Section Location**	**Notes**
General Mine Development Plan (GMDP)	Phased Mine Development and Progressive Reclamation	PP Table 32-1 (YOR 2017-0211-027-1)	In addition to providing flexibility in the schedule, maximizing ore grade, and allowing the HLF to be maintained at full production capacity, phased development of the mine will reduce pre-stripping requirements in the early years. Progressive reclamation and closure activities will begin as soon as mining is completed and will continue throughout the mine life.	RCP	Yes	**RCP** Section 2.3.2: Progressive Reclamation	Phased development of the mine is incorporated into the mine plan. Progressive reclamation activities will commence at the beginning of the Operations Phase (Years -1 to 9).
Heap Leach and Process Facility (HLPF)	Heap Leach Solutions	SIR1-5.7-R98 (YOR 2017-0211-324-1)	Upon completion of active leaching operations, solution management will be required until the closure cover is established, and clean runoff is diverted off the facility.	RCP	Yes	**RCP** Section 7.3.1: Heap Leach Pad Closure measures	
Heap Leach and Process Facility (HLPF)	Heap Leach Solutions	SIR1-9.4-R207 (YOR 2017-0211-325-1)	Water treatment of HLF draindown waters will continue until both seepage volumes and seepage chemistry are reduced sufficiently such that additional polishing measures (e.g., biological passive treatment) are demonstrated to meet post-closure discharge limits. An extensive testing and piloting program is planned for post-closure water management using biological passive treatment. Results of this program, along with results from the progressive rinsing and in situ reclamation proposed for the HLF, will dictate the timing of post-closure water treatment.	RCP	Yes	**RCP** Section 5.3.12: Site Water Management Infrastructure; Section 2.3.1: Reclamation Research	
Heap Leach and Process Facility (HLPF)	Heap Leach Solutions	SIR2-2.6-R2-14 (YOR 2017-0211-411-1)	The EBR will be operating year-round for treatment of rinse waters for the heap, but only during the open water period of May to September for treatment of excess heap leach rinse waters that are to be discharged to the environment. Phase 2 testing will optimize the EBR system to include and test any needed pre-and/or post-treatments required to achieve site water treatment objectives.	HLPF Plan; RCP	Yes	**HLPF Plan** Section 4.5.2: Chemistry of HLF Solutions **RCP** Section 2.3.1.2: Treatment Technologies Reclamation Research	The WTP will be available for treatment of site impacted water year round, but is planned to be used for excess heap leach solution during the open water period.
Heap Leach and Process Facility (HLPF)	Management of Non-Contact Water	PP Table 32-1 (YOR 2017-0211-027-1)	• Progressive closure of HLF will reduce length of time that HLF is at its maximum footprint size.	HLPF Plan; RCP	Yes	**HLPF Plan** Apppendix B: Heap Leach Pad Engineering Report for Licensing; **RCP** Section 7.3.1: Heap Leach Pad Closure Measures	
Heap Leach and Process Facility (HLPF)	Management of Non-Contact Water	SLR4-R4-2 (YOR 2017-0211-4259)	• Progressive reclamation of the heap leach pad will entail rinsing individual sections of the heap leach ore once they have undergone the complete gold recovery cycle. The heap will be rinsed (via solution from the rinse pipelines) and capped in stages; as each stage is capped, the raincoats for that area will be removed and used in other areas or incorporated as part of the closure capping.	HLPF Plan; RCP	Yes	**HLPF Plan** Apppendix B: Heap Leach Pad Engineering Report for Licensing; **RCP** Section 7.3.1: Heap Leach Pad Closure Measures	Partially incporporated. The heap solution will be recirculated for rinsing and not through specific "rinse pipelines", and reliance on raincoats is not included in current design.
Heap Leach and Process Facility (HLPF)	Management of Non-Contact Water	SIR6-R6-14 (YOR 2017-0211-7131)	The diversion channel along the western edge of the Alpha WRSF will be decommissioned in the Post-Closure phase once the water quality in the Alpha Pond has stabilized. The Facility Ponds will be decommissioned in the Post-Closure phase.	RCP	Yes	**RCP** Section 7.7: Site Water Management Infrastructre	Diversion channels and and Facility Pond will be decommissioned during the Active Closure Phase, once water quality in the Alpha Pond has stabilized.
Heap Leach and Process Facility (HLPF)	Heap Leach Pad Liner System	SIR1-9.3.2-R183 (YOR 2017-0211-325-1)	• Should groundwater and/or surface water monitoring indicate a leak after the facility has been decommissioned, an investigation will be undertaken to determine the size and extents of the leak and if natural attenuation processes are active. If warranted, active remediation such as groundwater interception, may be undertaken as appropriate.	RCP	Yes	**RCP** Section 7.3.1: Heap Leach Pad Closure Measures	
Heap Leach and Process Facility (HLPF)	HLF Cover System	SIR1-2.11-R44 (YOR 2017-0211-323-1)	Most of the HLF cover will be composed exclusively of geologic materials of rock and soil. In a small portion of the Coffee heap, the crest, and benches, a GCL will be included beneath the rock and soil layers.	RCP	Yes	**RCP** Section 7.3.1: Heap Leach Pad Closure Measures	
Heap Leach and Process Facility (HLPF)	HLF Cover System	SIR1-2.12-R52 (YOR 2017-0211-323-1)	Field trials with a minimum of two to three years of monitoring of the selected capping system is envisioned for the Project. For example, beginning in the fourth year of operation, the oldest portion of the heap will be rinsed, graded, and capped. This area will produce 15 years of data before final closure is completed. Even the last portions of the heap to be capped will undergo several years of monitoring.	RCP	Yes	**RCP** Section 2.3.1.3: Site Characterization Reclamation Research	
Heap Leach and Process Facility (HLPF)	HLF Design to Facilitate Progressive Closure	SIR1-2.12-R48 (YOR 2017-0211-323-1)	Side sloping may need to be scheduled for the warmer months due to freezing. Soils and rock placement will generally be done between May and December. GCL will only be installed immediately before the rock or soil cover is to be installed. GCL installation in May, July, and August will be limited to dry periods.	RCP	Yes	**RCP** Section 7.3.1: Heap leach Pad Closure Measures	
Heap Leach and Process Facility (HLPF)	HLF Design to Facilitate Progressive Closure	SIR1-2.12-R51 (YOR 2017-0211-323-1)	The RCP will also be frequently updated and reviewed (every two years) as part of the licensing conditions, and this will allow adaptations to the design based on field experience.	RCP	Yes	**RCP** Section 2.2: Sequences and Phases of Reclamation and Closure Planning	

Proponent Commitments - Reclamation and Closure Plan

FSR Plan	Mitigation Name	Reference	Proponent Committed Mitigation	Management Plan	Commitment Incorporated	Section Location	Notes
Heap Leach and Process Facility (HLPF)	HLF Design to Facilitate Progressive Closure	SIR1-Appendix 9-B (YOR 2017-0211-368-1)	Progressive reclamation and closure of the HLF includes measures designed to improve heap seepage water quality. Specifically, the addition of microbes, carbon, and nutrients to the heap during progressive rinsing and reclamation will foster reducing conditions within 368-1) the heap pore waters allowing for in situ denitrification and ultimately reductive precipitation of metals.	RCP	No	RCP Section 2.3.1.2: Treatment Technologies Reclamation Research	The HLF will be recirculated for rinsing and final gold recovery during early Post-mining Phase (Year 10-15). The addition of amendments during rinsing remains an option that may be considered. As part of treatment technologies reclamatio research, a pre-feasibility study evaluating permeable reactive barrier and biological reactor technologies has been completed, and a full feasibility study is being considered.
Socio-economic Management Plan (SEMP)	Workforce Transition Strategy	SIR1-12.1-R254 (YOR 2017-0211-326-2)	• Mine activities leading up to and during temporary mine closure or reduced scale of operation will be associated with ensuring that the site is secure and safe to minimize health and safety risks and ensuring compliance with all regulatory and licensing requirements to manage risks associated with reduced activity at the site.	RCP / Health and Safety Program	Yes	**RCP** Section 6: Temporary Closure **SEMP:** Section 4.2.1 Local Employment and Procurement Management Strategy - Mitigation Measure Category #3: Workforce Transition and Training	
Water Management Plan	Water Management Plan	SIR7-R7-4 (YOR 2017-0211-2174)	Stabilization of water quality in the Alpha Pond will be defined as follows: • No notable upward trends in the COPCs. • A sustained reduction in inter-annual variability in COPC concentrations. • All discharge COPC concentrations are consistently at levels that allow WQOs to be achieved in Halfway Creek.	RCP	Yes	**RCP** Section 7.7: Site Water Management Infrastructure	Reference for this commitment is for SIR7-R7-40. This is defined in the RCP during the closure phase, as a pre-condition for decommissioning of the Alpha Pond.
Water Management Plan	Water Management Plan		The proposed water treatment system is a two-stage process. The first stage of the treatment process will oxidize residual cyanide using hydrogen peroxide. The products of this process will be cyanate and/or ammonia and carbon dioxide. The second stage of the process will utilize a biological reactor system termed Electrochemical Biological Reactor or EBR.	HLPF Plan	No	HLPF Plan Section 4.5: Water Treatment of Heap Leach Solutions; Appendix D: Coffee Mine Water Treatment Design for Permitting (WesTech 2023) **RCP** Section 2.3.1.2: Treatment Technologies Reclamation Research	Cyanide destruction will occur through the SO_2/air method. Chlorination will be evaluated as an alternative. The water treatment system includes a 6 stage process, with cyanide destruction and EBR being two of the stages.
Water Management Plan	Water Management Plan	SIR4-R4 (YOR 2017-0211-4259)	Meteorological monitoring will include: • Operation of the existing weather stations, which are located at KM 11 of the mine access road (record period 2012-present; 975 m), and between the proposed HLF and Kona Pit locations (record period 2018-present; 1,300 m). • Continued monitoring of baseline snow courses to quantify snow water equivalent accumulation. All conveyance structures (drainage ditches, collection channels) and both sedimentation ponds and their dams will be inspected for stability (slumping or failure), signs of seepage, blockage due to ice or foreign debris and significant erosion or damage to any geosynthetic components. Monitoring by a qualified professional in accordance with the requirements of the CDA guidelines will be required. Monitoring of surface water during the Operation Phase, Reclamation and Closure and Post-closure Phases, in support of water management, will include both hydrologic (flow) monitoring and water quality sampling. A generic hydrologic monitoring program will focus below on monitoring concepts as they relate to: Mine Site Monitoring; Effluent Monitoring; and Receiving Environment Monitoring.	EMAMP; RCP	Yes	**EMAMP - Appendix D: Meteorological Monitoring Plan** Section 2.0: Monitoring Locations and Frequencies **EMAMP - Appendix K: Physical Monitoring Plan** Section 5.0: Water Management Infrastructure **EMAMP - Appendix B: SWQ Monitoring Plan** Section 3.0: Monitoring Methodology **EMAMP - Appendix A: Hydrology Monitoring Plan** Section 4.0: Monitoring Methodology **RCP** Section 7.11: Maintenance, Monitoring and Reporting Activities **EMAMP - Appendix C: Groundwater Monitoring Plan** Section 2: Mine Site Groundwater Monitoring Reporting and Annual Review sections of all above reports.	

Proponent Commitments - Reclamation and Closure Plan							
FSR Plan	**Mitigation Name**	**Reference**	**Proponent Committed Mitigation**	**Management Plan**	**Commitment Incorporated**	**Section Location**	**Notes**
Water Management Plan	Water Balance and Water Quality Model	TH Proposed Conditions (March 2020) (YOR 2017-0211-3971)	The Site-wide Water Balance and Water Quality and Heap Leach Facility models will be updated annually and include the following components: a) Updated water quality predictions for downstream receiving environment waterbodies, including expected-case and worst-case scenarios; b) Updated year-by-year capacity for emergency available storage in mined pits including consideration of storage that would or would not affect access to ore and impede mining; c) Discussion of the timeframe of water storage available prior to release of environment in the event of a loss in pumping ability; d) Updated schedule for water treatment implementation that includes engineering, procurement, construction, and commissioning; e) An annual water treatment discharge volume plan/goal for the upcoming year; and f) Reassessment of reoccurrence interval analyses and precipitation trends. g) Assessment of amount of raincoat deployment necessary to manage water in the event of the mine entering temporary closure (in order to set raincoat inventory requirements).	Water Management Plan; HLPF Plan; RCP	Yes	**WMP** Section 8.0: Annual Water Management Planning **HLPF MP** Section 4.5.7: Additional Design Testwork and Schedule	Precipitation and snowmelt recurrence interval analyses are not expected to be completed on an annual basis but will be reviewed in the case that large precipitation events are measured on-site that indicate potential exceedances of the design storm events used in water management infrastructure design.
Water Management Plan	Active Water Treatment Testwork	TH Proposed Conditions (March 2020) (YOR 2017-0211-3971)	The Proponent shall provide licensing bodies the results of any bench-scale electro bioreactor testwork. The Water Management Plan must include a water treatment section that describes the workplan and schedule for any pilot-scale and/or full-scale treatment plant design, construction, and operation. At a minimum, the workplan will include a discussion of the preliminary schedule covering kick-off of pilot design through operation of full-scale water treatment plant including key milestones such as: • kickoff of pilot design (should a pilot plant be determined to be required) • pilot deployment to site • pilot operation at site • pilot reporting • design of full-scale system • construction of full-scale system • beginning of full-scale operation The proponent shall provide licensing bodies the results of the passive treatment testing that assesses the use of passive bioremediation treatment of heap leach rinse solutions prior to authorization this treatment method at closure.	HLPF Plan; RCP	Yes	**HLPF Plan** Section 4.5: Water Treatment of Heap Leach Solutions; Appendix D: Coffee Mine Water Treatment Design for Permitting (WesTech 2023) **RCP** Section 2.3.1: Reclamation Research	
Water Management Plan	Passive Water Treatment Testwork	TH Proposed Conditions (March 2020) (YOR 2017-0211-3971)	The proponent shall provide licensing bodies the results of the passive treatment testing that assesses the use of passive bioremediation treatment of heap leach rinse solutions prior to authorization this treatment method at closure.	RCP	Yes	**RCP** Section 2.3.1.2: Treatment Technologies Reclamation Research	
Water Management Plan	Temporary Closure	TH Proposed Conditions (March 2020) (YOR 2017-0211-3971)	In the event of temporary closure, the Proponent shall: a) Within 3 months, provide regulators with a short term HLF water balance for solution recirculation, contingency volume, and time available and volume and quality of water required for HLF rinsing; b) Within 3 months, provide regulators with an implementation plan for the Water treatment plant (if not operational); c) If, while in temporary closure, the decision is made to enter permanent closure, the proponent shall provide regulators with an updated Reclamation and Closure Plan.	RCP	Yes	**RCP** Section 6: Temporary Closure; Section 6.5.2: Heap Leach Facility	
Wildlife Protection Plan (WPP)	Wildlife Protection Plan		• Reclaim riparian vegetation in areas affected by barge landing construction (restore shoreline habitat).	RCP	Yes	**RCP** Section 7.8.2: NAR and On-site Access Road	

APPENDIX 2-A

Summary of Consultation and Engagement Activities Related to Reclamation and Closure

1.0 Document Sharing Summary

Table 1-1 includes a summary of the timeline for Newmont's distribution of the Reclamation and Closure Plan (RCP) to First to support the Environmental and Socio-economic Assessment process and in preparation for Project licencing submission. Table 1-1 also includes the timeline for when subsequent comments/feedback were received by Newmont. Newmont incorporated the comments/feedback into the RCP where possible, and follow-up meetings between Newmont and First Nations were held when necessary to further discuss issues that arose following the document review process.

Table 1-1 Document Sharing Timeline

Date	Outgoing/Incoming	Details
28-Jan-19	Outgoing	NEM shared draft with TH, SFN, WRFN.
03-Jul-19	Incoming	TH shared comments with NEM.
27-April-21	Outgoing	NEM shared draft with WRFN
02-Nov-22	Outgoing	NEM shared draft with TH.
03-Nov-22	Outgoing	NEM shared draft with SFN and WRFN.

TH - Tr'ondëk Hwëch'in; SFN – Selkirk First Nations; WRFN – White River First Nation; NEM – Newmont.

2.0 Engagement Details

This section presents an overview of the key topics that were discussed during engagement events between Newmont and First Nations. The events highlighted below are those that were held outside of the regular biweekly meetings between Newmont and TH, and monthly meetings between Newmont and WRFN, and involved RCP-specific topics. General discussion topics for the ongoing engagement events are not included below.

Table 2-1 Key Engagement Events Between TH and NEM

Date	Meeting Topic	Details
30/31 August 2018	Technical Reclamation and Closure Workshop	NEM and TH met over a two-day workshop to review site-specific closure objectives and definitions from the Socioeconomic Closure Workshop from May 30, 2018. Recommendations to NEM on the draft RCP included refining closure objective evaluation criteria. NEM and TH evaluated closure alternatives for the pits with NEM committing to including alternative assessment in the RCP. NEM committed to arranging a teleconference to discuss adaptive management and environmental monitoring.
21/22 February 2019	Heap Leach Test Pad Design, Water, and Reclamation and Closure Workshop	NEM provided an overview of the Heap Test Cells Design Report and Heap Test Pad Program and Water Management Plans. NEM committed to considering snow as an insulator in the next iteration of the Heap Leach plan. Discussion on Phase I of water testing and the planned test work for Phase II. NEM committed to arranging a teleconference to discuss TH comments on the water monitoring plans.

Date	Meeting Topic	Details
17 December 2021	Reclamation and Closure	NEM presented the Alternatives Assessment Evaluations Overview. TH requested NEM re-examine the Evaluations in consideration of current gold prices. NEM stated additional work (further alternatives assessment, failure modes effects assessment (FMEA)) would be completed in January 2022 and that the results would be shared with TH and other First Nations for discussion. The type of habitat characteristics for end land use was discussed with TH raising the importance of considering the 40-mile caribou. Follow-up items included NEM providing a copy of the HLF Water Treatment Plant Treatability Assessment Report (2016) with TH, and sharing figures developed for the alternatives ranking exercise. NEM committed to re-examining the Alternatives Overview Assessment with consideration of current gold prices.
20 June 2022	Reclamation and Closure Meeting	NEM provided a presentation on the status of the RCP, reclamation research program approach, alternative assessment and FMEA, End Land Use Planning approach, temporary closure scenario, and next steps.

Table 2-2 Key Engagement Events Between SFN and NEM

Date	Meeting Topic	Details
26-28 September 2018	Closure, Site and Water Workshop	NEM and SFN met for a two-day workshop to discuss Project updates, site/mine refinements, mine closure, water quality and treatment, environmental monitoring, and adaptive management. SFN provided suggestions for inclusion in the RCP.

APPENDIX 2-B

Coffee Gold Mine – Revegetation Reclamation Research and Monitoring Report

DRAFT REPORT

Coffee Gold Mine – Revegetation Reclamation Research and Monitoring Report

Prepared for:

Newmont Corporation
166 Titanium Way, Suite 201
Whitehorse, YT Y1A 0G1

Prepared by:

Environmental Dynamics Inc.
2195 - 2nd Avenue,
Whitehorse, YT, Y1A 3T8
T: 867.393.4882
Edynamics.com

March 16, 2022

Document Control			
Lead Author	**Brett Pagacz (EDI)**	**Contributing Author(s)****	**Randy Lewis (Coffee Gold Mine Reclamation Advisor), and** **Katherine Stewart (Department Soil Science, University of Saskatchewan)**
Revision Manager**	**Anne MacLeod (EDI)**	**Contact Information**	**amacleod@edynamics.com**

*Include geomatics resource(s)

**Determined by Project Manager

Version Control			
Version	**Date**	**Issued by**	**Description**
1.0	February 10, 2017	Kathy Aviani	Format, transfer to Goldcorp template
1.0	March 24, 2017	Pamela O'Hara	Text revisions, delete appendices and incorporate relevant info
1.0	March 27, 2017	Jennie Gjertsen	Text revisions
1.0	March 27, 2017	Pamela O'Hara	Ok to clean copy, no further changes
2.0	March 16, 2022	EDI	Newmont format

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Project Summary 1
1.2 Scope and Objectives 4
1.3 Incorporation of Traditional Knowledge and Consultation Feedback 4
1.4 Synergies with Newmont Standards and Requirements and Other Project Documents 4
1.5 Roles and Responsibilities of Key Personnel 5

2.0 RECLAMATION RESEARCH AND MONITORING 7
2.1 Plants for Reclamation 7
2.2 Reclamation Demonstration Sites 9
2.2.1 Year 2013 9
2.2.2 Year 2014 9
2.2.3 Year 2015 10
2.3 Yukon Research Centre Studies 10
2.3.1 Seeding Trials 11
2.3.2 Greenhouse Trials 11
2.3.3 Results: 2015 Yukon Research Centre Studies 12

3.0 SEED COLLECTION, INVENTORY AND MAPPING 16

4.0 NURSERY PLANNING 17

5.0 FUTURE WORK 18

6.0 REFERENCES 19

LIST OF TABLES (WITHIN TEXT)

Table 1-1 Newmont Standards 5
Table 1-2 Key Project Personnel 6
Table 2-1 Native Grass Species Considered for Coffee Gold Mine Reclamation Studies 8
Table 2-2 Native Forb and Shrub Species Considered for Coffee Gold Mine Reclamation Studies 8
Table 2-3 Total Percent Cover for all Species in Boreal Low and Subalpine Ecosites 14

LIST OF FIGURES (WITHIN TEXT)

Figure 1-1 Coffee Project Location and Northern Access Route 2
Figure 1-2 Mine Site General Arrangement 3
Figure 2-1 2015 Seeding Trial Results from Boreal Low and Subalpine Ecotypes at the Coffee Gold Mine Project 14
Figure 2-2 2015 Greenhouse Trials using Arctic Lupine and Boreal Low and Subalpine Soils from the Project Site 15

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
ArCGIS	ArcGIS Mapping Program
BACI	Before-After-Control-Impact
BEM	Broad Ecosystem Mapping
CCME	Canadian Council for Ministers of the Environment
CEA	Cumulative Effects Analysis
CDC	Conservation Data Centre
CFIA	Canadian Food Inspection Agency
CoPCs	Chemical of Potential Concern
COC	Chain of Custody
DFO	Department of Fisheries and Oceans
ELC	Ecological and Landscape Classification
EDI	Environmental Dynamics Inc.
GPS	Global Positioning System
HLF	Heap Leach Facility
ICP-MS	Collision Cell Inductively Coupled Plasma-Mass Spectrometry
IUCN	International Union for Conservation of Nature
MAMP	Monitoring and Adaptive Management Plan
NAR	Northern Access Route
Project	Coffee Gold Mine
Proponent	Kaminak Gold Corporation, a wholly owned subsidiary of Goldcorp Inc.
QA/QC	Quality Assurance and Quality Control
QEP	Qualified Environmental Professional
Report	Revegetation Reclamation Research and Monitoring Report
ROM	Run-of-mine
TH	Tr'ondëk Hwëch'in
UTV	Side by Side Motor Device
VC	Valued Component

Acronym / Abbreviation	Definition
WRSF	Waste Rock Storage Facility
YISC	Yukon Invasive Species Council
YESAA	Yukon Environmental and Socio-economic Assessment Board
YRC	Yukon Research Centre

LIST OF SYMBOLS AND UNITS OF MEASURE

Symbol / Unit of Measure	Definition
ha	hectare
km	kilometre
km/hr	kilometer per hour
m	metre
mg/kg	milligrams per kilogram
Mt	Million tonnes
%	percent

1.0 INTRODUCTION

1.1 Project Summary

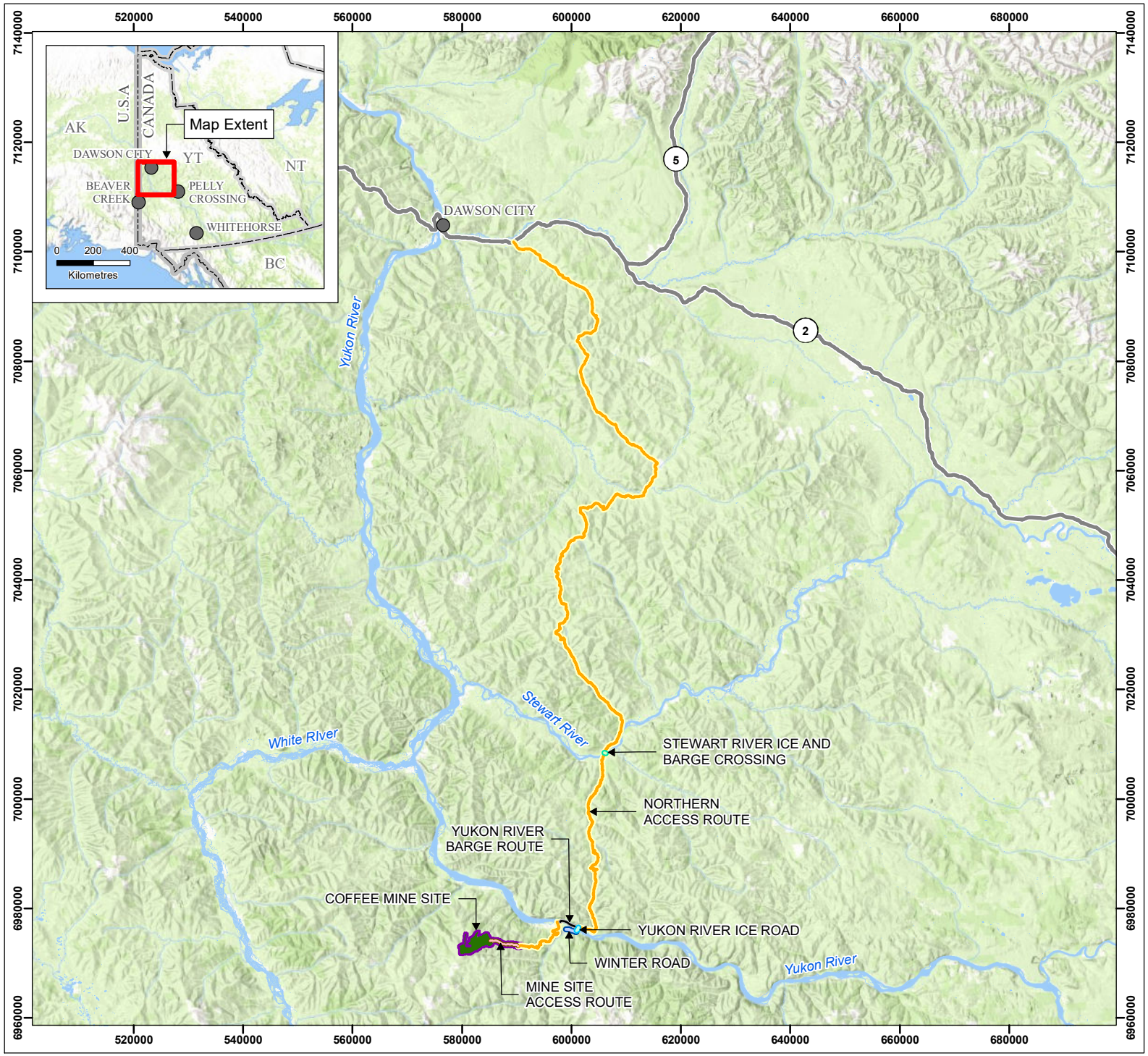
The proposed Coffee Gold Mine (the Project) is an open-pit gold mine owned by Goldcorp Kaminak Ltd, a subsidiary of Newmont, located in the White Gold District of west-central Yukon, approximately 130 km south of the City of Dawson, 140 km west of Pelly Crossing, 95 km south-west of Beaver Creek, and 330 km northwest of Whitehorse. The Project is located wholly within the traditional territory of Tr'ondëk Hwëch'in, partially within the traditional territory of Selkirk First Nation and First Nation of Na-cho Nyäk Dun, and partially within the asserted territory of White River First Nation. The Project contains several gold occurrences within an exploration concession covering an area of more than 600 km^2. The Mine Site will be accessed by road from Dawson via a 214-km all-season, gravel road with pull-outs, referred to as the Northern Access Route (NAR) (Figure 1-1). The NAR includes upgrades to 177 km of existing road and construction of 37 km of new single-lane, forestry-type access road. The NAR includes seasonal barge crossings on both the Stewart and Yukon rivers, with ice bridges in the winter months.

The Project is comprised of open pits named Latte, Double Double, Supremo and Kona, and one permanent Waste Rock Storage Facility (WRSF) named Alpha. The ore production rate is proposed to be up to approximately 9.0 million tonnes (Mt) per year, producing an estimated total of 67 Mt of heap leach feed over the 10-year Operation Phase. The conceptual-level estimate for waste material to be moved over the life of mine (LOM) is 330 Mt based on an average strip ratio of 5.0:1. The ore will be crushed and transported to the Heap Leach Facility (HLF) via overland conveyor or trucks for nine months of the year. During the three coldest months of winter, run-of-mine (ROM) ore will be stockpiled in the ROM stockpile. Gold will be extracted from gold-bearing leach solution by a six tonnes per day (t/d) adsorption, desorption, recovery carbon plant with mercury retorting to produce a final gold doré product. A total of 2.6 million ounces of gold is planned to be recovered over a 10-year mine life.

The Project phases are defined as follows:

- Construction Phase: Q2 Year –3 to end of Year –1 (30 months)
- Operation Phase: Year 1 to end of Year 9 (10 years)
- Reclamation and Closure Phase: Year 10 to end of Year 21, including a 6-year Post-Mining Closure Stage and a 5-year Active Closure Stage (11 years)
- Post-Closure Phase: Year 21 onwards as determined to be required.

These phases broadly describe the activities occurring within a particular time period; however, some activities will continue from one phase to another as mine site development advances with operational activities (e.g., Open Pits, WRSF). When areas that support mine operations are no longer required, they will be progressively reclaimed. The overall Project schedule is the general expected scenario for mine construction and operation; detailed activities are subject to change depending on detailed mine planning and the timing of receipt of authorizations.



COFFEE GOLD MINE

Coffee Project Location and Northern Access Route

Legend

- Stewart River Ice and Barge Crossing
- Yukon River Barge Route
- Yukon River Ice Road
- Winter Road
- Mine Site Access Route
- Northern Access Route
- Project Area
- Project Footprint
- Highway
- Waterbody

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Topographic Map
4. Inset Basemap: ESRI World Topographic Map

N

1:1,000,000

0 5 10 15 20 25

Kilometres

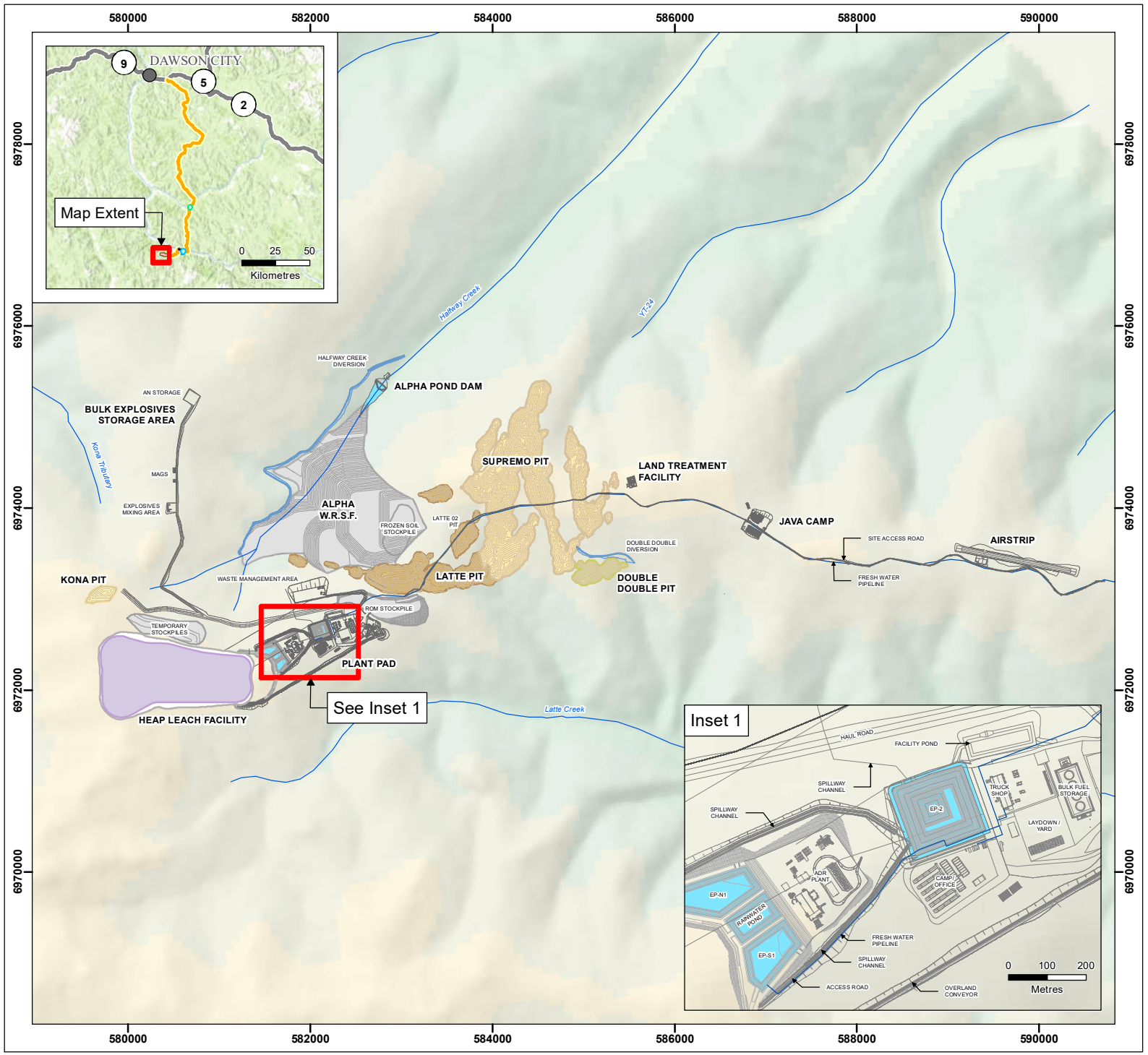
NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 1.1	Date: Mar 2, 2023	Drawn by: AS	Reviewed: KP

Newmont COFFEE

Path: S:\Geomatics\Projects\1038620\1mxd\Fig1_1_1038620_03_CoffeeProjectLoc_NorthernAccessRoute_230302.mxd



COFFEE GOLD MINE

General Arrangement - Mine Site

Legend

- Double Double Pit
- Kona Pit
- Latte Pit
- Supremo Pit

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Inset Basemap: ESRI World Topographic Map

N

1:60,000

0 0.5 1 1.5 2 2.5

Kilometres

NAD 1983 UTM Zone 7N

Page Size: 8 ½" x 11"

Figure 1.2	Date: Oct 6, 2023	Drawn by: AS	Reviewed: CH

Newmont COFFEE

Path: S:\Geomatics\Projects\103862\03\mxd\MXDFig1_2_103862_03_GeneralArrangement_231006.mxd

1.2 Scope and Objectives

Construction, operation, and closure of the Project have the potential to negatively impact vegetation within or near the project area which may affect the environment. This Revegetation Reclamation Research and Monitoring Report (the Report) is intended to summarize research concerning revegetation and reclamation and identify and demonstrate how appropriate management techniques will reduce the potential for any vegetation-related adverse effects to the environment and describes the measures that will be undertaken to reclaim adverse affects generated by Project activities.

This Plan has been written to meet the guidance provided in the *Plan Requirement Guidance for Quartz Mining Projects* (YWB and EMR 2013).

This Report is provided in conjunction with several other plans to meet the requirements for quartz mine applications for a Quartz Mining License and a Water Use Licence under the *Quartz Mining Act* and the *Waters Act*, respectively. Other applicable regulations related to vegetation management and monitoring are detailed in Section 2.0.

1.3 Incorporation of Traditional Knowledge and Consultation Feedback

Consultation during preparation of the Project Proposal (2017-0211) identified vegetation as a valued component that should have a range of mitigation measures implemented in order to minimize change (Goldcorp 2017). Specific concerns included habitat loss, change in vegetation health due to dust deposition, and risk of introduction and spread of invasive plant species.

This draft Report is provided for review and feedback by stakeholders to address the above concerns. Once reviewed, any further concerns, and where they have been addressed in the revised plan will be summarized here.

1.4 Synergies with Newmont Standards and Requirements and Other Project Documents

As an important part of Newmont's internal governance process, Newmont has implemented Global Policies and Standards (Global Standards) that are reviewed and preliminarily approved by a Global Policies & Standards Committee. The Global Standards provides the framework and standards for Newmont sustainability management and ensures a consistency of approach for implementing these global policies across the Company.

The Standards apply to all directors, officers and employees of Newmont Corporation, its subsidiaries, and any other entities that it controls. A variance request process for existing or future conditions is in place. The process provides an alternative mechanism for those instances where a Newmont site/operation cannot logistically or feasibly conform to a requirement established in a Standard due to special conditions or unique hardships. The Standards are intended to be fully integrated into all core business functions, and they emphasize sustainability, responsibility, and accountability at all organizational levels.

The list of Standards is provided in Table 1-1.

Table 1-1 Newmont Standards

Standard	
Air Emissions Management Standard	Land Acquisition and Involuntary Resettlement Standard
Biodiversity Management Standard	Local Procurement and Employment Standard
Closure and Reclamation Management Standard	People Policy
Code of Conduct	Product Stewardship Standard
Community Investment and Development Standard	Social Baseline and Impact Assessment Standard
Cultural Resource and Management Standard	Stakeholder Relationship Management Standard
Drug and Alcohol Policy (Coffee-Specific)	Tailings Storage Facility and Heap Leach Facility Environmental Standard
Hazardous Materials Management Standard	Tailings Storage Facilities Technical and Operations Standard
Health and Safety Policy	Waste Management Standard
Human Resources Standard	Waste Rock and Ore Stockpile Management Standard
Human Rights Standard	Water Management Standard
Indigenous Peoples Standard	

While this Report can be reviewed in isolation to inform a review of the specific actions for vegetation management and monitoring, this report should be viewed in concert with the following additional management plans in order to attain a holistic understanding of the Project:

- Access Route Construction Management Plan
- Access Route Operational Management Plan
- Reclamation and Closure Plan
- Explosives Management Plan
- Emergency Response Plan
- Spill Contingency Plan
- Vegetation Protection Plan
- Vegetation Monitoring and Adaptive Management Plan
- Water Management Plan
- Wildlife Protection Plan.

1.5 Roles and Responsibilities of Key Personnel

The Proponent has committed to providing the necessary human, material, and financial resources to implement and maintain the Revegetation Reclamation Research and Monitoring Report. Key Project personnel responsible for being familiar with the contents of this Report are shown in Table 1-2.

Table 1-2 Key Project Personnel

Role	Responsibility
Mine General Manager	Overall responsibility for Mine Site management.
Operations Manager	Responsible for mine planning and production, mine technical monitoring, and mine regulatory compliance.
H&S Manager	Responsible for conducting regular safety site inspections and implementing the appropriate controls in a timely manner. The H&S Manager shall maintain records of all safety inspections as well as any actions taken because of these inspections throughout the life of the Project. Where safety inspections show the potential for environmental effects, the H&S Manager will work in collaboration with the Environment Department.
CSR Department	Responsible for recording and addressing any complaints received from nearby land users, or other interested parties regarding vegetation-related impacts off-site. The CSR department shall maintain records of all complaints received as well as any actions taken because of these complaints.
Environmental Manager	Responsible for permitting, environmental monitoring, and regulatory compliance.

2.0 RECLAMATION RESEARCH AND MONITORING

Since the inception of mine exploration associated with the Project, areas disturbed for drilling have been mechanically restored using machinery to replace the vegetation mat. From 2013 to 2015, Kaminak initiated progressive reclamation research alongside exploration activities to test the effectiveness of various reclamation techniques under different site conditions.

2.1 Plants for Reclamation

Not all species have equal weight in providing ecosystem services to the environment (Lawton 1994); therefore, identifying northern plant species that promote effective ecosystem processes is crucial for reclamation. Effective ecosystem processes include below-ground processes, such as nutrient cycling, water cycling, decomposition, and energy flow that support the production of plant matter. In consideration of this, a preliminary list of potential native species for reclamation at the Project was developed by looking at the local availability of plant species recommended for use in the Yukon by the Yukon Revegetation Manual (Matheus & Omtzigt 2013).

Field investigations were conducted in conjunction with baseline rare plant surveys carried out by EDI from July 5 to 9, 2014. Native species considered for reclamation studies were selected based on moderate to high distribution and abundance within the Project area. Abundance was rated on a scale from 1 to 9 based on the British Columbia Ministry of Forests Weed Density Distribution Classes (Luttmerding et al. 1990). These guidelines provide a density distribution for plants growing in a 20 m x 20 m area and take into consideration continuous occurrence and clumped distribution. Locations were marked with a GPS and categorized into broad regional areas.

Candidate native species for reclamation studies identified as having moderate or high abundance included grasses, nitrogen-fixing forbs, and shrubs. Table 2-1 and Table 2-2 provide a preliminary list of native grass species and native forb and shrub native grass species, respectively, that may be considered for reclamation and studies.

Table 2-1 Native Grass Species Considered for Coffee Gold Mine Reclamation Studies

Common Name	Species Name	Ecotype	Abundance[a]	Latitude	Longitude
Alpine bluegrass	*Poa alpina*	Subalpine	4	62.8743	-139.4360
Alpine sweetgrass	*Hierochloe alpina*	Subalpine	7	62.7664 62.8743 62.8878	-139.0063 -139.4360 -139.3299
Bluejoint reedgrass	*Calamagrostis canadensis*	Boreal	8	62.9142	-139.0837
		Subalpine	4	62.8878	-139.3299
Fowl bluegrass	*Poa palustris*	Boreal	7	62.8882 62.9142	-139.0784 -139.0837
		Subalpine	4	62.8878	-139.3299
Glaucous bluegrass	*Poa glauca*	Boreal	7	62.8882 62.8804	-139.0784 -139.1018
Northern rough fescue	*Festuca altaica*	Subalpine	7	62.7986 62.8743 62.8878	-139.0282 -139.4360 -139.3299
Ticklegrass	*Agrostis scabra*	Boreal	5-7	62.8806 62.9084	-139.1002 -139.0697
Tufted hairgrass	*Deschampsia cespitosa*	Boreal	7	62.9144	-139.0868

Note: a. Abundance was rated on a scale from 1 to 9 based on the British Columbia Ministry of Forests Weed Density Distribution Classes to provide a baseline value for abundance and distribution (Luttmerding et al. 1990).

Table 2-2 Native Forb and Shrub Species Considered for Coffee Gold Mine Reclamation Studies

Common Name	Species Name	Notes
Alpine bearberry	*Arctous alpina*	Found in open subalpine not dominated by high shrubs > 2 m tall, such as scrub birch.
Alpine sweet-vetch	*Hedysarum alpinum*	Found in the low boreal forest along the Yukon River. Nitrogen fixing plant.
Arctic lupine	*Lupinus arcticus*	Found in open subalpine not dominated by high shrubs > 2 m tall, such as scrub birch. Nitrogen fixing plant.
Arctic willow	*Salix arctica*	Found in open subalpine not dominated by high shrubs > 2 m tall, such as scrub birch.
Bog bilberry	*Vaccinium uliginosum*	Found in moist subalpine and boreal forest
Canada buffalo-berry	*Shepherdia canadensis*	Found in dry subalpine and boreal forest. Nitrogen fixing plant.
Dwarf birch	*Betula glandulosa*	Widespread in subalpine
Gray-leaved willow	*Salix glauca*	Widespread in subalpine
Lowbush cranberry	*Vaccinium vitis-idaea*	Widespread at all elevations
Mountain avens	*Dryas* spp.	Found in open subalpine not dominated by high shrubs > 2 m tall, such as scrub birch.
Northern bedstraw	*Galium boreale*	Found in subalpine and boreal forest

2.2 Reclamation Demonstration Sites

Mine exploration involves surface disturbance where the vegetation mat is removed for drilling core samples. The outcome of drilling activities is commonly referred to as drill sites/fences. As exploration activities progress, these disturbances create a need for progressive reclamation and revegetation. Additional disturbances which present an opportunity to test methods of reclamation and revegetation onsite are cut slopes along the existing access road between the Coffee exploration camp and the deposit (i.e., Java Road). These areas are prone to erosion; therefore, various methods of reclamation and revegetation (i.e., site prescription) must be tested to determine the most effective solution to reduce erosion and stabilize slopes. Kaminak Environmental Monitors conducted preliminary research at reclamation demonstration sites in 2013. In 2014, Kaminak, in collaboration with Arctic Alpine Reclamation Group, expanded reclamation demonstration sites to include data collection and monitoring, as well as new sites).

2.2.1 Year 2013

In 2013, reclamation studies tested basic site prescriptions at existing drill sites/fences. The objective was to test natural regeneration through mechanical reclamation and seeding. To conduct mechanical reclamation, machinery is commonly used to replace the original vegetation layer from where it was removed. A combination of machinery and manual labor was used to conduct this work. Kaminak Environmental Monitors used shovels and rakes to replace soil, vegetation, and boulders in an effort to emulate a well-known reclamation technique referred to as “rough and loose”. Rough and loose surface treatments provide ecosystem benefits by minimizing compaction, controlling erosion, and creating conditions that promote revegetation of the site (Polster 2009). The rough and loose approach promotes a diversity of habitats by creating topographic heterogeneity, which supports early and successful establishment of pioneering species (Holling 1973).

In 2013, sites were seeded with native seed from Arctic Alpine Reclamation Group, including 20% tickle grass (*Agrostis scabra*) 20% alpine bluegrass (*Poa alpina*), 20% glaucous bluegrass (*Poa glauca*), 20% Rocky Mountain fescue (*Festuca saximontana*), and 20% tufted hairgrass (*Deschampsia caespitosa*) at a rate of 1500 pure live seeds per square metre (PLS/m^2). The seed was applied with a manual seed spreader and raked into the soil materials.

2.2.2 Year 2014

In 2014, reclamation studies expanded to include long-term monitoring plots at existing and new reclamation demonstration sites including drill sites/fences and cut slopes.

The objective was to test and monitor various site prescriptions at reclamation demonstration sites to determine which prescriptions are most effective for reclamation and revegetation for the Project. The following site prescriptions were applied to new disturbed sites in 2014 including drill sites/fences, and cut slopes along the Java Road:

1. Mechanical Reclamation (MR).
2. Mechanical Reclamation + Seeding (MRS).
3. Mechanical Reclamation + Raking + Seeding + Raking (MRRSR).

4. Mechanical Reclamation + Bio-engineering + Seeding + (MRBS).

Drill sites/fences were treated with site prescriptions one (MR), two (MRS) or three (MRRSR) which included mechanical reclamation, seeding, and/or raking. For those site prescriptions that included seeding, in 2013, seed was sourced from Arctic Alpine Reclamation Group. In 2014 and 2015, seed was locally collected onsite and included a mixture of grasses, nitrogen-fixing forbs, and shrubs (for details on seed collection refer to Section 3.0 Seed Collection, Inventory, and Mapping**)**.

Site prescription four (MRBS) was only applied at selected cut slopes along the Java Road and tested local seed mixtures and bio-engineering techniques. Bio-engineering techniques involved staking and bundling cuttings from local shrubs including willow (*Salix* spp.), alder (*Alnus viridis*), balsam poplar (*Populus balsamifera*), and birch (*Betula glandulosa*). Native seed was also applied to the cut slopes; the seed mix included alpine bluegrass (*Poa alpina*), glaucous bluegrass (*Poa glauca*), Rocky Mountain fescue (*Festuca saximontana*), tufted hairgrass (*Deschampsia caespitosa*), and boreal wormwood (*Artemisia norvegica* ssp. *saxatilis*). Seed was applied at a rate of 1500 PLS/m^2.

Demonstration sites along the Java Road focused on cut slopes. Cut slope site prescription trials focused on three main sites located at KM 1.6, 3.2, and 7.2. Cut slope sites were different in size; site one at KM 1.6 was 35 m x 2.5 m (87 m^2), site two at KM 3.2 was 195 m x 3 m (585 m^2) and site three was 285 m x 90 m (25,650 m^2). Site three was further divided into eight, 30 m plots. For all sites, native species cuttings were inserted horizontally (bundles) and vertically (stakes) into the soil. Willow, alder, balsam poplar, and Labrador tea (*Rhododendron groenlandicum*) were used as cuttings for bioengineering. All erosion sites were treated with site prescription four (MRBS), which included soil bioengineering techniques. Soil bioengineering is the use of living plant materials to perform specific engineer functions (Schiechtl 1980). To test the effectiveness of site prescriptions at demonstration sites, four 1 m^2 long-term monitoring plots were established at selected demonstration sites.

2.2.3 Year 2015

Reclamation demonstration sites established in 2013 and 2014 were monitored in 2015. To determine the effectiveness of site prescriptions at drill sites/fences, the percent cover of germinating plants were measured at all four 1x1 m plots within a site. At cut slope sites, the percent cover of vegetation was also recorded, as indicated by the percent of live stakes and bundles. Results for the reclamation demonstration sites will be provided following future onsite monitoring activities that will be undertaken by Randy Lewis and Environmental Monitors.

2.3 Yukon Research Centre Studies

In 2015, the Yukon Research Centre (YRC) established seeding trials to test various reclamation techniques in different ecotypes present onsite at the Project site. In addition, greenhouse trials were conducted to test the relationship between soil amendments and the recovery of ecosystem processes (i.e., nitrogen-fixation). Seeding trials were conducted onsite at the Project site in conjunction with the NTR course. Greenhouse trials were conducted at the YRC by trained staff, as a laboratory experiment. Both trials support reclamation research and monitoring activities as part of the Project.

2.3.1 Seeding Trials

Seeding trials were conducted to determine germination rate and percent cover of native seed applied to different ecotypes using various reclamation techniques. Using a randomized block design, trials were established at both boreal low and subalpine sites. At each site ten blocks each with seven different reclamation techniques were installed for a total of 140 plots. The reclamation techniques were applied in 1 m² plots and randomly assigned within each block. At a minimum, all plots were situated 1 m apart and 1 m from the edge of the site. The following seven reclamation techniques were tested:

- Boreal low, organic matter and seed (BOS)
- Subalpine, organic matter and seed (SOS)
- Boreal low, organic matter, fertilizer and seed (BOFS)
- Subalpine, organic matter, fertilizer and seed (SOFS)
- Fertilizer and seed (FS)
- Seed only (S), and
- Control, no addition (C).

The two types of organic matter applied as a soil amendment were Boreal low (BO) and Subalpine (SO). The BO amendment was harvested from a low-lying bog underlain by permafrost at approximately 50 to 100 cm located near the airstrip. The SO amendment was harvested from the top 50 cm of the soil profile in subalpine birch heath located adjacent to a subalpine drill site/fence. Kaminak Environmental Monitors, NTR students, and YRC researchers applied organic matter at 5% (v/v) to the top 5 cm of soil and fertilizer (19:19:19 NPK) was added at 160 kg/ha. A native seed mix was applied at a rate of 1500 PLS/m². The native seed mix included alpine bluegrass (*Poa alpina*), glaucous bluegrass (*Poa glauca*), Rocky Mountain fescue (*Festuca saximontana*), tufted hairgrass (*Deschampsia caespitosa*) and boreal wormwood (*Artemisia norvegica* ssp. *saxatilis*). Plots were seeded from June 15 to 16, 2015 and measured for germination and percent cover from August 17 to 18, 2015. Although the seed used in this initial trial was not from site, all species in the mix were found to occur naturally on-site and was sourced from the Alaska Seed Bank to maintain regional continuity. For additional information on local seed collections that were carried out concurrently to this trial please refer to Section 3.0 Seed Collection, Inventory and Mapping**.**

2.3.2 Greenhouse Trials

To test the relationship between soil amendments and the recovery of ecosystem processes a greenhouse trial was conducted at the Yukon Research Centre (YRC) using a common native species found at the Project site. Arctic lupine (*Lupinus arcticus*) is an understory species that possesses natural nitrogen-fixing abilities. Through a symbiotic relationship with a strain of bacteria known as rhizobia, lupine can fix nitrogen to assist growth, development and reproduction of plants in the surrounding soil and promotes ecosystem processes. This process occurs in tiny, round nodules on the roots and is a good indication of site conditions that will support natural regeneration.

In a controlled growth chamber, eight treatments were tested to determine ethylene production in lupine after three months of growth. Ethylene is a natural plant hormone that is produced as a by-product during

all stages of tissue development. It is produced from all parts of higher plants, including leaves, stems, flowers, fruits, roots, tubers and seeds. The amount of ethylene produced (ppm/h) by individual lupine plants growing in a medium was measured for each of the following treatments:

- Inoculum peat and seed (IP-S)
- pH adjusted, inoculum peat and seed (pHIP-S)
- Inoculum seed (IS)
- Peat and seed (P-S)
- pH adjusted, peat and seed (pHP-S)
- Seed only (S)
- Inoculum peat and inoculum seed (IP-IS), and
- pH adjusted, inoculum peat and inoculum seed (pHIP-IS).

Lupine root nodules were harvested onsite June15–16, 2015. Root nodules were kept in a cool, dark fridge until processing on June 26, 2015. Both roots and nodules were washed with a small brush to remove soil, rinsed with deionized (DI) water, sterilized with ethanol by submersing it in the liquid for 30 seconds then rinsed by DI water six times. Nodules were separated from the roots using a sterile scalpel, weighed and then ground with a mortar and pestle. Ground nodules were added to a yeast sucrose broth (YSB; Vincent 1970). The YSB was made by mixing 100 g of baker's yeast with one litre of cold DI water. The mixture sat at room temperature for one hour then was autoclaved at 120°C for 40 min. Following this it was left to settle before adjusting the pH to 6.10 with calcium carbonate (CaCO3). The mixture was left to stand for 24 hours at room temperature, then was diluted to 1500 ml with DI water to create enough broth for all treatments.

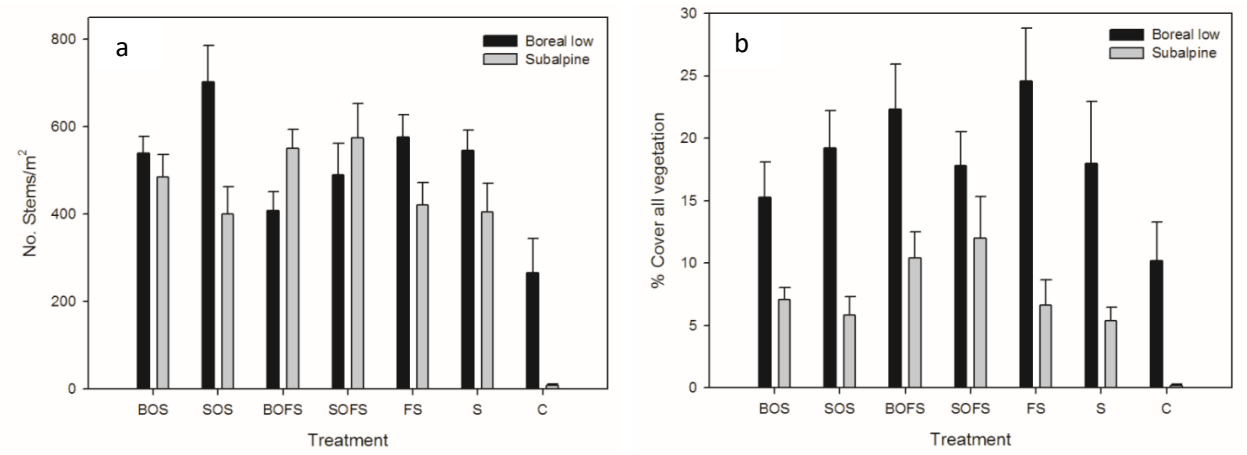
Potting soil and organic peat were collected from two locations onsite June 14, 2015, from the boreal low (62˚54.267', -139˚04.666') and subalpine (62˚53.043', -139˚17.429') areas. The peat was processed for the potting trials by sieving, air drying, sterilizing in an autoclave at 120 ° C for one hour, then grinding the material in a food processor. It was neutralized with $CaCO_3$ at a rate of 10 km/m^3 (12 g added to 1200 ml of peat). Sterilized peat was then mixed with the YSB to achieve 50% moisture v/v (700 ml peat was mixed with 700 ml YSB). Finally, both peat and lupine seeds were soaked in the YSB for 24 hours or DI water. Two lupine seeds were planted per tube of 150 ml of soil and watered to field capacity with DI water. After approximately three months soils were measured by ARAs-acetylene reduction assays to determine amount of ethylene produced (ppm/h).

2.3.3 Results: 2015 Yukon Research Centre Studies

Seeding Trials

Overall organic matter and fertilizer amendments had little to no effect on germination rates of the native seed mix for either the boreal low or subalpine ecotypes (Panel a in Figure 2-1); However, the addition of fertilizer either alone or in addition to organic matter affected the percent cover of vegetation found growing at sites within these ecotypes (Panel b in Figure 2-1). In general, aboveground cover was higher in all plots with fertilizer amendments in both the boreal low and subalpine ecotypes. This suggests that at least in the

first growing season aboveground biomass production can be promoted by the use of commercial fertilizers. Further research is needed to determine the long term effectiveness of fertilizer addition on plant growth. Total percent cover for all species was three times higher in the boreal low (18%) than the subalpine (6%), which was in part driven by the recruitment of native local volunteer species (6%) establishing in the research plots (see Table 2-3). While further monitoring is needed to determine the effectiveness of these amendments over time it is evident that different approaches will likely be required in different ecotypes. High recruitment from the seed bank at the boreal low site indicates that natural revegetation will likely occur with minimal interventions; however, the low aboveground cover and lack of recruitment from the seed bank at the subalpine ecotype indicates that a more extensive revegetation strategy will likely need to be developed.



Note: Germination rate (number of stems/m^2) is on the left (a) and percent cover (%) is on the right (b);
Source: Stewart 2015a.

Figure 2-1 2015 Seeding Trial Results from Boreal Low and Subalpine Ecotypes at the Coffee Gold Mine Project

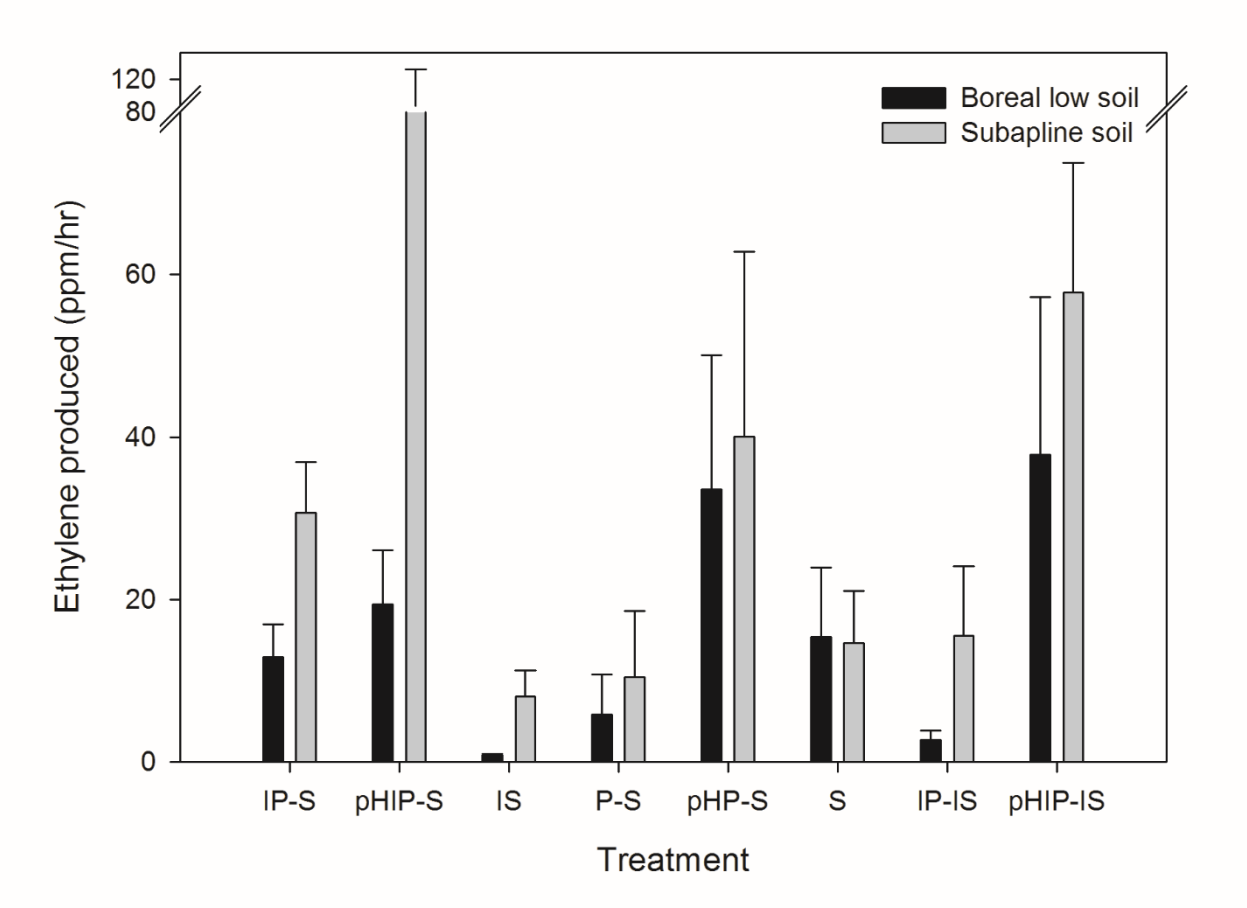
Table 2-3 Total Percent Cover for all Species in Boreal Low and Subalpine Ecosites

Ecotype	Total Cover (%)	Grass Cover (%)	Volunteer Species (%)
Boreal low	18	12	6
Subalpine	6	6	0

Greenhouse Trials

Ethylene production (i.e., nitrogen-fixation) from lupine was significantly different between boreal low and subalpine soils within some treatments (Figure 2-2). Nitrogen fixation was higher in subalpine than boreal low soils for the following treatments: IP-S (Inoculum peat and seed), pHIP-S (pH adjusted, inoculum peat and seed, IS (Inoculum seed) and IP-IS (Inoculum peat and inoculum seed). There was no difference in nitrogen fixation between subalpine and boreal low soils for the following treatments: P-S (Peat and seed), pH-S (pH adjusted, peat and seed), S (Seed only), and pHIP-IS (pH adjusted, inoculum peat and inoculum seed).

Between treatments, pH adjustment of peat led to higher rates of nitrogen-fixation. This may be due naturally low acidic/high alkaline subalpine soil or a naturally high number of rhizobium in the soil. Quantification of the rhizobium associated with each treatment could determine if rhizobium colonization rates were higher in the above treatments or if higher alkaline conditions only increased nitrogen-fixation activity, while maintaining similar colonization rates.



Source: Stewart 2015a.

Figure 2-2 2015 Greenhouse Trials using Arctic Lupine and Boreal Low and Subalpine Soils from the Project Site

3.0 SEED COLLECTION, INVENTORY AND MAPPING

In 2014, Kaminak initiated onsite seed collection and inventory for use in reclamation studies based on the preliminary list of potential species for reclamation (see Section 2.1 Plants for Reclamation**)**. This was expanded in 2015 through the work with the Yukon Research Centre. Disturbed and undisturbed vegetation communities in the boreal low, boreal high and subalpine ecotypes were surveyed to identify species naturally recolonizing disturbed areas. Due to higher rates of natural recovery and the reduced adverse effects expected in the boreal low ecotype (i.e., no Project mining operations in the boreal low), seed collection sites were selected in the boreal high and subalpine ecotypes. Seed collection sites also considered the availability of native species for bio-engineering bundles and stakes. Native seed was collected during the fall of 2014 and 2015 from KM zero (i.e., old airstrip) to KM 20 (i.e., Java Road). Detailed locations are provided online as part of an interactive seed source map available at:

http://yrc-c.maps.arcgis.com/apps/MapJournal/index.html?appid=30b9ade6ce39467d8bb503fbfe4147b5

More than 30 candidate species were collected from 26 locations including grasses, nitrogen-fixing forbs, and shrubs. Seed collection considered plant phenology according to species. Plant phenology refers to the timing of plant growth and development. This can vary by season and is dependent on factors such as climate, elevation, and aspect. All seed was harvested by hand then dried and stored in the temporary nursery located onsite at the Coffee exploration camp.

Early successional species colonizing disturbed areas within the boreal high and subalpine ecotypes included prickly rose (*Rosa acicularis*), red raspberry (*Rubus idaeus*; boreal high only), fireweed (*Chamerion angustifolium*), bitter fleabane (*Erigeron acris*), tall lungwort (*Mertensia paniculata*; boreal high only), blue-joint reedgrass (*Calamagrostis canadensis*) and *Poa* grass species. This suggests that these species are good indicators of disturbed areas in these ecotypes and may be appropriate candidates for reclamation and revegetation.

4.0 NURSERY PLANNING

Using native species for northern reclamation is a challenge due to lack of available seed stock. In 2014 and 2015, Kaminak initiated preliminary plans to examine the basics of operating a nursery onsite. As part of this pilot project, Environmental Monitors and students from the NTR program established a temporary nursery at the Coffee exploration camp and participated in native seed potting trials and target species transplants. To prepare seeds for planting in nursery pots all seeds were cleaned by sieving to separate the seed from the husk and outer covering and then dried on a mesh rack. Following this, seeds were planted in nursery pots with soil collected onsite and watered to examine survival. Target species transplants were potted as soon as possible to prevent drying or damage to the root system.

Newmont will seek opportunities to work with local or Yukon First Nation businesses who are interested in establishing a nursery to grow native species for use in reclamation research and ultimately to cultivate seed and plants for use in reclamation activities (i.e., species that are adapted to the growing and climatic conditions that occur at the Mine Site).

5.0 FUTURE WORK

Newmont has committed to continue reclamation research and monitoring as part of reclamation and closure planning. Future work aims to increase the scope and depth of research to find innovative restoration techniques that are Project specific. One way that this can be achieved is by understanding rhizosphere (i.e., plant-root interface) properties of boreal plants and their potential to restore belowground processes (Iversen et al. 2015). This is important because understanding how these plant species interact with soil is fundamental to the development of sound and successful restoration practices that not only promote predictability of plant community assemblages, but also ensure restoration of key ecosystem processes in soils that support these communities over the long-term (Kardol and Wardle 2010; Quideau et al. 2013). It has been identified that more knowledge is needed on the use of local peat as a soil amendment during restoration and to address the management of a large ice-rich peat deposit overlying one of the major proposed pits onsite (i.e., Supremo). In addition, understanding the relationship between soil biological community development, carbon and mineral nutrient availability, and ecosystem function will provide important information for the reclamation and closure plan. To fulfill these knowledge gaps, Newmont has committed to a three-year (2016 to 2018) reclamation research program with Katherine Stewart (Assistant Professor, University of Saskatchewan) to:

1. Characterize the rhizosphere of northern native plants that are potential candidates for restoration to understand the relationship between the diversity and abundance of plant roots, soil bacteria, fungi, and archaea with ecosystem functions (i.e., soil nitrogen and carbon cycling and storage).
2. Examine the use of local peat as a soil amendment during restoration and the potential impact of stockpiling on above and belowground plant-soil systems.
3. Investigate the interaction of peat soil amendments with northern plant species and rhizospheres.
4. Establish a three-year field trial to evaluate the restoration of plant-soil materials on existing disturbance (e.g., drill fences) in subalpine areas.

This work will result in the training of two technicians, two masters' students, and three undergraduate student assistants. It will also engage Newmont's environmental monitoring team by involving the Environmental Monitors in field trial establishment and monitoring.

6.0 REFERENCES

Holling, C.S. 1973. Resilience and stability of ecological systems. Annu. Rev. Ecol. Syst. 4: 1-23.

Iversen, C.M., V.L. Sloan, P.F. Sullivan. E.S. Euskirchen, A.D. McGuire. R.J. Norby, A.P. Walker, J.M. Warren, and S.D. Wullschleger. 2015. The unseen iceberg: plant roots in Arctic tundra. New Phytologist. 205(1): 34-58.

Kardol, P., and D.A. Wardle. 2010. How understanding aboveground-belowground linkages can assist restoration ecology. Rends in Ecology & Evolution 25 (11):670-679.

Lawton, J.H. 1994. What do species do in ecosystem? Oikos. 71: 367-374.

Luttmerding, H.A., D.A. Demarchi, E.C. Lea, D.V. Meidinger, and T. Vold. (editors). 1990. Describing ecosystems in the field. 2nd Edition. B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forestry. Ministry of the Environment (MOE) Manual 11. Victoria, B.C.

Matheus, P.E. and C.M. Omtzigt. 2013. Yukon revegetation manual: practical approaches and methods. Whitehorse, Yukon. 182 pages. ISBN 978-0-9919499-0-8. Available at: http://www.yukonrevegetationmanual.ca/. Accessed January 1, 2016.

Polster, D.F. 2003. Soil bioengineering for slopes stabilization and site restoration. Paper presented at Sudbury Mining and the Environment III. Laurentian University, Sudbury, Ontario. May 25-28, 2003.

Polster, D.F. 2009. Natural Processes: The application of natural systems for the reclamation of drastically disturbed sites. Paper presented at the B.C. Technical and Research Committee on Reclamation, BC Mine Reclamation Symposium. Cranbrook, B.C. September 14-17, 2009.

Quideau, S.A., M.J.B. Swallow, C.E. Prescott, S.J. Grayston, and S.W. Oh. 2013. Comparing soil biogeochemical processes in novel and natural boreal forest ecosystems. Biogeosciences 10:5651-5661.

Schiechtl, H. M. (Trans. N.K. Horstmann, 1980). Bioengineering for land reclamation and conservation. University of Alberta Press. Edmonton. Alberta. 404 pp.

Stewart, K. 2015a. Seeding and greenhouse trials preliminary results. Yukon Research Centre. Whitehorse, Yukon.

Stewart, K. 2015b. Natural Sciences and Engineering Research Council of Canada proposal: boreal rhizosphere restoration, restoring belowground processes with northern native plants. Proposal 441262.

Vincent, J.M. 1970. A manual for the practical study of the root-nodules. Blackwell Scientific Publications. IBP Handbook 15 Oxford and Edinbugh

APPENDIX 2-C

2021 Revegetation Research at Minto Mine – Year 1 Progress Report

Yukon University

Revegetation research at Minto Mine

Year 1 Progress Report | November 2021

UNIVERSITY OF ALBERTA

Acknowledgements:

Dr. Simon Landhäusser at the University of Alberta was instrumental in study design and provided long-distance guidance as needed – thank you for your continued support despite Covid-19 travel restrictions! Thank you to Minto Explorations Ltd. for providing a research location and logistical support when our research team was on site. The authors would also like to thank field assistants Amanda Eskridge, Taylor Belanksy, Ben McGrath and Kirsten Reid for their invaluable support setting up the experiment. Thank you to Brittany Hynes for organizing and sending field equipment from the University of Alberta. Seed collection support from Maria Ledergerber, Brett Isbister, Bonnie Burns and Jared Gonet was greatly appreciated.

Funding for this research was generously provided by Natural Science and Engineering Research Council of Canada, Mitacs, Yukon University's Innovation and Entrepreneurship, Weston Family Foundation and the Yukon Mining Research Consortium: Minto Explorations Ltd., Newmont Corporation, BMC Minerals Ltd., Victoria Gold Corp., Casino Mining Corp., Selwyn Chihong Mining Ltd., and Alexco Resource Corp.

Project Team:

Krystal Isbister, PhD Student, University of Alberta/YukonU Research Centre
Dr. Guillaume Nielsen, NSERC Industrial Research Chair in Northern Mine Remediation, YukonU Research Centre

This publication may be obtained from:

YukonU Research Centre, Yukon University
500 University Drive P.O. Box 2799
Whitehorse, Yukon Y1A 5K4
867 456 6986 or 1 800 661 0504
www.YukonU.ca/research

Table of Contents

Introduction 1
Experimental design 2
Experiment set-up in 2021 4
Project area description 4
Site selection and preparation 5
Experiment layout 5
Biotic structure establishment 5
Species selection for shrub shelters 6
Seedling procurement 6
Abiotic structure installation 7
Transect Installation 8
Baseline sampling and environmental monitoring 8
Remaining experiment set-up activities 9
Characterization of mountain avens 9
Soapberry establishment 9
Transects for living shelters 9
Species selection for target species 10
References 11
Appendix 1. June 16th and July 24th vascular plant species list from Southwest Waste Dump 14
Appendix 2. September 2021 photopoints 15

List of Figures

Figure 1. Green alder seedling facilitating the “capture” of windblown seeds. 1
Figure 2. Within block layout of transects and germination/seedling plot replicates. See Figure 3. for detailed layout of each replicate. 3
Figure 3. Replicate layout for germination/seedling plots. Target species will be selected in 2022. 3
Figure 4. Minto Mine revegetation research location on the Southwest Waste Dump. 5
Figure 5. Minto Mine revegetation experiment layout 5
Figure 6. Planting rows of alder along a stringline in Block 2. The short fence (left) and tall fence (right) are already installed. 7
Figure 7. Seedbed preparation with a hand-held cultivator along a transect. 8
Figure 8. Amanda and Taylor celebrating successful weather station installation. 8
Figure 9. Examining freshly prepared Blocks 3 and 4, looking east. 10

List of Tables

Table 1. Summary of experiment treatments…… 2

Table 2. Seed source locations for shelter species…….. 6

Table 3. Alder seedling characteristics from twenty randomly selected seedlings…….. 7

Table 4. Mean soil characteristics and standard error (n=3) from baseline sampling in June 2021 and single red residuum sample results. TOC=total organic carbon and TIN=total inorganic nitrogen…. 9

Table 5. Shrub seedling heights (n=10) in September 2021……..9

Introduction

Revegetation is a key process in reclamation as it ultimately determines future land uses by people and wildlife (Guittony 2020). The majority of boreal reclamation research focuses on oil sands mining in the Boreal Plains Ecoregion of Alberta with a strong emphasis on soil amendments of peat and forest floor materials, as well as extensive tree planting (Dhar et al. 2018). Forest floor salvage and peat amendments can reintroduce plant propagules and improve soil characteristics; tree planting reduces the time to canopy closure and can limit establishment of weedy species (Macdonald et al. 2015). In the Yukon, most mines are in remote locations without significant peat or topsoil resources. Access to locally sourced tree seedlings is also limited. Best practice in revegetation is to optimize the use of local resources (Guittony 2020) and thus exploring alternative techniques for northern regions is warranted.

Facilitation by woody shrubs in restoration projects has been documented in dry, arid climates, but not tested in northern systems (Gómez et al 2004; Castro et al. 2004; Gómez -Aparacio et al. 2005). Research studying shrub encroachment in arctic and alpine tundra provides evidence that tall shrubs have a strong, year-round influence on northern non-forested community dynamics (review by Myers-Smith et al. 2011). Plants can facilitate the survival and growth of their neighbors by providing more favorable environmental conditions such as reduced soil and air temperature extremes, nitrogen fixation, attracting pollinators and providing physical protection from herbivory (Castro et al. 2004 Baraza et al. 2006; Padilla and Pugnaire 2006; Dona and Galen 2007; Brooker et al. 2008). In cold climates, vertical structure such as a shrub canopy can increase the capture of snow which dramatically alters both summer and winter soil conditions (Kreyling 2019). Vertical structure can also reduce the loss of soil and seeds to wind erosion (Peterson 2001).



Figure 1. Green alder seedling facilitating the “capture” of windblown seeds.

Facilitation between plants is most common in harsh environments, especially during the establishment and early growth life stages (Maestre et al. 2009). Growth of shrubs alters abiotic and biotic conditions in non-forested northern ecosystems; in a reclamation setting, the presence of shrubs may facilitate establishment and growth of other species. The strength of facilitation effects from the physical characteristics of vertical structure versus biological characteristics of shrubs is unclear.

The main objectives of this study are to evaluate the usefulness of vertical structure in facilitating the arrival, establishment and growth of northern plants and compare the effects of living vs. non-living structure.

More specifically, the hypothesizes investigated in this study are:

1) Vertical structures improve growing season soil moisture by increased wind protection, snow capture and soil shading.
    a. The magnitude of effect is proportional to structure height and distance from structure
    b. Living structures increase soil moisture more than inert structures as litter increases soil organic matter and thus water holding capacity
2) Living vertical structures improve growing season plant available nitrogen by nitrogen fixation and litter deposition
    a. The magnitude of effect is species specific
    b. The magnitude of effect is proportional to structure height and distance from structure
3) Increases in soil moisture and plant available nitrogen provided by woody shrubs improves plant growth under harsh, northern conditions
    a. Facilitation by woody shrubs is stronger than competition during establishment and early growth of target species
4) Vertical structure increases natural deposition of seeds
    a. From animal/bird dispersal using the perches/cover
    b. From wind dispersal, slowing wind currents to deposit seeds

Experimental design

The study design is a randomized complete block experiment with biotic and abiotic structures of three different heights for a total of four blocks of six treatments (Table 1.). Treatments are in rows perpendicular to the dominant wind direction. Spacing between rows is based on the tallest treatment in each row to avoid interference between treatments; main effects of treatments are expected between two and seven times structure height (AAFC 2010). See the Experiment Layout Section for more details on actual site layout.

Table 1. Summary of experiment treatments

Treatment Height	Biotic Structure	Abiotic Structure
Tall	Green alder	0.65 m snow fence
Medium	Soapberry	0.35 m snow fence
Short	Smooth-leaf mountain avens	0 m control

To determine whether vertical structure facilitates seed capture, three 0.25 m wide transects with a smooth, uniform seedbed will be installed straddling each treatment from -1 to 7x the treatment height (Figure 2.). In Blocks 1-3, soil moisture and temperature sensors will also be installed along the centre transect at -1, 1, 3, and 7x the treatment height.

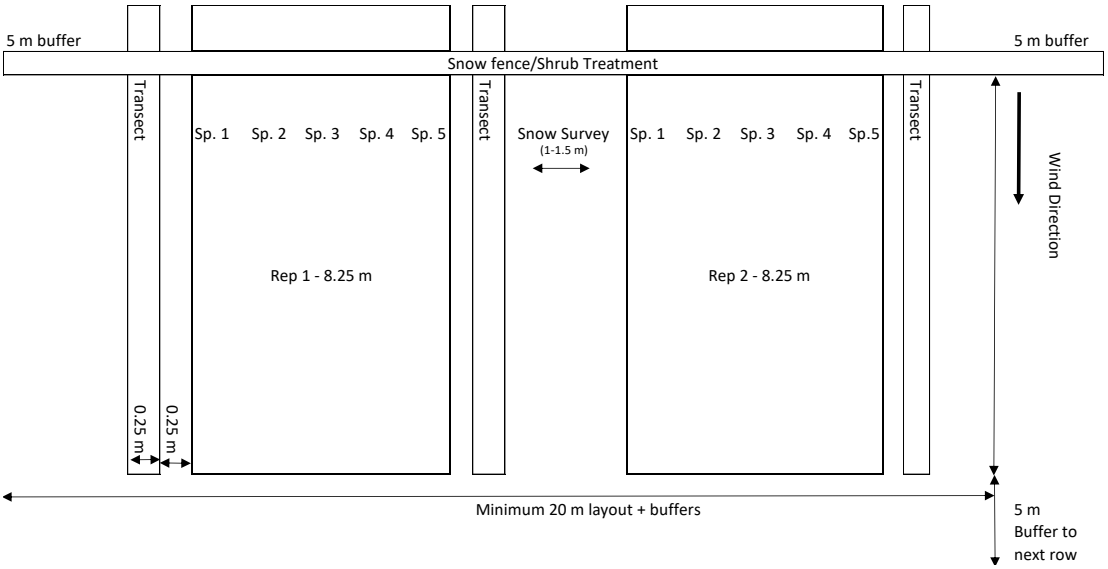


Figure 2. Within block layout of transects and germination/seedling plot replicates. See Figure 3. for detailed layout of each replicate.

In Year 3 (2023), small plots will be established at -1, 1, 3, and 7x the height of the shelter to evaluate the effect of vertical structure on the germination, establishment and growth of target northern plants (Figure 3.). Shrub heights in each treatment will be averaged from measurements in Year 3 to determine the treatment height. For each target species, paired comparisons of spring vs. fall seeding/planting will be tested. Germination trials of 100 seeds will be installed in 0.15 m^2 plots; protection from herbivory will be provided if required. Plant performance will be tested by planting six seedlings in 0.5 x 0.15 m plots. A minimum distance of 0.25 m between plots will be maintained. Germination percentages, seedling survival, seedling height will be sampled in September of Year 4 (2024).

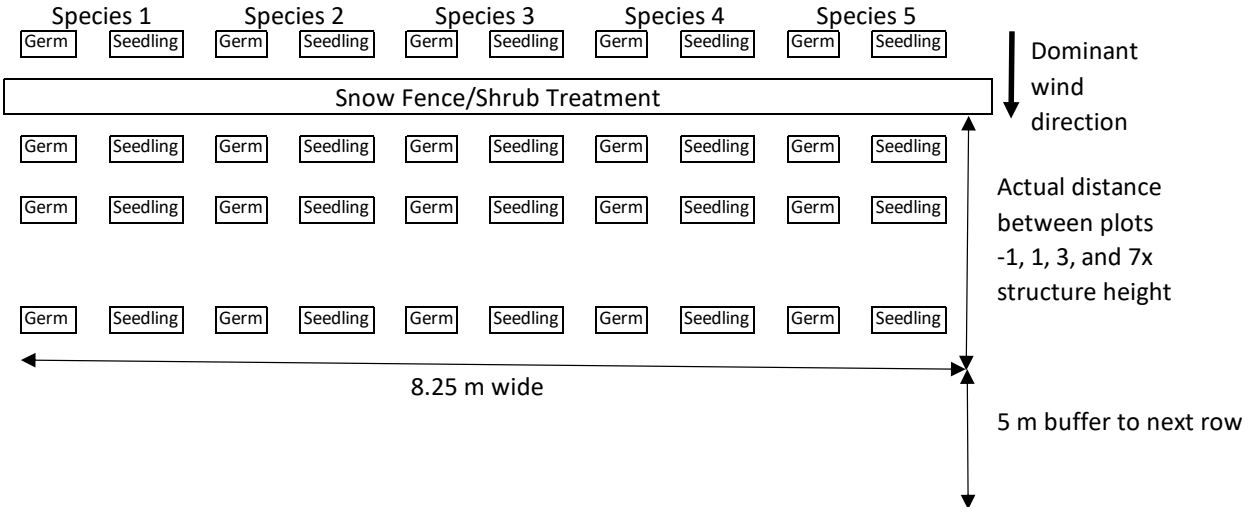


Figure 3. Replicate layout for germination/seedling plots. Target species will be selected in 2022.

Experiment set-up in 2021

Project area description

The research will be located at the Minto Mine in central Yukon, Canada (62.620097°N, 137.276705°W). The site is within the Yukon Plateau-Central Ecoregion of the Boreal Cordillera Ecozone and is characterized by long, cold winters and short, warm summers (Smith et al. 2004). The ecoregion was almost entirely glaciated three million years ago, but the Minto Mine site remained unglaciated during the last glacial maximum (Smith et al. 2004). The northernmost Holocene volcano in Canada, Nelruna (Volcano Mountain), is located about 30 km northeast of the mine and last erupted between 5,000-10,000 years ago (name from Ritter et al. 1977; Smith et al. 2004). Historical annual average temperature was -4°C, though average temperatures in Yukon have risen by 2°C in the past 50 years and increased precipitation is expected in the future (Streiker 2016). Currently, Minto Mine has limited precipitation (<300 mm/year) due to the rain shadow effect of the St. Elias-Coast Mountains (Smith et al. 2004). Wildfire is common due to low precipitation and has resulted in various successional stages of plant communities surrounding the mine (Access Consulting 2013).

The mine footprint is within the Boreal Low Bioclimate Zone-Yukon Plateau North Subzone, with potential for Boreal High Bioclimate Zones at the uppermost elevations (McKenna and Flynn 2017). Most of the surrounding area is forested with pure or mixed stands of trembling aspen (*Populus tremuloides*), white spruce (*Picea glauca*) and lodgepole pine (*Pinus contorta*) depending on drainage, aspect and fire history. Black spruce (*Picea mariana*) forests are found on cool, north facing slopes that have not burned within the last 100 years (Access Consulting 2013). Shrub dominated plant communities (*Salix* spp. and *Betula glandulosa*) are found on the edges of wetlands and riparian areas, and grassland communities are located on dry, warm and nutrient-poor slopes (Access Consulting 2013).

The mine is located within the Traditional Territory of the Selkirk First Nation: Northern Tutchone peoples who share a language and close ties with the First Nation of Na-cho Nyäk Dun and Little Salmon Carmacks First Nation. The majority of Yukon-based citizens live in the community of Pelly Crossing (TPWG 2021), on the banks of Ts'éki Netú (Pelly River), about 60 km upstream of the confluence with Tagé Cho (Yukon River) (Ritter et al. 1977). The Minto Mine area is about 40 km southwest of Pelly Crossing and, prior to the mine, was known as Marten Hill due to a high marten population in the area (Selkirk First Nation 2018).

The mine is also close to Łútsäw Dachäk (Minto Landing), an important gathering and harvesting site beside Tagé Cho and at one point a small settlement (Selkirk First Nation 2018). Łútsäw Dachäk is actively used and the location where Selkirk First Nation representatives signed Self-Government and Final Agreements with the Governments of Canada and Yukon in July of 1997. Included in these agreements was 4,740 km^2 Category A and B Settlement Lands. Minto Explorations Ltd. was in the process of developing the Minto Mine prior to the Final Agreement and is situated in Category A Settlement Land Parcel R-6A. Selkirk First Nation owns the land though the mine is regulated under federal and territorial legislation through special conditions in the Final Agreement (GC, SFN and YG 1997).

Site selection and preparation

A site visit to Minto Mine was completed May 27th, 2021 to identify a location for the research. Site criteria were a 1.5 ha area with minimal slope, final soil cover in place, minimal existing vegetation, and significant wind exposure. The site would need to remain undisturbed for a minimum of four years. A suitable site was identified on the Southwest Waste Dump (see Figure 4.). The waste rock was capped with 0.5 m of overburden in 2014-2015 and the overburden ripped east-west to 30 cm by a Caterpillar 16G grader in early June of 2021.

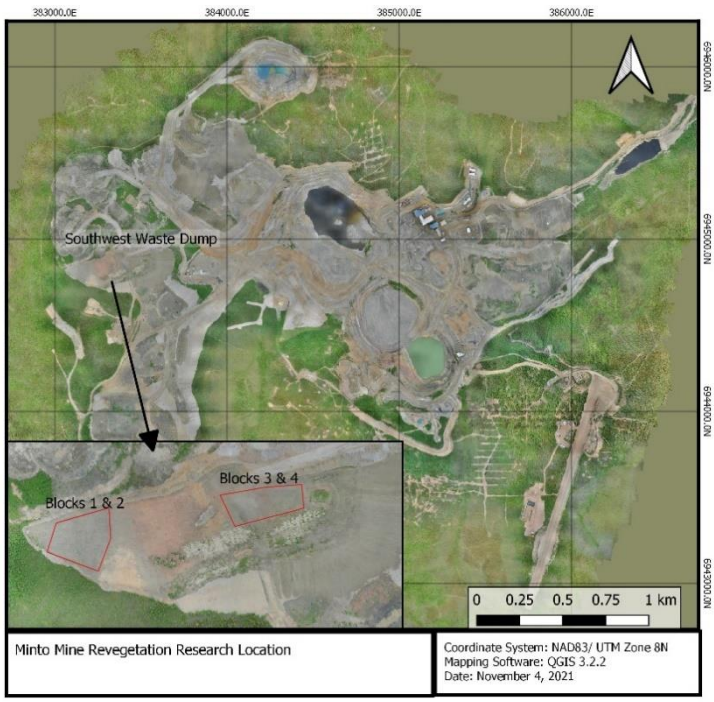


Figure 4. Minto Mine revegetation research location on the Southwest Waste Dump.

Experiment layout

The dominant wind direction (300° W/NW) was determined from Minto Exploration Ltd.'s 2020 weather data. Treatments were laid out in rows along a bearing of 120° with one to three treatments per row. Rows with tall treatments were spaced at 15 m, medium treatments at 10 m and short treatments at 7.5 m (Figure 5.). Treatments were 25-35 m long depending on the length of each row with two exceptions: control treatments in block two (18.5 m) and block four (23.5 m).

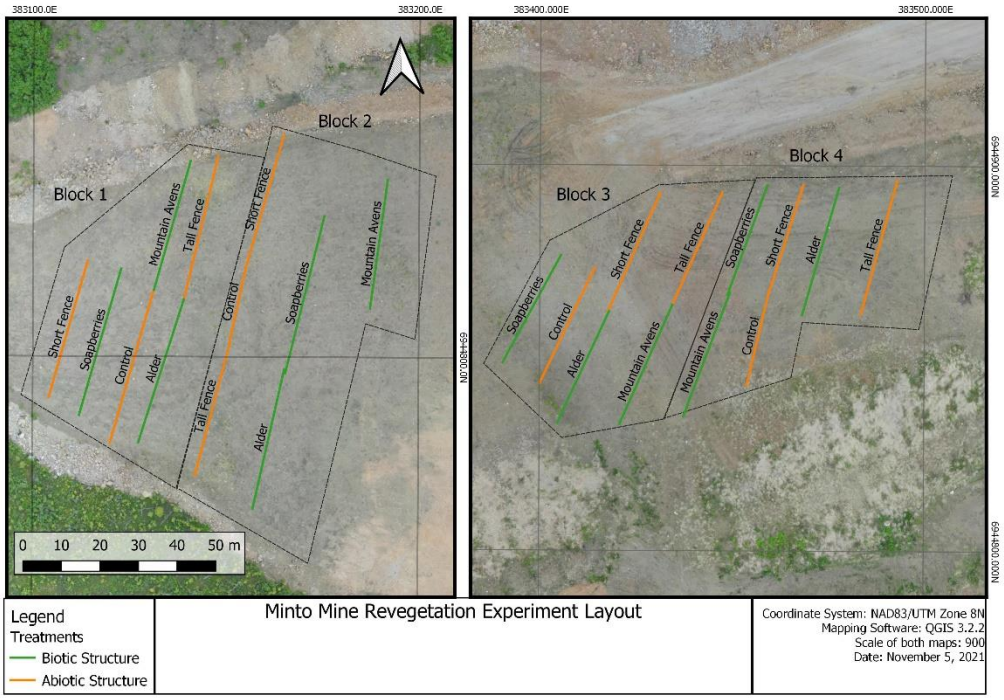


Figure 5. Minto Mine revegetation experiment layout

Biotic structure establishment

Species selection for shrub shelters

Green alder (*Alnus viridis* subsp. *crispa*), soapberry (*Shepherdia canadensis*) and smooth-leaf mountain avens (*Dryas integrifolia*) were selected for tall, medium and short biotic structures. Primary succession processes in northern systems indicate shrubs, especially nitrogen fixers, have a prominent role. Nitrogen fixation by shrubs in early seral stages is a primary determinant of total nitrogen within the climax system though legumes can also contribute (Jacobson and Birks 1980; Chapin et al. 2006; Buma et al. 2017). Green alder and soapberry are well known nitrogen fixers; the evidence is inconclusive for smooth-leaf mountain avens though yellow mountain avens (*D. drummondii*) are capable (Kohls et al. 1994; Rhoades et al. 2008; Callender et al. 2016). Mat-forming shrubs, especially *Dryas* spp., and erect shrubs also capture wind-blown soil fines which stimulates soil development on glacial moraines and outwash (Viereck 1966; Birks 1980; Buma et al. 2017). These species are native to the Yukon and tolerate poorly developed soils and harsh conditions associated with mine sites.

Seedling procurement

Green alder seeds were collected from five populations in late September and early October of 2019 (Table 2.). Seeds were air dried and shipped to NATS Nursery in Abbotsford, BC. Seedlings were grown over the summer of 2020, hardened and frozen for overwinter storage. Alder was shipped frozen by air in February 2021. Soapberry and smooth-leaf mountain aven seeds were each collected from a single population near Whitehorse. Aven seeds were air dried and soapberries kept moist in the fridge until shipping to NATS Nursery in August. Both aven and soapberry seedlings were grown over the summer of 2021, however delayed germination of soapberries meant they were not ready for outplanting in September. Soapberries are expected to be ready in the spring of 2022.

Table 2. Seed source locations for shelter species

Species	Ecoregion	Landmark	Coordinates
Green alder	Yukon Plateau Central	Cabin Gulch	62°16'26"N, 137°9'32"W
Green alder	Yukon Plateau Central	Freegold Road	62°20' 46"N, 137°14'10"W
Green alder	Pelly Mountains	Little Salmon Lake	62°12'21"N, 134°47'24"W
Green alder	Yukon Southern Lakes	Copper Haul Road	60°42'44"N, 135°10'7"W
Green alder	Yukon Southern Lakes	Grey Mountain	60°39'50"N, 134°54'26"W
Soapberries	Yukon Southern Lakes	Deep Creek	61° 4'34"N, 135°12'30"W
Mountain avens	Yukon Southern Lakes	Grey Mountain	60°39'34"N, 134°53.81"W

Green alder seedlings were removed from freezer storage June 13th and planted 0.3 m apart on June 14-16th, 2021 (Figure 6.). Boxes of seedlings were kept in the adjacent forest for shade and covered with a Silvicool Tarp (Bushpro) until planting. Each replicate received 100 L of water the day of planting and another 100 L of water 24 hrs after planting. Alder replicates received 50 L of water June 24th and 70 L of water July 1st. An additional 20 L mixed with 30 mL of soluble 10-40-25 fertilizer (GardenPRO Water Soluble Superbloom) was applied to each alder replicate June 24th and July 20th.

Twenty alder seedlings were randomly selected during planting to determine seedling characteristics (Table 3.). Alder height, root collar, shoot count and presence of nodules was determined in the field. Seedlings were kept cool during transport and frozen at the Yukon Research Centre Lab.

Root to shoot ratios were determined by separating the root and shoot at the root collar, washing the roots thoroughly and drying samples at 70°C for 24 hrs before weighing to the nearest 0.1 mg.

Table 3. Alder seedling characteristics from twenty randomly selected seedlings.

Characteristic	Mean	SE (n=20)	Min	Max
Height (cm)	1.28	± 0.92	1	16.8
Root Collar Diameter (mm)	0.98	± 0.14	2.54	4.65
Shoot #	1.11	± 0.39	2	9
R:S Ratio (g)	1.22	± 0.13	1.02	3.38

Avens were hardened at NATS Nursery, shipped by air to Whitehorse, and planted September 14-16th, 2021. Boxes of seedlings were stored at the research site and covered with a Silvicool tarp (Bushpro) until planting. Avens were planted 0.1 m apart and each replicate was watered with 20 L to improve seedling-soil contact. Twenty-five seedlings were randomly selected for characterization. Seedlings are currently in the freezer and will be processed this winter following the same procedure as the alders.

Soapberries will be planted in spring 2022 at 0.2 m apart.

Abiotic structure installation

Orange snow fencing with 50% porosity was cut into 0.6 and 0.3 m strips. Medium duty steel T-rails were cut into 1.4 m and 0.75 m posts. The tall and medium snow fencing was installed June 12-17, 2021. Posts were spaced at 2 m and pounded in with a mallet or post pounder to the height of the treatment. Snow fencing was installed with the factory edge up, raised 5 cm above the ground to account for variation in microtopography for a final height of 0.65 and 0.35 m respectively. Controls were marked with a wooden stake at each end, but no further structure added.



Figure 6. Planting rows of alder along a stringline in Block 2. The short fence (left) and tall fence (right) are already installed.

Transect Installation

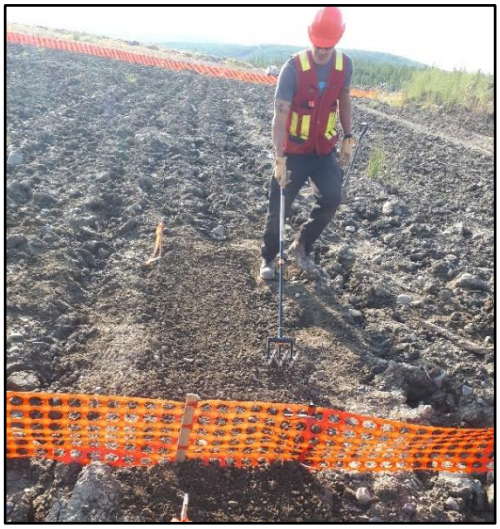


Figure 7. Seedbed preparation with a hand-held cultivator along a transect.

Three uniform seedbeds perpendicular to each abiotic treatment replicate were established July 20-24th, 2021 (Figure 7.). Smooth 0.35 m wide belt transects were created with shovels, mattocks and Fiskars Extended Reach Cultivators. Transect lengths straddled the centerline and were based on the height of the treatment: -0.65 to 4.55 m (tall), -0.35 to 2.45 m (medium) and -0.25 to 1.75 m (short) (Figure 7.). Four Hobo EC-5 Soil Moisture Smart Sensor or Decagon 5TM Soil Moisture Sensors and four Maxim Integrated iButton Thermochron F5 temperature data loggers were installed at intervals along the centre transect in each replicate based on treatment height. Soil moisture sensors log hourly and temperature sensors log every three hours. Seedbeds at biotic treatments will be established in 2023 once the final shrub heights for the experiment are known.

Baseline sampling and environmental monitoring

A weather station was installed in June 2021 near Block 2 to monitor climate conditions (Figure 8.). Data is logged by a HOBO USB Microstation outfitted with an Onset Photosythetic Light Smart Sensor, Davis Wind Speed and Direction Smart Sensor, Davis Rain Gauge Smart Sensor, Decagon EC-5 Soil Moisture Sensor and Onset Smart Temperature Sensor. An additional HOBO External Temperature and Relative Humidity logger was also installed. Two Reconyx HP2X Hyperfire 2 Professional Covert IR Cameras were set up overlooking the site to monitor overall conditions with a daily photo at 1 pm.



Figure 8. Amanda and Taylor celebrating successful weather station installation.

A vegetation inventory of the waste dump surrounding the research site was conducted June 16th and confirmed July 24th (Appendix 1.). Baseline soil samples were collected June 15-16th. Three composite samples were collected in each block and treatment for a total of 12 samples. A separate composite sample was taken of the red residuum material that occurs around the research site and sporadically in Block 3. Each sample was analyzed for pH, electrical conductivity, soil texture, total carbon, total organic carbon, total nitrogen, % organic matter, plant available NPK and trace metals. Copper was the only metal above CCME guidelines and only in Block 3 replicate; the red residuum sample confirmed this material as the source. Select soil sample results are summarized in Table 4.

Table 4. Mean soil characteristics and standard error (n=3) from baseline sampling in June 2021 and single red residuum sample results. TOC=total organic carbon and TIN=total inorganic nitrogen.

Block	pH	Texture	TOC (w/w%)	TIN mg/kg	PO4-P mg/kg	K mg/kg	Cu mg/kg
B1	8.43 ± 0.05	Clay Loam	0.27 ± 0.03	2.83 ± 0.47	0.66 ± 0.08	64.84 ± 6.56	40.12 ± 1.11
B2	8.47 ± 0.05	Clay Loam	0.35 ± 0.09	2.33 ± 0.38	0.69 ± 0.16	60.90 ± 3.83	40.38 ± 2.32
B3	8.73 ± 0.09	Loam	0.17 ± 0.05	1.50 ± 0.19	0.66 ± 0.16	51.14 ± 2.83	92.85 ± 2.56
B4	8.67 ± 0.02	Clay Loam	0.17 ± 0.01	2.07 ± 0.03	1.05 ± 0.31	68.52 ± 2.19	52.63 ± 0.54
Resi-duum	8.7	Sandy Clay Loam	0.12	2.40	0.68	62.9	214.8

The above ground structure and biomass of green alders were sampled July 20-24th, 2021, following the Tall Shrub Monitoring Protocol for Arctic Canada and Alaska (Myers-Smith et al. 2012). Ten randomly selected alders within each replicate were tagged and sampled for stem count, stem diameter, annual growth, maximum canopy height, and canopy area.

Heights of 10 randomly selected mountain avens and previously tagged alders in each replicate were measured September 14th-17th, 2021 (Table 5.). Weather station, transect sensors and time lapse photo data were also downloaded at this time. A full series of photopoints was taken September 16th, 2021 (Appendix 2.).

Table 5. Shrub seedling heights (n=10) in September 2021

	Alder		Mountain Avens	
Block	Mean Height (cm)	SE	Mean Height (cm)	SE
B1	25.29	± 2.17	4.33	± 0.42
B2	12.5	± 0.80	4.96	± 0.28
B3	13.14	± 1.23	4.66	± 0.46
B4	13.48	± 1.54	4.31	± 0.39

Remaining experiment set-up activities

Characterization of mountain avens

Twenty-five seedlings are currently frozen and seedling height, root collar diameter, presence of nodules and root to shoot ratio will be measured over the winter.

Soapberry establishment

Soapberry seedlings are growing at NATS Nursery in Abbotsford, BC and will be shipped frozen to Whitehorse in the spring of 2022. Seedlings will be planted with 0.2 m spacing shortly after receipt.

Transects for living shelters

Transects along alder, soapberry and mountain aven treatments will be established in 2023 once final height for the experiment is known.

Species selection for target species

Species selection for the target species remains unknown. The plan is to follow up with the Mining Manager at Selkirk First Nation about whether there is interest in collaborating on species selection. Seeds need to be collected in 2022. If there's either limited interest or Covid prevents engagement, species selection can be done with existing written material. Selkirk First Nation has published several in-depth heritage reports and Minto Mine's Reclamation and Closure Plan does include Selkirk First Nation's high level reclamation objectives (Minto Exploration Ltd. 2020).

Once species are selected, seeds will be collected from wild populations in Yukon, cleaned and either stored at the Yukon Research Centre or shipped to NATS Nursery for propagation.



Figure 9. Examining freshly prepared Blocks 3 and 4, looking east.

References

Access Consulting. 2013. Minto ecosystems and vegetation baseline report – YESAB project proposal phase V-VI. Prepared for Minto Explorations Ltd. Whitehorse (YT). 15 p.

[AAFC] Agriculture and Agri-Food Canada. 2010. Design Guidelines for Farmyard, Field, Roadside, Livestock, Wildlife, and Riparian Buffer Plantings on the Prairies. AAFC No. 11215E. Agri-Environment Services Branch, Agroforestry Development Centre: Indian Head (SK). 26 p.

Baraza E, Zamora R, Hódar JA. 2006. Conditional outcomes in plant-herbivore interactions: neighbours matter. Oikos 113: 148-156.

Birks HJB. 1980. The present flora and vegetation of the moraines of the Klutlan Glacier, Yukon Territory, Canada: a study in plant succession. Quaternary Research 14: 60-86.

Brooker RW, Maestre FT, Callaway RM, Lortie CL, Cavieres LA, Kunstler G, Liancort P, et al. 2008. Facilitation in plant communities: the past, the present and the future. Journal of Ecology 96: 18-34.

Buma B, Bisbing S, Krapek J, Wright G. 2017. A foundation of ecology rediscovered: 100 years of succession on the William S. Cooper plots in Glacier Bay, Alaska. Ecology 98: 1513-1523.

Callaway R. 1998. Competition and facilitation on elevational gradients in subalpine forests of the northern Rocky Mountains, USA. Oikos 82: 561-573.

Callender KL, Roy S, Khasa DP, Whyte LG, Greer CW. 2016. Actinorhizal alder phytostabilization alters microbial community dynamics in gold mine waste rock from northern Quebec: a greenhouse study. PLoS ONE 11: e0150181.

Castro J, Zamora R, Hódar, JA, Gómez JM, Gómez-Aparacio L. 2004. Benefits of using shrubs as nurse plants for reforestation in Mediterranean mountains: a 4-year study. Restoration Ecology 12: 352-358.

Chapin SF III, Viereck LA, Adams P, van Cleve K, Fastie CL, Ott RA, Mann D, Johnstone JF. 2006. Chapter 7: Successional processes in boreal forests. In: Chapin FS III, Oswood MW, van Cleve K, Viereck LA, Verbyla DL (Eds.). Alaska's changing boreal forest. Oxford University Press: New York (NY). 368 p.

Dhar A, Comeau PG, Karst J, Pinno BD, Chang SX, Naeth AM, Vassov R, Bampfylde C. 2018. Plant community development following reclamation of oil sands mine sites in the boreal forest: a review. Environmental Review 26: 286-298.

Dona AJ, Galen C. 2007. Nurse effects of alpine willows (*Salix*) enhance over-winter survival at the upper range limit of fireweed, *Chamerion angustifolium*. Arctic, Antarctic, and Alpine Research 39: 57-64.

Gómez-Aparicio L, Gómez JM, Zamora R, Boettinger JL. 2005. Canopy vs. soil effects of shrubs facilitating tree seedlings in Mediterranean montane ecosystems. Journal of Vegetation Science 16: 191-198.

Gómez-Aparicio L, Zamora R, Gómez JM, Hódar JA, Castro J, Baraza E. 2004. Applying plant facilitation to forest restoration: a meta-analysis of the use of shrubs as nurse plants. Ecological applications 14: 1128-1138.

[GC, SFN and YG] The Government of Canada, the Selkirk First Nation and the Government of Yukon. 1997. Selkirk First Nation Final Agreement. 451 p.

Guittony M. 2020. Chapter 12: revegetation of mine sites. In: Bussièrre B, Guittony M (Eds.). Hard Rock Mine Reclamation: from prediction to management of acid mine drainage. CRC Press: Boca Raton (FL). 408 p.

Jacobsen GL, Birks HJB. 1980. Soil development on recent end moraines of the Klutlan Glacier, Yukon Territory, Canada. Quaternary Research 14: 87-100.

Kohls SJ, van Kessel C, Baker DD, Grigal DF, Lawrence DB. 1994. Assessment of N_2 fixation and N cycling by Dryas along a chronosequence within the forelands of the Athabasca Glacier, Canada. Soil Biology and Biochemistry 26: 623-632.

Kreyling J. 2019. The ecological importance of winter temperate, boreal and arctic ecosystems in times of climate change. In: Cánovas F., Lüttge U., Leuschner C., Risueño MC. (eds) Progress in Botany 81: Springer, Cham.

Macdonald SE, Landhäusser SM, Skousen J, Franklin J, Frouz J, Hall S, Jacobs DF, Quideau S. 2015. Forest restoration following surface mining disturbance: challenges and solutions. New Forests 46: 703-732.

Maester FT, Callaway RM, Valladares F, Lortie CJ. 2009. Refining the stress-gradient hypothesis for competition and facilitation in plant communities. Journal of Ecology 97: 199-205.

McKenna K, Flynn N. 2017. Chapter 5.0: The Boreal Low Zone of Yukon. In: Southern Lakes Boreal Low Subzone (BOLsl): A Field Guide to Ecosite Identification. Department of Environment, Government of Yukon: Whitehorse (YT). 266 p.

Minto Exploration Ltd. 2020. Minto RCP Minto Mine Reclamation and Closure Plan 2020-01. Minto Exploration Ltd: Whitehorse (YT). 239 p.

Myers-Smith IH, Forbes BC, Wilmking M, Hallinger M, Lantz T, Blok D, Tape KD, Macias-Fauria M et al. 2011. Shrub expansion in tundra ecosystems: dynamics, impacts and research priorities. Environmental Research Letters 6: 045509.

Myers-Smith IH, Lantz TC, Leathem J, Briggs A, Elliot T, Grabowski M, Stafl N. 2012. Draft Tall Shrub Monitoring Protocol for Arctic Canada and Alaska. Available from: https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/ShrubMonitoringProtocol.pdf

Padilla FM, Pugnaire FI. 2006. The role of nurse plants in the restoration of degraded environments. Frontiers in Ecology and the Environment 4: 196-202.

Peterson DA. 2001. Long term gravel pad reclamation on Alaska's North Slope. Restoration and Reclamation Review 7.

Rhoades C, Binkley D, Oskarsson H, Stottlemyer R. 2008. Soil nitrogen accretion along a floodplain terrace chronosquence in northwest Alaska: influence of nitrogen-fixing shrub *Shepherdia canadensis*. Ecoscience 15: 223-230.

Ritter J, McGinty T, Edwards J. 1977. The Selkirk language noun dictionary. Council of Yukon Indians: Whitehorse (YT). 125 p.

Selkirk First Nation. 2018. Selkirk First Nation traditional use study 2017. Selkirk First Nation: Pelly Crossing (YT). 170 p.

Smith CAS, Meikle JC, Roots CF (Eds.). 2004. Ecoregions of the Yukon Territory: biophysical properties of Yukon landscapes. PARC Technical Bulletin No. 04-01. Agriculture and Agri-Food Canada: Summerland (BC).

Streiker J. 2016. Yukon Climate Change Indicators and Key Findings 2015. Northern Climate ExChange, Yukon Research Centre, Yukon College: Whitehorse (YT). 84 p.

[TPWG] Tri-Partite Socio-economic Working Group. 2021. Minto Mine Socio-Economic Monitoring Program Annual Report 2016 to 2018. Selkirk First Nation, Government of Yukon and Minto Explorations Ltd: http://www.selkirkfn.com/files/6416/2636/6955/2016-to-2018-annual-report-final_rev2.pdf [Accessed 3Nov21].

Vierek LA. 1966. Plant succession and soil development on gravel outwash of the Muldrow Glacier, Alaska. Ecological Monographs 36: 181-199.

Appendix 1. June 16th and July 24th vascular plant species list from Southwest Waste Dump

Achillea millefolium
Agrostis scabra
Alnus viridis subsp*. crispa*
Arctagrostis latifolia
Boechera sp.
Calamagrostis canadensis
Caryophyllaceae sp.
Chamerion angustifolium
Chamerion latifolium
Crepis elegans
Crepis tectorum
Deschampsia cespitosa
Descurainia sp.
Elymus trachycaulus
Equisetum arvense
Equisetum sylvaticum
Erigeron acris
Festuca altaica
Festuca saximontana
Hordeum jubatum
Lepidium sp*.*
Mertensia paniculata
Pinus contorta
Polemonium acutiflorum
Polygonum alaskanum
Populus balsamifera
Rorippa sp*.*
Rubus idaeus
Salix alaxensis
Salix arbusculoides
Salix bebbiana
Salix glauca
Salix sp.
Stelleria longipes

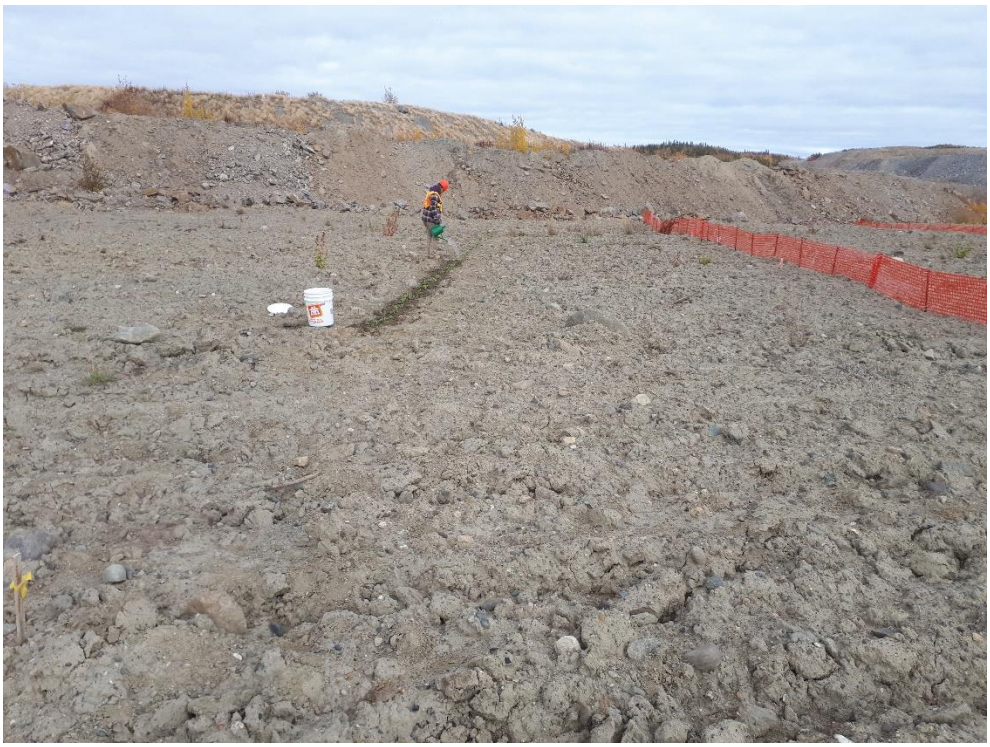
Appendix 2. September 2021 photopoints



B1T1 – Alders: September 17, 2021



B1T2 – No soapberries yet: September 17, 2021



B1T3 – Mountain avens: September 17, 2021



B1T4 – Tall Fence: September 17, 2021



B1T5 – Short fence: September 17, 2021



B1T6 – Control: September 17, 2021



B2T1 – Alders: September 17, 2021



B2T2 – No soapberries yet: September 17, 2021



B2T3 – Mountain avens: September 17, 2021



B2T4 – Tall fence: September 17, 2021



B2T5 – Short fence: September 17, 2021



B2T6 – Control: September 17, 2021



B3T1 – Alders: September 17, 2021



B3T2 – No soapberries yet: September 17, 2021



B3T3 – Mountain Avens: September 17, 2021



B3T4 – Tall fence: September 17, 2021



B3T5 – Short fence: September 17, 2021



B3T6 – Control: September 17, 2021



B4T1 – Alders: September 17, 2021



B4T2 – No soapberries yet: September 17, 2021



B4T3 – Mountain avens: September 17, 2021



B4T4 – Tall fence: September 17, 2021



B4T5 – Short fence: September 17, 2021



B4T6 – Control: September 17, 2021

APPENDIX 2-D

Coffee Project Water Treatment: From Feasibility Studies to a Conceptual System Design



COFFEE PROJECT WATER TREATMENT:

FROM FEASIBILITY STUDIES TO A CONCEPTUAL SYSTEM DESIGN

Comprehensive Report

Prepared For:
Newmont Mining

Prepared By:
WesTech Engineering

September 2021

WESTECH®

ENVIRONMENTAL INNOVATIONS INOTEC

TABLE OF CONTENTS

LIST OF FIGURES 2

LIST OF TABLES 4

EXECUTIVE SUMMARY 5

INTRODUCTION 7

TIMELINE OF EVALUATIONS, TESTING, CONSULTATIONS, AND PROCESS DESIGN 7

PREDICTED WATER QUALITY AND TREATMENT NEEDS 8

TREATMENT PROCESSES 10

ELECTRO-BIOCHEMICAL REACTOR 10

ARSENIC REMOVAL BY FERRIC COAGULATION/PRECIPITATION 10

SULFATE PRECIPITATION 11

IN-SITU BIOREMEDIATION 11

TESTWORK 12

TESTING PHASES AND OBJECTIVES 12

EXPERIMENTAL DESIGN AND PROCEDURES 13

Microbial Screening *13*
Phase I Feasibility Testing *13*
Phase I In-Situ Feasibility Testing *14*
Phase II Bench-Scale Testing *15*

SAMPLING AND ANALYSIS 16

Feasibility Testing *16*
Bench-Scale Testing *17*
Data Analysis, Interpretation, and Quality Control *18*

RESULTS 19

PHASE I FEASIBILITY RESULTS 19

Chemistry and Treatability Assessment *19*
Microbial Screening and Assessment Results *19*
Feasibility Treatment of Contaminants of Interest *21*
Feasibility Treatment of Other Contaminants and By-Product Formation *23*
Feasibility of In-Situ Denitrification *24*

PHASE I FEASIBILITY CONSULTATIONS, FEEDBACK, AND INFORMATION REQUESTS 25

PHASE II BENCH-SCALE TESTING RESULTS 33

Preliminary Assessments *33*
Bench-Scale Testing *37*

PRELIMINARY DESIGN AND OPERATIONAL PARAMETERS 60

CONCLUSIONS 61

List of Figures

Figure 1. Feasibility testing and consultations timeline 8

Figure 2. Process flow diagram of the Phase I feasibility test system 13

Figure 3. Process flow diagram of a Phase I feasibility in-situ testing; test stage #1. 14

Figure 4. Process flow diagram of a Phase I feasibility in-situ testing; test stage #2. 14

Figure 5. Process flow diagram of the Phase II bench-scale Coffee treatment systems. 15

Figure 6. Phase II bench-scale setup of treatment train A. 16

Figure 7. Phase II bench-scale sampling locations. 17

Figure 8. Phase I feasibility EBR nitrate-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once. 21

Figure 9. Phase I feasibility EBR nitrite-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once. 21

Figure 10. Phase I feasibility EBR arsenic removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once. 22

Figure 11. Phase I feasibility EBR uranium removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once. 22

Figure 12. Phase I feasibility in-situ denitrification from Coffee Gold spent ore and water. The dashed vertical line corresponds to the day when the column influent was switched from the EBR effluent to deionized water. 25

Figure 13. Arsenic ferric co-precipitation jar test results. 35

Figure 14. Sulfate precipitation jar tests with barium chloride and barium hydroxide salts. 35

Figure 15. Selected snapshots of denitrification and sulfate reduction microbial screening tests using various denitrifying (A – J) and sulfate-reducing (1 – 9) strains. 37

Figure 16. Phase II bench-scale denitrification results: System A validation. 37

Figure 17. Phase II bench-scale sulfate results: System A validation. 38

Figure 18. Phase II bench-scale uranium results: System A validation. 38

Figure 19. Phase II bench-scale arsenic results: System A validation. 39

Figure 20. Phase II bench-scale denitrification results: System B validation. 39

Figure 21. Phase II bench-scale sulfate results: System B validation. 40

Figure 22. Phase II bench-scale uranium results: System B validation. 40

Figure 23. Phase II bench-scale arsenic results: System B validation. 41

Figure 24. Phase II bench-scale denitrification results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. The bottom graph focuses on nitrate-N results below 20 mg/L. 42

Figure 25. Phase II bench-scale nitrite results: System A overall nitrite results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. 42

Figure 26. Phase II bench-scale sulfate results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. 43

Figure 27. Phase II bench-scale uranium results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. 44

Figure 28. Phase II bench-scale arsenic results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. 45

Figure 29. Phase II bench-scale arsenic speciation results: System A. Values averaged over three data points. 46

Figure 30. Phase II bench-scale results: System A overall BOD data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. 52

Figure 31. Phase II bench-scale results: System A overall COD data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. 52

Figure 32. Phase II bench-scale results: System A overall phosphate-P data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. 53

Figure 33. Phase II bench-scale results: System A gross radiation results. 53

Figure 34. Phase II bench-scale results: System A radium-226 results. 54

Figure 35. Phase II bench-scale results: System A solids radiation results. 56

Figure 36. Quality control results for total arsenic analysis. 57

Figure 37. Quality control results for total uranium analysis. 58

Figure 38. Quality control results for nitrate-N analysis. 59

Figure 39. Quality control results for sulfate analysis. 59

List of Tables

Table 1. Criteria for a three-phase water treatment technology selection process..... 8

Table 2. Water quality predictions of the HLF rinse solutions..... 9

Table 3. Analytes and analytical methods used in the EBR bench-scale tests. 16

Table 4. Water chemistry of Coffee Gold leach solutions used during feasibility testing. 20

Table 5. Average Phase I feasibility treatment performance. 23

Table 6. Average Phase I feasibility in-situ denitrification performance..... 24

Table 7. Feedback and information requests obtained through the consultations with the stakeholders..... 25

Table 8. Water chemistry comparison of the modeling predictions and the received solutions. Treatment targets provided as a reference. 33

Table 9. Sulfate precipitation with barium salts. Reagent dosage, sludge volume, and water loss comparison. 36

Table 10. Arsenic speciation results, including the following arsenic species: As(V) – arsenate, As(III) – arsenite, MM-As – monomethylarsonic acid, DM-As – dimethylarsonic acid, and a sum of unknown species. 45

Table 11. The average concentration of anions throughout the Phase II bench-scale testing. Three-point average..... 46

Table 12. The average concentration of metals throughout the Phase II bench-scale testing. Three-point average..... 48

Table 13. Selenium speciation results, including the following arsenic species: Se(VI) – selenate, Se(IV) – selenite, Se-CN – selenocyanate, MeSe(IV) – methylselenic acid, Se-Met – selenomethionine, $SeSO_3$ – selenosulfate, and a sum of unknown species..... 50

Table 14. The average concentration of cyanides throughout the Phase II bench-scale testing. Three-point average. ... 50

Table 15. The average concentration of nutrients throughout the Phase II bench-scale testing. 51

Table 16. Phase II bench-scale results: Radiochemistry analysis of water samples collected from all the treatment stages. One data point. 54

Table 17. Phase II bench-scale results: Radiochemistry analysis of solids samples collected from all the treatment stages. One data point. 55

Table 18. Toxicity characteristic leaching procedure (TCLP) results..... 56

Table 19. Analytical precision and accuracy during bench-scale testing of Coffee waters. 58

Table 20. Summary of the design and operational parameters for pilot-scale testing..... 60

EXECUTIVE SUMMARY

WesTech Engineering (formerly Inotec) was contracted to develop a conceptual water treatment system for the Coffee Mine's heap leach rinse waters. In order to increase confidence in the proposed treatment, reduce uncertainty and risks, and develop a site-specific approach for the treatment of the Coffee waters, the testing was designed in three phases. This report conglomerates the results of Phase I feasibility evaluations and Phase II bench-scale laboratory testing and summarizes the feedback obtained from the stakeholders (Newmont, Tr'ondek Hwech'in, and the Canadian regulatory agencies). Once the mine is operational, and heap waters are available, the system design and expected performance will be demonstrated during the Phase III pilot-scale trial.

The Phase I feasibility testing successfully demonstrated the removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Even though arsenic removal was demonstrated with the biological treatment, the feasibility testing proved that long retention times and high nutrient doses would be required to meet the required discharge levels. The Phase I recommendation was to investigate phys-chem arsenic removal options.

Upon completing Phase I feasibility testing, WesTech and Newmont sought out feedback from the stakeholders through a series of water-treatment-focused workshops. The consultations yielded positive feedback, identified additional contaminants of interest, and resulted in the addition of several analytical parameters to the monitoring list, strengthening the testing design and outcomes. Sulfate and antimony were identified as potential additional contaminants of interest. Thiocyanate, sulfide, arsenic and selenium speciation, and radiochemistry were added to the analytical schedule.

The Phase II bench-scale testing removed all contaminants of interest to below their respective discharge targets. The best approach for the Coffee Mine water treatment was confirmed to be a multi-stage treatment train, consisting of a phys-chem pretreatment for arsenic and sulfate precipitation, biological EBR treatment for denitrification and metals polishing, and a small aerobic post-treatment for removal of residual nutrients and reintroduction of dissolved oxygen. **The demonstrated benefits of the tested treatment train included:**

1) **a significantly smaller biological EBR system footprint;**
2) **no need for complex organic nutrient addition;**
3) **lower organic carbon requirement, thus lower residual nutrient concentrations; and**
4) **continuous removal of some radioisotopes in the pretreatment, which resulted in little to no accumulation of gross radiation within the EBR bioreactor matrix.**

Arsenic was removed to below the discharge target of 0.035 mg/L using ferric co-precipitation. Barium precipitation of sulfate was demonstrated to be dose-dependent and was optimized to target sulfate discharge target of 1,500 mg/L. The limited evaluation of only two barium salts resulted in residual chloride concentrations; further jar tests will be required once the mine is operational and actual site waters are available to establish the most suitable reagent dose to avoid generating excess chlorides.

The EBR treatment successfully removed nitrate-N to below the detection limit of 0.3 mg/L and uranium to less than 0.1 mg/L (its discharge target) with ethanol as a sole nutrient source and a hydraulic retention time of 7 to 11 hours. Once optimized to target only nitrate and uranium, the EBR system was demonstrated to allow residual arsenic and sulfate to pass through without further reducing either one. The speciation results showed that the EBR system did not produce any methylated arsenic species, even during the preliminary testing stages, when residual arsenic was biologically removed. Several other metals (Sb, Cu, Hg, Mo, and Ni) were reduced by the EBR system from elevated levels to below

their discharge targets, while some multivalent metals (Fe and Mn) were not targeted and passed through the EBR system unchanged. Hardness minerals (Ca, Mg) were shown to be present at elevated concentrations in the Coffee waters and will likely need to be removed by a water softening pretreatment to meet their discharge limits. The EBR system also polished WAD cyanide to below the detection limit of 0.006 mg/L.

Once the pretreatment was optimized, ethanol was used as a sole nutrient source for the EBR treatment, resulting in a low residual nutrient generation. BOD and ammonia were removed in the aerobic post-treatment step, but a spike of phosphate and manganese was experienced in the aerobic column effluent, which can only be attributed to the leaching of these metals from the pumice support matrix. Quality control will be conducted on the media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of metals occurs.

A set of preliminary design and operational parameters was developed for a pilot-scale trial based on the results obtained from bench-scale testing. Conducted over a minimum of three months, the on-site demonstration trial is a required last step before the preliminary engineering of the water treatment plant can be completed. The testwork and analytical plan will include, at the minimum, the same level of detail as the Phase II bench-scale program.

INTRODUCTION

TIMELINE OF EVALUATIONS, TESTING, CONSULTATIONS, AND PROCESS DESIGN

The proposed Coffee Gold project is located in the west-central Yukon Territory, approximately 130 km south of Dawson City. Acquired in 2016 by Goldcorp (subsequently, Newmont), Coffee is a high-grade potential open pit and heap leach development project that lies within the traditional territory of Tr'ondek Hwech'in (TH).

WesTech Engineering (formerly Inotec) was contracted to develop a treatment system for the Coffee Mine's heap leach rinse waters. In order to increase confidence in the proposed treatment, reduce uncertainty and risks, and develop a site-specific treatment approach for the treatment of the Coffee waters, the testing was designed in three phases.

Phase I - Treatability assessment and proof-of-concept, conducted in 2016, consisted of laboratory assessment tests and evaluation of site water chemistry. Tests included column heap leach to generate water for treatment, site water chemistry evaluation, microbial screening tests, and treatment effectiveness assessment.

Phase II - Continuous flow laboratory column tests, conducted in 2020, were used to develop an overall treatment approach for the Coffee Gold heap leach rinse waters and to develop operational parameters for on-site pilot-scale tests.

Phase III – On-site pilot tests, to be conducted once mine is operational, are needed to validate the selected unit processes for treatment of all the contaminants of interest in the actual Coffee Gold heap leach rinse waters and to develop operational parameters, design criteria, and preliminary CAPEX/OPEX estimates for a full-scale facility.

This tiered approach was developed based on the EPA's Guide for Conducting Treatability Studies Under CERCLA: Biodegradation Remedy Selection (EPA/540/R-93/519b). The specific characteristics of each phase are provided in Table 1.

WesTech has worked with the project since 2015. Our main objective has been to design a water treatment system that meets the discharge limits using a phased feasibility testing approach that de-risks the process and considers input from all the stakeholders. Several treatment methods have been considered to meet the treatment objectives, and the resulting treatment train utilizes multiple unit processes, including phys-chem and biological methods. The overall timeline of feasibility testing and consultations is summarized in Figure 1. Ample time was allocated after each testing phase for consultations with Tr'ondek Hwech'in and the Canadian regulatory agencies to identify areas of concern and develop appropriate protocols for future testing to address them.

Table 1. Criteria for a three-phase water treatment technology selection process.

Phase/Scale	Phase I: Feasibility Study (completed)	Phase II: Lab Bench-Scale Test (completed)	Phase III: On-Site Pilot Demo (to be completed)
Goal	Process screening	Process selection	Process design
Degradation of the contaminant of interest	Positive degradation	Meets effluent compliance standards under test conditions	Meets compliance standards under site conditions
Extent of treatment	Estimate/ Qualitative	Measure/ Quantitative	Measure/ Quantitative
Biodegradation rate	Crude estimate	Defensible estimate	Quantified
Process control and reliability	Not available	Assess potential	Demonstrate
Process optimization	Not available	Estimate	Refined estimate/ Demonstrate
Study time	2-8 weeks	2-6 months	2-6 months
Full-scale cost estimate	Not available	Rough	Detailed/ Refined

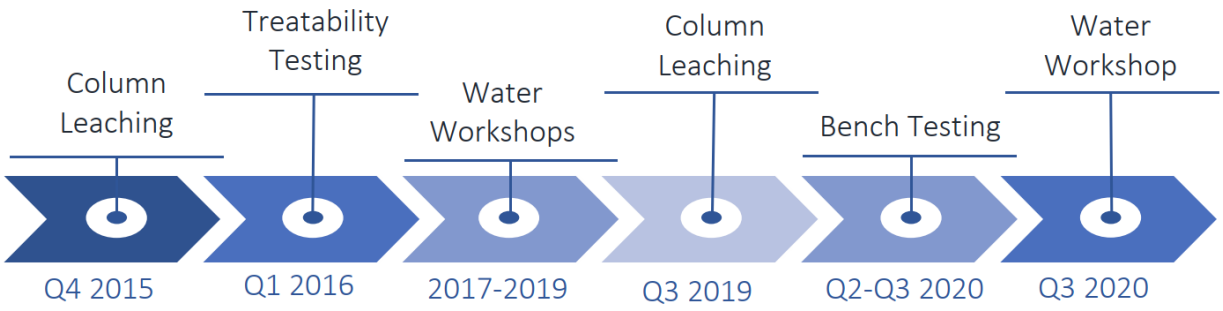


Figure 1. Feasibility testing and consultations timeline.

Predicted Water Quality and Treatment Needs

Developing a conceptual water treatment design for a prospective mine is challenging as without an operational mine, no heap leach rinse waters exist for treatment evaluations. Predicting water quality generated by the heap leach facility (HLF) during rinsing is crucial for identifying the parameters of concern and developing a treatment system with appropriate unit processes. Water modeling, performed by Lorax Environmental Services, identified the target parameters for Phase I treatability testing as nitrate/nitrite, arsenic, and uranium (Table 2). Additionally, sulfate and antimony were added to the list of target parameters for Phase II bench-scale testing based on the input from TH. The treatment targets were based on a back-calculation approach to arrive at allowable concentrations in the discharge to achieve Use-Protection water quality objectives in Halfway Creek.

Table 2. Water quality predictions of the HLF rinse solutions.

Parameter [mg/L]	HLF Rinse Modeling	Treatment Target
NH_3-N	0.025-0.06	8
NO_3-N	275-307	3
NO_2-N	1.6-1.9	0.09
Cl	115-123	290
SO_4	2300-2516	1500
Alkalinity, as $CaCO_3$	47-87	500
WAD-CN	0.09-0.2	0.025
Al	0.06-0.2	0.06
Ag	0.00009-0.00125	0.00009
As	0.66-2	0.035
Ca	204-350	180
Cd	0.00004-0.00013	0.00004
Cr	0.004-0.014	0.001
Cu	0.004-0.014	0.004
Fe	0.15-0.5	0.05
Hg	0.0001-0.00026	0.0001
Mg	117-155	50
Mn	0.016-0.06	0.016
Mo	0.033-0.105	0.033
Na	890-1168	890
K	8-11	8
Ni	0.002-0.006	0.002
Pb	0.00032-0.0013	0.0032
Sb	0.17-0.5	0.07
Se	0.0015-0.005	0.0015
Tl	0.0015-0.004	0.0015
U	0.3-0.685	0.1
Zn	0.02-0.052	0.02

TREATMENT PROCESSES

ELECTRO-BIOCHEMICAL REACTOR

Microbes mediate the removal of metal and inorganic contaminants through electron transfer (redox processes). For example, denitrification can be described by the following redox reaction:

$$NO_3^- + 5e^- + 6H^+ \rightarrow \frac{1}{2}N_2 + 3H_2O \quad (1)$$

The biotransformation shown in Reaction 1 occurs under anaerobic, reductive conditions, requiring low dissolved oxygen (DO) levels and a negative oxidation-reduction potential (ORP) environment. Five electrons are needed to reduce one molecule of nitrate to nitrogen gas. Other constituents, such as dissolved oxygen, nitrite, arsenate, selenate, chromate, sulfate, etc., add to the electron demand.

In conventional biological treatment systems, the electrons required for contaminant transformation are supplied in the form of excess nutrients added to the system. Conventional biotreatment systems require excess nutrients/chemicals to compensate for inefficient and variable electron availability to adjust reactor ORP chemistry and for contaminant removal (electron release from organic nutrients requires nutrient metabolism that proceeds at a variable rate). Excess nutrients used to compensate for system sensitivity lead to significantly increased biomass production, resulting in additional CAPEX and OPEX (higher nutrient consumption and management of the excess biomass production).

The Electro-Biochemical Reactor (EBR) technology overcomes these shortcomings by decoupling the electron provision from organic carbon metabolism. The electrons are directly supplied to the reactor and microbes, using a low applied potential (1-3V) across the bioreactor at low milli-Amp levels. The current of 1 mA provides 6.2×10^{15} electrons per second. In contrast, one molecule of acetic acid, commonly used as a nutrient in the water treatment processes, provides only eight electrons under complete metabolism. These electrons replace and supplement the electrons customarily supplied to the conventional bioreactor system by excess nutrients, with considerable savings and multiple reactor, microbial, and environmental benefits. The directly supplied electrons are readily available to the microbes in a consistent, controllable manner without metabolic energy expenditure. Moreover, these "free electrons," from the microbes' standpoint, make the EBR bioreactors more robust and less sensitive to wide fluctuations in water chemistries than the past generations of conventional biotreatments.

ARSENIC REMOVAL BY FERRIC COAGULATION/PRECIPITATION

Even though the EBR technology was validated for arsenic removal to concentrations of less than 0.015 mg/L from initial values in excess of 1.0 mg/L (i.e., > 98.8% removal), evaluation of other arsenic removal methods and integration into the proposed treatment train was recommended. The initial bench-scale treatability assessments indicated that a relatively long retention time and high nutrient loading would be required to target arsenic biologically.

Ferric-based coagulation and flocculation is a widely used arsenic removal method in wastewater and drinking water treatment. It uses a metal-based coagulant, such as ferric chloride ($FeCl_3$), which hydrolyzes in water to form positively charged ferric hydroxide [$Fe(OH)_3$]. Dissolved arsenic oxyanions are negatively charged and readily sorb to the positively charged ferric hydroxide particles. The process is sensitive to the oxidative state of arsenic; if any reduced arsenic oxyanions, such as arsenite, are present, they must be oxidized to arsenate first for the ferric coagulation step to be effective.

Sulfate Precipitation

In contrast to contaminants such as nitrate, arsenic, and heavy metals, sulfate has no primary standard for drinking water or aquatic life. Numerous treatment technologies for efficient sulfate removal exist, including biological and physical processes. As an alternative option for biological sulfate removal, sulfate precipitation using physicochemical methods was evaluated. The most commonly used technology for reducing high sulfate concentrations is lime precipitation, which generates calcium sulfate (gypsum). This method is effective for sulfate concentrations higher than the gypsum solubility limit of 1,500-2,000 mg/L. As a polishing step for sulfate removal, barium sulfate precipitation can be applied. Barium sulfate has very low solubility in water (~ 2.5 mg/L), with the final sulfate concentration limited only by the amount of barium added and reaction time.

In-Situ Bioremediation

The basic premise of bioremediation is to accelerate microbial activity using nutrients (carbon, phosphorus, nitrogen, etc.) to create conditions conducive to biodegradation of target contaminants. In general, in-situ bioremediation is designed to modify the environmental conditions, typically through oxidation/reduction manipulation, to create an environment that stimulates the growth of indigenous and added microbes and the subsequent degradation of the target contaminants via microbial catalyzed reactions.

This testing focused on in-situ denitrification (nitrate reduction). Nitrate is an important co-contaminant because it is a preferred electron acceptor that needs to be reduced or removed before metal removal is effectively targeted. Nitrate is the most ubiquitous groundwater contaminant in North America and is common at many mining sites due to the use of ammonium nitrate in blasting. Nitrate is non-sorptive and does not exchange on many surfaces. It has a very low probability of retardation onto soil colloids. Nitrate reduction occurs during anaerobic respiration; in the absence of oxygen (<2 mg/L dissolved oxygen) and the presence of a carbon source, bacteria utilize nitrates as electron acceptors during respiration.

In mining waters, nitrate-N is typically found at tens or hundreds ppm levels as compared to ppb concentrations most metals like arsenic and uranium are present at. Since nitrate is a preferred electron acceptor and is typically present in mining waters several orders of magnitude higher than dissolved metals, the majority of the retention time required for an active biological treatment is spent on denitrification. Longer retention times require larger bioreactors, which in turn means higher CAPEX (capital expenditures). A holistic mine site water management and treatment should include in-situ denitrification within the heap followed by a smaller active treatment for metals removal.

TESTWORK

TESTING PHASES AND OBJECTIVES

WesTech has completed Phases I and II of feasibility and system design stages. The objectives of the two phases were as follows:

Phase I:

Provide **a proof-of-concept** for removal of nitrate, arsenic, and uranium from the Coffee Mine heap leach rinse waters.

- Task 1 – Spent Ore Column Leaching Tests. Task 1 was used to generate leach waters for Tasks 2 through 4.
- Task 2 – Microbial Screening and Treatability Assessment. The goal of Task 2 was to develop microbial consortia for Tasks 3 and 4.
- Task 3 – EBR Validation Testing. The goal of Task 3 was to provide a proof-of-concept evaluation of the EBR technology for the treatment of the Coffee Gold leach waters.
- Task 4 – In-Situ Testing. The goal of Task 4 was to evaluate microbial in-situ denitrification of the Coffee Gold spent ore materials.

Phase II:

Develop and **optimize a systems approach** to treating all parameters present above the discharge standards in the Coffee Mine heap leach rinse waters

- Task 1 – Side-by-side evaluations of two treatment approaches. The goal was to determine the optimal process design for nitrate, uranium, sulfate, and arsenic removal to below the discharge objectives.
- Task 2 – System stress-testing to determine the optimal system configuration and operational conditions (including required chemical doses and hydraulic retention times).
- Task 3 – Treatment train design to meet all discharge requirements (including required pretreatment, e.g., for cyanide destruction, and any needed post-treatment, e.g., for aeration and BOD and ammonia oxidation).
- Task 4 – Development of the required design information for Phase III testing.

Experimental Design and Procedures

Microbial Screening

Microbial isolation and screening tests were conducted on solutions received and initial column materials at 5ºC and 20 ºC. Microbes isolated from the Coffee Mine waters and spent ore materials were tested for their ability to remove arsenic, uranium, nitrate, sulfate, and antimony. These isolates were tested in direct comparative screening tests alongside WesTech's repository microbes to select a site-specific inoculum for the removal of contaminants of interest.

These tests provided the microbes for Phase I and Phase II testing. A microbial population screened to be effective at removing arsenic, uranium, nitrate, sulfate, and antimony was grown into an inoculum for feasibility and bench-scale testing.

Phase I Feasibility Testing

The process flow diagram for the feasibility testing is shown in Figure 2. The feasibility setup consisted of a two-stage, up-flow, fixed bed EBR system. The tests were conducted under continuous flow conditions, i.e., the water was treated 24 hours per day, seven days per week. The system was operated using a total hydraulic retention time (HRT) of 44 hours. The bioreactors were provided with laboratory-grade nutrients (tryptic soy broth) rich in macro- and micro-elements. The long HRT and laboratory-grade nutrients were chosen to ensure that no limiting conditions (e.g., nutrient-limited) occurred that could affect the proof-of-concept testing.

The column tests were conducted continuously for two months for process assessment and validation testing. The goal of validation testing was to generate sufficient compliance data (i.e., nitrate, arsenic, and uranium concentrations in the treatment effluent below desired levels). The system initially treated leach waters pumped twice through the Coffee Gold spent ore columns. However, since uranium concentrations have decreased after the second pass through the spent ore columns, it was decided to treat first pass leach solutions instead.

Prior to the biological EBR treatment, cyanide destruction in the leachate solutions was performed using hydrogen peroxide treatment; nitrate-N was readjusted to at least 150 mg/L, and pH of the water was dropped to about 6.5.

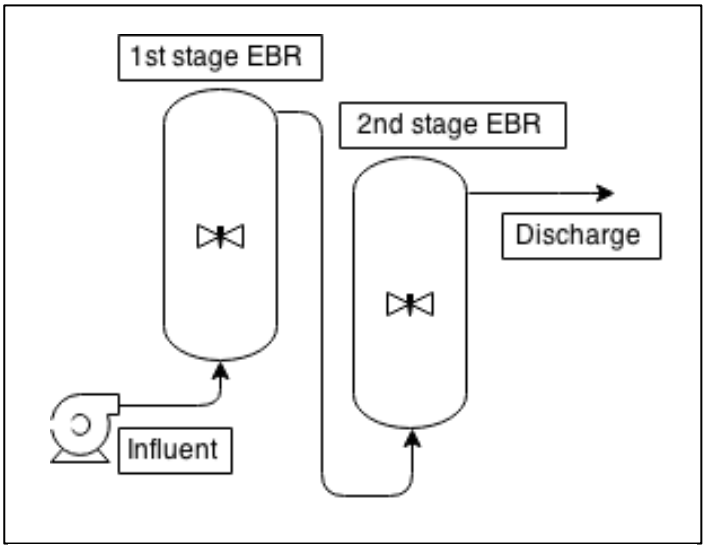


Figure 2. Process flow diagram of the Phase I feasibility test system.

Phase I In-Situ Feasibility Testing

Two 100-kg test columns were constructed, each containing three lithologies and two weathering zones of mined materials that represent thoroughly mixed Coffee Gold leach pad materials in the following percentages: 80% Supremo, 18% Latte, and 2% Kona. The columns went through a series of conditioning steps to ensure the effluent water chemistries from both columns were similar. One of the constructed columns was used as a test column; the other one was used as a control (baseline) column. The in-situ testing progressed in two testing stages:

1. Application of the EBR effluent spiked with 150 mg/L nitrate-N at a flowrate of 1L per day. The in-situ column influent was supplemented with nutrients, while the control column influent was filtered to remove microbial cells and residual nutrients. The process flow diagram is shown in Figure 3.
2. Application of DI water spiked with 150 mg/L nitrate-N at a flowrate of 1L per day. The in-situ column influent was supplemented with nutrients, but the control column was not. The process flow diagram is shown in Figure 4.

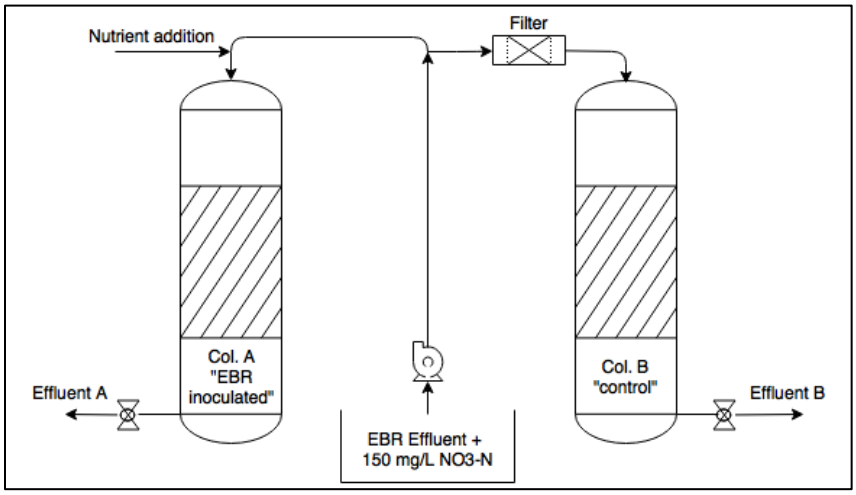


Figure 3. Process flow diagram of a Phase I feasibility in-situ testing; test stage #1.

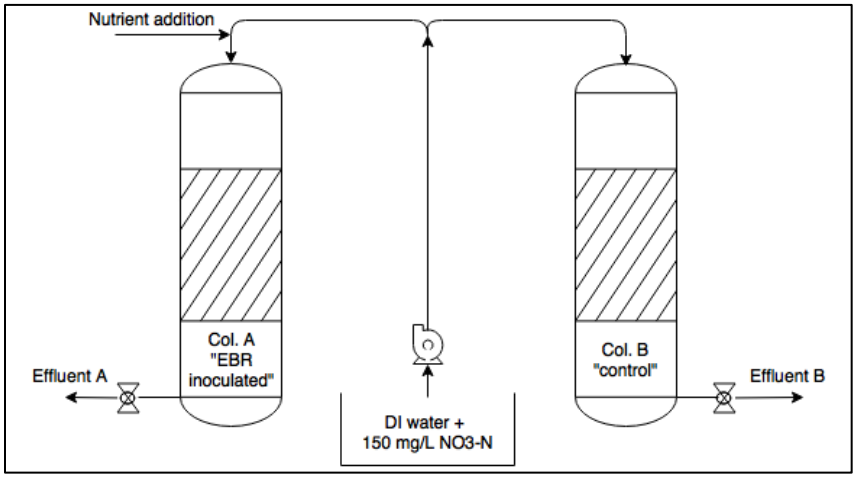


Figure 4. Process flow diagram of a Phase I feasibility in-situ testing; test stage #2.

Phase II Bench-Scale Testing

Leach and rinse waters were generated by Kappes, Cassiday & Associates at their metallurgical laboratory in Reno, NV, and shipped to WesTech. The process flow diagram for the bench-scale setup is shown in Figure 5. The required pretreatments included cyanide destruction and pH adjustment; both were performed as batch treatments. Two treatment trains were evaluated concurrently as a core treatment. In system A, chemical precipitation methods (ferric coagulation for arsenic removal and barium precipitation of sulfate) were tested in conjunction with a two-stage EBR system for denitrification, uranium reduction, and metals polishing. System B targeted all contaminants with the EBR treatment alone. Following the core treatments, aerobic post-treatments were tested for the removal of residual nutrients.

Both treatment trains utilized up-flow, fixed bed EBR bioreactors. Each EBR column was equipped with sampling ports halfway up the column and at the effluent point. The tests were conducted under continuous flow conditions, and the systems were initially operated using a 24-hr HRT per reactor, with samples collected from sampling ports correlating to 12-hr HRT intervals. The bench-scale EBRs had an empty bed volume of 1,610 mL (per reactor). The activated carbon used to fill the columns had a pore space of 42%.

The photograph in Figure 6 shows the bench-scale setup for treatment train A. Not pictured are the chemical pretreatments that were performed in batches. The system was initially designed to use only one pump and gravity flow between the reactor stages (as can be still seen in Figure 6 from the differences in elevation between the test columns). However, since large sample volumes were required for the routine internal and external analyses, and the forward flow was only 1.0 - 1.5 mL/min, an intermediary sample storage jug was placed between the reactor stages and a second pump was installed.

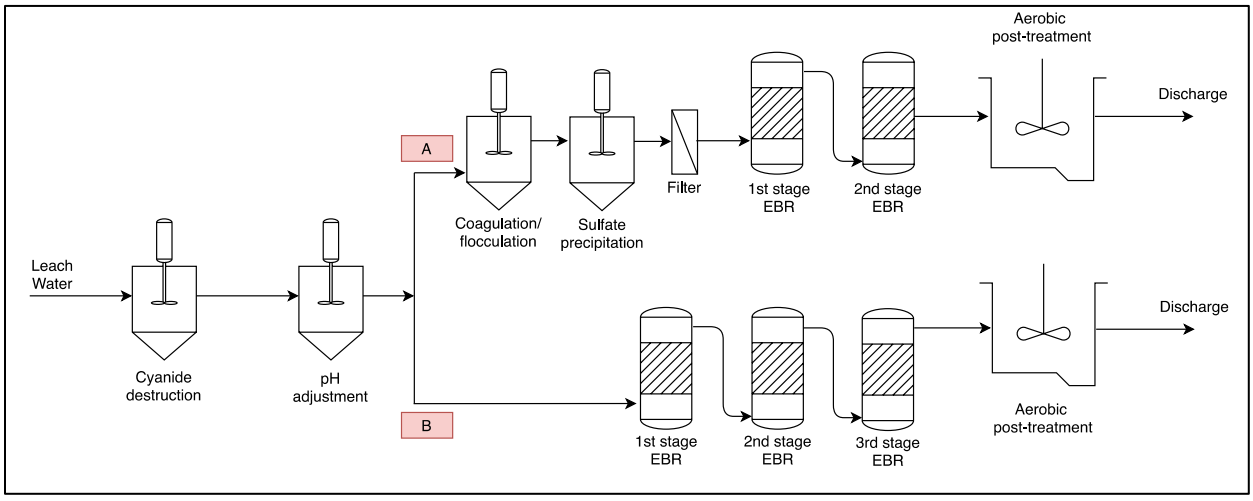


Figure 5. Process flow diagram of the Phase II bench-scale Coffee treatment systems.



Figure 6. Phase II bench-scale setup of treatment train A.

SAMPLING AND ANALYSIS

Feasibility Testing

Daily in-house measurements included flowrate, pH, ORP, DO, temperature, nutrient addition, conductivity, and nitrate-N. Influent and EBR effluent samples were collected in 5-day intervals and sent out to ALS Analytical Laboratories in Vancouver, Canada, for a complete suite analysis (Table 3).

Table 3. Analytes and analytical methods used in the EBR bench-scale tests.

Analyte	Method	Method Number
Hardness	EDTA Titration	APHA 2340B
pH	Automated pH meter	APHA 4500-H pH Value
TDS	Gravimetric	APHA 2540 C
Alkalinity	Titration	APHA 2320 Alkalinity
Bromide	Ion Chromatography (IC)	EPA 300.1
Chloride	Ion Chromatography (IC)	EPA 300.1
Fluoride	Ion Chromatography (IC)	EPA 300.1

Analyte	Method	Method Number
Total Nitrogen	Colorimetric	APHA Method 4500-P (J) / NEMI 5735
Ammonia-Nitrogen	Fluorescence	J. ENVIRON. MONIT., 2005
Nitrite-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Nitrate-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Total Phosphorus	Colorimetric	APHA 4500-P Phosphorus
Orthophosphate	Colorimetric	APHA 4500-P Phosphorus
Sulfate	Ion Chromatography (IC)	EPA 300.1
Total Cyanide	Continuous Flow Analyzer (CFA)	ISO 14403:2002
WAD Cyanide	Continuous Flow Analyzer (CFA)	APHA 4500-CN CYANIDE
Total Metals	Collision/Reaction Cell – Inductively Coupled Plasma (CRC-ICP)	EPA 200.2/6020A
Total Mercury	Cold Vapor Atomic Absorption Spectrophotometry (CVAAS)	EPA 1631E

Bench-Scale Testing

Sampling locations are marked in Figure 7. For process assessment, raw waters, pretreated waters, EBR sampling locations, and post-treatment were analyzed. The in-house analysis included pH, ORP, DO, conductivity, temperature, nitrate, nitrite, sulfate, and COD. These measurements were taken three times a week. Routine metals analyses were performed by a certified independent analytical laboratory, American West Analytical Labs (AWAL) in Salt Lake City, UT, using Ion-Coupled Plasma/Mass-Spec (ICP-MS), method EPA 200.8. In addition to these frequently monitored parameters, a chemistry suite analysis was performed on system influents and effluents once per month by AWAL. Samples for arsenic and selenium speciation were submitted once per month to Brooks Applied Labs in Bothell, WA. Upon completion of testing, the system was taken apart, and any accumulated or generated solids, including the activated carbon media, were sampled and sent to AWAL for TCLP analysis and Pace Analytical Laboratories for rad-chemistry analysis.

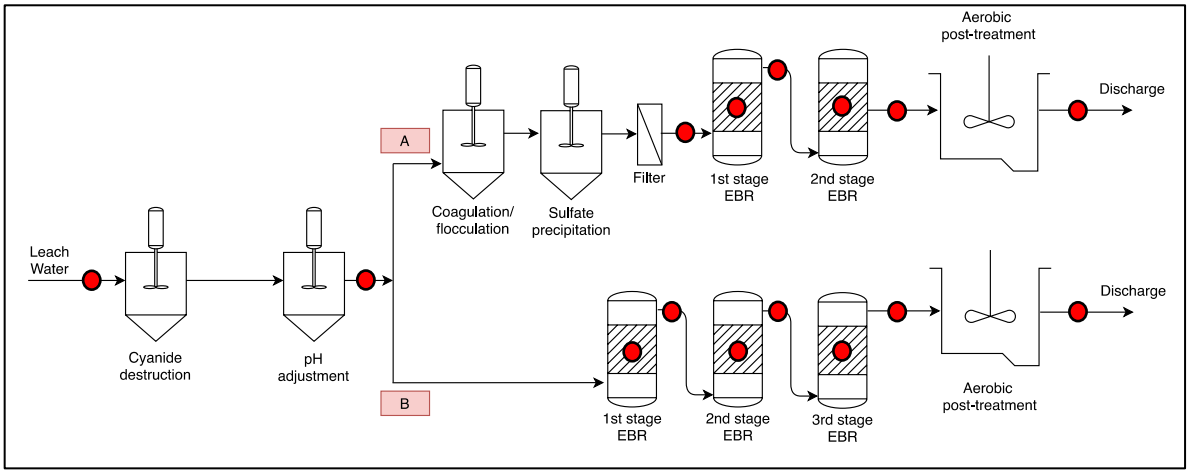


Figure 7. Phase II bench-scale sampling locations.

Data Analysis, Interpretation, and Quality Control

The influent and effluent nitrate, sulfate, uranium, and arsenic concentrations were measured, which allowed the calculation of percent removals and treatment efficiencies. A 30-day continuous operation was required to demonstrate the repeatability of results and reliability of the treatment process. Taking measurements at different sampling points (corresponding to different retention times) determined the removal kinetics.

Quality control was performed on all analyses. As part of the internal quality control testing, AWAL Laboratories performed method blanks (MB), laboratory control samples (LCS), matrix spikes (MS), and matrix spike duplicates (MSD) on the submitted samples. The recoveries of the spiked analyte are evaluated to determine the accuracy in a given matrix, while the comparison between the MS and MSD shows how precise the procedure is in a given matrix.

RESULTS

PHASE I FEASIBILITY RESULTS

Chemistry and Treatability Assessment

The leachate solution chemistry treated by the feasibility test system is shown in Table 4. Nitrate-N (105 mg/L) and uranium (144 µg/L) concentrations were within the biological treatability range. Arsenic levels of 1.1 mg/L were at the upper limit of biological treatability. Compounds that often compete with nitrate, arsenic, and uranium for electrons during biotreatments, e.g., nitrite, and other metal oxyanions, such as selenate or chromate, were not present at concentrations that would impact the biological treatment performance.

Inorganic parameters that often have an inhibitory effect on microbial metabolism, such as chlorides, were present at low levels. Total and WAD cyanides were elevated and needed to be destroyed prior to the biological treatment. Due to the nature of the spent ore, the generated leach solutions had pH of about 8.7 and needed to be adjusted to 6.5 for optimal denitrification and As/U removal.

Water chemistry assessment strongly suggested that the biological treatment would be effective at removing the contaminants of concern. Additionally, the EBR technology also reduced the concentration of some other metals, such as aluminum, antimony, cadmium, chromium, copper, mercury, molybdenum, nickel, and tin.

Microbial Screening and Assessment Results

Nitrate-, arsenic-, and uranium-reducing microorganisms were isolated from the Coffee Gold waters and spent ore materials received and screened with WesTech's repository strains to examine their bioremediation potential in the site waters at 5°C and 20°C. The microbial screening is used to 1) determine whether a given contaminant is easy or difficult to remove in given water chemistry using the EBR technology; 2) identify a best performing microbial population in the given water chemistry (contaminant transformation, temperature dependence, performance robustness); 3) select an adjusted/enhanced microbial consortium that is the most compatible with the unadjusted native population; and 4) condition the selected microbial consortia for optimal biological performance.

With an evaluation of the obtained wastewater chemistry, good positive denitrification and microbial arsenic/uranium reduction screening results were obtained. Selected microbes were further screened, conditioned, and characterized to develop the inocula for the feasibility tests. From the various consortia tested in the Coffee Gold waters, the best inoculum was selected based on:

- Nitrate/As/U reduction potential at low and high temperatures.
- Robustness in the Coffee Gold waters at low and high temperatures.
- Compatibility with indigenous microbes present in the Coffee Gold waters.
- The ability to maintain an integrated biofilm with desired contaminant removal characteristics.

Table 4. Water chemistry of Coffee Gold leach solutions used during feasibility testing.

Parameter	Concentration
Metals	
Aluminum	1.5 mg/L
Antimony	30.8 µg/L
Arsenic	1.1 mg/L
Barium	70.5 µg/L
Cadmium	3.7 µg/L
Calcium	37.5 mg/L
Chromium	10.3 µg/L
Cobalt	239 µg/L
Copper	0.5 mg/L
Iron	0.5 mg/L
Lead	1.1 µg/L
Magnesium	5.9 mg/L
Manganese	32 µg/L
Mercury	3.7 µg/L
Molybdenum	75 µg/L
Nickel	118 µg/L
Potassium	83 mg/L
Selenium	2.1 µg/L
Silver	5.2 µg/L
Sodium	234 mg/L
Strontium	186 µg/L
Thallium	0.88 µg/L
Tin	7.7 µg/L
Titanium	9.3 µg/L
Uranium	144 µg/L
Vanadium	1.2 µg/L
Zinc	187 µg/L
Inorganics	
pH	8.7
Hardness, Total (as $CaCO_3$)	118 mg/L
Alkalinity, Total (as $CaCO_3$)	188 mg/L
Ammonia as N	13 mg/L
Chloride	6.8 mg/L
Fluoride	0.35 mg/L
Cyanide, Total	24 mg/L
Cyanide, WAD	25 mg/L
Nitrate as N	105 mg/L
Nitrite as N	0.3 mg/L
Total N	130 mg/L
Sulfate	160 mg/L
Dissolved Orthophosphate	0.13 mg/L

Feasibility Treatment of Contaminants of Interest

The feasibility testing validated the biological treatment for the removal of nitrate, arsenic, and uranium from Coffee Gold heap leach rinse waters. Figure 8 and Figure 9 show the reduction of nitrate-N and nitrite-N by the feasibility test system. Nitrate-N concentrations were spiked to a minimum of 150 mg/L in the influent waters and averaged 188 mg/L during the 2-month test period. **The feasibility EBR system consistently removed both nitrate-N and nitrite-N to below detection limits** (0.19 mg/L and 0.04 mg/L, respectively).

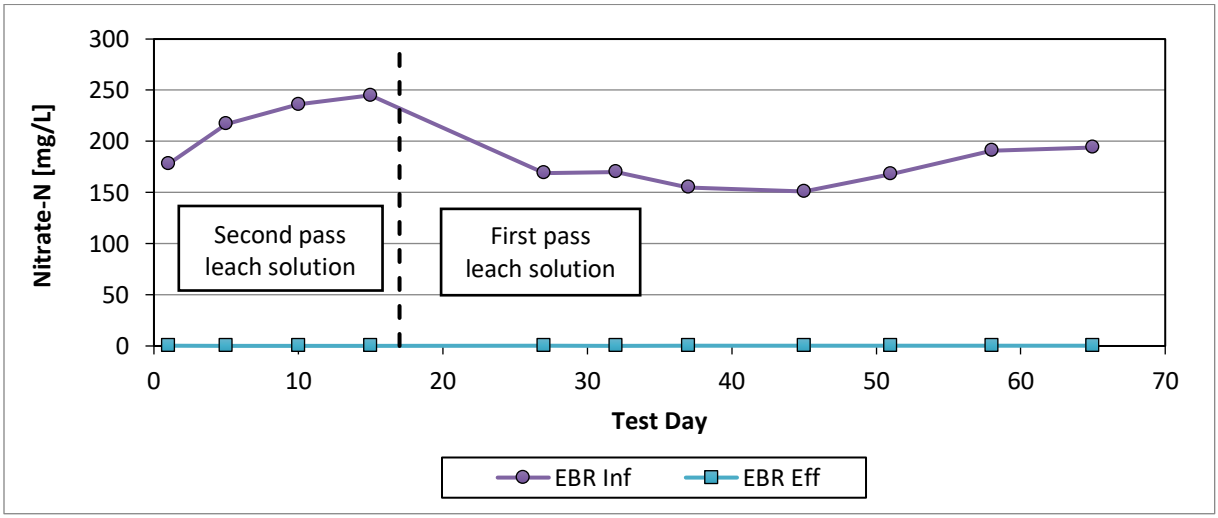


Figure 8. Phase I feasibility EBR nitrate-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

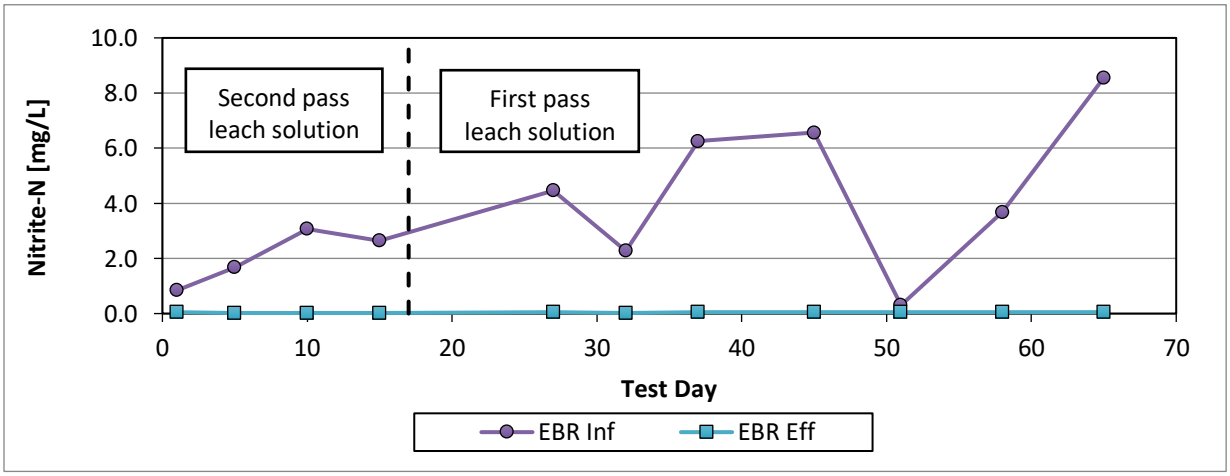


Figure 9. Phase I feasibility EBR nitrite-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Arsenic removal for the initial two weeks averaged 60% (Figure 10). Process and bioreactor operation were adjusted to improve the EBR performance. **After system modifications were implemented, arsenic removal increased to an average of 98.8%.** Total arsenic was removed from the average of 1,113 µg/L in the leach waters to an average of 12.9 µg/L in the EBR system effluent.

Uranium removal averaged 99.1%, with the EBR system effluent concentrations averaging 0.8 µg/L (Figure 11). Influent uranium levels varied between 34 µg/L and 154 µg/L, with the average concentrations of 92.5 µg/L. Table 5 summarizes the feasibility performance.

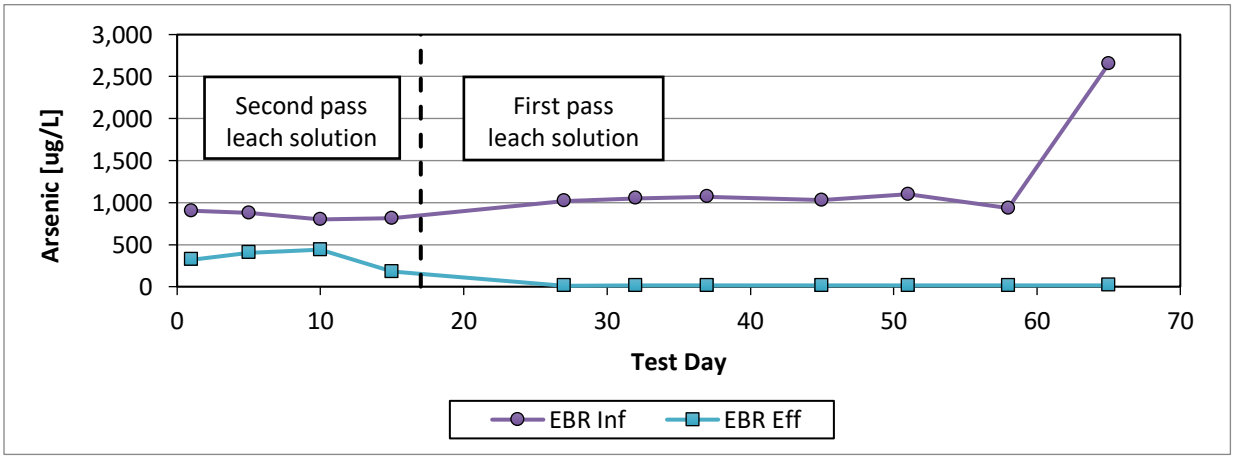


Figure 10. Phase I feasibility EBR arsenic removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

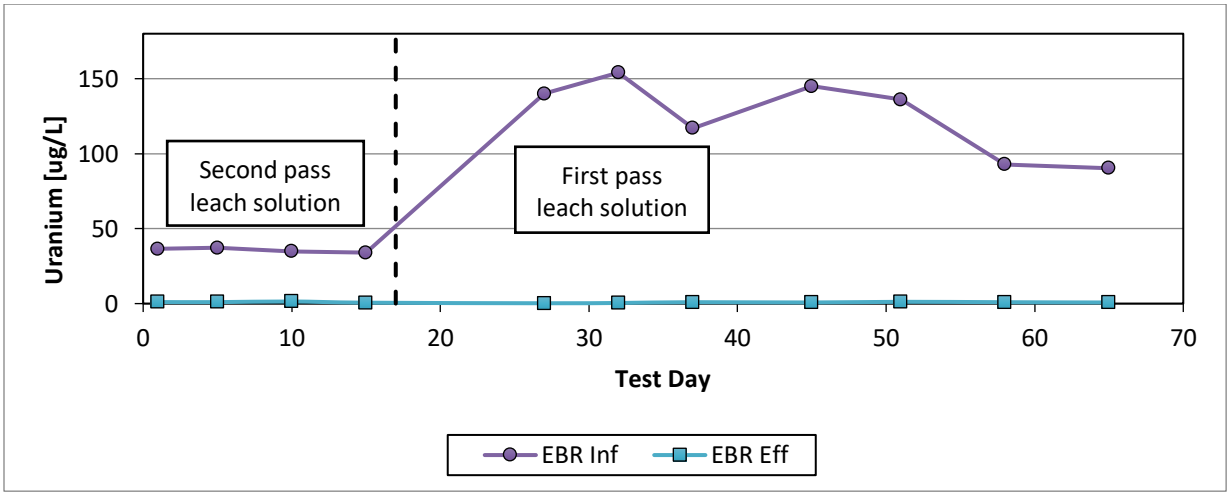


Figure 11. Phase I feasibility EBR uranium removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Table 5. Average Phase I feasibility treatment performance.

Parameter	Average Influent	Average Effluent	% Removal
Nitrate-N [mg/L]	188	< 0.19	> 99.9%
Nitrite-N [mg/L]	3.7	< 0.04	> 98.9%
As [µg/L]	1,113	12.9*	98.8%
U [µg/L]	92.5	0.8	99.1%
Al [µg/L]	737	< 35.8	> 95.1%
Sb [µg/L]	33.2	< 0.35	> 98.9%
Cd [µg/L]	1.3	< 0.02	> 98.5%
Cr [µg/L]	10.7	< 0.66	> 93.8%
Co [µg/L]	269	122	54.6%
Cu [µg/L]	267	< 2.4	> 99.1%
Fe [µg/L]	2.2	0.23	89.5%
Pb [µg/L]	1.9	< 0.17	> 91.0%
Hg [µg/L]	1.6	0.03	98.1%
Mo [µg/L]	59.5	< 6.9	> 88.4%
Ni [µg/L]	75.1	< 2.3	> 96.9%
Se [µg/L]	2.9	1.2	58.6%
Ag [µg/L]	3.9	< 0.06	> 98.5%
Tl [µg/L]	0.8	< 0.03	> 96.2%
Sn [µg/L]	32.5	0.8	97.5%
Zn [µg/L]	76.1	38.1	49.9%
WAD Cyanide [mg/L]	0.03	< 0.007	> 76.7%
Total Cyanide [mg/L]	0.48	0.16	66.7%
Ammonia-N [mg/L]	15.3	208	NA
Orthophosphate [mg/L]	0.2	47.1	NA

*after process adjustment

NA – not applicable

Feasibility Treatment of Other Contaminants and By-Product Formation

Besides arsenic and uranium, the feasibility test system removed other metals to various degrees (Table 5). **Over 90% average removal efficiencies were achieved for Al, Sb, Cd, Cr, Cu, Pb, Hg, Ni, Sn, Ag, and Tl.** Total and WAD cyanide were still present in the leach waters after cyanide destruction with peroxide, albeit at much lower concentrations (0.48 mg/L and 0.03 mg/L, respectively). The EBR system degraded WAD cyanide to below the detection limit of 0.007 mg/L and total cyanide to average levels of 0.16 mg/L (Table 5).

As expected in this preliminary treatability evaluation, nutrient levels (e.g., ammonia-N and orthophosphate) were elevated in the test system effluent. The scope of work for the feasibility phase was focused on the initial validation of the biological process for removal of contaminants of interest (i.e., proof-of-concept) and not on process optimization. In field applications, minimum nutrient additions to the biological system are established and balanced, often resulting in minimal (if any) increases in residual nutrients in the system effluent. However, if ultra-low levels of ammonia or BOD are required in the system effluent, a conventional aerobic bioreactor polishing step can be used. Aerobic bioreactors are a well-established technology for nutrient removal from municipal wastewaters, where they have been successfully implemented for over a century. Phase II bench-scale testing will investigate the optimal nutrient composition and dosage to more accurately define what levels of residual nutrients can be expected in the full-scale plant effluent.

Feasibility of In-Situ Denitrification

Table 6 summarizes average nitrate-N concentrations during two in-situ testing phases. Figure 12 shows the results of in-situ denitrification in the Coffee Gold spent ore materials.

For the initial three weeks of operation, both columns were irrigated with 1 L/day of the EBR effluent spiked with about 150 mg/L nitrate-N; the influent to the control column was filtered before it was applied to the top of the column. During test stage 1, the average in situ test column effluent contained 13.9 mg/L NO_3-N, while the average control column effluent was 103 mg/L NO_3-N. It should be noted that nitrate-N concentrations in the control column decreased with time to about 50 mg/L, which can be explained by the fact that the EBR effluent applied to the top of this column, although filtered, still contained excess nutrients in the form of organic carbon, nitrogen, and phosphorus, that allowed the native denitrifying population to carry out partial denitrification.

For the following four weeks, both columns were irrigated with 1 L/day of deionized (DI) water spiked with about 150 mg/L nitrate-N. The in-situ test column was provided with the required nutrients daily. During test stage 2, the average in-situ test column effluent contained 26.4 mg/L NO_3-N, while the average control column effluent was 146 mg/L NO_3-N. The negligible nitrate removal in the control column as compared to the in-situ column demonstrated the effectiveness of in-situ denitrification.

The feasibility testing proved the in-situ treatment to be a feasible approach to controlling nitrates within the heap environment. Lowering the nitrate concentrations in the heap leach rinse solutions in-situ would significantly impact the size, capital cost, and operating expenditures of the active water treatment system.

Table 6. Average Phase I feasibility in-situ denitrification performance.

	Control	In Situ	Control	In Situ
	EBR Effluent + 150 mg/L NO_3-N		DI Water + 150 mg/L NO_3-N	
NO_3-N [mg/L]	103	13.9	146	26.4

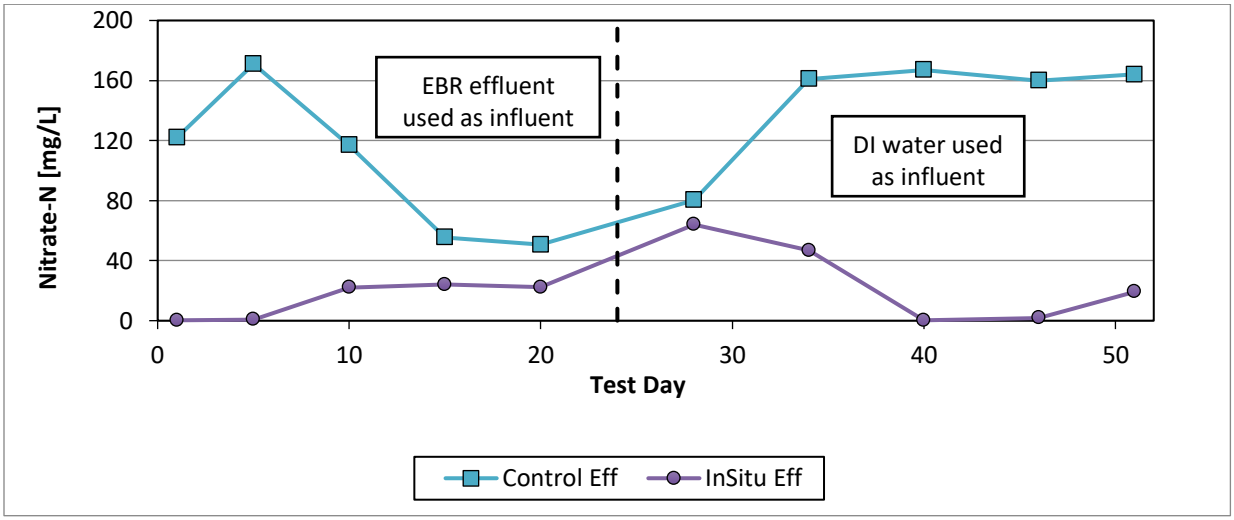


Figure 12. Phase I feasibility in-situ denitrification from Coffee Gold spent ore and water. The dashed vertical line corresponds to the day when the column influent was switched from the EBR effluent to deionized water.

PHASE I FEASIBILITY CONSULTATIONS, FEEDBACK, AND INFORMATION REQUESTS

The feasibility testing concluded with a final report submitted to Newmont (then Goldcorp) in August 2016. Following the report submittal, Newmont elicited feedback from the stakeholders, most notably the First Nations and their representatives (Tr'ondek Hwech'in and Source Environmental Associates) in 2017, as well as the Canadian and local regulatory agencies through the YESAB review process in 2018. Several technical meetings and workshops were held for consultations. WesTech participated in the meetings to provide clarifications and adjust the planned Phase II testwork based on the feedback. Table 7 lists the feedback and action items identified through the process.

Table 7. Feedback and information requests, obtained through consultations with the stakeholders.

Requested by/ Reference	Issue and Rationale	Feedback and Information Request	Solution & Action Item
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Will the Heap Leach Facility pose a concern for long-term water quality downstream of the proposed project? Are water treatment plans for the active closure phase and the post-closure phase sufficient?	The information provided is not adequate to assess the short-term and long-term water quality associated with the Heap Leach Facility. Additional information is required. The descriptions of the active and passive treatment design plans in the submission are not sufficient for EA-level review.	Phase I Feasibility was a "proof-of-concept" test focused on establishing whether or not the waters can be treated and on identifying suitable treatment options. Phase II testing will define the required treatment train in more detail.

Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Residual Ammonia and Ortho-phosphate across Active Treatment. Appendix A of the EBR feasibility report shows the change in concentrations of a variety of constituents across the system.	What level of residual orthophosphate and ammonia could be expected in the EBR effluent after nutrient dosage has been optimized?	The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations would not affect the evaluated treatment approach. Data from other testing were shared to show what residual nutrient levels were generated in the past by the EBR system. Phase II testing will use commercial-grade nutrients and will optimize nutrient addition to demonstrate what residual nutrient levels can be expected from a full-scale treatment system at the Coffee Mine.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Residue Characterization and Management. The EBR system is a biological system and so biosolids waste residue will be generated. No information on the characterization and handling of this waste is presented in the documentation.	Elaborate on the residue characterization, geochemical stability, disposal/handling plan, and long-term management plan.	The preliminary residue characterization will be performed in the form of TCLP testing of the reactor's support media upon the completion of Phase II testing. On-site Phase II pilot-scale demonstration testing will define the volume and inform a long-term management plan.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Adaptability. Three things must be achieved for the water treatment to be a success - denitrification with no residual ammonia/other	The level of nitrate in the plant feed will decrease over time as CN is washed out of the HLF as there is a finite load of N on site. On the other hand, As and U will persist on a longer time scale. As such, it is likely that later in the	From the ORP-ladder perspective, uranium bioreduction occurs at similar if not more energetically favorable ORP ranges than denitrification. The process will be staged, and the denitrification reactor-stage will never be driven to low

	nutrients, metal reduction, and conversion of sufficient sulphate to sulphide to precipitate metals without leaving residual sulphide in solution.	project, the influent concentration of NO3 will be low while influent As and U will be high. Can the EBR system effectively achieve the three goals described with only a single lever of control, ORP?	enough ORPs to generate ammonia. After cyanides/nitrates are washed out from the HLF, the redundant denitrification reactors can either be taken offline, adapted to treat more volume for uranium removal, or used for other metals polishing. Phase II bench-scale testing will also evaluate alternative treatment options for Arsenic removal.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Residual Chloride from Active Treatment. Appendix A of the EBR feasibility report shows an increase in chloride.	Why is chloride being added across the circuit? Can this addition be mitigated in some way? Is there a minimum level of chloride that must be present for the EBR system to be effective?	Chlorides are not required for the bioreactors and were a byproduct of a laboratory-grade nutrient mixture used. The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations would not affect the evaluated treatment approach, but it resulted in increases in parameters, such as chlorides, that will not be present in commercial-grade nutrients. Phase II bench-scale testing will use commercial-grade nutrients to demonstrate that no chloride increases are expected from the full-scale facility.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Sulphur Deportment across Active Treatment. Appendix A of the EBR feasibility report shows sulphate removal of 100-150 mg/L across the system	What is the form of the sulphur removed from the system using the SBR?	Sulfur undergoes a number of biochemical transformations within the bioreactor, depending on the treatment conditions, with hydrogen sulfide gas generation as the most dominant pathway. Phase II bench-scale testing will evaluate two options for

	and simultaneous generation of 3-4 mg/L of sulphide. Given that only trace levels of metals are removed by the system, there is a gap between the influent and effluent total sulphur.		sulfate removal: 1) EBR treatment with expected H_2S gas generation, and 2) chemical precipitation pre-treatment.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Bioavailability of Metals across Active Treatment. The bioavailability of dissolved metals can be enhanced through contact with reductive biological treatment systems which generate species such as methylated arsenic species. These organic-metal complexes can be significantly more bioavailable than their inorganic counterparts.	Has Inotec analyzed the speciation of residual metal that is not removed through the EBR for this project or any others? Particularly arsenic, as this is a key constituent of concern in the project.	Arsenic and selenium speciation will be included in the Phase II bench-scale testing analytical plan. Methylated arsenic species have never been observed in our past testing.
Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Deportment of Cyanide Residue across Active Treatment. Oxidative treatment of cyanide can lead to the formation of cyanate, and reductive treatment of cyanide and cyanide degradation products can lead to formation of thiocyanate.	How do cyanate/thiocyanate behave in the EBR system? Are either removed/generated in the process? Given the amount of sulphate reduction occurring in the system (see previous point about sulphur deportment), the formation of thiocyanate may be occurring simultaneously.	Thiocyanate analysis will be included in the Phase II bench-scale testing analytical plan.

Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Startup/Shutdown. The EBR system is a biological system that is to be run seasonally for 6 months of the year. The startup/shutdown of biological processes can be lengthy.	How long is the startup period before the EBR is system is generating effluent meeting discharge targets? Does plant shutdown have an impact on effluent discharge quality?	Generally, the EBR system has been shown to require 5-14 days to reach steady-state during the initial start-up of a new facility and less than an hour to 7 days after long-term shutdowns. Shutdowns are not expected to have an impact on the effluent discharge quality
Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Variability with Flow. The rate of EBR treatment is expected to vary between 4 and 10 L/s. The Inotec document describes a 44h hydraulic retention time (HRT) in the system.	How sensitive to HRT is the discharge quality of the plant? Will performance change if HRT varies because there is excess water on site (or not enough)? If this risk is significant, is a surge pond available to modulate variability in water availability?	Phase I Feasibility was a "proof-of-concept" test focused on establishing whether or not the waters can be treated and on identifying suitable treatment options. The HRTs used were far from optimized and were long enough as not to affect the treatment efficacy. Phase II bench-scale testing will optimize the HRT range, which we expect to be several times shorter. Based on the variable flow expectations, an equilibration basin or tank is expected to be required for a full-scale facility.
Environment and Climate Change Canada – YESAB, 02/2018	The Proponent states that for heap leach solutions only, cyanide destruction followed by an Electrochemical Biological Reactor (EBR) will be employed to treat water to discharge quality. EBRs have not typically been proposed nor used for Yukon projects and their suitability	Clarify whether the proposed water treatment system has been tested (bench-scale) using a synthesized heap leach solution (of the characteristics expected for this project) to proof of concept level and its applicability in a Northern context. If this has yet to be demonstrated, provide clarification whether the Proponent is planning on conducting bench-scale	The proposed phased testing approach includes feasibility (proof-of-concept) testing and bench-scale testing on heap leach solutions generated from the Coffee Project ore materials. The on-site pilot-scale demonstration will be conducted as a final step of a full-scale water treatment design. The phased testing and process development approach minimizes the risks associated with technology

	/ performance in a Northern context remains uncertain. It is not clear what testing has been conducted to suggest suitability for this aspect of the project in particular.	testing as part of the water treatment system finalization, as well as characterizing the resulting effluent prior to implementation.	selection and treatment implementation.
Environment and Climate Change Canada – YESAB, 02/2018	Elevated uranium concentrations in both groundwater quality and surface water quality baseline have been identified. Radium 226 (Ra226) is a daughter isotope resulting from the radioactive disintegration series (decay) of uranium. Given that uranium is a parameter of concern and has been shown to be present and in exceedance as per the above-mentioned, it is not without reason to assume that Ra226 concentrations may end up in the receiving environment throughout the life of the project.	Ra226 is a deleterious substance as set out in Schedule 4 of the MMER. Predictions for Ra226 have been generated by the water quality model for pit lakes and settling ponds. Demonstrate that a non-acutely toxic effluent as required by the MMER will be met throughout the life of the project (i.e. construction, operation, and closure).	Radium-226, as well as other radiochemistry parameters, will be included in the Phase II bench-scale testing analytical plan.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in,	The test work for the biological treatment proposed (EBR) shows a very significant increase in phosphate,	The Inotec EBR work plan authored Oct 30, 2017 included an objective in Phase 2 of determining the optimal dosage of nutrients to minimize	The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations

Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	ammonia and chloride across the treatment system. These increases are not accounted for in the WQ model. These will be ecologically significant because of the low nutrient levels in northern water courses. The increase in chloride across the system is relevant both because of the direct toxicity of salinity on freshwater species and the corrosive impact for metal release in the rock drain.	residual nutrients in the effluent. Phase 2 also includes development of an integrated treatment train include pre-treatment (ex. cyanide destruction) and post-treatment (nutrient polishing). The minimum residual nutrient levels in EBR effluent while still reaching nitrate/arsenic/uranium levels can be assessed. Following this, the requirement of nutrient polishing systems can be evaluated and supported through testing or other reference sites.	would not affect the evaluated treatment approach, but it resulted in increases in parameters, such as chlorides, that will not be present in commercial-grade nutrients. Phase II testing will use commercial-grade nutrients to demonstrate ammonia, phosphate, and chloride levels more representative of the proposed full-scale treatment system.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	The active water treatment system will produce some quantity of waste biomass and carbon, likely both as a periodic bleed from the system and during the final reclamation of the system after shutdown of the EBR. Plans for characterizing this material were not covered in the EBR workplan.	The upcoming Phase 2 EBR test work is a good opportunity to characterize waste and help inform disposal plans. TCLP is one option for characterization, but depending on residue disposal options that are on the table and the amount of material generated during Phase 2 testing, different characterization could be done.	TCLP analysis will be added to the Phase 2 test work, but the pilot test materials would provide better data as they would represent testing conducted with actual wastewaters. TCLP tests will be done on both sets of test materials.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in,	Arsenic speciation in the feed	The Phase II work plan describes use of ferric coagulation to remove arsenic from water. Arsenic removal in this way will depend on	Arsenic speciation of the influent waters will be included in Phase II testing.

Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018		arsenic speciation – As(V) is more amenable to ferric than As(III). Arsenic in the HLF water may be more reduced (from the reductive conditions in the heap) or more oxidized (from use of peroxide to destroy cyanide upsteam of the EBR) or a mix of the two. Consideration of speciation in the test plan/analytics is recommended.	
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	Organo-arsenic complexes in EBR effluent	The EBR systems involve biological activity and therefore have the potential to convert inorganic arsenic species to organic species. Organic arsenic species can be more bio-accumulative. It is recommended that arsenic speciation analysis be conducted on treatment effluent in future testing campaigns so as to better evaluate the impact of the project on biota in the receiving environment.	Arsenic speciation of the effluent waters will be included in Phase II testing.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	Cyanate formation potential	Cyanate is a likely byproduct of cyanide destruction with peroxide and so should be expected in the EBR feed. It is recommended that cyanate assay be incorporated into the Phase 2 laboratory program (in addition to the thiocyanate as was noted in the Oct 30, 2017 Phase 2 EBR workplan).	Thiocyanate analysis will be included in Phase II testing. Cyanate analysis is not available through the selected analytical laboratory. Cyanate will be added to the pilot-scale analytical plan.

PHASE II BENCH-SCALE TESTING RESULTS

Preliminary Assessments

The Obtained Leach Water Chemistry and Experimental Implications

The chemistry of the waters generated by Kappes, Cassiday & Associates in the leach testing differed from the water modeling performed by Lorax Environmental (Table 8), as was discussed by WesTech and Lorax when deciding how to best approach the needed chemistry adjustments. Limitations of an accelerated leaching procedure, as well as scaling issues of a small-scale leach column, likely contributed to the discrepancies.

Batches of the waters delivered to WesTech's laboratories were spiked with the parameters of concern (NO_3, SO_4, As, U, and Sb) to match the upper modeling predictions. These parameters are highlighted in blue in Table 8. Counter ions were chosen with a goal to balance the major ion chemistry and included Ca, Mg, Na, and Cl.

Certain other influent water chemistry parameters exceeded the predicted levels by up to several orders of magnitude (NH_3, alkalinity, Al, Ag, and Cu). They are highlighted in yellow in Table 8. Except for alkalinity, **these concentrations in the generated waters exceeded their respective treatment targets. Water chemistry was not adjusted to lower their concentrations.**

Table 8. Water chemistry comparison of the modeling predictions and the received solutions. Treatment targets are provided as a reference.

Parameter [mg/L]	HLF Rinse Modeling	Coffee Waters	Treatment Target
NH_3-N	0.025-0.06	19	8
NO_3-N	275-307	117	3
NO_2-N	1.6-1.9	0.9	0.09
Cl	115-123	12	290
SO_4	2300-2516	105	1500
Alkalinity, as $CaCO_3$	47-87	284	500
WAD-CN	0.09-0.2	0.03	0.025
Al	0.06-0.2	5.7	0.06
Ag	0.00009-0.00125	0.027	0.00009
As	0.66-2	0.559	0.035
Ca	204-350	12	180
Cd	0.00004-0.00013	0.00012	0.00004
Cr	0.004-0.014	0.0012	0.001
Cu	0.004-0.014	0.029	0.004
Fe	0.15-0.5	0.077	0.05
Hg	0.0001-0.00026	0.000013	0.0001
Mg	117-155	1.6	50
Mn	0.016-0.06	0.025	0.016
Mo	0.033-0.105	0.035	0.033
Na	890-1168	238	890
K	8-11	6.5	8

Parameter [mg/L]	HLF Rinse Modeling	Coffee Waters	Treatment Target
Ni	0.002-0.006	0.006	0.002
Pb	0.00032-0.0013	0.0006	0.0032
Sb	0.17-0.5	0.084	0.07
Se	0.0015-0.005	0.0008	0.0015
Tl	0.0015-0.004	0.0006	0.0015
U	0.3-0.685	0.306	0.1
Zn	0.02-0.052	0.005	0.02

Chemistry Assessment

Evaluation of the chemistries suggested that most of the parameters of interest were well within the treatability range. A discussion of the treatability assessment and the identified potential issues are presented below.

Nitrate-N, uranium, and sulfate concentrations of 300 mg/L, 600 μg/L, and 2,500 mg/L, respectively, were within the biological treatability range. Inorganic parameters, such as chlorides and cyanides, which often have an inhibitory effect on microbial metabolism, were present at low levels. Additionally, the elevated alkalinity and presence of nitrates would benefit the biological treatment approach, maintaining an optimum pH of the system. No microbial inhibitory parameters were identified.

In terms of potential issues, as demonstrated in the Phase I feasibility testing, arsenic concentrations were present at the upper margin of biological treatability. What is more, the compounds that often compete for electrons during biotreatments, e.g., nitrate, nitrite, sulfate, and other metal oxyanions, such as arsenate, were present at elevated concentrations, complicating the treatment approach. Finally, from the system design perspective, due to the concentrations of sulfate, aluminum, calcium, and other water hardness parameters, bioreactor operation must be conducted within design specifications to prevent the potential for excessive precipitation formation. **The chemistry assessment concluded that, while treatable, the complexity of the Coffee waters presents a challenging scenario for full-scale system design based solely on biological treatment.**

Jar Testing

The generated waters contained only 0.5 mg/L total As. The solutions were spiked with sodium arsenite to reach the forecasted As levels of 2 mg/L. Arsenite is the less oxidized species of As, and it is more difficult to remove using ferric co-precipitation. **Arsenite was chosen for this testing as "the worst-case scenario" for chemical pretreatment.** The actual As speciation in the future Coffee waters is uncertain, but arsenate is generally a more prevalent species in mining environments.

Ferric co-precipitation tests demonstrated the impact of arsenic speciation on the performance (Figure 13). When no oxidizing agent was present, negligible arsenic removal was achieved. **Once arsenic was oxidized, ferric co-precipitation decreased As concentrations to at or below the treatment target.** Permanganate was used in the jar testing procedure as a strong oxidizer. Since the proposed treatment includes the destruction of cyanide by oxidation with hydrogen peroxide, it is expected that most of arsenic present will be converted to arsenate, rendering the ferric co-precipitation a suitable option for As pretreatment.

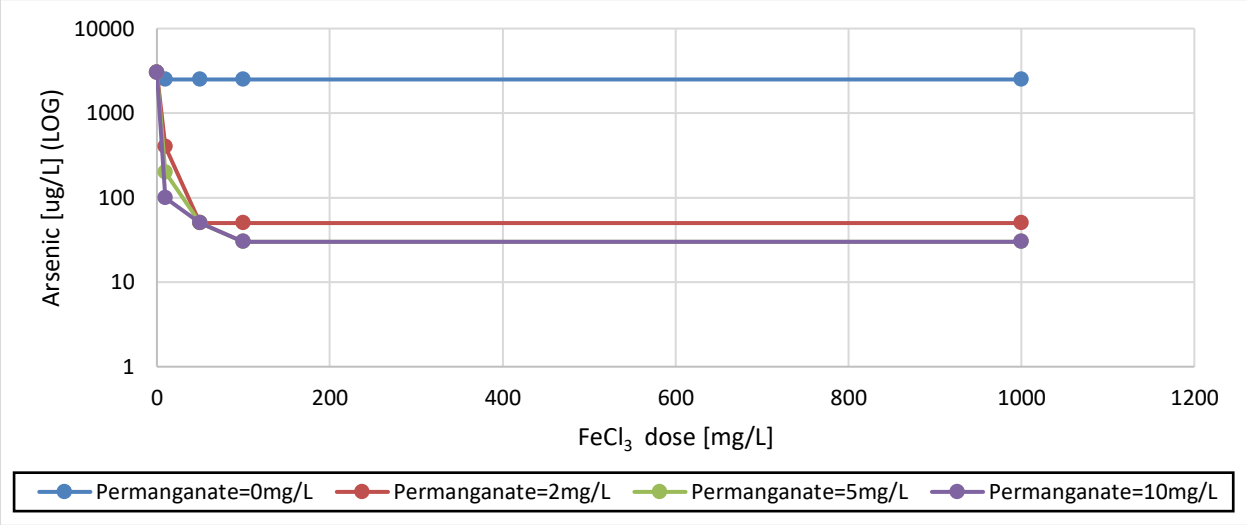


Figure 13. Arsenic ferric co-precipitation jar test results.

Sulfate is forecasted to be present at approximately 2,300-2,500 mg/L in Coffee Mine waters, which is a threshold of gypsum solubility. At such high concentrations, under specific conditions, a portion of sulfate might be expected to precipitate out of solution within the bioreactor – a scenario that should be avoided.

Sulfate precipitation pretreatment with barium salts (barium chloride and barium hydroxide) was investigated in the absence and presence of lime additions (Figure 14).

- **Treatment efficiency was shown to be directly proportional to the barium dose.**
- **Lime additions improved sulfate precipitation, but only at higher Ba doses. With the sulfate treatment target of 1,500 mg/L, lime addition was shown not to be needed.**

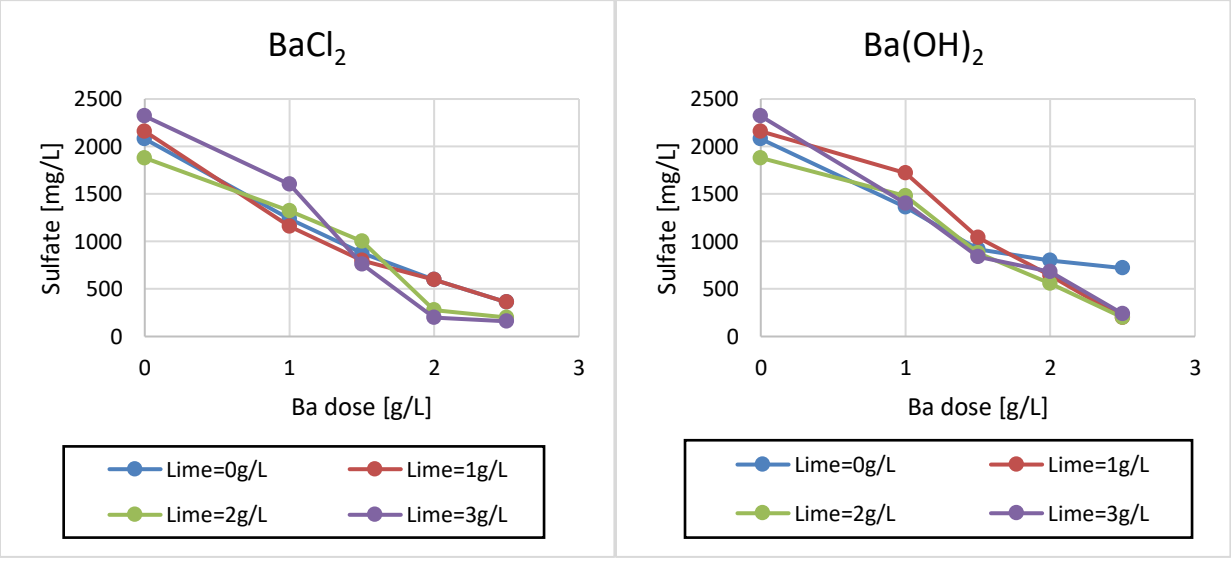


Figure 14. Sulfate precipitation jar tests with barium chloride and barium hydroxide salts.

As both evaluated barium salts proved to be effective for sulfate precipitation from the Coffee waters, other treatment parameters were considered (Table 9). Precipitated sludge resulting from barium hydroxide addition was more amorphous, took longer to settle, and generated more sludge volume than barium chloride treatment. **Barium chloride was initially chosen as a precipitation reagent for the bench-scale testing** because it yielded better results per Ba dose than $Ba(OH)_2$, the produced sludge had more beneficial characteristics, and barium chloride addition would not require an additional pH adjustment step.

Table 9. Sulfate precipitation with barium salts. Reagent dosage, sludge volume, and water loss comparison.

	$BaCl_2$	**$Ba(OH)_2$**
Min. Ba dose to meet discharge target	0.72 g/L	0.83 g/L
Equivalent reagent dose	1.28 g/L	1.91 g/L
Sludge volume	10 mL/L treated	23 mL/ L treated
Sludge volume (extrapolated)	10 L/m^3 treated	23 L/m^3 treated
Sludge weight (extrapolated)	12.6 kg/m^3 treated	25.6 kg/m^3 treated
Dry sludge weight (extrapolated)	3.5 kg/m^3 treated	4.2 kg/m^3 treated
Water loss (extrapolated)	9.1 kg/m^3 treated	21.5 kg/m^3 treated

Microbial Screening and Assessment

Microbes present in the received water samples were cultured. This task provided information about concentrations and colony types of microbes present (i.e., microbial diversity). Understanding the native population is as crucial as understanding water chemistry since indigenous microbes can either hinder or enhance the biotreatment.

The microorganisms isolated from the waters received were screened with WesTech's repository strains to examine their contaminant-reducing potential in the site waters. The microbial screening was performed as a batch, qualitative assessment toward a selection of a robust microbial population. It was used 1) to determine whether a given contaminant was easy or difficult to remove in the given water chemistry using biological treatment; 2) to identify the best performing microbial population in the given water chemistry (contaminant transformation, performance robustness, etc.); 3) to select an adjusted/enhanced microbial consortium that was the most compatible with the unadjusted native population; and 4) to condition the selected microbial consortia for optimal EBR performance.

The microbes screened included denitrifiers, uranium reducers, arsenic reducers, antimony reducers, and sulfate reducers, matched with the indigenous microbial population. **With an evaluation of the obtained water chemistry, microbial screening tests demonstrated favorable biological treatment of all contaminants of concern.** Figure 15 shows a snapshot of the screening results of denitrification and sulfate reduction. Only a few microbial strains tested are shown in the figures to help with legibility. Out of dozens of microbial strains tested, selected few were further screened to develop the inocula for bench-scale tests.

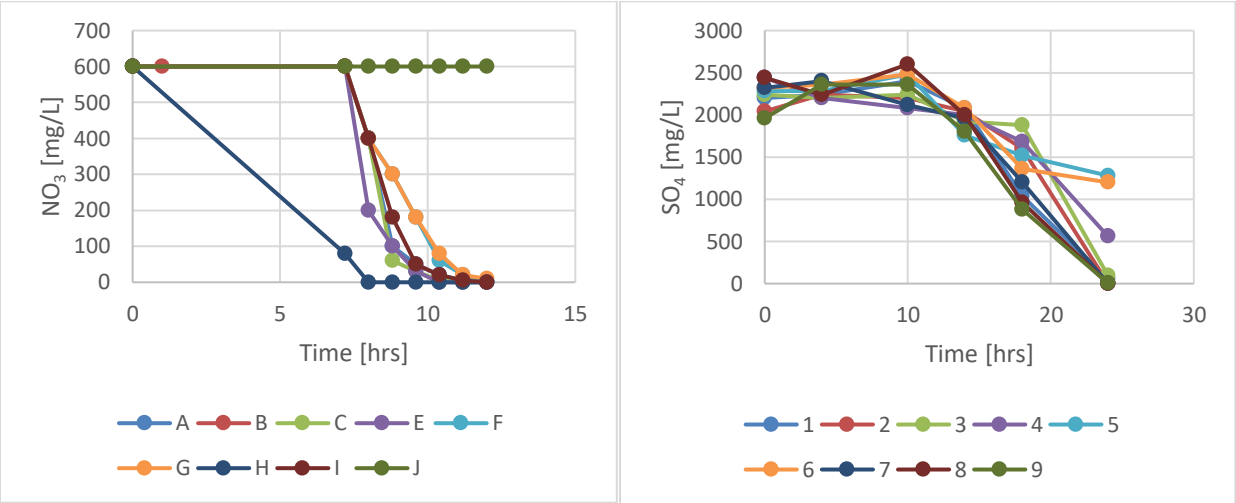


Figure 15. Selected snapshots of denitrification and sulfate reduction microbial screening tests using various denitrifying (A – J) and sulfate-reducing (1 – 9) strains.

Bench-Scale Testing

System A: Validation Results of Contaminants of Interest

The validation phase of the bench-scale EBR testing with System A was completed successfully for all contaminants of concern. Nitrate-N was consistently removed to below the detection limit of 0.5 mg/L within the first EBR stage and remained nondetectable throughout the treatment (Figure 16).

Sulfate was successfully removed to below the discharge target of 1,500 mg/L in the phys-chem pretreatment stage and remained within compliance throughout the treatment (Figure 17). Sulfate removal in the pretreatment can be adjusted further based on Ba dose. The increase in sulfate concentration observed in the aerobic column during the post-treatment optimization was expected. The post-treatment's main goal was residual COD/BOD oxidation; once that goal was achieved, system optimization in terms of the HRT and the required aeration was performed to avoid re-oxidizing reduced species.

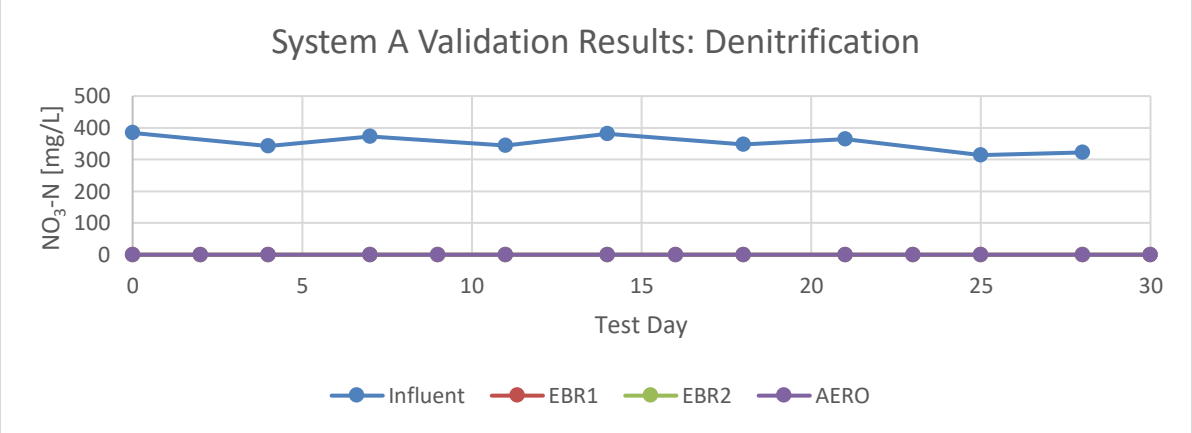


Figure 16. Phase II bench-scale denitrification results: System A validation.

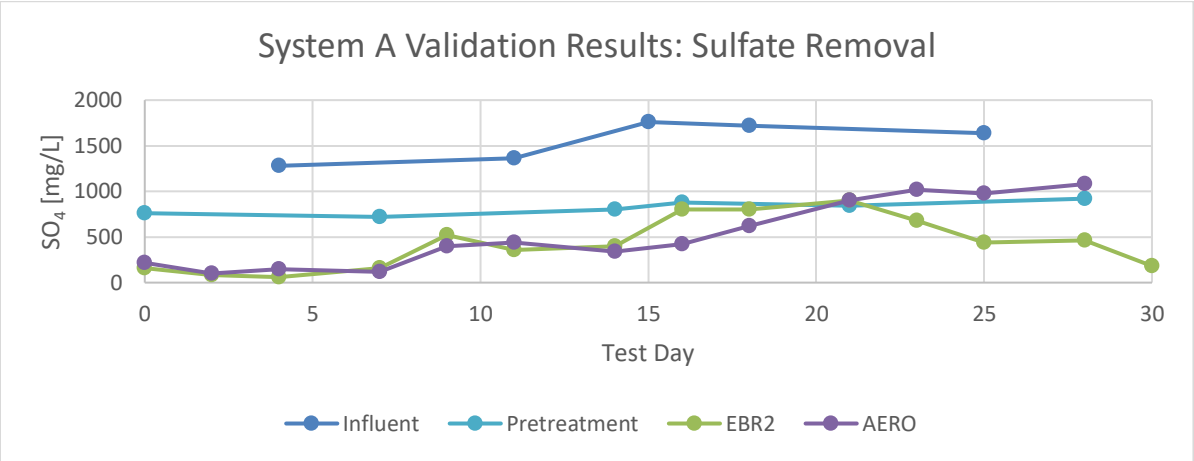


Figure 17. Phase II bench-scale sulfate results: System A validation.

A 30% total uranium reduction was achieved in the phys-chem pretreatment. The EBR system further reduced uranium to below the detection limit of 0.002 mg/L (Figure 18). Uranium removal kinetics followed linear fit in the first-stage EBR, designed for denitrification, and an exponential fit in the second-stage EBR, designed for metals removal.

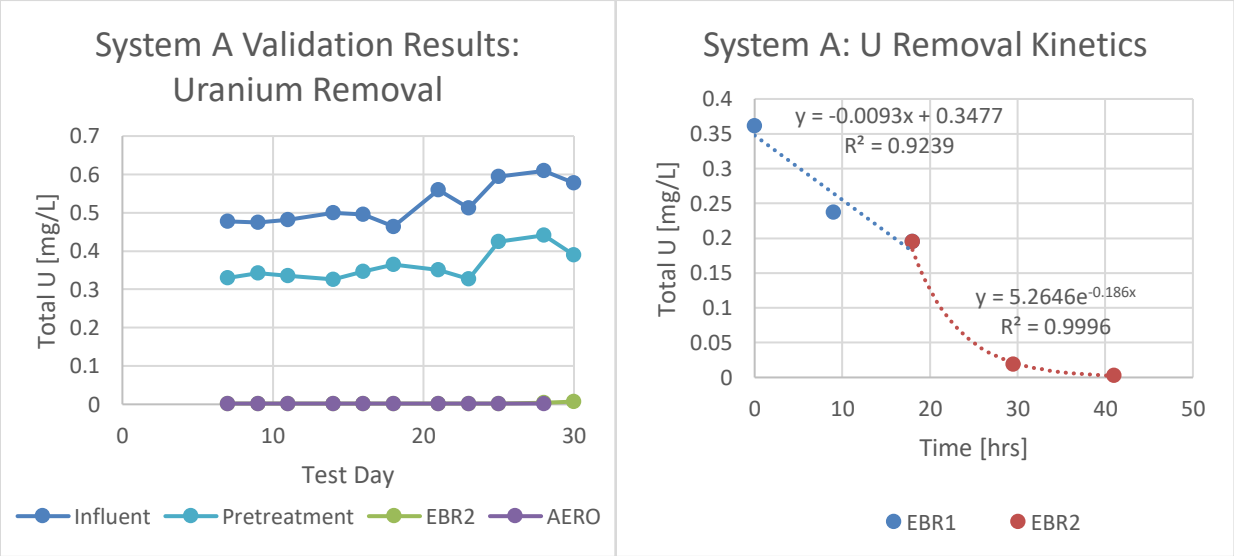


Figure 18. Phase II bench-scale uranium results: System A validation.

Total arsenic was removed to an average of 0.4 mg/L in the phys-chem pretreatment using a 20 mg/L $FeCl_3$ dose (Figure 19). Further pretreatment optimization was needed to lower the As level in the pretreatment step. The goal of the optimization was to demonstrate that the arsenic discharge target can be achieved with the ferric co-precipitation alone, without the need for a biological polishing step. The EBR system polished arsenic levels to an average of 0.009 mg/L.

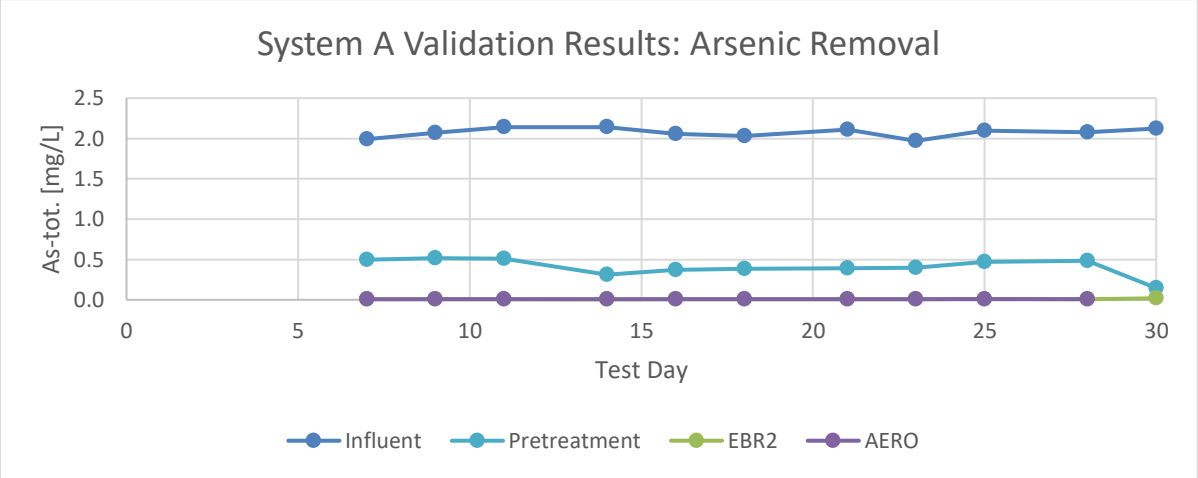


Figure 19. Phase II bench-scale arsenic results: System A validation.

System B: Validation Results of Contaminants of Interest

The validation phase of the bench-scale EBR testing with System B was completed successfully for nitrate, sulfate, and uranium removal. Successful arsenic removal was achieved during start-up and the first couple of weeks of steady-state operation, but a troubling upward trend in As concentrations was observed with time.

Nitrate-N was removed on average to 1.6 mg/L within the first EBR stage (average 16-hr HRT) and remained nondetectable throughout the rest of the treatment (Figure 20).

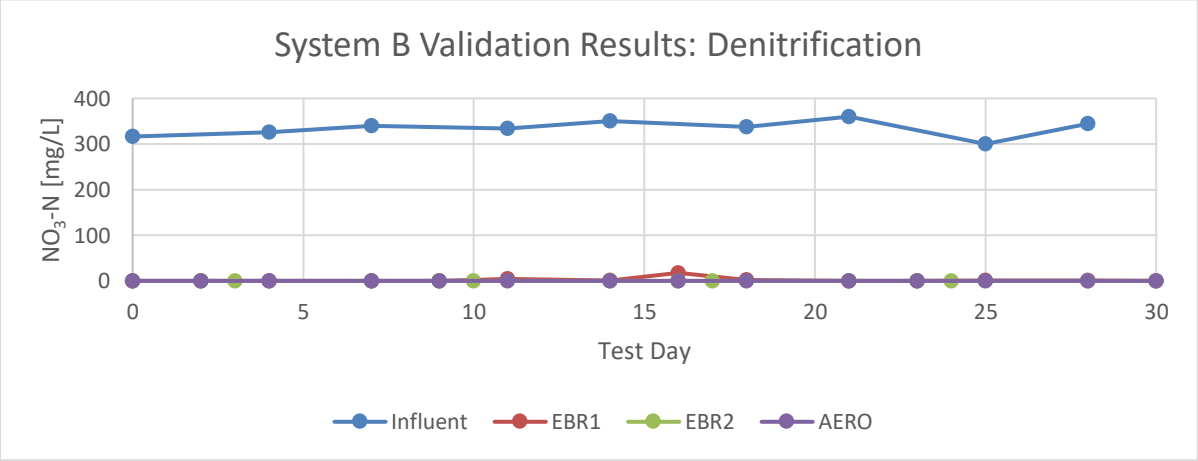


Figure 20. Phase II bench-scale denitrification results: System B validation.

Sulfate was successfully removed to below the discharge target of 1,500 mg/L in the second EBR stage (average 30-hr HRT) and remained within compliance throughout the treatment (Figure 21). Based on the first month of data, the influent's sulfate spike was adjusted further to match the upper modeling predictions.

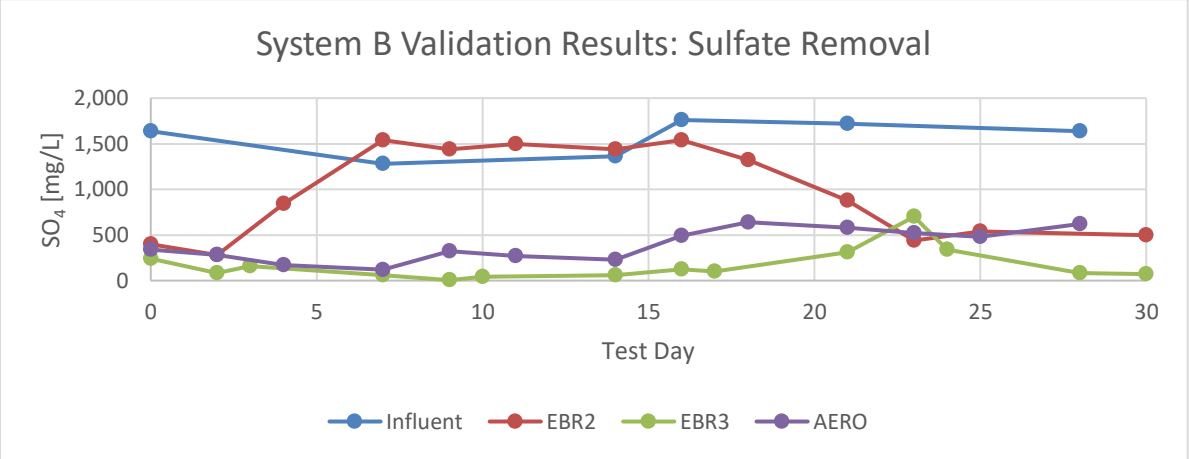


Figure 21. Phase II bench-scale sulfate results: System B validation.

The EBR system consistently reduced total uranium to below the detection limit of 0.002 mg/L (Figure 22). Average U-total concentrations of 0.14 mg/L, 0.007 mg/L, and <0.002 mg/L were achieved in the consecutive EBR reactor stages.

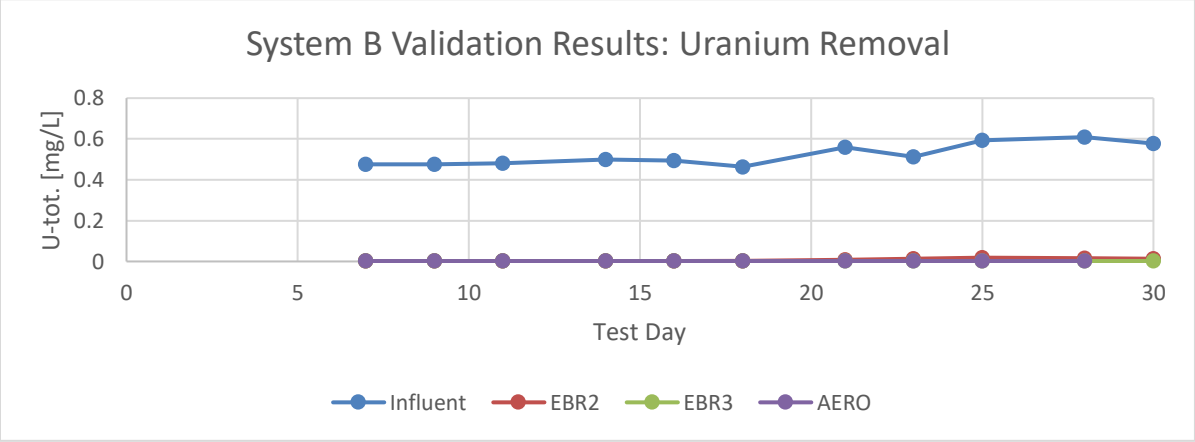


Figure 22. Phase II bench-scale uranium results: System B validation.

Total arsenic was removed to an average of 0.03 mg/L in the EBR system effluent; however, As concentrations had steadily increased throughout the validation phase (Figure 23). Arsenic levels in the system effluent during the last week of validation testing averaged 0.048 mg/L.

Based on the chemistry assessment results indicating a high load of oxyanions acting as competing electron-acceptors and the degrading As removal performance in the continuous-flow bench tests, System B treatment approach was deemed unsuitable for the Coffee Gold waters. Testing of System B was discontinued, and further testing focused on optimization and stress-testing of System A.

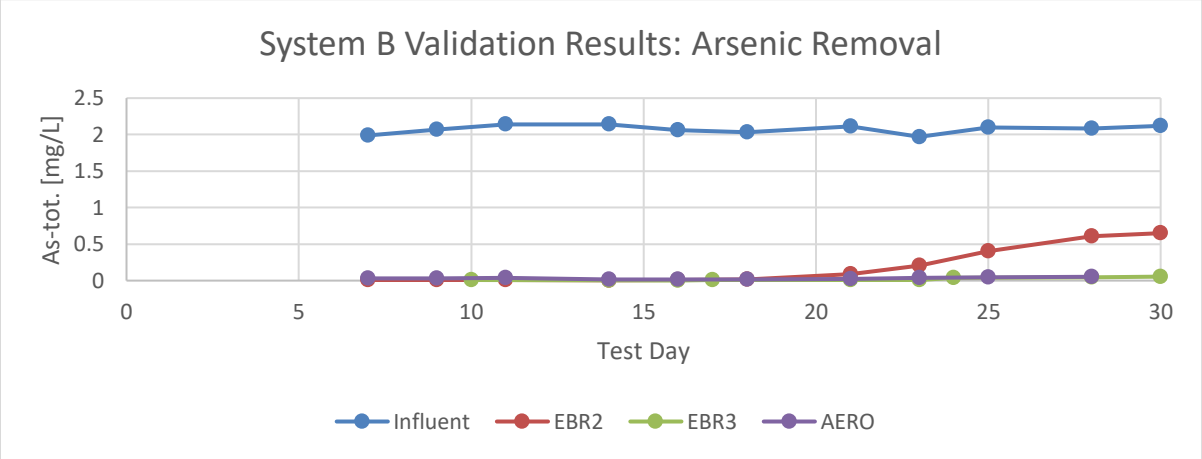


Figure 23. Phase II bench-scale arsenic results: System B validation.

System A: Stress-Testing Results of Contaminants of Interest

System stress-testing included changing the nutrient type and concentration (from the mixture of molasses and ethanol to ethanol alone) and increasing flowrates to evaluate different hydraulic retention times.

The stress-testing events yielded observable responses in nitrate concentrations in the mid-point sampling port of the first-stage EBR but had little to no effect on EBR1 effluent concentrations (Figure 24). Even though the denitrification performance was not driven to failure during stress-testing, the obtained data is sufficient to aid the pilot-scale system design. During the final four weeks of testing, the first stage EBR was operated at an average HRT of 7-hours and provided with average ethanol (nutrient) concentration of 0.6 mL/L. **Except for a stress response on test day 88, the average resulting nitrate-N concentrations in EBR1 effluent were non-detectable (<0.3 mg/L), meeting the discharge target of 3 mg/L.**

Each EBR stress-testing event affected the aerobic post-treatment performance and required system optimization (bottom graph in Figure 24). For example, as nutrient additions were lowered, the BOD loading into the aerobic column decreased as well, rendering it oversized. With extra dissolved oxygen no longer consumed by residual organics, the intermediary denitrification by-products (e.g., NO_2^-, NO, N_2O) were oxidized back to nitrate. Since reducing the aerobic post-treatment size was not feasible on the bench-scale once the columns were constructed, the post-treatment was optimized by balancing the frequency and intensity of oxygen gas additions. At the end of the testing, the aeration was only turned on for one minute every three hours instead of running continuously, meaning that the aerobic post-treatment column was significantly oversized.

Nitrite removal followed a similar trend to nitrate (Figure 25). **While the samples collected from the mid-point EBR1 showed elevated nitrite-N concentration in response to stress-testing events, the average EBR1 effluent was 0.037 mg/L, and the EBR2 effluent was non-detectable (<0.01 mg/L).** During the final four weeks of testing, after the required oxygen gas addition optimization, the average nitrite-N discharge from the aerobic post-treatment column was 0.02 mg/L. The treatment target for NO_2-N is 0.09 mg/L.

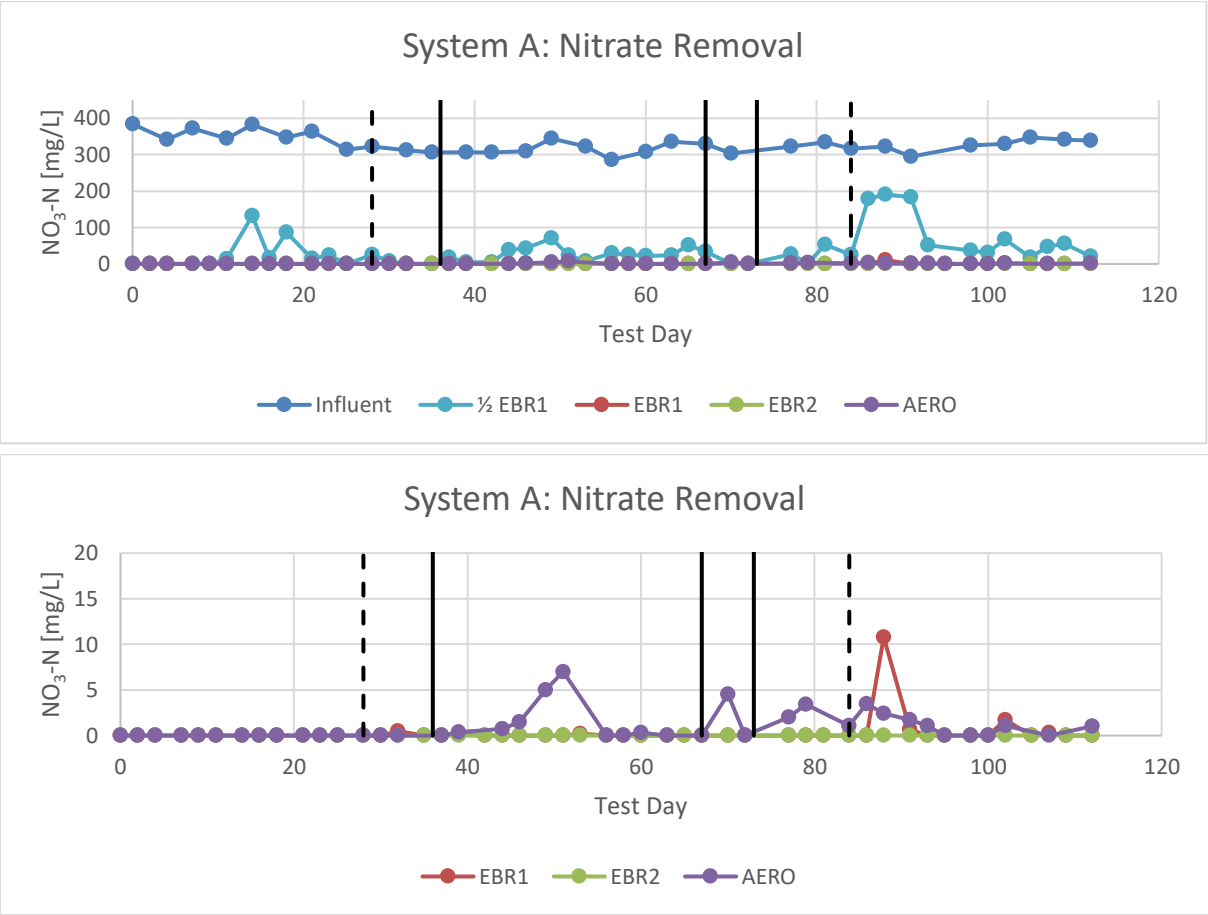


Figure 24. Phase II bench-scale denitrification results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. The bottom graph focuses on nitrate-N results below 20 mg/L.

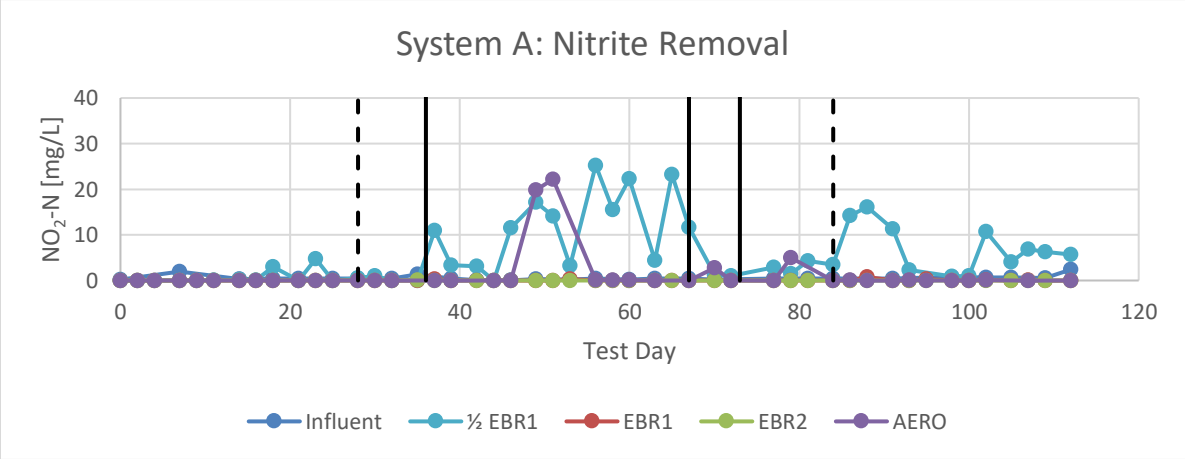


Figure 25. Phase II bench-scale nitrite results: System A overall nitrite results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

The sulfate spike in the influent waters was increased after the initial 30-day operation period to match the upper modeling predictions. After the adjustment, influent sulfate levels varied between 2,340-3,350 mg/L. The average influent concentration of 2,820 mg/L slightly exceeded the upper modeling prediction of 2,500 mg/L.

Barium precipitation pretreatment target was set at 1,500 mg/L - the treatment target. **The average sulfate concentration in the pretreatment effluent was 1,513 mg/L** (Figure 26). The preliminary jar test experiments showed that the final sulfate concentration was directly correlated to the barium dose, i.e., lower sulfate concentrations can be achieved with higher barium doses if needed.

During stress-testing, various operating conditions were evaluated to establish the optimal conditions to ensure that the EBR system reduced no or little additional sulfate. Short HRT, lack of complex nutrient additions, and balanced nutrient concentrations were found to be the most optimal operating conditions to limit sulfate bioreduction. **Since both arsenic and sulfate were removed to below their respective discharge limits in the chemical pretreatment steps, biological EBR treatment could be maintained at higher ORP ranges without using excess nutrients and thus limiting the creation of problematic by-products, such as hydrogen sulfide or methyl-arsonic acids.**

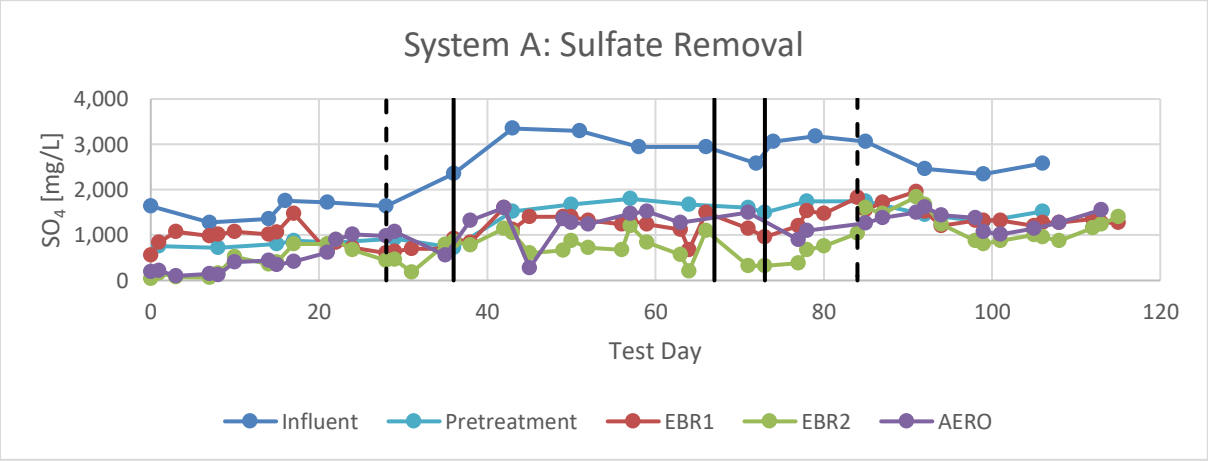


Figure 26. Phase II bench-scale sulfate results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

An average total uranium removal of 39% was achieved with the chemical precipitation pretreatment alone (Figure 27). The average total uranium influent concentrations were reduced from 0.56 mg/L in the raw Coffee water (after spiking) to an average of 0.34 mg/L in the pretreatment effluent. Uranium co-precipitation with barium sulfate has been known and studied for decades. The proposed chemical structure of the resulting precipitate is a double potassium sulfate complex of U(IV) or $K_2Ba[U(SO_4)_4]$. That is supported by a decrease in potassium concentrations in the pretreatment effluents. Since the co-precipitation mechanisms depend on uranium speciation, the actual pretreatment efficiency for uranium removal will be determined during on-site pilot-scale testing of the Coffee Mine waters.

Further removal of total uranium to below the discharge target 0.1 mg/L was achieved with the first-stage EBR treatment during test days 37 through 79 (Figure 27). The average HRT of EBR1 during that time was 11 hours, and the average ethanol nutrient concentration was 0.9 mL/L. Once the nutrient

additions to EBR1 were lowered to 0.6 mL/L and the HRT of the system was reduced to 7 hours, the resulting EBR1 effluent contained, on average, 0.17 mg/L total uranium. The second EBR stage maintained total uranium concentrations at or below the discharge target throughout the test's entire duration. The aerobic post-treatment did not affect total uranium concentrations.

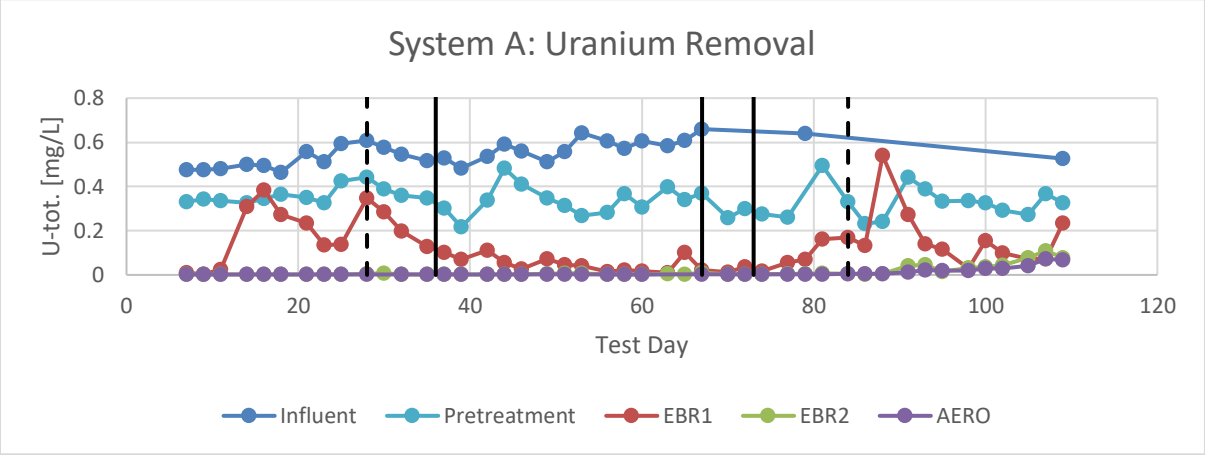


Figure 27. Phase II bench-scale uranium results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Ferric arsenic co-precipitation pretreatment was optimized after the first four weeks of operation (Figure 28). **On average, the initial 79% removal efficiency was improved to 98.4%, removing total arsenic to 0.035 mg/L.** The factors affecting the pretreatment efficiency were the ferric chloride dose, as well as the type of barium pretreatment used for sulfate precipitation since barium sulfate sludge acted as coagulant/flocculant for arsenic co-precipitation. Increasing ferric chloride dose from 20 mg/L to 30 mg/L on test day 30 improved the system efficiency; the resulting total arsenic concentrations in the pretreatment effluent decreased from 0.43 mg/L to 0.077 mg/L. When barium hydroxide was used for sulfate precipitation instead of barium chloride, starting on test day 50, total arsenic concentrations dropped further to 0.029 mg/L. A short-lived evaluation of barium carbonate between test days 77 and 82 showed to be detrimental to both arsenic and uranium removal in the pretreatment; total arsenic concentrations peaked at 0.411 mg/L during that test.

Whenever arsenic concentrations spiked in the pretreatment effluent, a similar spike was observed later in the first-stage EBR effluent. Once the pretreatment was optimized, the EBR configuration and operating conditions were to specifically not target any arsenic reduction.

Arsenic speciation was performed three times throughout the bench trial – at the end of validation testing (day 28), early on during stress-testing when arsenic removal was still in steady-state operation (day 70), and at the end of stress-testing (day 113). The predominant arsenic species in the influent water was arsenate, as expected due to the use of hydrogen peroxide for cyanide destruction (Table 10). After arsenic precipitation pretreatment, arsenate remained the predominant species. The EBR system generated progressively more reduced arsenic species but never produced any methylated arsenic by-products. Depending on the operating conditions, the aerobic post-treatment re-oxidized most of the arsenic remaining in the system into the least bioavailable and less toxic As(V).

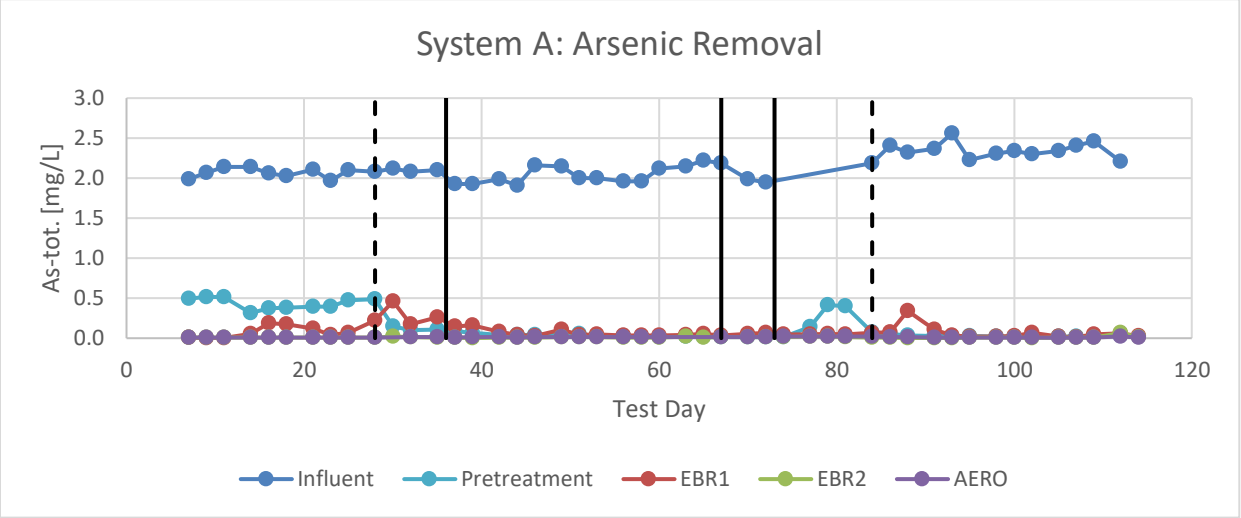


Figure 28. Phase II bench-scale arsenic results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Table 10. Arsenic speciation results, including the following arsenic species: As(V) – arsenate, As(III) – arsenite, MM-As – monomethylarsonic acid, DM-As – dimethylarsonic acid, and a sum of unknown species.

Test Day	As Species	Influent	Pretreatment	EBR1	EBR2	Aerobic
28	**As(V)**	2170 µg/L	119 µg/L	2.34 µg/L	3.16 µg/L	6.44 µg/L
	As(III)	<2.0 µg/L	<0.80 µg/L	200 µg/L	4.88 µg/L	1.77 µg/L
	MM-As	<4.5 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L
	DM-As	<2.5 µg/L	<1.0 µg/L	<1.0 µg/L	<1.0 µg/L	1.06 µg/L
	Unknown	7.8 µg/L	7.5 µg/L	12.9 µg/L	1.48 µg/L	<1.0 µg/L
70	**As(V)**	2,000 µg/L	12.4 µg/L	1.55 µg/L	<0.80 µg/L	6.25 µg/L
	As(III)	<0.80 µg/L	<0.80 µg/L	31 µg/L	2.31 µg/L	<0.80 µg/L
	MM-As	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L
	DM-As	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L
	Unknown	13.2 µg/L	<1.00 µg/L	19.2 µg/L	12.5 µg/L	1.17 µg/L
113	**As(V)**	1730 µg/L	11.2 µg/L	0.821 µg/L	2.03 µg/L	17.8 µg/L
	As(III)	<0.80 µg/L	<0.80 µg/L	25.3 µg/L	5.29 µg/L	<0.80 µg/L
	MM-As	1.21 µg/L	1.21 µg/L	<0.80 µg/L	<0.80 µg/L	<0.80 µg/L
	DM-As	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L
	Unknown	6.47µg/L	<1.00 µg/L	1.05 µg/L	11.4 µg/L	<1.00 µg/L

Arsenic species concentrations varied between testing stages and operating conditions. To illustrate the speciation transformations, Figure 29 shows average arsenic species concentrations across the treatment system.

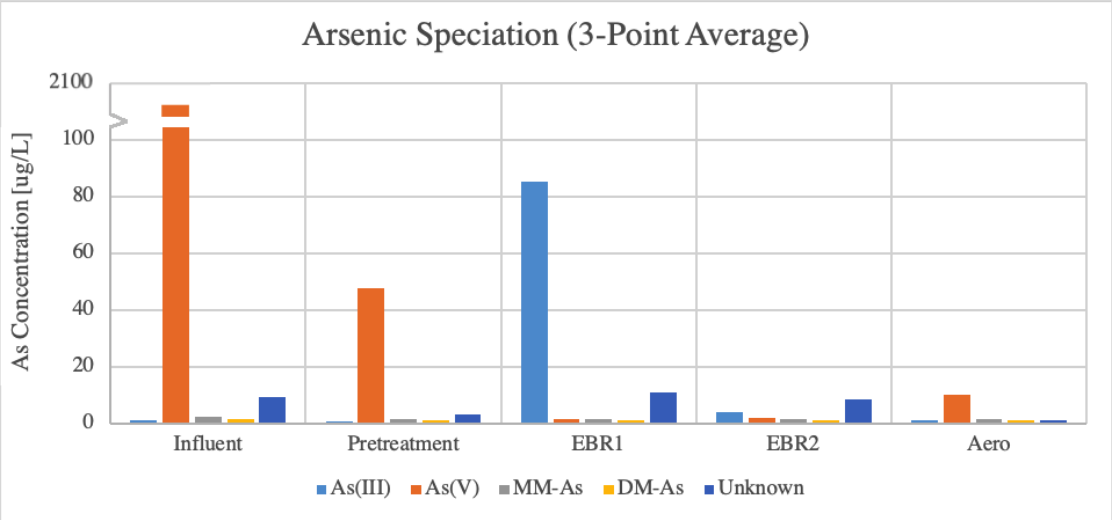


Figure 29. Phase II bench-scale arsenic speciation results: System A. Values averaged over three data points.

System A: Anions

Analytical suite chemistry scans were performed three times throughout the test – at the end of validation testing (day 28), early on during stress-testing when arsenic removal was still in steady-state operation (day 70), and at the end of stress-testing (day 113). **Because of the different testing-stage goals and changing operating conditions across all the treatment units, many of the evaluated parameters were never in a true steady-state. Drawing conclusions based on a limited set of three data points collected during various operating conditions has a number of limitations.**

Table 11 summarizes the results of major ions analysis. Nitrate-N, nitrate-N, and sulfate concentrations obtained from the analytical laboratory support the routine in-house analysis performed at WesTech's labs.

Table 11. The average concentration of anions throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Nitrate-N [mg/L]	335	303	0.034	<0.01	<0.01	3.0
Nitrite-N [mg/L]	1.04	1.57	<0.04	<0.02	<0.02	0.09
Sulfate [mg/L]	2,703	1,530	1,397	902	1,237	1,500
Sulfide [mg/L]	<0.016	<0.01	0.38	0.24	<0.01	N/A
Chloride [mg/L]	138	577	665	648	695	290

The average sulfide concentrations remained nondetectable in the influent and chemical pretreatment effluent, increased to 0.38 mg/L and 0.24 mg/L in the EBR stages, and were oxidized to below the detection limit of 0.01 mg/L in the aerobic post-treatment. While higher than the odor threshold of 0.5 μg/L, the average sulfide concentrations generated within the EBR reactors were orders of magnitude lower than the US OSHA health and safety standards. US OSHA defines sulfide exposure ranges as 100 mg/L (immediately dangerous to life or health), 50 mg/L (maximum peak for 10 minutes), 30 mg/L (maximum concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or serious health effects).

Because of the reagents used in the chemical precipitation steps, chloride levels spiked in the pretreatment effluent and remained elevated throughout the system. The highest chloride concentration in the pretreatment (836 mg/L) was detected when barium chloride was used as a sulfate precipitation reagent. Due to that high concentration, an adjustment was made to use barium hydroxide as a sulfate precipitant instead. However, since hydrochloric acid was used twice in the treatment train following this change (once to adjust the pH after cyanide destruction and the second time to neutralize the pH after barium hydroxide addition), chloride levels remained elevated at 307 mg/L. **We recommend performing additional sulfate precipitation jar tests with different barium salts that would not cause chloride increases (such as barium carbonate) once the mine is operational and actual site waters are available.**

System A: Metals

The average concentrations of metals collected throughout the individual treatment units are summarized in Table 12. For ease of interpretation, these results can be divided into five categories:

1. **Metals present in the influent waters within the forecasted ranges that were already below the discharge targets.**
    - Lead: present below the detection limit of 0.002 mg/L in the influent and throughout the treatment stages.
2. **Metals present in the influent waters within the forecasted ranged but exceeding the discharge targets.**

    2.1. Metals treated to below their respective discharge targets.
    - Molybdenum: present at 0.048 mg/L in the influent, removed to 0.04 mg/L in the pretreatment. The discharge goal of 0.033 mg/L was met within the first-stage EBR.
    - Nickel: present at 0.0053 mg/L in the influent, removed to less than 0.003 mg/L in the chemical pretreatment. The discharge goal of 0.002 mg/L was met within the first-stage EBR.
    - Calcium: present at 261 mg/L in the influent, removed to less than 90 mg/L in the final effluent. Calcium treatment target is 180 mg/L.

    2.2. Metals not treated to below their respective discharge targets.
    - Manganese: present at 0.029 mg/L in the influent. The initial spike of manganese concentrations observed throughout the EBR system was attributed to the addition of molasses as a nutrient source. Stress-testing with ethanol as the sole nutrient demonstrated that manganese could be maintained at or below the influent concentrations throughout the EBR treatment. Since no nutrients or reagents were added to the aerobic post-treatment column, a further spike discovered in the aerobic system effluent can only be

attributed to the microbial support media – in this case, pumice was used as a cost-effective alternative to activated carbon. Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of manganese occurs.

Table 12. The average concentration of metals throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Aluminum-tot. [mg/L]	<0.1	<0.1	<0.1	<0.1	<0.1	0.06
Antimony-tot. [mg/L]	0.61	0.38	0.06	0.02	<0.008	0.07
Arsenic-dis. [mg/L]	2.05	0.16	0.15	0.02	0.01	N/A
Barium-tot. [mg/L]	0.17	0.10	0.04	0.06	0.09	N/A
Cadmium-tot. [mg/L]	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00004
Calcium-tot. [mg/L]	261	259	98	58	87	180
Chromium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.001
Copper-tot. [mg/L]	0.018	0.006	<0.003	<0.003	<0.004	0.004
Iron-tot. [mg/L]	0.105	<0.1	0.23	0.12	<0.16	0.05
Lead-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0032
Magnesium-tot. [mg/L]	195	121	124	114	112	50
Manganese-tot. [mg/L]	0.029	0.024	0.062	0.064	0.271	0.016
Mercury-tot. [mg/L]	0.0034	0.00013	<0.0001	<0.00009	<0.00009	0.0001
Molybdenum-tot. [mg/L]	0.048	0.040	0.02	<0.005	<0.002	0.033
Nickel-tot. [mg/L]	0.0053	<0.003	<0.002	<0.002	<0.002	0.002
Potassium-tot. [mg/L]	16.2	12.1	14.7	14	13.7	8
Selenium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0015
Silver-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.00009
Sodium-tot. [mg/L]	1500	1433	1460	1443	1430	890
Thallium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0015
Uranium-dis. [mg/L]	0.61	0.35	0.22	0.004	<0.002	N/A
Zinc-tot. [mg/L]	<0.008	<0.006	<0.01	<0.006	<0.006	0.02

3. Metals present in the influent waters outside of the forecasted ranges.

3.1. Metals present in the influent waters at higher concentrations than forecasted and removed by the treatment to below their respective discharge targets.

- Antimony: influent concentrations of 0.61 mg/L reduced to 0.38 mg/L in the chemical pretreatment and reduced further by the biological treatment to 0.06 mg/L and 0.02 mg/L in the consecutive EBR stages. The discharge target of 0.07 mg/L was met in EBR1.
- Copper: present at 0.018 mg/L in the system influent, reduced by 66.7% in the pretreatment, and removed further biologically to below the detection limit of 0.003 mg/L. The discharge goal of 0.004 mg/L was met in the first EBR stage.

- Mercury: present at 0.0034 mg/L in the influent, reduced to 0.00013 mg/L in the chemical pretreatment. The discharge limit of 0.0001 mg/L was met within the first-stage EBR.

3.2. Metals present in the influent waters at higher concentrations than forecasted and not removed by the treatment to below their respective discharge targets.

- Magnesium: present at 195 mg/L in the influent, removed in the chemical pretreatment to 121 mg/L. It remained at a similar level throughout the biological treatment, exceeding the discharge limit of 50 mg/L. Water softening pretreatment step should be added to remove excess hardness minerals during pilot-scale testing.
- Potassium: present at 16.2 mg/L in the influent, removed to 12.1 mg/L in the pretreatment, and varied between 13.7-14.7 mg/L in the biological treatment. The upper-level prediction for potassium in Coffee waters is 11 mg/L. The discharge target is 8 mg/L.
- Sodium: present at 1,500 mg/L in the influent and not removed by any treatment stages. The upper-level prediction for sodium in Coffee waters is 1,168 mg/L.

3.3. Metals present in the influent waters at lower concentrations than forecasted.

- Iron: present in the influent at 0.105 mg/L. The initial spike of iron concentrations observed throughout the EBR system was attributed to the addition of molasses as a nutrient source. Stress-testing with ethanol as the sole nutrient demonstrated that iron remained at or below the influent concentrations.
- Zinc: present in the influent below the detection limit of 0.008 mg/L. Remained nondetectable throughout the treatment.

4. Metals with analytical detection limits higher than the discharge target.

- Aluminum: present below the detection limit of 0.1 mg/L.
- Cadmium: present below the detection limit of 0.0005 mg/L.
- Chromium: present below the detection limit of 0.002 mg/L.
- Selenium: present below the detection limit of 0.002 mg/L. Selenium speciation results are shown in Table 13, indicating that the influent concentrations averaged about 1 μg/L, with a somewhat even distribution between selenate and selenite. The EBR system removed both selenate and selenite below the detections limits. No other (often more bioavailable and/or more toxic) species of selenium were detected throughout the treatment.
- Silver: present below the detection limit of 0.002 mg/L.
- Thallium: present below the detection limit of 0.002 mg/L.

5. Metals with no specified discharge targets.

- Dissolved arsenic: present at 2.05 mg/L in the influent, reduced to 0.16 mg/L in the pretreatment, and further reduced biologically to 0.02 mg/L in the EBR treatment.
- Barium: present at 0.17 mg/L in the influent, reduced to 0.10 mg/L in the pretreatment, remained at similar levels throughout the rest of the treatment.
- Dissolved uranium: present at 0.61 mg/L in the influent, removed to 0.35 mg/L in the pretreatment. Reduced biologically to 0.004 mg/L.

Table 13. Selenium speciation results, including the following arsenic species: Se(VI) – selenate, Se(IV) – selenite, Se-CN – selenocyanate, MeSe(IV) – methylselenic acid, Se-Met – selenomethionine, $SeSO_3$ – selenosulfate, and a sum of unknown species.

Test Day	Se Species	Influent	Pretreatment	EBR1	EBR2	Aerobic
28	**Se(VI)**	0.403 µg/L	0.365 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L
	Se(IV)	0.789 µg/L	0.173 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-CN	<0.25 µg/L	<0.05 µg/L	<0.05 µg/L	<0.05 µg/L	<0.05 µg/L
	Me-Se(IV)	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-Met	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-SO_3	<0.30 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L
	Unknown	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
113	**Se(VI)**	0.507 µg/L	0.395 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L
	Se(IV)	0.252 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-CN	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L
	Me-Se(IV)	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-Met	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-SO_3	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L
	Unknown	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L

System A: Cyanides

The average concentrations of cyanides are summarized in Table 14. The biological treatment removed total cyanide from 0.35 mg/L to 0.16 mg/L. WAD cyanide's elevated levels in the influent (0.04 mg/L), while lower than the predicted levels of 0.09-0.2 mg/L, exceeded the discharge target of 0.025 mg/L; **the EBR system removed WAD cyanide to below the detection limit of 0.006 mg/L. Thiocyanates remained relatively stable throughout the treatment.**

Table 14. The average concentration of cyanides throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Total CN [mg/L]	0.35	0.40	0.22	0.17	0.16	N/A
WAD CN [mg/L]	0.041	0.038	<0.015	<0.006	<0.006	0.025
Thiocyanate [mg/L]	0.40	0.33	0.24	0.40	0.22	N/A

System A: Residual Nutrients

While Table 15 provides a summary of residual nutrients results from the entire duration of bench-scale testing, some of the averaged data might be misleading. The residual nutrient parameters were monitored throughout the testing, and their concentrations changed depending on the operating

conditions and the goals of a given testing stage. All residual nutrient parameters, except for total organic carbon (TOC), were monitored twice a week.

Ammonia-N and organic carbon were present in the Coffee waters at significantly higher concentrations than the modeling had forecasted for the on-site chemistry. This was likely caused by natural cyanide bio-attenuation in Coffee solutions during storage since several biochemical metabolic pathways of cyanide biodegradation produce organic carbon and ammonia. When received at WesTech's Labs in October 2019, WAD cyanide concentration in the leach solution was 0.691 mg/L; by the time the rinse solutions were delivered in February 2020, WAD cyanide concentration in the leach solution dropped to 0.116 mg/L, indicating that natural biodegradation was occurring in the barrels. In the same period, ammonia-N increased in the leach solution from 68 mg/L to 83.4 mg/L.

Such high ammonia and organics concentrations are not expected to be present during normal operation of the mine and only occurred because of the prolonged storage of the generated leach waters. Ammonia-N is expected to be found at 0.025-0.06 mg/L in the heap leach rinse solutions, which is considerably lower than the discharge target of 8 mg/L. Even though the average ammonia-N concentrations in the system effluent were at 27.9 mg/L, the EBR system removed it to less than 20 mg/L through cell assimilation, while the aerobic post-treatment decreased it further to 7 mg/L. Conditions in the aerobic post-treatment had to be closely controlled to limit available oxygen that could lead to nitrate/nitrite production.

Organic carbon indicators, i.e., biological oxygen demand (BOD), chemical oxygen demand (COD), and total organic carbon (TOC), all followed the same trend. Medium concentrations of organics were found in the system influent, then increased in the biological EBR system before being oxidized to CO_2 and removed in the aerobic post-treatment. The average organics concentrations given in Table 15 can be misleading since they disregard a bench-scale project's optimization, adjustments, and stress-testing conditions. Figure 30 and Figure 31 illustrate the organics loading changes throughout the testing stages, using BOD and COD as examples. During the first month of operation, both the anaerobic and aerobic unit processes were in start-up and equilibration modes; the elevated nutrient levels in the EBR system were expected during start-up. The aerobic post-treatment needed time to establish a high-density biofilm on the support media to sustain the needed oxidation kinetics. **When the aerobic biofilm was well-established in the last 45 days of operation, the effluent BOD concentrations were typically below the detection limit of 5 mg/L.**

Table 15. The average concentration of nutrients throughout the Phase II bench-scale testing.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
BOD [mg/L]	21.7	17.3	312	517	582	N/A
COD [mg/L]	104	112	307	704	498	N/A
TOC [mg/L]	5.2	4.0	96	69	116	N/A
Ammonia-N [mg/L]	27.9	22.3	21.2	19.7	7.0	8
Phosphate-P [mg/L]	0.41	0.33	0.54	1.93	5.85	0.14

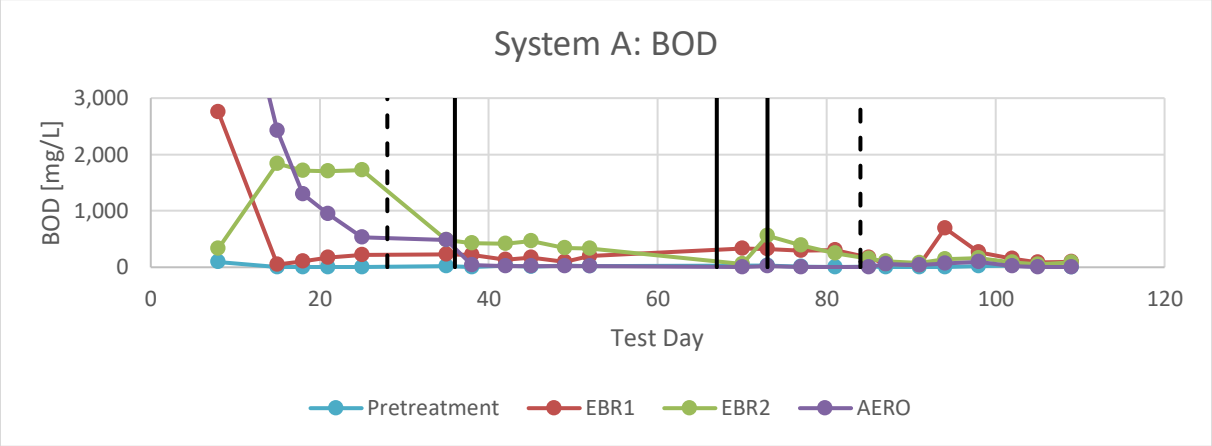


Figure 30. Phase II bench-scale results: System A overall BOD data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

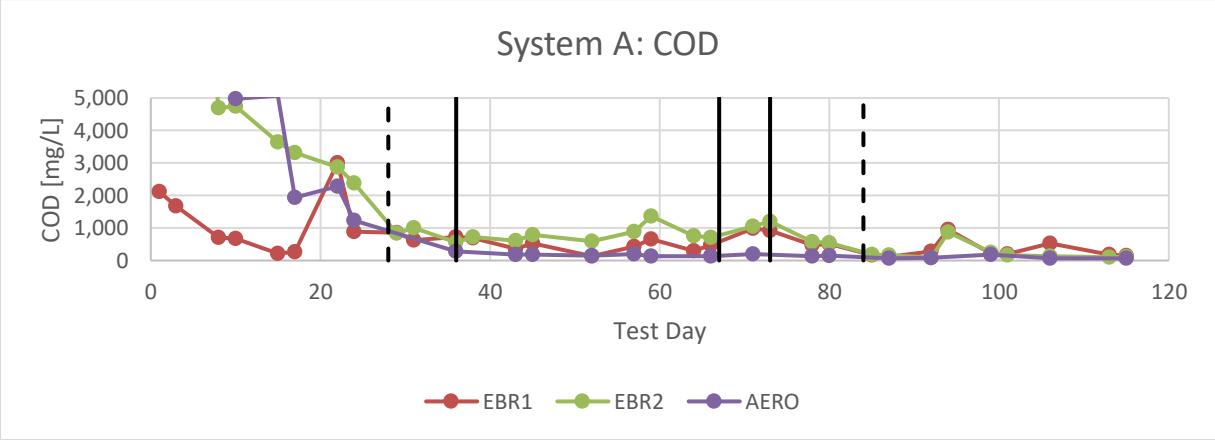


Figure 31. Phase II bench-scale results: System A overall COD data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Total phosphate-P was present in the influent waters at 0.41 mg/L – a level twice as high as the water quality modeling had forecasted. As a residual nutrient, phosphate followed a similar trend throughout the EBR treatment system as the residual organics (Figure 32). Initial elevated concentrations can be attributed to start-up and steady-state operation using molasses/ethanol mixture as a nutrient. During the last two weeks of operation, once the system was stabilized and ethanol was used as a sole carbon source, the average EBR effluent PO_4-P concentrations were 0.18 mg/L for EBR1 and 0.35 mg/L for EBR2, when the average system influent carried 0.25 mg/L PO_4-P. With no external source of phosphorus, the slightly elevated levels detected in the second-stage EBR as compared to the system influent can only be explained by residual concentrations still being rinsed out from the preliminary testing stages. **A pilot- and full-scale installation is expected to not require any external phosphate additions and that the EBR system would remove some of the PO_4-P present in the influent waters through assimilatory pathways.**

Since no nutrients or reagents were added to the aerobic post-treatment column, the continuously elevated phosphate levels discovered in the aerobic system effluent can be attributed to the microbial support media – in this case, pumice was used as a cost-effective alternative to activated carbon. Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of phosphate occurs.

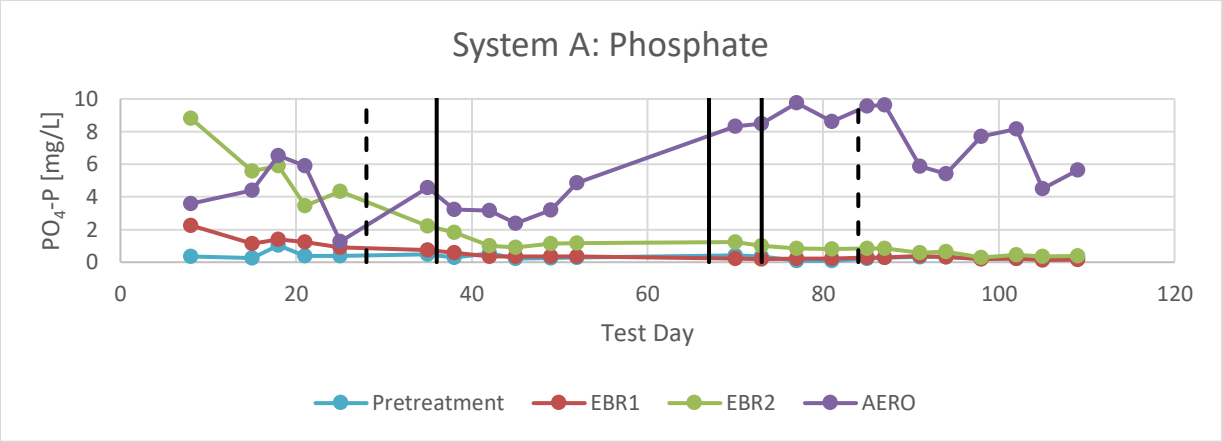


Figure 32. Phase II bench-scale results: System A overall phosphate-P data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

System A: Radiochemistry

Water samples from System A were sent for radiochemistry analysis to Pace Analytical Laboratories. The general trend can be illustrated by the gross radiation graph, shown in Figure 33. Table 16 shows the detailed results of the radiochemical analysis. Most of the analyzed radioisotopes were present at concentrations lower than their respective uncertainty errors. Gross alpha and beta radiation spiked in the pretreatment effluent waters before dropping back down in the biological treatment effluents.

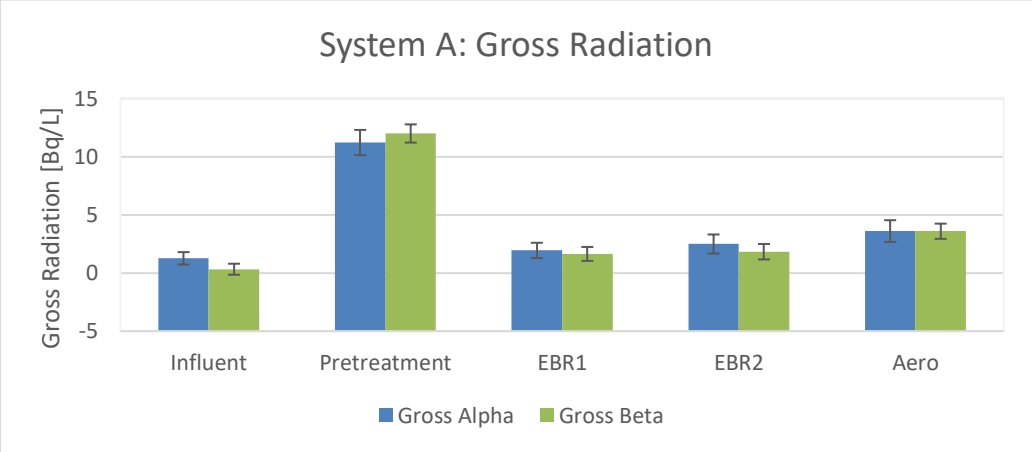


Figure 33. Phase II bench-scale results: System A gross radiation results.

Table 16. Phase II bench-scale results: Radiochemistry analysis of water samples collected from all the treatment stages. One data point.

	Influent	Pretreatment	EBR1	EBR2	Aero
Gross Alpha [pCi/L]	33.9 ±14.5	303 ±29.3	52.3 ±17.8	67.3 ±22.1	97.3 ±25.3
Gross Beta [pCi/L]	8.64 ±12.8	324 ±21.2	44.2 ±16.2	49.4 ±18.0	96.9 ±17.7
Ra-226 [pCi/L]	0.207 ±0.233	1.21 ±0.407	0.212 ±0.188	0.03 ±0.102	-0.0056 ±0.176
Ac-228 [pCi/L]	4.34 ±10.4	-3.90 ±12.6	4.38 ±10.7	6.78 ±9.97	1.43 ±10.1
Am-241 [pCi/L]	-23 ±13.9	-9.36 ±22.1	-13.5 ±13.5	-14.2 ±13.3	-12.9 ±13.2
Sb-124 [pCi/L]	-0.385 ±3.19	-3.29 ±4.19	0.399 ±3.32	1.52 ±3.28	3.86 ±3.34
Be-7 [pCi/L]	33.9 ±45.5	11.1 ±35.9	24.3 ±47.1	-11.7 ±49.6	13.7 ±51.6
Bi-212 [pCi/L]	-19.7 ±43.5	-29.6 ±57.1	23.7 ±45.2	-11.6 ±44.8	43.4 ±43.9
Bi-214 [pCi/L]	12.1 ±7.16	16.3 ±9.14	48.8 ±9.59	8.7 ±6.69	8.79 ±6.65
Ce-137 [pCi/L]	2.09 ±3.66	-1.75 ±4.42	1.67 ±3.64	0.352 ±3.49	-1.98 ±3.69
Co-60 [pCi/L]	0.435 ±2.51	0.429 ±3.32	-0.255 ±2.46	1.8 ±2.49	0.211 ±2.51
Ir-192 [pCi/L]	-0.658 ±3.68	-0.0703 ±3.55	0.251 ±4.01	-5.54 ±3.88	-4.38 ±3.97
Pb-212 [pCi/L]	-2.20 ±6.69	6.68 ±6.96	3.69 ±6.97	3.98 ±6.48	7.61 ±6.80
Pb-214 [pCi/L]	6.7 ±8.66	6.22 ±7.87	21.3 ±9.35	2.62 ±8.56	9.59 ±8.75
K-40 [pCi/L]	-12.3 ±45.5	31.3 ±53.9	7.76 ±45.6	-0.959 ±47.8	4.97 ±47.1
Sc-46 [pCi/L]	-0.117 ±3.66	-3.65 ±4.37	-1.03 ±3.75	1.65 ±3.79	2.7 ±3.92
Tl-208 [pCi/L]	-0.723 ±3.33	1.97 ±4.43	3.66 ±3.57	0.429 ±3.37	4.3 ±3.55
U-235 [pCi/L]	4.77 ±23.9	0.975 ±5.11	0.766 ±4.75	-10.8 ±23.4	-4.35 ±23.9
U-238 [pCi/L]	155 ±84.6	-21.7 ±54.1	14.4 ±50.0	29.8 ±51.5	26.1 ±50.9
Ce-134 [pCi/L]	-0.709 ±2.20	0.121 ±2.80	-1.07 ±2.34	0.35 ±2.20	1.53 ±2.14

In terms of compliance with the proposed water discharge standards, Figure 34 shows radium-226 analysis results. Ra-226 has a discharge target of 0.016 Bq/L (corresponding to 0.432 pCi/L), which was met throughout all treatment stages, except for the pretreatment effluent.

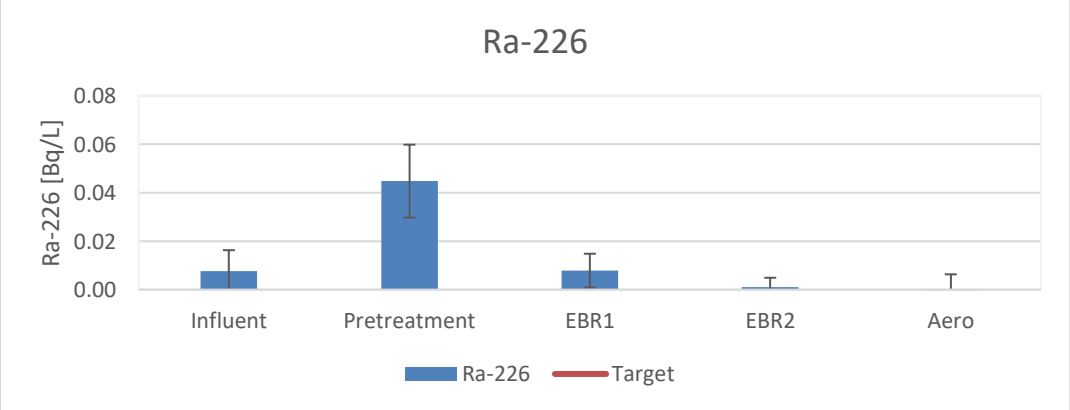


Figure 34. Phase II bench-scale results: System A radium-226 results.

At the conclusion of bench-scale testing, the columns were taken apart, and solids were collected from each treatment stage. This included the dewatered pretreatment sludge, activated carbon support media with any residual precipitates and microbial biofilm from the EBR columns, and the pumice support media with any residual precipitates and microbial biofilm from the aerobic post-treatment. **Except for Pb-214, Tl-208, U-235, and U-238, most of the analyzed radioisotopes were present at concentrations lower than their respective uncertainty errors (Table 17).**

Table 17. Phase II bench-scale results: Radiochemistry analysis of solids samples collected from all the treatment stages. One data point.

	Pretreatment Sludge	EBR1 Solids	EBR2 Solids	Aero Solids
Gross Alpha [pCi/g]	29 ±2.76	8.83 ±1.53	9.57 ±1.63	3.71 ±2.19
Gross Beta [pCi/g]	17.8 ±2.10	11.6 ±1.66	8.01 ±1.87	8.2 ±2.06
Ra-226 [pCi/g]	0.472 ±0.157	0.25 ±0.09	0.204 ±0.0821	0.434 ±0.115
Ra-228 [pCi/g]	0.165 ±0.169	0.112 ±0.106	0.0344 ±0.109	0.354 ±0.158
Bi-212 [pCi/g]	0.0469 ±0.65	0.54 ±0.389	0.0452 ±0.324	0.662 ±0.488
Pb-212 [pCi/g]	0.0146 ±0.101	0.175 ±0.0648	0.12 ±0.0581	0.554 ±0.0974
Pb-214 [pCi/g]	0.445 ±0.128	0.299 ±0.0757	0.222 ±0.0678	0.382 ±0.103
K-40 [pCi/g]	0.649 ±0.692	0.276 ±0.319	0.166 ±0.341	12 ±1.74
Tl-208 [pCi/g]	0.0175 ±0.0605	0.068 ±0.0361	0.0645 ±0.043	0.153 ±0.050
U-235 [pCi/g]	0.389 ±0.364	0.0441 ±0.0347	0.0761 ±0.039	0.13 ±0.232
U-238 [pCi/g]	5.05 ±2.26	3.79 ±1.54	4.27 ±1.62	0.193 ±0.487

As a point of reference, the US EPA does not consider radium as a "source material," and therefore, it would not be considered a by-product if present in the water treatment residuals. Uranium, however, is considered a "source material." The US EPA classifies any waste (solid or liquid) containing more than 0.05% by weight uranium, a low-level radioactive waste. That weight percentage corresponds to approximately 335 pCi/g for uranium.

The low concentration of radioisotopes in the Coffee waters implies a risk that they might be concentrated in one or multiple stages of the treatment, producing a radioactive by-product or waste that will be difficult to dispose of. Utilizing an optimized chemical pretreatment step removes both uranium isotopes (U-235 and U-238) from the influent waters continuously without generating even low-level radioactive sludge. U-238 concentrations in the influent waters were reduced from 155 ±84.6 pCi/L to levels below the uncertainty errors in the pretreatment step (Table 16), while only generating 5.05 ±2.26 pCi/g of U-238 in the sludge (Table 17). This point is also illustrated by the gross radiation detected in solids collected from the treatment stages (Figure 35). **A low-level peak of gross radioactivity in the pretreatment sludge suggests a concentration of the radioisotopes that can be safely disposed.**

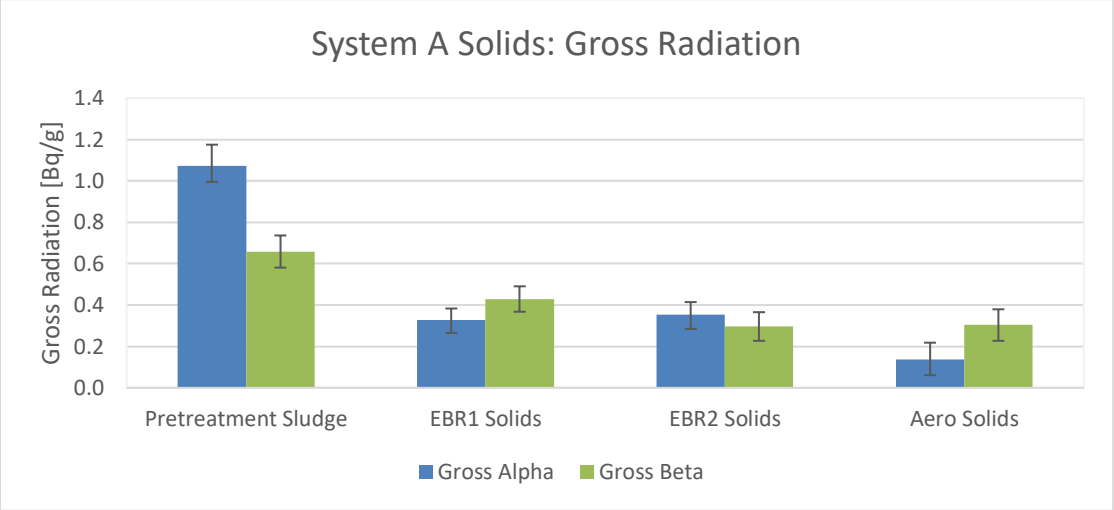


Figure 35. Phase II bench-scale results: System A solids radiation results.

System A: Toxicity Characteristic Leaching Procedure

At the conclusion of bench-scale testing, the columns were taken apart, and solids were collected from each treatment stage. This included the dewatered pretreatment sludge, activated carbon support media with any residual precipitates and microbial biofilm from the EBR columns, and the pumice support media with any residual precipitates and microbial biofilm from the aerobic post-treatment. The solids were submitted to AWAL laboratories for toxicity characteristic leaching procedure (TCLP) analysis.

All the collected solids passed the TCLP analysis (Table 18). Most metals were not leached in detectable quantities from any generated solids. The only exceptions were arsenic (leached out of the pretreatment sludge at 0.128 mg/L – well below the allowable limit of 5 mg/L) and barium (leached out of the EBR1 solids at 0.34 mg/L – well below the allowable limit of 100 mg/L). Since the ferric co-precipitation is a one-pass system, similar TCLP results from the pretreatment sludge can be expected from the pilot-scale test and full-scale installation. The EBR system has the potential of concentrating the contaminants with time. Assuming a linear accumulation and leachability of barium in the first-stage EBR, it would take 33,823 days of continuous operation (or about 93 years) to reach the allowable limit of 100 mg/L in the EBR solids.

Table 18. Toxicity characteristic leaching procedure (TCLP) results.

	Pretreatment Sludge	EBR1 Solids	EBR2 Solids	Aero Solids	Limit
As [mg/L]	0.128	<0.02	<0.02	<0.02	5.0
Ba [mg/L]	<0.3	0.34	<0.3	<0.3	100.0
Cd [mg/L]	<0.0035	<0.0035	<0.0035	<0.0035	1.0
Cr [mg/L]	<0.2	<0.2	<0.2	<0.2	5.0
Pb [mg/L]	<0.01	<0.01	<0.01	<0.01	5.0
Hg [mg/L]	<0.01	<0.01	<0.01	<0.01	0.2
Se [mg/L]	<0.01	<0.01	<0.01	<0.01	1.0
Ag [mg/L]	<0.01	<0.01	<0.01	<0.01	5.0

Quality Control Results

As part of the internal quality control testing, AWAL Labs performed method blanks (MB), laboratory control samples (LCS), matrix spikes (MS), and matrix spike duplicates (MSD) on the submitted samples. Method blanks use an analyte-free matrix, such as deionized water, through the complete procedure; it is used to evaluate contamination potential due to sample preparation and analytical procedure. Laboratory control sample uses the same analyte-free matrix as MB but is spiked with a known concentration of the analyte of interest; it is used to determine if the procedure is working within the established control limits, without the interference from the sample matrix. Finally, matrix spike uses an aliquot of the sample spiked with a known concentration of the analyte of interest; it is used to determine whether the procedure works within the established control limits, including sample matrix interferences. The matrix spike is routinely performed in duplicate as the MSD. The recoveries of the spiked analyte are evaluated to determine the accuracy in a given matrix, while the comparison between the MS and MSD shows how precise the procedure is in a given matrix.

For total metals analysis, the acceptable recovery control limits for the QC samples must be within 75%-125%. The recoveries of both total arsenic (Figure 36) and total uranium (Figure 37) were well within the acceptable recovery limits. Based on the standard deviations obtained from matrix spikes and matrix spike duplicates, the precision of total arsenic measurements was defined as ±0.0028 mg/L, while the accuracy was ±0.0068 mg/L (Table 19). For total uranium, the precision and accuracy were ±0.0061 mg/L and ±0.0111 mg/L, respectively. **The established precisions and accuracies of the total metals analyses were an order of magnitude lower than their respective discharge targets, giving us high confidence in the obtained results.**

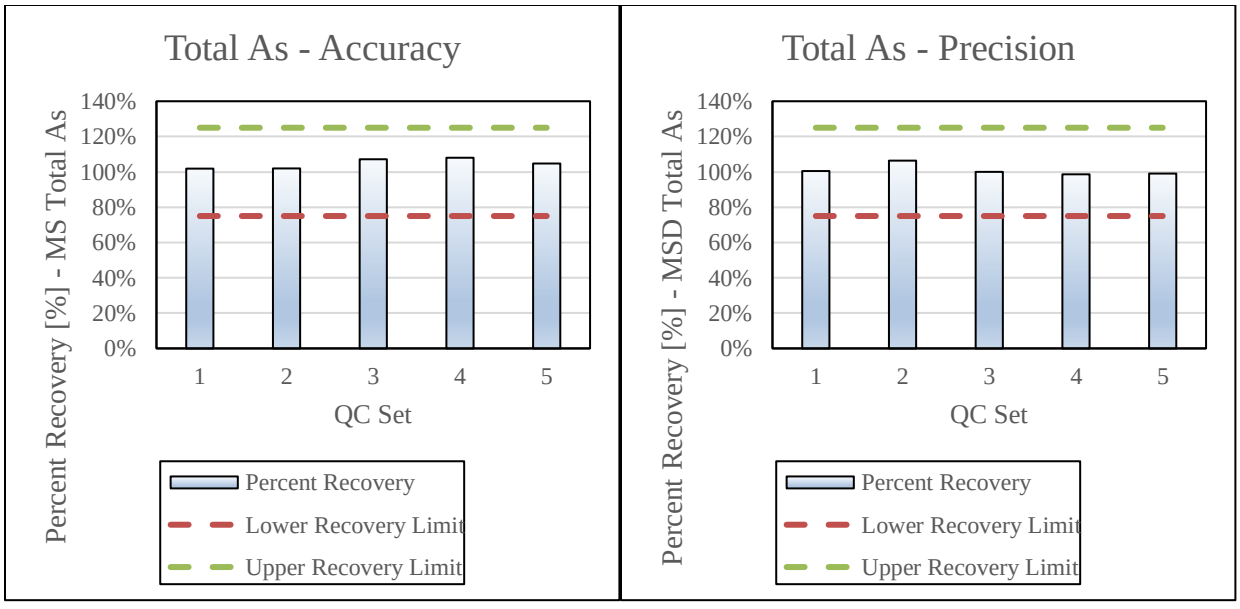


Figure 36. Quality control results for total arsenic analysis.

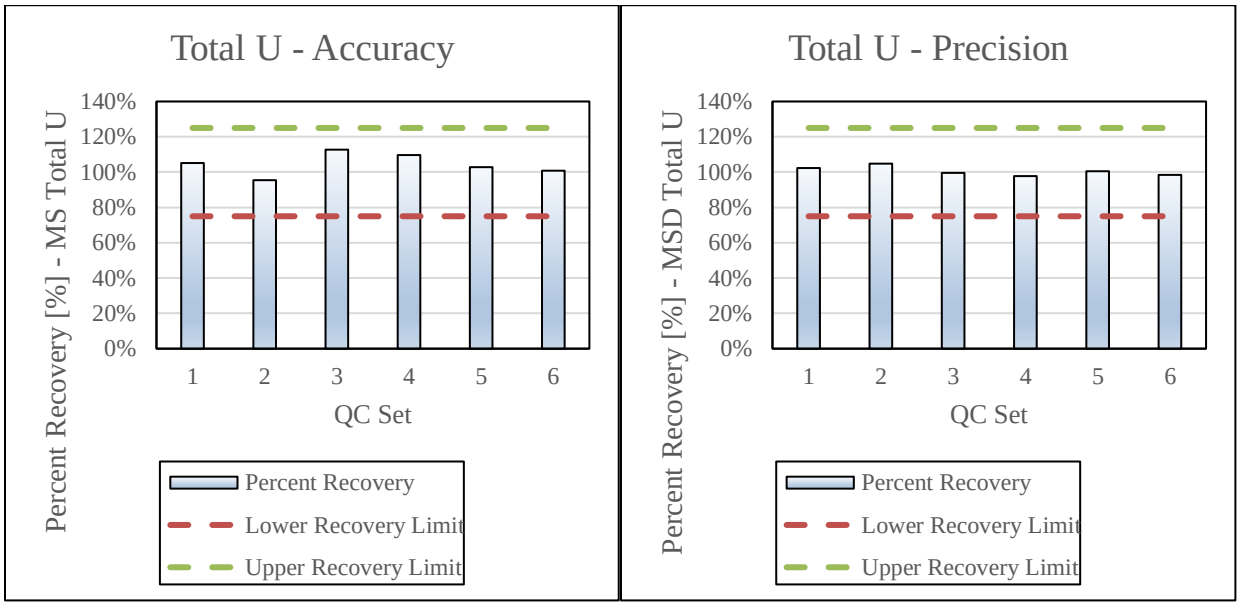


Figure 37. Quality control results for total uranium analysis.

Table 19. Analytical precision and accuracy during bench-scale testing of Coffee waters.

	Average Precision [mg/L]	Average Accuracy [mg/L]
Arsenic-tot.	±0.0028	±0.0068
Uranium-tot.	±0.0061	±0.0111
Nitrate-N	±0.01	±0.04
Sulfate	±11.7	±61.9

For anions, the acceptable recovery control limits must be within 90%-110%. The recoveries of nitrate-N and sulfate were shown to be within these limits (Figure 38 and Figure 39). Very high precision (±0.01 mg/L) and accuracy (±0.04 mg/L) were established for nitrate-N analysis (Table 19). Sulfate analysis carried a ±11.7 mg/L precision and ±61.9 mg/L accuracy, providing very high confidence in the obtained results compared to the 1,500 mg/L discharge target.

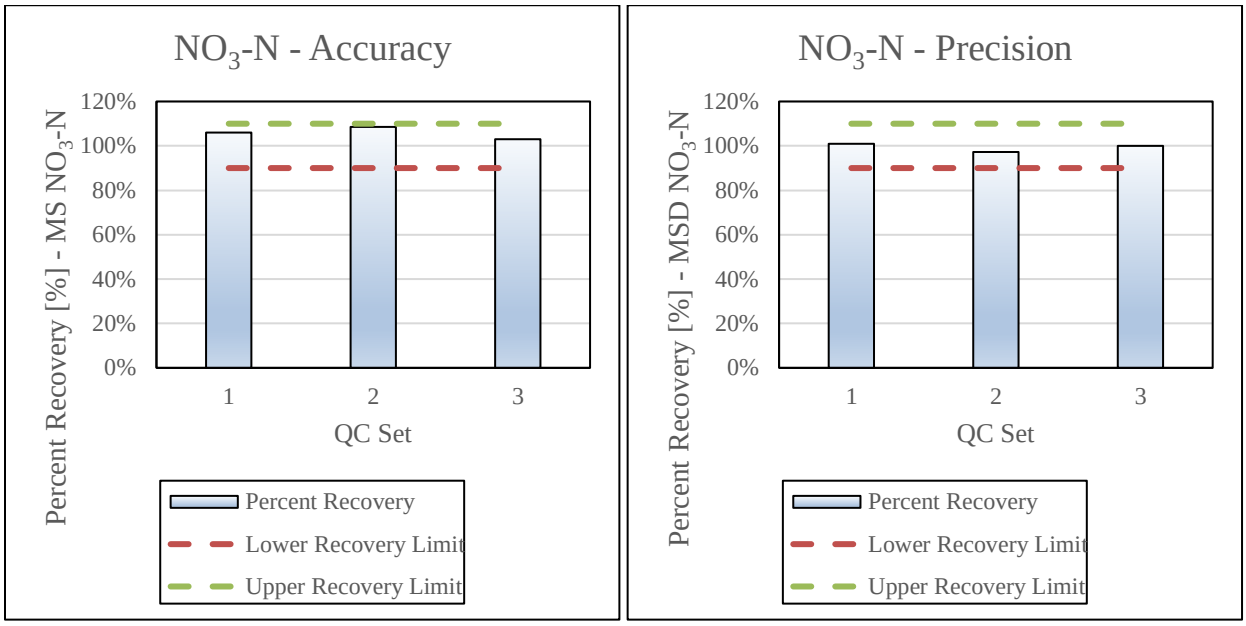


Figure 38. Quality control results for nitrate-N analysis.

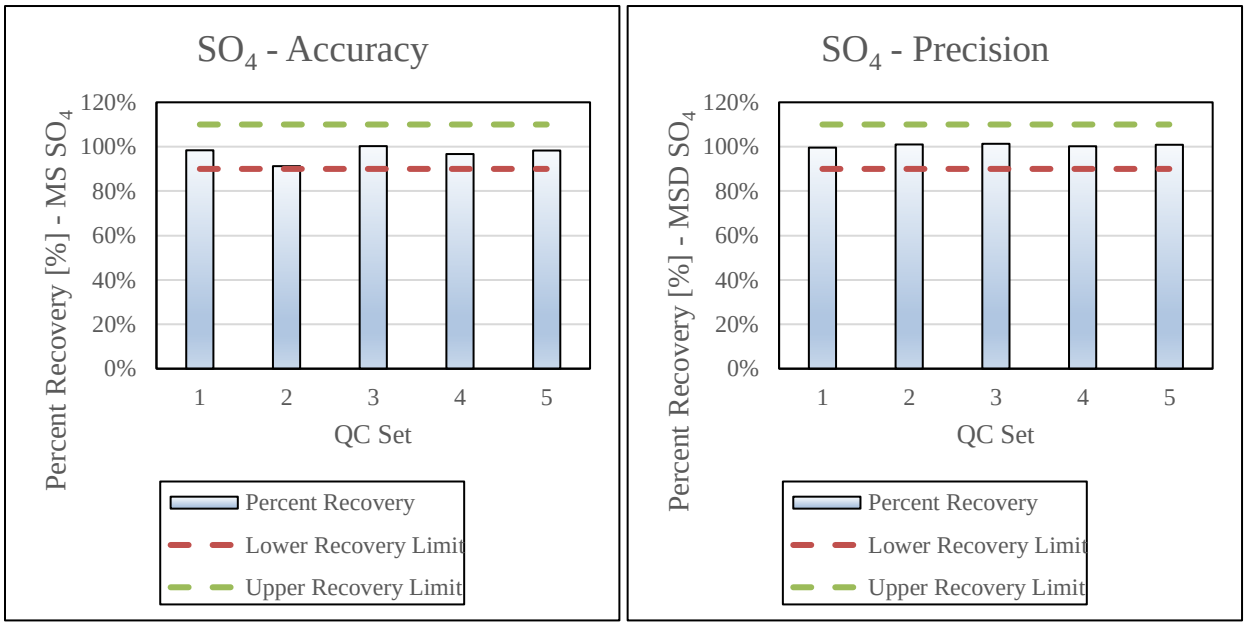


Figure 39. Quality control results for sulfate analysis.

Preliminary Design and Operational Parameters

Based on the results obtained from bench-scale testing, a set of preliminary design and operational parameters was developed for a pilot-scale demonstration trial (Table 20). It is recommended that the pilot be conducted once the Coffee Mine is operating and actual leach waters are generated.

The pilot demonstration is a required last step before preliminary engineering of the water treatment plant can be completed. The on-site demonstration will be conducted over at least a three-month period with a seasonal temperature change. The testwork and analytical plan will be developed prior to the pilot demonstration and will include at the minimum the same level of detail as the Phase II bench-scale program.

Table 20. Summary of the design and operational parameters for pilot-scale testing.

Unit process	Retention time	Reagent dose
Ferric Co-precipitation	~ 1hr	~ 30 mg/L $FeCl_3$
Sulfate Precipitation	~1 hr	~ 2 g/L Ba
EBR Treatment	7-10 hrs	0.6-0.9 mL/L ethanol
Aerobic Post-treatment	< 1hr	Continuous air addition

CONCLUSIONS

The Phase I feasibility testing successfully demonstrated the removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Nitrate-N was removed from an average of 188 mg/L to below the detection limit of 0.19 mg/L. After process adjustments, average removals of 98.8% and 99.1% were achieved for arsenic and uranium, respectively. Furthermore, sixteen other metals, as well as total and WAD cyanides, were removed by the EBR system.

Even though arsenic removal was demonstrated with the biological treatment, the feasibility testing proved that long retention times and high nutrient doses would be required to meet the required discharge levels. The Phase I recommendation was to investigate phys-chem arsenic removal options.

The in-situ feasibility tests demonstrated enhanced denitrification upon inoculation with the EBR effluent and nutrient additions. Natural nitrate reduction occurred in the control column upon nutrient additions due to the presence of a native denitrifying microbial population. However, inoculation with the EBR microbial population enhanced the denitrifying performance. Nitrate-N was reduced in the in-situ test column from approximately 150 mg/L to 13.9 mg/L when the EBR effluent was used to irrigate the columns, and it was reduced to 26.4 mg/L when DI water was used as column influent.

In line with the Phase I findings, the Phase II bench-scale testing demonstrated that the best approach for the Coffee Mine water treatment is a multi-stage treatment train that consists of a phys-chem pretreatment for arsenic and sulfate precipitation, biological EBR treatment for denitrification and metals polishing, and a small aerobic post-treatment for removal of residual nutrients and reintroduction of dissolved oxygen. The list below presents the detailed findings pertaining to each unit process.

1. Chemical pretreatment

- **The pretreatment design took advantage of combining three steps to benefit the overall system performance.** The cyanide destruction step aided the oxidation of more reduced arsenic species and converted them into arsenate, which is the most amenable form of arsenic to ferric co-precipitation. Instead of further reagent additions after ferric dosing, barium salts that were used to precipitate sulfate also acted as coagulants and flocculants for the already formed arsenic precipitates.
- **System optimization demonstrated that arsenic could be removed to below the discharge target of 0.035 mg/L with ferric co-precipitation alone.**
  - Arsenic analysis had an accuracy of ±0.0068 mg/L.
- **Sulfate was shown to be removed from the Coffee waters to below the discharge target of 1,500 mg/L with barium precipitation alone.** Jar tests demonstrated that barium dose is directly proportionate to the amount of sulfate precipitated; greater or lower sulfate removal can be achieved with an adjusted Ba dose.
  - Sulfate analysis had an accuracy of ±61.9 mg/L.
  - The evaluated barium salts (barium chloride and barium hydroxide) resulted in elevated chloride concentrations passing through the treatment system. A jar test examination of

different barium salts alone and in combination is recommended once the mine is operational and actual site waters are available to establish the most suitable reagent dose to avoid generating excess chlorides.

  - **The implications of the successfully demonstrated pretreatment of both arsenic and sulfate include the need for a significantly smaller biological EBR system, no requirement for the addition of complex organic nutrients, and a lower organic carbon addition, resulting in lower residual nutrient concentrations.**
- **A 39% removal of total uranium was achieved on average with the chemical precipitation pretreatment.**
  - The pretreatment sludge removed the radioisotopes, rendering the following EBR treatment less likely to accumulate them. The average gross alpha radiation in the pretreatment sludge was 29 ±2.76 pCi/g, while gross beta radiation was 17.8 ±2.10 pCi/g.
- **Sludge generated in the pretreatment passed the TCLP analysis.**

2. EBR treatment

- **A single-stage EBR treatment operated with a 7-hr HRT and a 0.6 mL/L ethanol dose removed nitrate-N to below the detection limit of 0.3 mg/L.**
  - Nitrate-N analysis had an accuracy of ±0.004 mg/L.
  - Average nitrite-N concentration (an intermediary denitrification by-product) in EBR1 was 0.037 mg/L, meeting the discharge target of 0.09 mg/L.
- **Total uranium removal to below the discharge target 0.1 mg/L was achieved with the first-stage EBR treatment using an 11-hour HRT and 0.9 mL/L ethanol dose.**
  - Total uranium analysis had an accuracy of ±0.0111 mg/L
- Once optimized to target only nitrate and uranium, the EBR system was demonstrated to allow residual arsenic and sulfate to pass through without further reducing either one.
  - The speciation results show that the EBR system did not produce any methylated arsenic species, even during the preliminary testing stages, when residual arsenic was removed biologically.
- **In addition to the contaminants of interest, the EBR system removed the following metals from elevated concentrations in the influent waters to below their respective discharge targets: antimony, copper, mercury, molybdenum, and nickel.**
  - The EBR system removed all selenium species to below detection, including organo-selenium species that are more bioavailable in the natural environment.
  - Iron and manganese were present in the influent waters above their discharge targets and passed through the EBR system largely unchanged after the system was provided with ethanol as a sole nutrient source.
  - If present above their respective discharge targets, magnesium and calcium will need to be removed through an additional softening pretreatment step prior to EBR treatment. Although possible, removing hardness minerals in the EBR system is not advised because their elevated concentrations would load the bioreactor bed with solids and blind the activated carbon media in a relatively short amount of time (a few years).

- Monovalent cations, such as potassium and sodium, were present at higher levels than forecasted by the water quality models and exceeded their respective discharge targets. The EBR system cannot be used to target them.

- **The EBR system polished WAD cyanide to below the detection limit of 0.006 mg/L.**
- **Once the pretreatment was optimized, ethanol was used as a sole nutrient source for the EBR treatment, resulting in low residual nutrient generation.**
  - Ammonia-N concentrations of several mg/L were removed through an assimilatory pathway in the EBR treatment. However, since the influent NH_3-N concentrations were 465-times higher than forecasted (27.9 mg/L, instead of 0.06 mg/L), elevated ammonia still passed through the EBR system.
  - Average BOD concentrations stabilized at about 100 mg/L in the EBR system effluent.
  - Phosphate concentrations of 0.18 mg/L and 0.35 mg/L were generated from EBR1 and EBR2, respectively, when the average system influent carried 0.25 mg/L PO_4-P. A pilot- and full-scale installation is expected to not require any external phosphate additions and that the EBR system would remove some of the PO_4-P present in the influent waters through assimilatory pathways.
- **Neither the EBR treated effluents nor the EBR solids, including the activated carbon matrix as well as any precipitated residues and biofilm, accumulated gross radiation.**
- **EBR solids, including the activated carbon matrix as well as any precipitated residues and biofilm, passed the TCLP test.**

3. Aerobic post-treatment

- **Once optimized, the aerobic post-treatment removed BOD to below the detection limit of 5 mg/L.**
- **On average, the aerobic column removed ammonia-N to 7 mg/L, meeting the discharge goal of 8 mg/L while not generating excess nitrate/nitrite species.** The influent ammonia-N concentrations are forecasted to be present at 465-times lower concentrations (up to 0.06 mg/L) in the Coffee waters.
- **A significant spike of phosphate-P (5.85 mg/L on average) detected in the aerobic post-treatment effluent is attributed to phosphorus leaching out of the microbial support media (pumice) since no nutrients or reagents were added to the system.**
  - Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of phosphate occurs.
- The aerobic post-treatment did not negatively affect any parameters removed by the EBR treatment upstream, except for manganese.
  - Manganese concentrations spiked in the post-treatment effluent to an average concentration of 0.271 mg/L – over 4.2x increase from the EBR system effluent. Since no nutrients or reagents were added to the post-treatment, the source of manganese can only be attributed to the pumice used as a support matrix inside the column.

APPENDIX 2-E

Work Plan to Demonstrate Feasibility of Passive Bioremediation Treatment of Heap Leach Rinse Solutions at Closure

TECHNICAL MEMORANDUM

To:	Jennie Gjertsen, Goldcorp
From:	Alan Martin Jane Nieuwenburg David Flather (Lorax Environmental Services Ltd.)
Date:	October 31, 2017
Subject:	**Coffee Gold Project: Work Plan to Demonstrate Feasibility of Passive Bioremediation Treatment of Heap Leach Rinse Solutions at Closure**

1. Introduction

The Coffee Gold Project (the Project) is evaluating the use of semi-passive treatment at closure to treat drain down from the decommissioned heap leach facility (HLF). Parameters of potential concern (POPCs) have been identified as arsenic, nitrate and uranium. Nitrate represents a residual product of cyanide degradation while As and U represent leached components from the ore. A semi-passive treatment system based on the principles of permeable reactive barrier (PRB) technology is being considered for the closure phase of the Project. In PRB systems, a permeable matrix (*e.g.*, gravel) is amended with one or more materials to create a reactive medium for contaminant removal. For example, zero-valent iron (ZVI) and/or carbon-based organic materials (*e.g.*, straw, sawdust, wood chips, etc.) have been successful in treating arsenic, nitrate and uranium (USEPA, 2005).

PRBs have been used for the treatment of groundwater contaminants since the 1980s, and have been documented in numerous reports and publications that summarize extensive research, field trials and full-scale implementations (*e.g.*, USEPA, 1998, 2005; Blowes *et al*., 2000; ITRC, 2005, 2011). There are numerous examples of successful full-scale PRB installations that have been operating for more than five to ten years. In this regard, PRBs are acknowledged as an appropriate and cost-effective technology for the treatment of mine-influenced water (ITRC, 2013). Given that PRBs are contained within the subsurface environment, they are minimally influenced by atmospheric temperature, and have been shown to function well in cold-interior climates (Benner *et al*., 1997).

To assess the potential application of PRB technology at the Project, a literature review was conducted (Lorax, 2017). The Lorax (2017) memorandum includes a general description of PRB systems, an overview of the biogeochemical processes responsible for the removal of arsenic, nitrate, and uranium, and a description of case studies summarizing the application of PRB systems designed to treat these parameters. Overall, the memorandum concluded that all Project POPCs have the potential to be treated using a common treatment design. Potential risks were also identified, including the potential for the generation of potentially-harmful by-products (*e.g.*,

ammonia, nitrite, ferrous Fe) as well as the performance of passive treatment systems in cold-interior climates.

Development of a final passive treatment system design will be dependent on the outcome of pre-feasibility level (lab-scale) and feasibility level (on-site pilot scale) studies. This memorandum, prepared by Lorax Environmental Services Ltd. (Lorax), provides a description of the proposed work plan in support of the lab-scale and on-site pilot-scale assessments. Ultimately, these components will be used to evaluate the merits and risks associated with passive treatment at the Project, and provide the input for final design.

2. Conceptual Design for Post-Closure Passive Treatment

During operations and the early stages of closure of the HLF, geomembrane covers (raincoats) will be used to reduce the amount of meteoric water infiltrating into the heap and entering the process solution. The heap will be rinsed and capped in stages (progressive closure), and as each stage is capped, the raincoats for that area will be removed and used in other areas or incorporated as part of the closure capping. Rinsing will be completed in two phases.

Phase I – Preliminary Rinsing

Preliminary rinsing of the heap will occur using process solution with the pH adjusted to below about 8 to facilitate the removal of cyanide through volatilization. The high vapor pressure of HCN causes free cyanide to volatilize where conditions favor a significant concentration of this species (pH below approximately10) and therefore volatilization increases with decreasing pH. The preliminary rinsing will continue until the chemistry of the heap effluent reaches approximate equilibrium with the rinse solution. Preliminary rinsing will begin in project Year 4 or 5 and then occur annually until about two years after cessation of active leaching for gold recovery, or until about project Year 13. Preliminary rinsing will advance along the heap in the same direction as ore stacking (east to west) and, once started, will progress at approximately the same rate as the westward advancement or stacking of the heap;

Phase II – Final Rinsing

Final rinsing is designed to dramatically reduce contaminant levels in heap solutions with the ultimate objective of reducing contaminant concentrations to levels acceptable for direct discharge to the environment. Final rinsing of the heap will be performed using fresh water (stored in the rainwater pond during or following the spring freshet or the mid-summer rainfall events), and treated process solution from the electrochemical bioreactor (EBR) or a combination of the two. The effluent from final rinsing will then be used as either rinse water from preliminary rinsing, or makeup water for the process circuit until active leaching for gold recovery is completed. Under the current HLF water balance, discharge of excess rinse water from the HLF to the receiving environment will be required beginning in approximately Year 9; this excess rinse water will require active treatment. Active treatment will involve the addition of hydrogen peroxide to

remove residual cyanide followed by biological treatment using electrochemical biological reactor technology (EBR) to remove nitrate (via denitrification) and reduce metals/metalloids to below discharge limits. Details on the workplan proposed for advancing the design of the EBR system for Coffee is presented under a separate memorandum.

As indicated above, some treated water from the EBR system will be used in Final Rinsing of heap leach cells. Final rinsing will begin one year after preliminary rinsing (project Year 5 or 6) and will continue until the entire heap has been rinsed, approximately Year 15. Rinsing with treated heap leach solutions is designed to foster *in situ* treatment of the heap and reduce the overall time for chemical stabilization of the heap leach pad. The concept is to rinse with EBR treated solutions as this water will be both free of contaminants and contain microbes from the bioreactor adapted to treating heap chemistry. Nutrients and soluble carbon (e.g. methanol, molasses, other soluble sugar and phosphate) will likely be added to the treated solutions prior to rinsing and application on the heap.

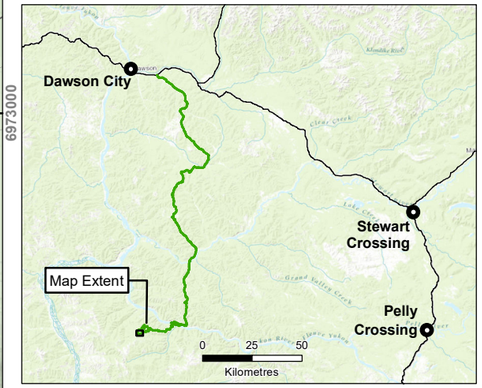
The addition of microbes, carbon and nutrients to the heap will foster reducing conditions within the heap pore waters allowing for *in situ* denitrification and the potential for reductive precipitation of metals and metalloids within the heap. This phase of *in situ* treatment is designed to treat constituents within the heap, as well as decreasing metals concentration to sufficient levels to either directly discharge, or at least provide water that is of sufficiently good quality to only require polishing in a passive treatment system.

The current conceptual design for this passive treatment system entails the conversion of one or more event ponds into bioremediation cells (Figure 2-1). A total of three events ponds could be available at closure for conversion to bioremediation cells. The total storage volume of the three events ponds combined is on the order of approximately 430,000 m^3. The proposed passive treatment system will ultimately be designed to collect heap leach seepage originating from the decommissioned facility and convey the solution through events ponds that have been converted to bioremediation treatment cells. To improve system performance and robustness under the climatic conditions experienced at Coffee, treatment will occur in the subsurface to minimize the potential influence of freezing temperatures during the spring and fall shoulder periods of open water. Seepage flow from the HLF will be conveyed to the subsurface through permeable coarse rock drains constructed along the upstream slope of the events ponds (Figure 2-2).

This design illustrates a two-stage treatment system, with the first cell serving to facilitate denitrification (using organic matter) and the second cell serving to reduce arsenic and uranium concentrations (using a combination of organic matter and ZVI) (Figure 2-2). Currently, it is not clear if a one-stage or two-stage system will be required. However, the two-stage conceptual design provides an example of how the system may be tailored to maximize the potential for nitrate reduction to proceed to nitrogen gas, and minimize the generation of ammonia.

COFFEE GOLD MINE

Heap Leach Facility at End of Operations



Legend

- Municipality
- Project Footprint
- Highway
- Waterbody
- Watercourse
- A-A' Cross Section

Proposed Infrastructure

- WRSF
- Backfill
- Total Pit Outline
- Event Pond
- Heap Leach Access Disturbance Footprint
- Leach Pad Contour (20m)
- Leach Pad Contour (5m)
- Heap Leach Pad Base

N

1:10,000

0 100 200 300

Meters

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

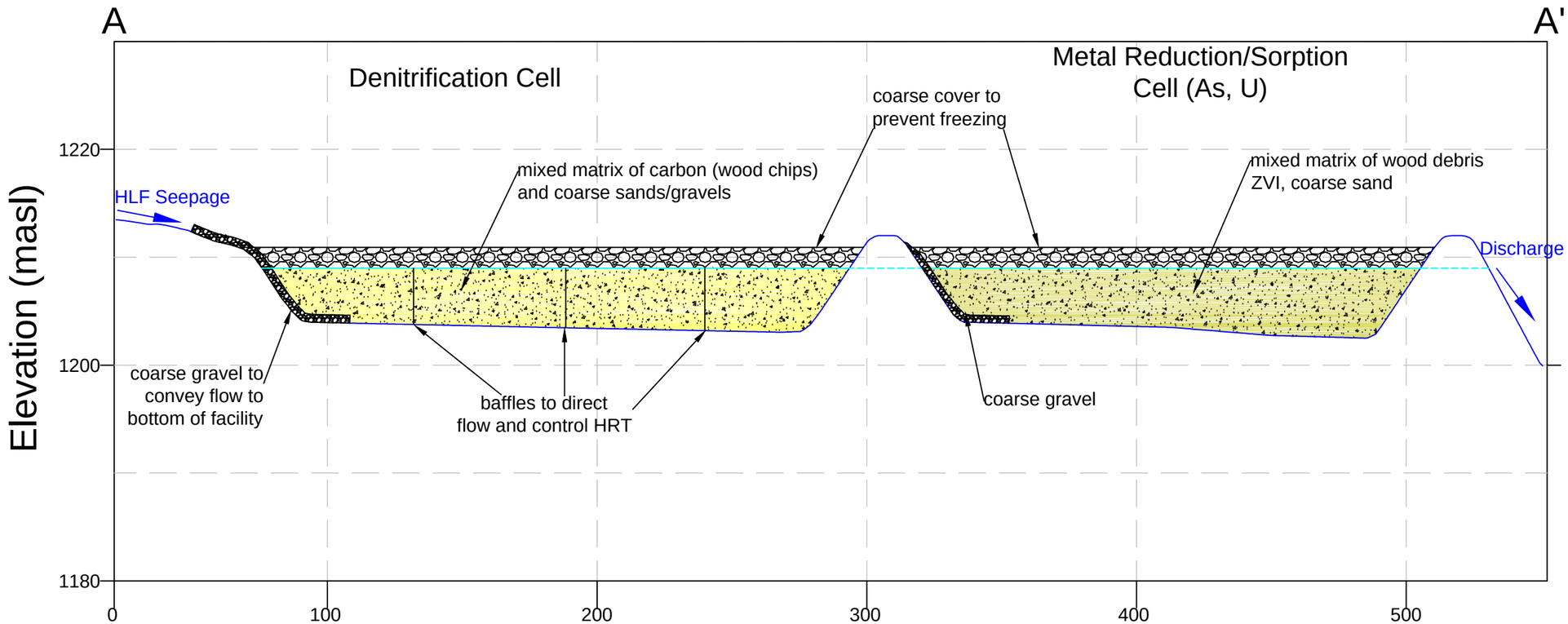
Figure 2-1	Date: Sep 26, 2017	Drawn by: GM	Reviewed: JS/LF

GOLDCORP

Path: D:\User Data\Fixtures\Dropbox\Mines\Documents\coffee\HLF Cross Section Location.mxd

COFFEE GOLD MINE

Cross Section through Converted Events Ponds



Legend

V.E. =4X

Figure 2-2	Date: Sep 26, 2017	Drawn by: SSS	Reviewed: JS

GOLDCORP

Path: P:\@Drafting\Coffee Gold\Drafting Figures\Auto Cad Figures\Cross Sections\Event Ponds\CS-A-A Event Ponds_20170926.dwg

In the presence of organic carbon (*e.g.*, wood chips), reduction of nitrate to nitrogen gas (N_2) under anaerobic conditions is thermodynamically favoured (Robertson and Cherry, 1995; Robertson *et al.*, 2000), as per Equation 1:

$$5CH_2O_{(s)} + 4NO_3^- \rightarrow 2N_{2(g)} + 5HCO_3^- + 2H_2O + H^+ \quad \text{Equation 1}$$

Reduction of nitrate to nitrogen gas is the preferred reaction pathway, since the nitrogen is removed from the system via release of N_2 gas to the atmosphere. In contrast, the reduction of nitrate to ammonia is not preferred, since the ammonia may be re-oxidized at some point downstream with no net loss from the system. Reduction of NO_3^- by ZVI, for example, may generate ammonia instead of nitrogen gas (Cheng *et al.*, 1997; Zhu and Getting, 2012), as per Equation 2.

$$4Fe(0) + NO_3^- + 10H^+ \rightarrow 4Fe^{2+} + NH_4^+ + 3H_2O \quad \text{Equation 2}$$

Although the final treatment configuration will be based on the results of the lab-scale and pilot-scale testwork, the basic principles are illustrated in Figure 2-2. In this design, seepage from the HLF will be conveyed to the pond bottom via a coarse gravel drain and permit upward vertical flow through the permeable reactive matrix. The reactive medium will comprise a mixture of gravel and amendments (*e.g.*, organic carbon and/or ZVI) to promote conditions conducive to the removal of nitrate, arsenic and uranium. Wood chips represent an ideal source of organic carbon given their local availability and successful application in bioremediation systems (USEPA, 1998). Baffles may be used to lengthen the flow pathways and maximize HRT. A 1 to 2 m layer of granular material will be placed on top of the reactive matrix to provide an insulating barrier to cold temperatures, thereby maximizing treatment potential during the winter months (Figure 2-2).

The conceptual design illustrated here deviates from traditional PRBs in terms of how flow is delivered and conveyed through the treatment system. In PRBs, flow is governed by the local groundwater flow field, and is placed to intercept a contaminated groundwater flow path. In the conceptual design described here, flow through the permeable reactive matrix is driven by upward hydraulic gradients imposed by the conveyance of the HLF effluent to the bottom of a lined pond (*i.e.*, imposition of upward flow).

Ultimately, the discharge from the passive treatment system will drain to the Latte pit, prior to release to the receiving environment. The long residence time afforded by the Latte pit will allow for final polishing processes if necessary, that may include particle settlement, oxidation of reduced species (*e.g.*, ammonia, nitrite, ferrous iron), and nutrient uptake by algae.

3. Proposed Work Plan

Based on the conceptual design for closure, a combination of lab-scale and on-site pilot-scale testwork is proposed. Pre-feasibility work will include lab-based column experiments, while feasibility testwork will entail the construction of a pilot-scale system at site. Each of these components is described in turn below.

3.1 Pre-Feasibility Column Testwork

As part of the pre-feasibility testwork program, column experiments will be conducted at the University of Waterloo (UW), under the oversight of Dr. David Blowes and Jeff Bain. David Blowes is one of the original pioneering scientists behind PRB technology, and together with Jeff Bain, bring considerable experience to the project. The column experiments will be used to:

- Demonstrate proof of principle (*i.e.*, can the technology reduce POPC concentrations to acceptable levels?);
- Determine POPC removal rates, which in turn have relevance to hydraulic retention time (HRT) requirements and treatment system dimensions;
- Evaluate the risks and merits associated with various reactive media, including wood chips and ZVI;
- Identify the nature of secondary minerals that may clog the system over time (relevance to the potential for hydraulic failure and system longevity); and
- Identify any potentially-problematic by-products that may be generated within the treatment system (*e.g.*, nitrite, ammonia, ferrous iron, hydrogen sulfide).

To address these objectives, three column configurations are proposed (Figure 3-1). The first configuration will encompass two columns in series, as per the conceptual design for the full-scale system illustrated in Figure 2. The first column (gravel + wood chips) will be used to promote denitrification (reduction of nitrate to nitrogen gas), while the second column (gravel + wood chips + ZVI) will be designed to reduce arsenic and uranium concentrations. Some arsenic and uranium removal may also occur in the first column in the presence of wood chips alone (Figure 3-1).

Column configurations #2 and #3 comprise single reaction cells, containing gravel + wood chips + ZVI (Figure 3-1). In the presence of ZVI, the reduction of nitrate to nitrogen gas can be favoured with sufficient organic carbon present, which is required to nourish denitrifying microbial assemblages (David Blowes, Pers. Comm.). In other words, the potential for ammonia generation can be theoretically minimized. Accordingly, it is possible that desired treatment outcomes may be achieved with a singular bioremediation design (i.e., single stage). To test this combined matrix, column configurations #2 and #3 have been designed with varying proportions of gravel + wood chips + ZVI (Figure 3-1).

Columns will be operated under fully saturated conditions over a period of 6 to 12 months, commencing in the first quarter of 2018. The columns will be configured to accommodate HRTs on the order of 4-7 days. Effluents will be monitored on a bi-weekly basis for a full suite of parameters including:

- General parameters: pH, redox potential, EC, temperature
- Major ions: Ca, Mg, Na, K, F, Cl, Br, HCO_3, SO_4
- Nitrogen and phosphorus (P) species: ammonia, nitrite, nitrate, phosphate-P, total-P

- Trace elements: As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sb, Se, Ti, Tl, V, U, Zn
- Organics: DOC, propionate, acetate (as indicators of carbon reactivity)
- Other: H_2S

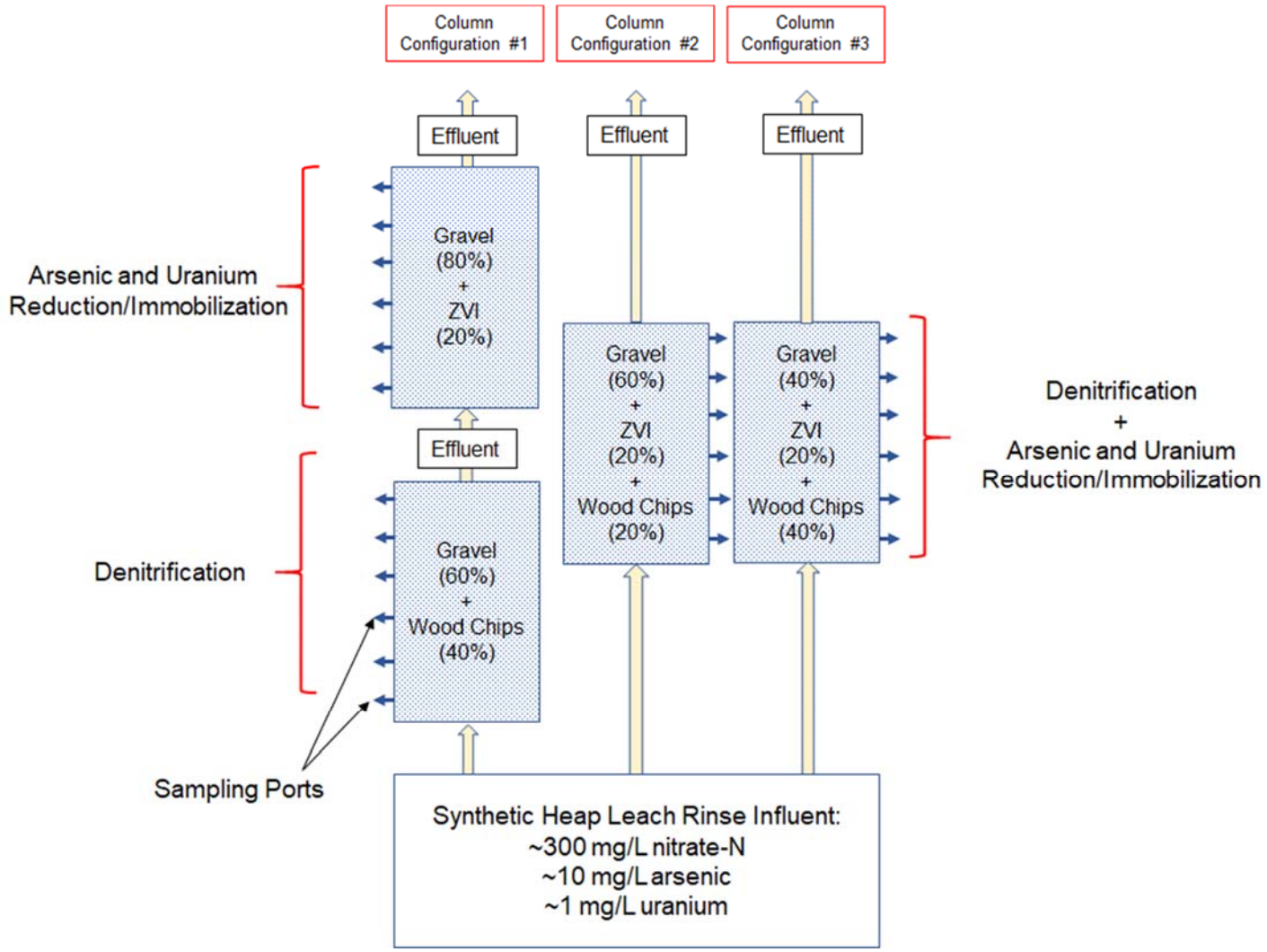


Figure 3-1: Conceptual schematic of proposed lab-based passive treatment experiments. ZVI = zero valent iron.

In addition to the column effluents, water quality samples will be periodically collected at multiple points within each column (sample ports shown in Figure 3), to quantify the spatial distribution of POPCs along the length of the column. These profile data are used to better quantify reaction rates.

The UW column experiments will require the generation of a synthetic HLF seepage. A representative solution will be generated by cyanide leaching of representative Coffee Gold ore. In order to produce representative nitrate concentrations, leaching solutions will be spiked with 300 mg/L nitrate-N.

3.2 Feasibility On-Site Pilot Scale Testwork

Feasibility testwork will be conducted on a pilot-scale under site climate conditions at the mine. This will involve the construction of a small-scale passive treatment system similar to the conceptual configuration shown in Figure 2-2. To permit acquisition of the most valuable data, pilot-scale experiments will be implemented with similar materials and construction methods as would be used for a full-scale application. The spatial dimensions of the pilot-scale test have not been finalized, and will be informed by the results of the lab-scale work. Overall, the results of pilot- scale testwork will be used to better quantify:

- Reaction rates under site conditions;
- Limits of system performance;
- Longevity;
- HRT requirements;
- System dimensions and footprint;
- Potential failure modes (hydraulic failures, generation of problematic parameters); and
- Construction and operational costs.

Effluents representative of the HLF will become available in the early closure period (Year 4) owing to progressive reclamation. This will provide an invaluable opportunity to conduct the pilot-scale studies with actual effluent, which will increase the confidence in the resulting data and the final design recommendations.

4. Closure

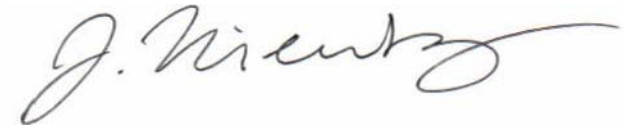
We trust that this memorandum meets your expectations at this time. Please contact the undersigned with any questions or comments.

Respectfully submitted,
Lorax Environmental Services Ltd.

Prepared by:



Alan Martin, M.Sc., P.Geo., R.P.Bio
Principal, Senior Geochemist



Jane Nieuwenburg, B.A.Sc., EIT
Chemical Engineer

Reviewed by:



David Flather, M.Sc.
Principal, Senior Geochemist

References

Benner, S.G., Blowes, D.W., Ptacek, C.J. (1997). A full-scale porous reactive wall for prevention of acid mine drainage. Ground Water Monit. Rem. 17, 99-107.

Blowes, D.W., Ptacek C., Benner S.G., McRae C.W.T., Bennett T.A. and Puls R.W. (2000). Treatment of inorganic contaminants using permeable reactive barriers. Journal of Contaminant Hydrology, 45:123-137.

Cheng, I. F., Muftikian, R., Fernando, Q., & Korte, N. (1997). Reduction of nitrate to ammonia by zero-valent iron. Chemosphere, 35(11), 2689-2695.

ITRC (2005). Permeable Reactive Barriers: Lessons Learned/New Directions. Prepared by The Interstate Technology & Regulatory Council (ITRC) Permeable Reactive Barriers Team. February 2005.

ITRC (2011). Permeable Reactive Barrier: Technology Update. Prepared by The Interstate Technology & Regulatory Council (ITRC) PRB: Technology Update Team. June 2011. http://itrcweb.org/Guidance/ListDocuments?TopicID=19&SubTopicID=23#.

ITRC (2013). Biochemical Reactors for Mining-Influenced Water. Prepared by The Interstate Technology & Regulatory Council (ITRC) Biochemical Reactors for Mining-Influenced Waste Team. November 2013.

Lorax (2017). Coffee Gold Project: *In Situ* Passive Treatment of Arsenic, Nitrate, and Uranium using Permeable Reactive Barriers. Technical memorandum submitted to Goldcorp Inc. Prepared by Lorax Environmental Services Ltd., September 26, 2017.

USEPA (1998). Permeable Reactive Barrier Technologies for Contaminant Remediation. Prepared by U.S. Environmental Protection Agency.

USEPA (2005). Permeable Reactive Barriers for Inorganic and Radionuclide Contamination. Prepared by Bronstein K., National Network of Environmental Management Studies Fellow. Prepared for the U.S. Environmental Protection Agency, August, 2005.

Robertson, W.D. and Cherry, J.A. (1995). In situ denitrification of septic-system nitrate using reactive porous media barriers: field trials. Groundwater, 33(1), 99-111.

Robertson, W. D., Blowes, D. W., Ptacek, C. J., & Cherry, J. A. (2000). Long-term performance of in situ reactive barriers for nitrate remediation. Groundwater, 38(5), 689-695.

Zhu, I., & Getting, T. (2012). A review of nitrate reduction using inorganic materials. Environmental Technology Reviews, 1(1), 46-58.

APPENDIX 2-F

Laboratory Scale Study of Nitrate and Arsenic Removal via Permeable Reactive Barrier under Cold Conditions

August 2020

Independent Study (NSCI 202): Laboratory Scale Study of Nitrate and Arsenic Removal via Permeable Reactive Barrier under Cold Conditions

Yukon University

Project team:

Chelsey Zurkan	Student, Yukon University
Dr. Guillaume Nielsen	NSERC Industrial Research Chair in Northern Mine Remediation, Yukon University Research Centre
Ben McGrath	Laboratory Technician, Yukon University

This publication may be obtained online at yukonu.ca/research

This publication may be obtained from:

YukonU Research Centre, Yukon University
520 University Drive
P.O. Box 2799,
Whitehorse, Yukon
Y1A 5K4
(867) 668-8895
1-800-661-0504
yukonu.ca/research

Table of Contents

List of Abbreviations **4**
1. Introduction **1**
2. Materials and Methods **3**
2.1. Synthetic Mine Water Preparation **3**
2.2. Column Construction **5**
2.3 Column Substrates **6**
2.4. Hydraulic Residence Time **7**
2.5. Experimental Design **7**
3. Results and Discussion **8**
3.1. Porosity and flow rate calculation **8**
3.2. Arsenic **8**
3.2. Nitrate **12**
3.3. pH **15**
4. Conclusions **15**
Appendix A **22**
Appendix B **24**

List of Abbreviations

AMD Acid Mine Drainage

As Arsenic

DIW Deionized Water

EC Electrical Conductivity

Fe Iron

HRT Hydraulic retention time

ML Metal Leaching

NO_3^- Nitrate

ORP Oxidation Reduction Potential

PRB Permeable Reactive Barrier

S Sulfur

SMW Synthetic Mine Water

SO_4^{2-} Sulfate

TOC Total Organic Carbon

ZVI Zero-valent Iron

1. Introduction

The mine life cycle, from exploration to mine closure can be fast-paced and volatile, therefore careful consideration should be given to remediation planning of mine sites. Ensuring strategies are developed which are both cost effective, and appropriate to the climate and biome of which the mine site is located, are essential. Of particular concern to gold-mining operations in Northern climates are waste by-products of cyanide degradation; metal leaching (ML) and acid mine drainage (AMD); and extreme cold conditions which have potential to hamper biological processes involved in bioremediation methods.

Exposure of mine tailings to water and oxygen cause acid-generating reactions to occur and the now-reactive tailings become a source of the effluent commonly known as AMD in ground and surface water (Johnson 2003). Generally, AMD is characterized by low pH and high concentrations of sulphate, iron, and dissolved metals (Blowes et al. 1994).

Due to the acidic conditions created by AMD, arsenic sulfidic ore such as arsenopyrite (FeAsS) leaches arsenic from gold heap leaches (Roussel et al. 2000). Arsenic (As) in aquatic environments usually exists in inorganic forms as arsenate (As(V)) and arsenite (As(III)). As (III) is usually more mobile and toxic then As (V) although As (III) can also become immobilized in the presence of sulfide (Bissen and Frimmel 2003; Stauder et al. 2005). However, ML of As from arsenic minerals at neutral pH due to oxidation can occur in heap leach waste (Mend 10.1).

Cyanide leaching is used in 90% of gold ore beneficiation (Yarar 2002). The cyanide used in ore processing degrades into a combination of ammonia, carbonate, and sulfate, wherein ammonia

converts to nitrate (NO_3^-) through the 2-step nitrification process, leaving nitrate as a by-product in the surrounding groundwater and waterways (Akcil 2003). High levels of NO_3^- in waterways, and consequently drinking water, can potentially cause methemoglobinemia in infants and gastrointestinal cancer in adults (Kundu et al. 2008). As well, excessive nutrients, such as phosphate and NO_3^-, can lead to eutrophication of waterways (Boeykens et al. 2017).

Many methods of removing and/or reducing As and NO_3^- from mine waste have been studied. Engineered denitrification systems with woodchips used as a carbon source have been studied and implemented in agricultural settings for the removal of nitrate. These engineered dentrification systems provide an environment that supports the growth of denitrifying bacteria. Denitrifying bacteria utilize nitrate to oxidize woodchip carbon, and in the process reduce NO_3^- to N_2 gas (Blowes et al. 1994; van Driel et al. 2006; Christianson et al. 2010, 2011a,b; Schipper et al. 2010; Woli et al. 2010).

Zero-valent iron (ZVI) has been successfully deployed as a reactive material for the treatment of arsenic (Su and Puls 2001). ZVI immobilizes As by adsorption of As (V) or As (III) onto iron corrosion products in the shell surrounding the elemental iron core and this is sometimes accompanied by reduction As (V) to As (III) (Rao et al. 2009; Manning et al. 2002; Kanel et al. 2006; Bang et al. 2005). Adsorption contributes to the collection of molecules by the internal surface or the external surface of solid matter or by the surface of liquids. Absorption, with which it is often confused, refers to processes in which a substance enters the very interior of crystals, blocks of amorphous solids, or liquids. Adsorption is characterized by the ability of all solid substances to attract molecules of gases or solutions with which they are contacted to their surfaces.

Successful use of ZVI as a reactive material, in conjunction with the development of biological denitrification systems within a permeable reactive barrier (PRB) for the reduction of As and NO_3^- have been observed (Lee et al. 2009; Johnson et al. 2008). In spite of successful use of PRBs to treat these contaminants, there is very little data available on the efficacy of PRBs utilizing ZVI and denitrification under cold conditions.

In this bench-scale column experiment, the efficacy of a PRB at low temperature (4°C) was tested. The PRB consisted of ZVI for arsenic adsorption, woodchips for the facilitation of denitrifying bacterial activity to reduce nitrate, and gravel to create an insulating effect. Two columns with varying ratios of woodchips, gravel and ZVI (Tab. 1) were tested. The ratio of amendments and hydraulic residence time (HRT) were adapted from an experiment designed by Lorax Environmental Services Ltd. and implemented by YukonU Research Centre's Industrial Research Chair in Northern Mine Remediation for Newmont Corporation's proposed Coffee Gold Mine.

2. Materials and Methods

2.1. Synthetic Mine Water Preparation

A synthetic mine water (SMW) stock solution was prepared by adding specific heavy metals into deionized water to reach the concentrations similar to mean concentrations found in mine wastewater analyzed from Golden Predator's Brewery Creek mine located in Yukon. Due to the location's proximity to Coffee Gold mine and similar processing used, Brewery Creek mine was

chosen by Lorax Environmental Services Ltd. as an analog site to model predicted post-closure heap leach waste solution metal concentrations. The SMW stock solution was prepared using the following metal salts: KNO_3, $MgSO_4 \cdot 7H_2O$, As_2O_5, and $FeCl_3 \cdot 6H_2O$ (Tab. 1). Mass of each metal salt used calculated based on target metal ion concentration (App. A).

Table 1. Metal salts used to reach target concentrations of target metal ions in SMW solution.

Metal Salt	**Target Metal Ion**	**Target Concentration (mg/L)**
Potassium Nitrate (KNO_3)	Nitrate (NO^-_3)	300
Magnesium Sulphate Septahydrate ($MgSO_4 \cdot 7H_2O$)	Magnesium (Mg)	200
Arsenic Pentoxide (As_2O_5)	Arsenic (As^{+5})	20
Iron (III) Chloride Hexahydrate ($FeCl_3 \cdot 6H_2O$)	Iron (III) (Fe^{+3})	0.5

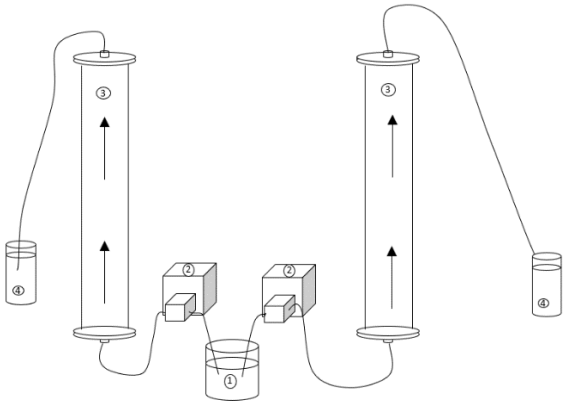
A total of 16 litres of SMW was prepared for the duration of the experiment based on the calculations of HRT and flow rates (App. B). The SMW was tested for pH, electrical conductivity (EC) and oxidation reduction potential (ORP). pH measurements were performed using a pH meter (650 PCD, Oakton, Vernon, IL, USA) equipped with a double junction Ag/AgCl electrode (Cole Parmer Canada, Montréal, QC, Canada). Calibration of the pH meter was performed before testing using certified buffer solutions (buffer solution pH 10.00; pH 7.00; pH 4.00, Fisher Scientific, Montréal, QC, Canada). Oxidation reduction potential (ORP) measurements were performed using a double junction electrode ORP (ORP Electrode tested. 59001-77, Cole Parmer, Montréal, QC, Canada). Calibration of the ORP meter was performed using a certified solution (ORP Standard, Thermo Fisher Scientific, Waltham, MA, USA). Electrical conductivity (EC) measurements were performed using an EC metre (650 PCD, Oakton, Vernon, IL, USA). Calibration of the EC metre was performed using a certified solution (Conductivity Standard, Thermo Fisher Scientific, Waltham, MA, USA). Two samples were taken of the SMW for metals and nitrate analysis. The metals sample was acidified with HNO_3

and analyzed via CRC ICPMS by ALS Environmental (Vancouver, BC). The NO_3^- sample was acidified with H_2SO_4 and analyzed via ion chromatography by ALS Environmental (Vancouver, BC).

2.2. Column Construction

Two cylindrical columns (Fig. 1) made of 1.1 cm thick Plexiglas™ were used for this experiment. The internal diameter of these columns was 6.4 cm, and the length was 63 cm. Each column was sealed closed at the bottom by bolting a Plexiglas™ plate to it with the same external diameter. Between the column and end plate, a rubber gasket was used to ensure an air-tight seal was achieved. Each end plate was fitted with an outlet port with ~ 1 mm opening hole and sealed additionally with epoxy. L/S Masterflex 16 ID tubing (Cole-Parmer Canada Company, Montreal QC) was attached to the outlet port.

0.45 μm cellulose acetate filter cut to the diameter of the column opening was wetted with deionized water and placed inside of the column against the end plate. To ensure equal distribution of SMW into each column, 139.58 g of Ottawa Sand (Fisher Scientific, Ottawa ON) was placed on top of the filter paper measuring ~ 1 cm in height in each column. The experimental setup was placed in a laboratory refrigerator (Fisher Scientific Isotemp Refrigerator, Ottawa, CA) to ensure a temperature of 4°C was maintained throughout the experiment.



(a)



(b)

Figure 1. (a) Schematic of column design and experimental setup. (1) influent (SMW); (2) peristaltic pump; (3) column; (4) effluent. Schematic is not to scale. (b) Picture of actual experimental setup located in the Yukon U Research Centre Laboratory.

2.3 Column Substrates

Each column had a unique mixture of reactive materials. The reactive materials used in this experiment were wood chips, gravel and ZVI. The different percentages of each material were chosen based on a design by Lorax Environmental Services Ltd. (Tab. 2). The ratio was chosen to design a column system which would allow for the treatment outcomes desired through a single-stage system.

The woodchips were sourced from Wiley Mill (Vancouver, BC) and were not representative of available woodland found near the Coffee mine. Gravel was sourced from the City of Whitehorse gravel pit (Whitehorse, YT). The gravel contained limestone and was not

characteristic of the geology found at Coffee Mine. The ZVI was -8 +50 mesh screened and sourced from Connelly GPM (Chicago, IL).

The mass of each substrate was calculated based on the density of each material. Each substrate mixture was amalgamated prior to packing into each column.

Table 2. Substrate (ZVI, gravel and woodchips) ratios of column 1 and column 2.

Substrate	Column 1	Column 2
Woodchips	20%	40%
Gravel	60%	40%
ZVI	20%	20%

2.4. Hydraulic Residence Time

A target HRT of 4 days was pre-determined by Lorax Environmental Services Ltd. (Vancouver, BC) in consultation with Dr. David Blowes (University of Waterloo, Waterloo ON). The flow rate was calculated by the pore volume for each column. The pore volume was determined by completely filling each packed column with deionized water (DIW). The volume of DIW used to fill each column was determined to be the pore volume.

2.5. Experimental Design

The SMW, Column 1 and 2 were placed in a refrigerator (Fisher Scientific Isotemp Refrigerator, Ottawa, CA) which was maintained at 4 C° for the duration of the experiment (Fig. 1b). SMW was fed via Masterflex peristaltic pumps (Cole-Parmer Canada Company, Montreal QC) from below the columns into the bottom port of each column. The SMW was fed continuously throughout the experiment with the exception of sampling days, wherein flow was stopped temporarily. Volume levels of effluent collected over each 4-day cycle was monitored to ensure target flow rates were maintained. On the 4th day of each cycle, flow was stopped, and samples

were taken for nitrate and metals analysis, as well as pH, EC and ORP measurements of the effluent. The effluent was then discarded, and flow was reinitiated into the columns to start the next 4-day cycle.

3. Results and Discussion

3.1. Porosity and flow rate calculation

The pore volumes were determined to be 834.9 mL for column 1 and 960.1 mL for column 2. To achieve the target HRT of 4 days the flow rates were back calculated using an HRT of 4 days and the pore volumes using the following formula:

Flow rate (m^3/day) = pore volume (m^3) / HRT (days) **Equation 1**

The flow rates were determined to be 0.14 mL/min for column 1 and 0.17 mL/min for column 2 (App. B).

3.2. Arsenic

The experiment began with an expected high concentration of As in the SMW influent, at 19.0 mg/L (target As concentration = 20 mg/L (table1)). Once SMW influent passed through each column, dramatic reduction As concentrations decreased dramatically. In column 1, the As concentration decreased to 6.43×10^{-2} mg/L after the initial 12-day period, and in column 2, the As concentration decreased to 1.12×10^{-3} (Fig. 2). Over time, As concentrations continued to trend downward in column 1, eventually reaching a concentration of 8.10×10^{-4} mg/L in effluent collected on the final (28th) day of the experiment. In column 2, the As concentration reached its lowest concentration on the 24th day at 9.50×10^{-4} mg/L. The As concentration began to rise in

the effluent of column 2 after the 24th day, rising from 9.50 x 10^{-4} mg/L to the final concentration of 1.81 x 10^{-2} mg/L.

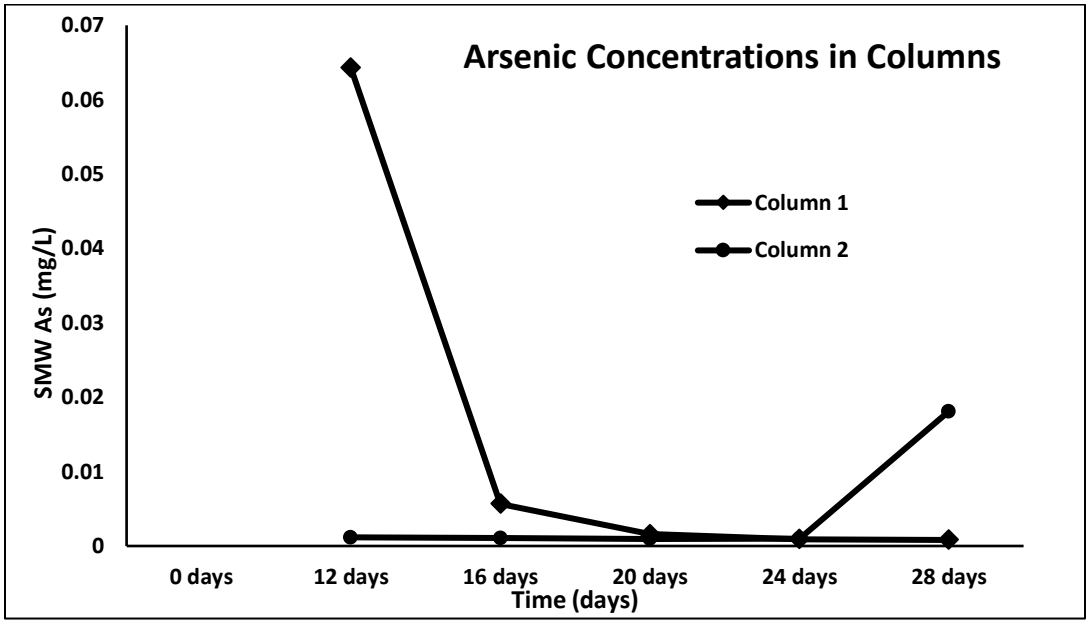


Figure 2. Graph of As concentrations (mg/L) over time throughout the experiment in column 1 and 2.

Overall, there was a high As removal rate of >99.0% observed in both column 1 and column 2 throughout the experiment (Fig. 3). A slight decrease in the removal rate of As in column 2 was observed on the final day, decreasing from 99.99% to 99.92%.

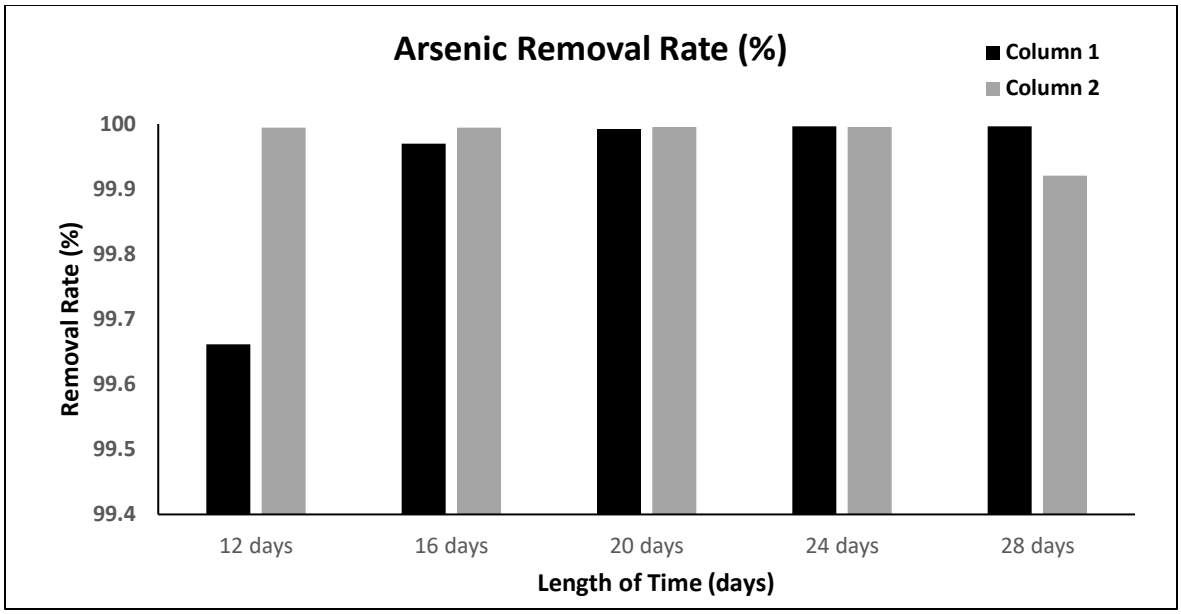


Figure 3. Removal rates (%) of As analyzed in the effluent of column 1 and 2 over time.

The decreased of As concentrations in the SMW throughout the experiment are consistent with the adsorptive qualities of ZVI. Over time, Iron (Fe) concentrations within effluent samples decreased over time in tandem with a decrease in As concentrations (Fig. 4). These findings suggest Fe corrosion products, such as ferrous hydroxide; mixed valence Fe oxides and hydroxides; and ferric oxyhydroxides formed.

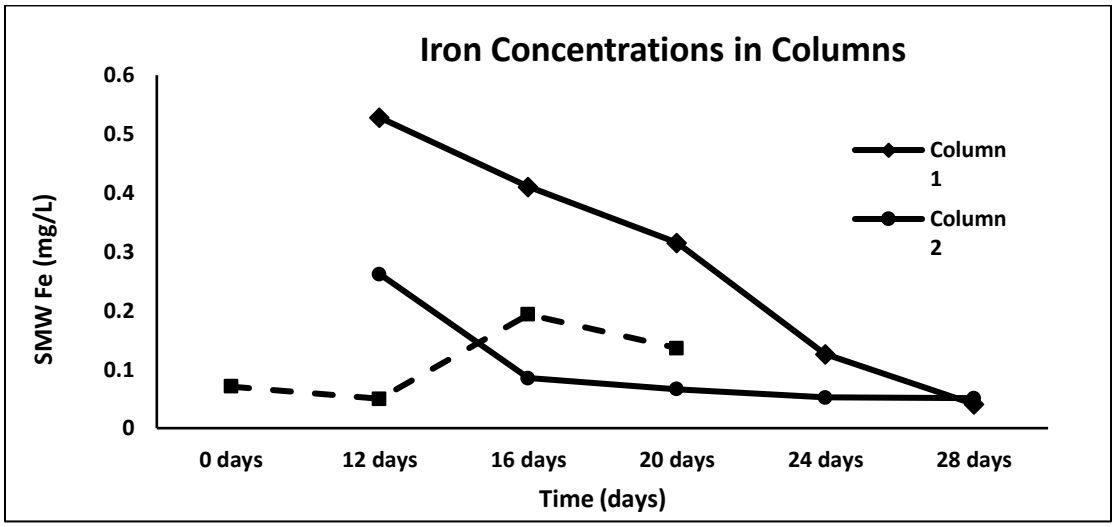


Figure 4. Graph of Fe concentrations over time throughout the experiment of column 1 and 2.

This was further demonstrated by visible greenish deposits, which were likely evidence of iron oxide formation (Fig. 5). Likely, As was adsorbed to ZVI within the columns, and Fe corrosion products complexed with the adsorbed As (Rao et al. 2009).



Figure 5. Green coloured deposit found in columns at end of experiment.

It is unknown whether the As (V) present in the SMW was reduced to As (III) within each of the columns. However, reducing conditions were observed through ORP readings of the effluent from each column throughout the experiment, ranging between -72 mV to -8 mV and -49.5 mV

to -0.3 mV, for Column 1 and 2 respectively. It is possible reduction of As (V) to As (III) occurred.

3.2. Nitrate

The target NO_3^- concentration of the SMW was 300 mg/L, however, upon analysis, the NO_3^- concentration was found to be 68.7 mg/L (Fig. 4). To exclude the possibility of faulty measurement of the original metal salt (KNO_3) in the creation of the SMW, back-calculation of the expected concentration of potassium based on the called for weight of KNO_3, was found to be 191.26 mg/L. The metals analysis of the SMW showed a potassium concentration of 191.0 mg/L (not shown). It is likely the NO_3^- decomposed to various nitrogenous products in solution, such as HNO_3, HNO_2, NO, NO_2, etc. (Stern 1972).

Each column produced a reduction of NO_3^- of varying concentrations in the first samples of effluent collected. Column 1 NO_3^- concentration decreased from 68.7 mg/L to 8.43 mg/L and in column 2 NO_3^- concentration decreased from 68.7 mg/L to 22.4 mg/L at day 12. After day 12, NO_3^- concentrations continued to be lower than SMW concentrations, however, removal rates lessened for the rest of the experiment (Fig. 6).

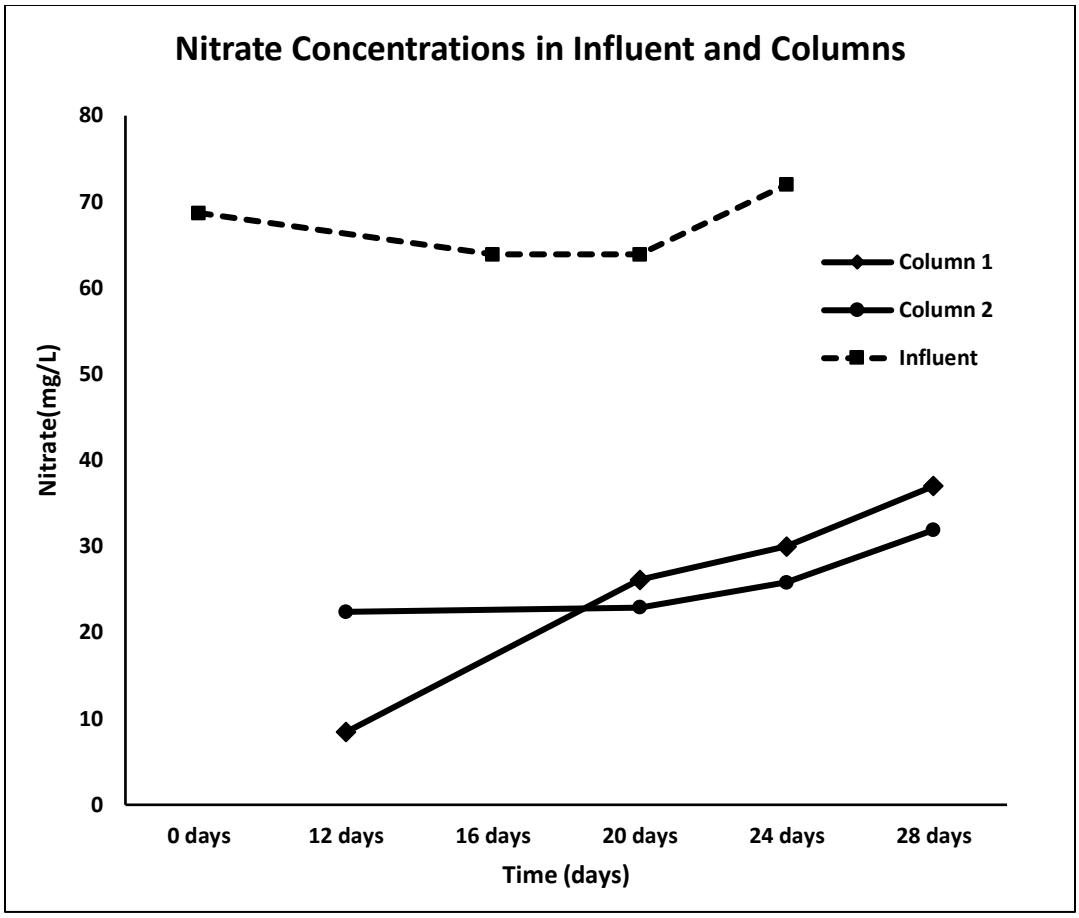


Figure 6. Graph illustrating the concentrations of NO_3^- in influent samples and effluent samples of column 1 and 2 over time.

Broadly, removal rates of NO_3^- in column 1 decreased from 87.7% to 48.6% over the course of the experiment. Removal rates of NO_3^- in column 2 decreased from 67.4% recorded at the beginning of the experiment to 55% removal rate recorded at the end of the experiment.

The concentrations of NO_3^- analyzed in the effluent of each column seem to indicate that denitrification is not the mechanism by which NO_3^- concentrations decreased in the columns. Although denitrifying bacteria are known for slow growth in culture (Koike and Hattori 1974), as well as the inhibiting effect cold temperatures can have on growth rates of denitrifying bacteria (Palacin-Lizarbe et al. 2018), the total length of the experiment, 4 weeks, is typically enough time for growth of denitrifying bacteria colonies. If substantial denitrifying bacteria colonies existed, i.e. if the columns were inoculated with bacteria from the gravel and woodchips

amendments, constant NO_3^- removal rates throughout the experiment would be observed. In contrast, a declining removal rate in each column was observed (Fig. 7).

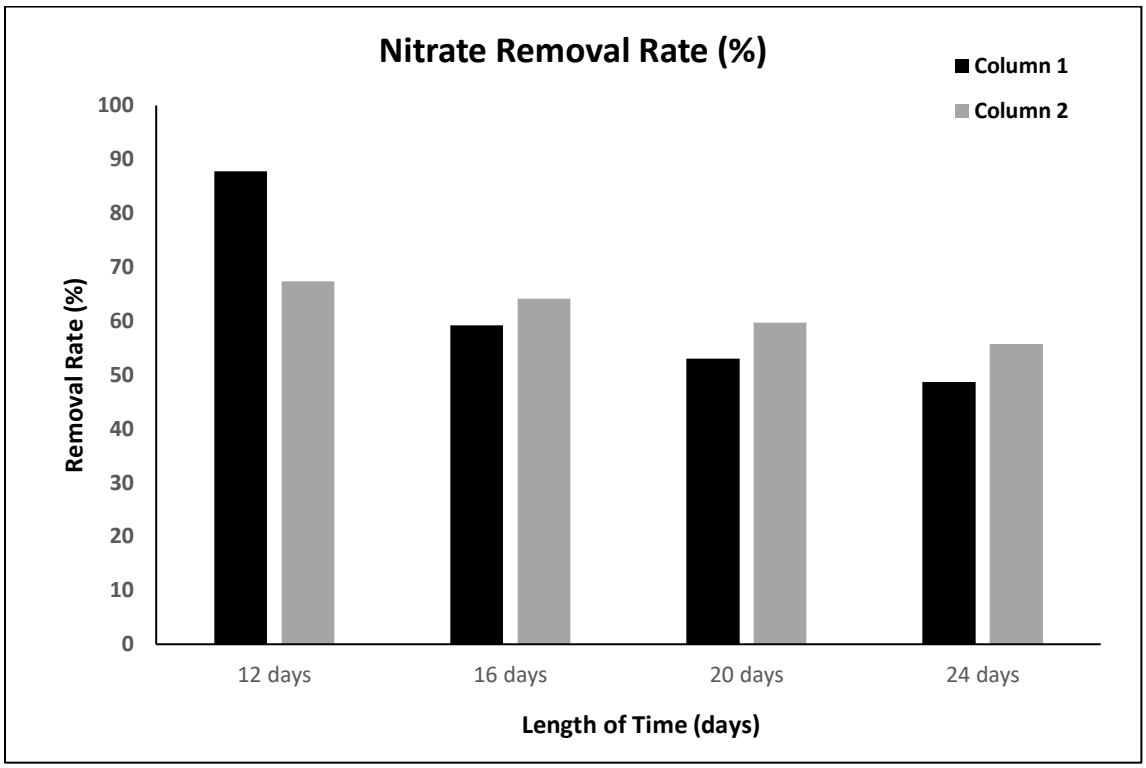


Figure 7. Graph showing NO_3^- removal rates in column 1 and 2 over time.

Total organic carbon (TOC) was analyzed in the SMW influent and effluent samples throughout the experiment. TOC analyzed from the effluent samples, had starting concentrations of 205.15 mg/L and 415.58 mg/L, for column 1 and 2 respectively. As no extraneous carbon source was added to the SMW, it is assumed TOC comes from woodchips. This aligns with the ratio percentage of woodchips in each column, as column 1 had 20% woodchips, and column 2 had double, at 40%. Over time, the TOC concentrations in the effluent of each column decreased with rates consistent of natural release of dissolved organic carbon from woodchips in bioreactors (Abusallout and Hua 2017). For this reason, it is unlikely the decrease in carbon over time can be attributed to denitrifying bacteria metabolic processes.

3.3. pH

pH analyzed in both the SMW influent, and effluent of each column, showed a progression of very acidic conditions in the SMW influent, pH 3.80 ± 0.03, to 8.86 ± 0.25 and 8.06 ± 1.47 for columns 1 and 2 respectively (Fig. 8). As the gravel used in the PRB had a makeup that included limestone, it is assumed the dissolution of $CaCO_3$ from the limestone created alkaline conditions within the columns, raising the pH overall (Cravotta and Traham 1999).

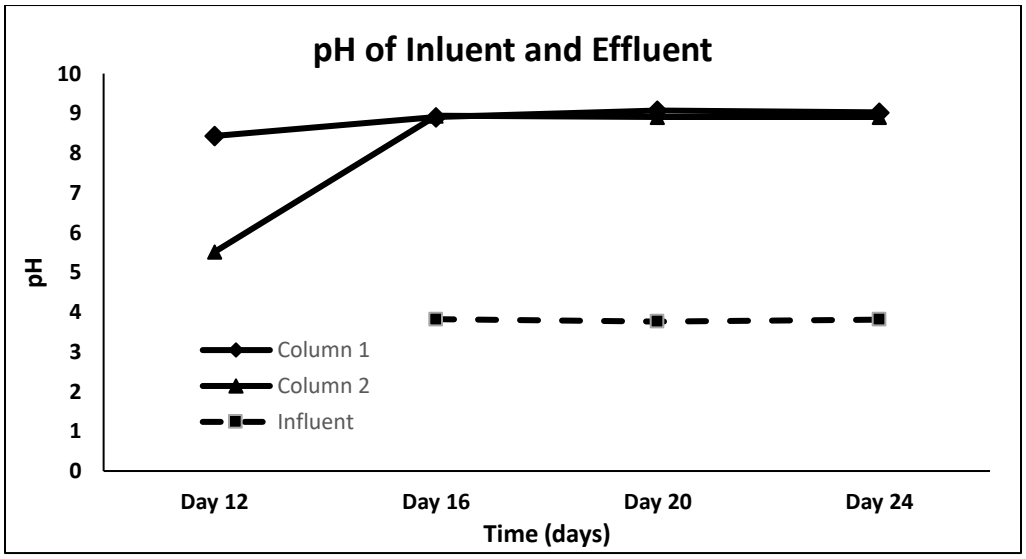


Figure 8. Progression of pH over time in influent and effluent of column 1 and 2.

4. Conclusions

Due to possible negative environmental and public health impacts, mitigating excessive metals and nutrient discharge, such as As and NO^{3-} from heap leach pads is of critical importance to the gold mining industry when considering mine waste management. While mitigation strategies need to be effective, Industry also seeks to reduce costs whenever possible. Bioremediation methods, such as PRBs, may potentially meet these demands. However, there is currently a dearth of research of the use of these methods in cold climates.

The results of this experiment demonstrated, under laboratory conditions, the capability of PRBs in reducing As and NO^{3-} concentrations to concentrations within the target concentrations for heap leach/passive treatment discharge during closure and water quality objectives (Lorax 2019).

This is especially true for multivalent metals such as the metalloid As, where reactive materials such as ZVI can be used as an adsorbent to remove As under cold climate conditions, as was demonstrated in this experiment.

Although there was a reduction in NO^{3-} overall, it cannot be determined if this was completed by adsorption or denitrification. Further study is needed to determine the efficacy of reducing NO^{3-} via denitrification within PRBs in cold climate conditions. Specifically, the use of analyses of parameters such as the progression of NO^{2-} concentrations, bacteria enumeration assays and genetic identification of existing bacterial colonies within PRBs.

Although there is a large body of literature on the efficacy of PRBs in mining activity, there is still a lack of data on their use in cold climate conditions. Of particular importance, and relevant to the parameters of concern in this experiment, is the ability to cultivate denitrifying bacteria in cold conditions typically found at mine sites in Yukon. Lastly, in light of effects of climate change, varying weather conditions, e.g. high vs low precipitation patterns, should also be considered in future cold climate PRB studies.

References

Abusallout I, Hua G. 2017. Characterization of dissolved organic carbon leached from a woodchip bioreactor. Chemosphere. 183:36-43.

Akcil A. 2003. Destruction of cyanide in gold mill effluents: Biological versus chemical treatments. Biotech Adv. 21: 501-511.

Balko BA, Tratnyek PG. 1998. Photoeffects on the reduction of carbon tetrachloride by zero-valent iron. J Phys Chem. 102(8): 1459-1465.

Bang S, Korfiatis GP, Meng X. 2005. Removal of arsenic from water by zero-valent iron. J Haz Mat. 121(1-3): 61-67.

Bissen M, Frimmel FH, 2003. Arenic-a review. Part 1: occurrence, toxicity, speciation, mobility. Acta Hydrochim Hydrobiol. 31(1): 9-18.

Blowes DW, Jambor JL, Alpers CN. 1994. The environmental geochemistry of sulfide mine-waste. Napean (ON): Mineralogical Association of Canada 438 p.

Blowes DW, Robertson WD, Ptacek CJ, Merkley C. 1994. Removal of agricultural nitrate from tile-drainage effluent water using in-line bioreactors. J Contam Hydrol. 15(3): 207-221.

Blowes DW, Ptacek CJ, Benner SG, McRae CWT, Bennett TA, Puls RW. 2000. Treatment of inorganic contaminants using permeable reactive barriers. J Contam Hydrol.45(1-2): 123–37.

Boeykens SP, Piol MN, Legal LS, Saralegui AB, Vazquez C. 2017. Eutrophication decrease: Phosphate adsorption processes in presence of nitrates. J Env Mgmt. 203(3): 888-895.

Cantrell KJ, Kaplan DI, Wietsma TW. 1995. Zero-valent iron for the in-situ remediation of selected metals in groundwater. J Hazard Mater. 42(2): 201–12.

Christianson LE, Bhandari A, Helmers M. 2011a. Pilot-scale evaluation of denitrification drainage bioreactors: Reactor geometry and performance. J. Env Eng. 137(4): 213–220.

Christianson L, Castello A, Christianson R, Helmer M, Bhandari A. 2010. Hydraulic property determination of denitrifying bioreactor fill media. Appl Eng Agric. 26(5): 849–854.

Christianson LE, Hanly JE, Hedley MJ. 2011b. Optimized denitrification bioreactor treatment through simulated drainage containment. Agric. Water Manage. 99(1): 85–92

Cravotta CA, Trahan MK. 1999. Limestone drains to increase pH and remove dissolved metals from acidic mine drainage. App GeoChem. 14(5):581-606.

Diez-Perez I, Sanz F, Gorostiza P. 2006. In situ studies of metal passive films. Curr Opin Solid State Mat Sci. 10(3-4): 144-152.

Farrell J, Kason m, Melitas N, Li T. 2000. Investigation of the long-term performance of zero-valent iron for reductive dichlorination of trichloroethylene. Env Sci Tech. 34(3): 514-521.

Farrell J, Wang J, O'day P, Conklin M. 2001. Electrochemical and spectroscopic study of arsenate removal from water using zero-valent iron media. Env Sci Tech. 35(10): 2026-2032.

Johnson DB. 2003. Chemical and microbiological characteristics of mineral spoils and drainage waters at abandoned coal and metal mines. Water, Air & Soil Pollut. 3:47-66.

Johnson RL, Thoms RB, O'Brien-Johnson R, Nurmi JT, Tratnyek PG. 2008. Mineral precipitation upgradient from a zero-valent iron permeable reactive barrier. Groundwat Monit & Remed. 28(3): 56-64.

Joo SH, Feitz AJ, Waite TD. 2004. Oxidative degradation of the carbothioate herbicide, molinate, using nanoscale zero-valent iron. Env Sci Tech. 38(7): 2242-2247.

Kanel SR, Greneche JM, Choi H. 2006. Arsenic (V) removal from groundwater using nano scale zero-valent iron as a colloidal reactive barrier material. Env Sci Tech. 40(6): 2045-2050.

Kanel SR, Manning B, Charlet I, Choi H. 2005. Removal of arsenic (III) from groundwater by nanoscale zero-valent iron. Env Sci Tech. 39(5): 1291-1298.

Koike I, Hattori A. 1974. Growth yield of a denitrifying bacterium, Psudomonas denitricans under aerobic and denitrifying conditions. Gen MicroBiol. 88: 1-10.

Kundu MC, Mandal B, Sarkar D. 2008. Assessment of the potential hazards of nitrate contamination in surface and groundwater in a heavily fertilized and intensively cultivated district of India. Env Monitor Assess. 146:183-189.

Lackovic JA, Nikolaidis NP, Dobbs GM. 2000. Inorganic arsenic removal by zero-valent iron. Env Eng Sci. 17(1): 29–40.

Lee KJ, Lee Y, Yoon J, Kamala-Kannan S, Park SM, Oh BT. 2009. Assessment of zero-valent iron as a permeable reactive barrier for long-term removal of arsenic compounds from synthetic water. Env Tech. 30(13): 1425-1434.

Li XQ, Elliott DW, Zhang WX. 2006. Zero-valent iron nanoparticles for abatement of environmental pollutants: material and engineering aspects. Crit Rev in Solid State & Mat Sci. 31(4): 111-122.

Martin A, Nieuwenberg J, Flather D. 2019. Coffee Gold Project: Work plan to demonstrate feasibility of passive bioremediation treatment of heap leach rinse solutions at closure. Technical Memorandum.

Manning BA, Hunt ML, Amrhein C, Yarmoff JA. 2002. Arsenic (III) and Arsenic (V) reactions with zerovalent iron corrosion products. Env Sci Tec. 36(24): 5455-5461.

Morrison SJ, Metzler DR, Carpenter CE. 2001. Uranium precipitation in a permeable reactive barrier by progressive irreversible dissolution of zerovalent iron. Env Sci Tech. 35(2): 385–90.

Noubactep C. 2008. A critical review on the process of contaminant removal in $Fe^0 – H_2O$ systems. Env Tech. 29(8): 909-920.

Palacin-Lizarbe C, Camarero L, Catalan J. 2018. Denitrification temperature dependence in remote, cold and N-poor lake sediments. Wat Resour Res. 54(2): 1161-1173.

Puls RW, Paul CJ, Powell RM. 1999. The application of in situ permeable reactive (zero-valent iron) barrier technology for the remediation of chromate-contaminated groundwater: a field test. Appl Geochem. 14(8): 989–1000

Rao P, Mak MSH, Liu T, Lai KCK, Lo IMC. 2009. Effects of humic acid on arsenic (V) removal by zero-valent iron from groundwater with special references to corrosion products analyses. Chemosphere. 75(2): 156-162.

Reinsch BC, Forsberg B, Penn RL, Kim CS, Lowry GV. 2010. Chemical transformations during aging of zerovalent iron nanoparticles in the presence of common groundwater dissolved constituents. Env Sci Tech. 44(9): 3455-3461.

Roussel C, Neel C, Bril H. 2000. Minerals controlling arsenic and lead solubility in an abandoned gold mine tailings. Sci Total Env. 263: 209-219.

Schipper LA, Robertson WD, Gold AJ, Jaynes DB, Cameron SC. 2010. Denitrifying bioreactors: An approach for reducing nitrate loads to receiving waters. Ecol Eng. 36(11): 1532–1543.

Shokes TE, M.oller G. 1999. Removal of dissolved heavy metals from acid rock drainage using iron metal. Environ Sci Tech. 33(:282–7.

Stauder S, Raue B, Sacher F. 2005. Thioarsenates in sulfidic waters. Env Sci Tech. 39(16): 5933-5939.

Stern K. 1972. High temperature properties and decomposition of inorganic salts part 3, nitrates and nitrites. Phys & Chem Ref Data. 1(3): 747-771.

Su C, Puls RW. 2001. Arsenate and arsenite removal by zerovalent iron: kinetics redox transformation and implications for in situ groundwater remediation. Env Sci Tech. 35(7): 1487-1492.

van Driel PW, Robertson WD, Merkley IC. 2006. Upflow reactors for riparian zone denitrification. J Env Qual. 35(2): 412-420.

Woli KP, David MB, Cooke RA, McIsaac GR, Mitchell CA. 2010. Nitrogen balance in and export in and export from agricultural fields associated with controlled drainage systems and denitrifying bioreactors. Ecol Eng. 36(11): 1558–1566

Yarar B. 2002. Long term persistence of cyanide species in mine waste environments. Tailing & Mine Waste. Tailings and Mine Waste 2002

Appendix A

Calculation of Target Metal Ion Concentrations in SMW

Arsenic

Metal salt used: As_2O_5, 229.8402 g/mol
Target metal ion concentration: 20.0 mg/L*

% Ratio

As = 149.8 g/mol / 229.8402 g/mol = 65.18%

20 mg = 0.02 g

$$\frac{0.02\ g}{x\ g} \times \frac{65.18\%}{100\ \%}$$

x = 0.0307 g/L of As_2O_5

Nitrate

Metal salt used: KNO_3, 101.1032 g/mol
Target metal ion concentration: 300.0 mg/L

% Ratio

NO_3 = 62.006 g/mol / 101.1032 g/mol = 61.33%

300 mg = 0.30 g

$$\frac{0.30\ g}{x\ g} \times \frac{61.33\%}{100\ \%}$$

x = 0.4892 g/L of KNO_3

Magnesium

Metal salt used: $MgSO_4 \cdot 7H_2O$, 246.48 g/mol
Target metal ion concentration: 200.0 mg/L

% Ratio

Mg = 24.3 g/mol / 246.48 g/mol = 9.86%

200 mg = 0.20 g

$$\frac{0.20\ g}{x\ g} \times \frac{9.86\%}{100\ \%}$$

x = 2.03 g/L of $MgSO_4 \cdot 7H_2O$

Iron

Metal salt used: $FeCl_3 \cdot 7H_2O$, 270.30 g/mol
Target metal ion concentration: 0.5 mg/L

% Ratio

Fe = 55.8 g/mol / 270.30 g/mol = 20.64%

0.5 mg = 0.0005 g

$$\frac{0.0005\ g}{x\ g} \times \frac{20.64\%}{100\ \%}$$

x = 0.0024 g/L of $FeCl_3 \cdot 7H_2O$

*20 mg/L was used as the target concentration for arsenic due to a misreading of projected heap leach solution arsenic concentrations for Coffee Gold mine. The actual projected concentration is 2.0 mg/L of arsenic.

Appendix B

Calculation of Flow Rates in Column 1 and 2

Equation: Flow rate (m^3/day) = pore volume (m^3) / HRT (days)

Column 1

Pore volume = 834.9 mL or 8.35 x 10^{-4} m^3

HRT target = 4 days

Flow rate (m^3/day) = 8.35 x 10^{-4} m^3 / 4 days

Flow rate = 2.087 x 10^{-4} m^3 / day

Flow Rate = 208.73 mL / day

Flow Rate = 0.14 mL/min

Column 2

Pore volume = 960.1 mL or 9.60 x 10^{-4} m^3

HRT target = 4 days

Flow rate (m^3/day) = 9.60 x 10^{-4} m^3 / 4 days

Flow rate = 2.40 x 10^{-4} m^3 / day

Flow Rate = 240.025 mL / day

Flow Rate = 0.17 mL/min

APPENDIX 2-G

Column Test Results for the Evaluation of Semi-Passive Zero Valent Iron Bioreactor Treatment Systems (Lorax)

Coffee Gold Project

Column Test Results for the Evaluation of Semi-Passive Zero Valent Iron Bioreactor Treatment Systems

Prepared by:
Lorax Environmental Services Ltd.
2289 Burrard St.
Vancouver, BC, V6J 3H9

Prepared for:
Newmont Goldcorp
666 Burrard St #3400
Vancouver, BC V6C 2X8

Project No. A362-1

August 23, 2022

Table of Conferences



Table of Contents

TABLE OF CONTENTS I

1. BACKGROUND AND OBJECTIVES

2. METHODS

2.1 EXPERIMENTAL DESIGN AND MATERIAL CHARACTERIZATION 2-1
2.2 COLUMN EXPERIMENT 2-2
2.2.1 TREATMENT CONFIGURATIONS 2-2
2.2.2 CONSTRUCTION AND OPERATION 2-3
2.2.3 INFLUENT CHEMISTRY 2-6
2.2.4 CARBON AMENDMENT 2-7
2.2.5 QUALITY ASSURANCE/QUALITY CONTROL 2-8

3. RESULTS AND DISCUSSION

3.1 SOLID PHASE CHARACTERISTICS 3-1
3.1.1 ACID-BASE ACCOUNTING 3-1
3.1.2 ELEMENTAL ABUNDANCE 3-2
3.1.3 CARBON, NITROGEN, PHOSPHORUS AND SULPHUR 3-3
3.1.4 SHAKE FLASK EXTRACTIONS 3-4
3.2 COLUMN EFFLUENT RESULTS 3-6
3.2.1 FLOW RATES AND HYDRAULIC RETENTION TIME (HRT) 3-6
3.2.2 DISSOLVED ORGANIC CARBON 3-7
3.2.3 pH 3-8
3.2.4 MAJOR IONS 3-9
3.2.5 PARAMETERS OF POTENTIAL CONCERN 3-11
3.2.5.1 NITRATE 3-11
3.2.5.2 ARSENIC 3-13
3.2.5.3 URANIUM 3-14
3.2.6 CONTAMINANT REMOVAL 3-15
3.2.6.1 REMOVAL RATES 3-15
3.2.6.2 CONTAMINANT MASS REMOVAL 3-21
3.2.7 TREATMENT BY-PRODUCTS 3-23
3.2.7.1 NITRITE AND AMMONIA 3-23
3.2.7.2 CYANIDE 3-24
3.2.7.3 TRACE METALS 3-25

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 SUMMARY OF KEY FINDINGS 4-1
4.2 CONCLUSIONS AND FUTURE WORK 4-2

5. CLOSURE

REFERENCES R-1

APPENDIX A: UPDATED WORK PLAN AND STANDARD OPERATING PROCEDURES FOR PASSIVE TREATMENT COLUMN STUDY

APPENDIX B: STATIC TEST RESULTS FOR COLUMN MATERIALS

APPENDIX C: COLUMN TESTWORK WATER QUALITY RESULTS

LIST OF FIGURES

FIGURE 2-1 PHOTOGRAPHS OF GRAVEL, WOOD CHIPS AND ZVI (FROM LEFT TO RIGHT). 2-2

FIGURE 2-2 TREATMENT COLUMN CONFIGURATIONS SHOWING SAMPLING LOCATIONS FOR EFFLUENT AND RHIZON CHEMISTRY. 2-3

FIGURE 2-3 PHOTOGRAPH OF COLUMN SET-UP AT THE YUKON RESEARCH CENTER LABORATORY. 2-5

FIGURE 3-1 WEEKLY EFFLUENT FLOW RATES AND CORRESPONDING HYDRAULIC RETENTION TIMES 3-7

FIGURE 3-2 TIME SERIES PROFILES FOR DOC IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. NOTE THAT A SAMPLE WAS COLLECTED FOR ANALY 3-8

FIGURE 3-3 TIME SERIES PROFILES FOR PH IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-9

FIGURE 3-4 TIME SERIES PROFILES FOR CONDUCTIVITY, TOTAL ALKALINITY, SULPHATE AND DISSOLVED NA AND CA IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-10

FIGURE 3-5 TIME SERIES PROFILE FOR NO_3-N IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-11

FIGURE 3-6 TIME SERIES PROFILE FOR NO_3-N IN C1AE AND HRT FOR THE C1 CONFIGURATION OVER 37 WEEKS OF OPERATION. 3-12

FIGURE 3-7 TIME SERIES PROFILE FOR NITRATE IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE)..... 3-13

FIGURE 3-8 TIME SERIES PROFILE FOR U IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE). 3-14

FIGURE 3-9 DISSOLVED U VERSUS ALKALNITY MEASURED IN C1B, C2 AND C3. 3-15

FIGURE 3-10 TIME SERIES PROFILES FOR NO_3-N MEASURED IN RHIZON SAMPLES IN C1A, C2 AND C3 (TOP TO BOTTOM) OVER 37 WEEKS OF OPERATION..... 3-16

FIGURE 3-11 TIME SERIES PROFILES FOR DISSOLVED AS MEASURED IN RHIZON SAMPLES IN C1B, C2 AND C3 (TOP TO BOTTOM) OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE). 3-17

FIGURE 3-12 TIME SERIES PROFILES FOR DISSOLVED U MEASURED IN RHIZON SAMPLES IN C1B, C2 AND C3 (TOP TO BOTTOM) OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE). 3-18

FIGURE 3-13 NO_3-N REMOVAL RATES MEASURED BETWEEN THE COLUMN INLET AND R1 FOR WEEKS CORRESPONDING TO RHIZON SAMPLE COLLECTION..... 3-19

FIGURE 3-14 WEEKLY EFFLUENT FLOW RATES AND CORREPONDING HYDRAULIC RETENTION TIME FOR C1. 3-19

FIGURE 3-15 ARSENIC REMOVAL RATES MEASURED BETWEEN THE COLUMN INLET AND R1 FOR WEEKS CORRESPONDING TO RHIZON SAMPLE COLLECTION. 3-20

FIGURE 3-16 URANIUM REMOVAL RATES MEASURED BETWEEN THE COLUMN INLET AND R1 FOR WEEKS CORRESPONDING TO RHIZON SAMPLE COLLECTION. 3-20

FIGURE 3-17 TIME SERIES PROFILES FOR NO2-N AND NH3-N IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-23

FIGURE 3-18 TIME SERIES PROFILES FOR WAD-CN IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-24

FIGURE 3-19 TIME SERIES PROFILES FOR DISSOLVED AL, CO, CU, SB AND SE IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-26

FIGURE 3-20 TIME SERIES PROFILES FOR DISSOLVED FE, MN, MO, NI AND ZN IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE)..... 3-28

LIST OF FIGURES

FIGURE 2-1 PHOTOGRAPHS OF GRAVEL, WOOD CHIPS AND ZVI (FROM LEFT TO RIGHT). 2-2

FIGURE 2-2 TREATMENT COLUMN CONFIGURATIONS SHOWING SAMPLING LOCATIONS FOR EFFLUENT AND RHIZON CHEMISTRY. 2-3

FIGURE 2-3 PHOTOGRAPH OF COLUMN SET-UP AT THE YUKON RESEARCH CENTER LABORATORY. 2-5

FIGURE 3-1 WEEKLY EFFLUENT FLOW RATES AND CORRESPONDING HYDRAULIC RETENTION TIMES 3-7

FIGURE 3-2 TIME SERIES PROFILES FOR DOC IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. NOTE THAT A SAMPLE WAS COLLECTED FOR ANALY 3-8

FIGURE 3-3 TIME SERIES PROFILES FOR PH IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-9

FIGURE 3-4 TIME SERIES PROFILES FOR CONDUCTIVITY, TOTAL ALKALINITY, SULPHATE AND DISSOLVED NA AND CA IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-10

FIGURE 3-5 TIME SERIES PROFILE FOR NO_3-N IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-11

FIGURE 3-6 TIME SERIES PROFILE FOR NO_3-N IN C1AE AND HRT FOR THE C1 CONFIGURATION OVER 37 WEEKS OF OPERATION. 3-12

FIGURE 3-7 TIME SERIES PROFILE FOR NITRATE IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE)..... 3-13

FIGURE 3-8 TIME SERIES PROFILE FOR U IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE). 3-14

FIGURE 3-9 DISSOLVED U VERSUS ALKALNITY MEASURED IN C1B, C2 AND C3. 3-15

FIGURE 3-10 TIME SERIES PROFILES FOR NO_3-N MEASURED IN RHIZON SAMPLES IN C1A, C2 AND C3 (TOP TO BOTTOM) OVER 37 WEEKS OF OPERATION..... 3-16

FIGURE 3-11 TIME SERIES PROFILES FOR DISSOLVED AS MEASURED IN RHIZON SAMPLES IN C1B, C2 AND C3 (TOP TO BOTTOM) OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE). 3-17

FIGURE 3-12 TIME SERIES PROFILES FOR DISSOLVED U MEASURED IN RHIZON SAMPLES IN C1B, C2 AND C3 (TOP TO BOTTOM) OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE). 3-18

FIGURE 3-13 NO_3-N REMOVAL RATES MEASURED BETWEEN THE COLUMN INLET AND R1 FOR WEEKS CORRESPONDING TO RHIZON SAMPLE COLLECTION..... 3-19

FIGURE 3-14 WEEKLY EFFLUENT FLOW RATES AND CORREPONDING HYDRAULIC RETENTION TIME FOR C1. 3-19

FIGURE 3-15 ARSENIC REMOVAL RATES MEASURED BETWEEN THE COLUMN INLET AND R1 FOR WEEKS CORRESPONDING TO RHIZON SAMPLE COLLECTION. 3-20

FIGURE 3-16 URANIUM REMOVAL RATES MEASURED BETWEEN THE COLUMN INLET AND R1 FOR WEEKS CORRESPONDING TO RHIZON SAMPLE COLLECTION. 3-20

FIGURE 3-17 TIME SERIES PROFILES FOR NO2-N AND NH3-N IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-23

FIGURE 3-18 TIME SERIES PROFILES FOR WAD-CN IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-24

FIGURE 3-19 TIME SERIES PROFILES FOR DISSOLVED AL, CO, CU, SB AND SE IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. 3-26

FIGURE 3-20 TIME SERIES PROFILES FOR DISSOLVED FE, MN, MO, NI AND ZN IN COLUMN EFFLUENTS OVER 37 WEEKS OF OPERATION. (NOTE THAT RESULTS ARE PRESENTED ON A LOGARITHMIC SCALE)..... 3-28

LIST OF TABLES

TABLE 2-1 SOURCES AND SPECIFICATIONS FOR COLUMN MATERIALS 2-1
TABLE 2-2 COMPOSITION AND ESTIMATED POROSITY OF EACH COLUMN 2-4
TABLE 2-3 TOTAL INFLUENT AND EFFLUENT VOLUMES DURING 37 WEEKS OF TESTING..... 2-5
TABLE 2-4 SEEPAGE WATER CHEMISTRY ESTIMATE FOR HLF PRIOR TO TREATMENT 2-6
TABLE 2-5 SYNTHESIZED INFLUENT CHEMISTRY RELATIVE TO TARGET CONCENTRATIONS 2-7
TABLE 3-1 ACID-BASE ACCOUNTING RESULTS OF COLUMN MATERIALS..... 3-1
TABLE 3-2 ELEMENTAL ABUNDANCE BY AQUA REGIA DIGESTION OF COLUMN MATERIALS..... 3-3
TABLE 3-3 CARBON, NITROGEN, PHOSPHORUS, SULPHUR CONTENT OF WOOD CHIPS 3-4
TABLE 3-4 SHAKE FLASK EXTRACTION RESULTS OF COLUMN MATERIALS 3-5
TABLE 3-5 MEDIAN REMOVAL RATES AND TIME TO REMOVAL FOR NITRATE, AS AND U..... 3-21
TABLE 3-6 MINIMUM AND MAXIMUM PERCENTAGES OF CONTAMINANT MASS REMOVAL 3-22

1. Background and Objectives

Newmont™

1. Background and Objectives

The Coffee Gold Project (the Project) is evaluating the use of semi-passive treatment at closure to treat drain down seepage water from the decommissioned heap leach facility (HLF). Parameters of potential concern (POPCs) in heap leach seepage waters have been identified as nitrate, arsenic and uranium. Nitrate represents a residual product of cyanide degradation while As and U represent leached components from mined ore.

A semi-passive treatment system, based on the combined principles of permeable reactive barrier (PRB) technology and biological reactor (BR) technology, is being considered for the closure phase of the Project. In PRB/BR systems, a permeable matrix is amended with one or more materials to create a reactive medium for contaminant removal. As part of the pre-feasibility testwork program, column experiments were conducted using varying compositions and configurations of gravel, wood chips and zero valent iron (ZVI) to evaluate treatment performance of the aforementioned POPCs. All column testwork was conducted at the Yukon Research Center, Yukon University with the support of Lorax Environmental Services Ltd. (Lorax).

The specific objectives of the column study include the following:

- Demonstrate proof of principle for the proposed technology to reduce POPC concentrations in heap leach seepage solutions to acceptable levels;
- Determine POPC removal rates, which are relevant to hydraulic residence time (HRT) requirements and treatment system dimensions;
- Assess the risks and merits associated with the reactive media;
- Evaluate the applicability of a carbon amendment to enhance nitrate removal; and,
- Identify any potentially problematic by-products that may be generated within the treatment system.

2. Methods

Newmont™

2. Methods

2.1 Experimental Design and Material Characterization

The reactive medium for the column study comprises a mixture of gravel, wood chips and ZVI to promote chemical conditions conducive to the removal of nitrate, As and U. The selection of column materials was informed by the current literature on PRB/BR as well as relevant considerations regarding the local availability of source materials. A rationale for the inclusion of each material as a component of the treatment columns is provided below.

- Gravel provides a permeable matrix for structural support and to enhance flow; additionally, the presence of mineral surface areas can faciliate contaminant removal via adsorption.
- Wood chips provide a carbon source (an electron donor) which can stimulate microbial activity to reduce contaminant species to less soluble forms.
- Zero valent iron (ZVI), in addition to or as an alternative to carbon, is an electron donor which can stimulate chemical reduction of contaminant species.

Specifications and photographs for column materials are presented in Table 2-1 and Figure 2-1 respectively. Note that these materials are not intended to be directly representative of the components that will ultimately be utilized for a semi-passive bioreactor at the Coffee site. Rather, selection was based on fulfillment of experimental design requirements with the primary objective of providing proof of principle for the use of a ZVI mixture for treatment of enriched contaminants in the HLF drain down seepage.

Table 2-1:
Sources and Specifications for Column Materials

Column Material	Source	Specifications
Gravel	City of Whitehorse, YT	The gravel is of mixed composition, containing roughly equal portions of an intrusive granite and mixed, fine-grained clastic sedimentary rocks. The gravel composition is decidedly heterogenous and derived from surficial materials. Grain sizes range from 8 mm to 16 mm.
Wood Chips	City of Whitehorse YT	50% wood chunks shredded by the Wiley Mill + 50% splintered wood (< 25 mm)
Zero Valent Iron (ZVI	Connelly GPM Inc. (Chicago, United States)	ETI CC-1004 (<2.4 mm)



Figure 2-1: Photographs of gravel, wood chips and ZVI (from left to right).

Analytical procedures applied for characterization of solid phase materials are described in the report: *Updated Work Plan and Standard Operating Procedures for Passive Treatment Column Study* (Lorax , 2020) and provided in full in Appendix A. Solid phase analytical testing of post-test column residues is planned for 2022 which will include supplementary mineralogy characterization.

2.2 Column Experiment

2.2.1 Treatment Configurations

Three column configurations were investigated in the bench-scale study (Figure 2-2). For all configurations, the composition of ZVI is maintained at 20%. Column Configuration #1 (C1) encompasses two columns in series:

- *Initital column C1A* - containing gravel and wood chips (and no ZVI) is intended to initially promote denitrification (the reduction of nitrate to nitrogen gas) prior to treatment via the secondary column (C1B)
- *Secondary Column C1B* - containing gravel and ZVI, and designed to reduce As and U concentrations.

Some degree of As and U removal may also occur in the primary column in the presence of wood chips alone. Column Configuration #2 (C2) and Column Configuration #3 (C3) comprise single reaction cells, containing a mixture of gravel, wood chips and ZVI (Figure 2-2). These experiments were designed to evaluate whether the desired treatment outcomes may be achieved with a single stage bioremediation design. To test the performance of this combined matrix, C2 and C3 have been designed with varying proportions of gravel (40% and 60%) and wood chips (20% and 40%) as noted in Figure 2-2.

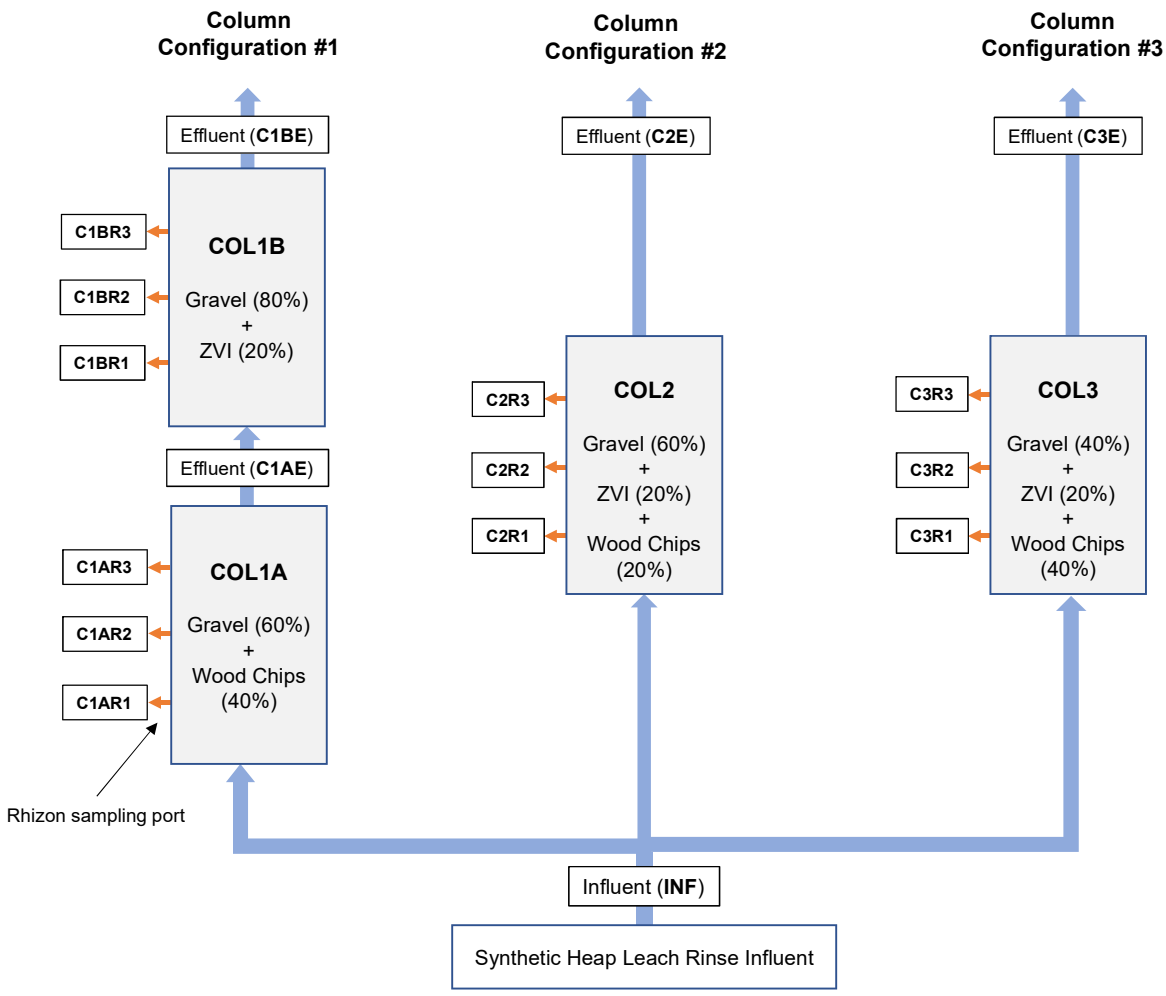


Figure 2-2: Treatment column configurations showing sampling locations for effluent and rhizon chemistry.

2.2.2 Construction and Operation

All columns were constructed and operated at the Yukon Research Center laboratory, Yukon University, Whitehorse YT. Complete descriptions related to column specifications, construction, operation and sampling procedures are provided in Appendix A.

Columns are composed of Plexiglass cylinders (total volume = 2.36 L) with an inlet at the base and terminus (top) of each column. Influent enters from the base of the column and flows upward to reduce the potential for the formation of preferential pathways. Three rhizon ports (*in situ* water quality samplers) are located equidistant along the length of each column with R1, R2 and R3 corresponding to 25%, 50% and 75% of the vertical treatment length, respectively (Figure 2-2).

During construction, materials were coned and quartered, homogeneously mixed in the designated proportions (% by volume) and packed in 2-3 cm lifts to minimize segregation. The composition of each column is summarized in Table 2-2.

Table 2-2:
Composition and Estimated Porosity of Each Column

Column	Mass of Gravel	Mass of ZVI	Mass of Wood Chips	Total Mass of Column Substrates	Total Water Added for Saturation	Estimated Porosity
	kg	kg	kg	kg	L	%
C1A	2.3	-	0.17	2.5	1.1	47
C1B	3.0	1.4	-	4.5	0.90	38
C2	2.3	1.4	0.087	3.8	1.0	42
C3	1.5	1.4	0.17	3.1	1.2	51

The experiment was initiated on July 1st, 2020 with the addition of influent to saturate the solid mixture in each column. Specifications for operation were informed by the selection of a target HRT representative of the treatment period required to achieve a specified removal performance. The selection of a target HRT was informed by several considerations including: i) the rate limiting step for POPC treatment which was predicted to be denitrification; ii) the volume of synthesized influent available (~350 L); and iii) a minimum operational period of six months to evaluate treatment performance. Based on these considerations, an HRT of 4 days was selected.

Flow was initiated on July 3, 2020 for column configurations C1, C2 and C3 at 21 mL/hr, 11 mL/hr and 13 mL/hr, respectively, to achieve the target HRT and was maintained throughout the duration of the experimental period. Columns were operated inside a fridge at 4˚C to more closely reflect site conditions (Figure 2-3).

Weekly flow monitoring and weekly to monthly water quality sample collection and analysis were performed according to the procedures outlined in Section 4 and Appendix A of Lorax (2020). All samples were collected under suboxic conditions, filtered (only for effluent samples) and preserved and submitted to ALS Laboratories.

Column operation was terminated on March 19, 2021 (week 37). Throughout the experimental period, 64 to 177 L (equivalent to 55 to 61 pore volumes) of synthesized drain down seepage water was treated within each configuration with >94% efficiency (Table 2-3).



Figure 2-3: Photograph of column set-up at the Yukon Research Center laboratory.

Table 2-3:
Total Influent and Effluent Volumes During 37 Weeks of Testing

Column Treatment System	Total Influent Volume	Total Effluent Volume	Percentage of Volume Treated	Number of Pore Volumes Treated
	L	L	%	#
C1	117	110	94	55
C2	64	61	95	61
C3	74	72	98	59

2.2.3 Influent Chemistry

The chemistry of influent used for column testwork represents a synthesized solution of expected drain down seepage water from the HLF which was modified to reflect the Upper Case predicted concentrations as detailed in Lorax (2022).

Table 2-4:
Seepage Water Chemistry Estimate for HLF prior to Treatment

		HLF Seepage Quality Estimate (Feed to Active and PTS)	
		Upper Case	**Base Case**
pH	s.u.	8.4	8.0
N-NH_4	mg/L	0.06	0.025
N-NO_3	mg/L	307	275
N-NO_2	mg/L	1.9	1.6
Cl	mg/L	123	115
Sulphate	mg/L	2516	2300
Total Alk	mg/$CaCO_3$/L	87	47
WAD-CN	mg/L	0.2	0.09
TDS	mg/L	4100	3000
Al	mg/L	0.2	0.06
Ag	mg/L	0.00125	0.00009
As	mg/L	2.0	0.66
Ca	mg/L	350	204
Cd	mg/L	0.00013	0.00004
Cr	mg/L	0.014	0.004
Cu	mg/L	0.014	0.004
Fe	mg/L	0.5	0.15
Hg	mg/L	0.00026	0.0001
Mg	mg/L	155	117
Mn	mg/L	0.06	0.016
Mo	mg/L	0.105	0.0330
Na	mg/L	1168	890
K	mg/L	11	8
Ni	mg/L	0.006	0.002
Pb	mg/L	0.0013	0.00032
Sb	mg/L	0.5	0.17
Se	mg/L	0.005	0.0015
Tl	mg/L	0.004	0.0015
U	mg/L	0.685	0.300
Zn	mg/L	0.052	0.02
Ra-226	Bq/L	0.07	0.05

The key parameters targeted for treatment for the study are summarized in Table 2-5. Sulphate is included as concentrations are predicted to be elevated, but treatment of this parameter is not an expected outcome of this study.

Table 2-5:
Synthesized Influent Chemistry Relative to Target Concentrations

Parameter	Unit	HLF Seepage Base Case	HLF Seepage Upper Case	SYN TEST 1	SYN TEST 2
				28-May-20	28-May-20
SO_4	mg/L	2,300	2,516	2,460	2,420
NO_3-N	mg/L	275	307	338	335
D-As	mg/L	0.66	2.0	2.1	2.1
D-U	mg/L	0.30	0.69	0.44	0.44

The synthesized solution was prepared by Inotec in March 2020 and shipped in HDPE drums to be stored at the Yukon Research Center laboratory for the duration of column testwork. Analytical samples were collected in May 2020 from each drum and was compared to the target concentrations prior to commencing with the column experiments. The results show that with the exception of U, concentrations of other POPCs were within >90% of the Upper Case target values; however, the test U influent concentration was well above the Base Case seepage prediction concentration (Table 2-5).

2.2.4 Carbon Amendment

During the first 16 weeks of operation, a minimal decline in nitrate concentrations was observed across all treatment configurations. Although dissolved organic carbon (DOC) was detectable in column effluents at a relatively stable concentration of ~30 mg/L, it was hypothesized that carbon released from the wood chips were not present in a readily labile form to support microbial denitrification.

Experiments of various scales and applications have utilized organic carbon amendments to stimulate anaerobic bacteria, including bench-scale reactor studies of mine waters. Sodium-acetate was chosen as the DOC source for this work since studies of similar scale have successfully used this reagent as an organic-carbon source in denitrification experiments (Cuervo and Lopez, 1999). Further, acetate has been cited as a suitable and favourable electron donor to stimulate microbial growth compared to other organic carbon sources such as ethanol, acetic acid, propionate and lactate (Srinandan *et al*., 2012; Calderer *et al*., 2010) and as a readily useable carbon source for denitrification (Flather, 1989).

Based on the literature review, a 2:1 carbon to nitrogen dose of Na-acetate ($NaCH_3COO$) was used to amend the influent throughout weeks 20 to 32. This amendment increased the DOC content in the influent water from <10 mg/L to ~590 mg/L.

2.2.5 Quality Assurance/Quality Control

QA/QC practices are conducted at various stages of sample collection through to analytical testing. Validated-clean sample bottles and preservatives are received from the analytical laboratory and are stored in a clean environment prior to use. Once samples are submitted to ALS, internal laboratory QC procedures are performed, which include analysis of method blanks, blank spikes, matrix spikes, reference standards and method duplicates at a minimum frequency for each analytical batch (*i.e.,* 1/20 samples). Results from these QC samples are not discussed in this report; however, the data quality objectives for laboratory QC samples need to be met by the analytical laboratory before a final report is issued.

In addition to the internal QC procedures performed at the analytical laboratory, monthly sampling of a method blank column (Col100-3.0) operated at the Lorax Laboratory (in Vancouver, B.C.) is conducted. Complete results are provided in Appendix C. Method blank samples are collected from a column constructed with similar materials as the treatment columns but containing only distilled water sourced from ALS Laboratories. This procedure is used to assess contamination associated with leaching from column materials and with the sample collection procedure, as the procedures used at Yukon Research Centre are based on practices developed at the Lorax Laboratory. A caveat of this approach is that it does not capture variability associated with the laboratory environment.

With respect to method blank results, parameters which show median concentrations within 5x the median levels observed in the treatment column leachates include TD-P and dissolved Al, Ba, Cd, Mn and Si. Although, there is some uncertainty associated with the concentrations of these parameters, it is not expected to considerably alter the interpretation of leachate chemistry.

3. Results and Discussion

Newmont™

3. Results and Discussion

3.1 Solid Phase Characteristics

The results of the static testwork conducted on the column materials are presented in the following sections with regards to acid-base accounting (ABA), elemental abundance, nutrient content and shake flask extractions (SFEs). Laboratory reports for these analyses are provided in Appendix B.

3.1.1 Acid-Base Accounting

Acid-base accounting was performed to ensure materials used in the column experiments were non-acid generating. Acid base accounting results for the gravel and ZVI samples are presented in Table 3-1.

Table 3-1:
Acid-Base Accounting Results of Column Materials

Parameter	Unit	Gravel	ZVI
Paste pH	s.u.	8.4	7.4
Total S	wt.%	0.16	0.10
Sulphate S	wt.%	<0.01	<0.01
Sulphide S	wt.%	0.11	0.01
AP	kg $CaCO_3$/t	3.4	3.1
Total C	wt.%	0.52	3.0
Total Inorganic C	wt.%	0.46	<0.01
CaNP	kg $CaCO_3$/t	38	<0.8
Modified NP	kg $CaCO_3$/t	49	66
NPR (CaNP/AP)	ratio	11	<0.25
NPR (Mod NP/AP)	ratio	14	21

Notes:
AP: Acid Potential in kg $CaCO_3$/t (Gravel- Sulphide-S wt.% x 31.25; ZVI- Total S wt.% x 31.25)
CaNP: Carbonate Neutralization Potential in kg $CaCO_3$/t (Total Inorganic Carbon wt. % x (100/12) x 10)
Modified NP: determined using the method outlined in Lawrence and Wang (1996)
NPR = net potential ratio, calculated by dividing NP by AP

Paste pH provides information on the availability of neutralization potential (NP) by indicating whether a sample is actively producing acidity. Both the gravel and ZVI samples show slightly alkaline pH values of 8.4 and 7.4, respectively. Total sulphur is low in both test samples and less than 0.2 wt.%. Sulphide S is the dominant sulphur species in the gravel sample and, thus will be used to estimate acid potential (AP). Conversely, the ZVI sample shows a sulphur inventory primarily comprised of acid insoluble S, the remaining

sulphur fraction not characterized as sulphide S or sulphate S. Since the sulphide S content of this sample is equivalent to the detection limit (0.01 wt.%), AP is conservatively calculated from the total S value.

Estimates of NP are provided in Table 3-1 including carbonate neutralization potential (CaNP) calculated from TIC content and bulk (modified) NP which measures the contribution of NP from carbonate and non-carbonate sources (*e.g.*, aluminosilicates). Although there is a lack of detectable TIC (<0.01 wt.%) in the ZVI sample indicating negligible CaNP, the modified NP value (66 kg $CaCO_3$/t) suggests there may be a considerable non-carbonate source of NP in ZVI. By comparison, the gravel sample shows general consistency between the CaNP and modified NP measurements (38 kg $CaCO_3$/t and 49 kg $CaCO_3$/t, respectively) suggesting that the NP contribution is dominantly from carbonate minerals and any NP from aluminosilicates is relatively minor.

Estimates of net potential ratio (NPR), calculated as NP/ AP, are determined using both CaNP and modified NP values. The classification scheme outlined by Price (2009) is applied to evaluate ARD potential, with samples showing NPR values ≥2 being designated as non-potentially acid generating (non-PAG) while samples showing NPR values <2 are considered potentially acid generating (PAG). NPRs for the gravel sample are both >2 indicating that this sample is considered non-PAG. For the ZVI sample, there is uncertainty associated with the NPR calculated by CaNP due to the TIC being below the detection limit. However, the NPR measured using modified NP strongly suggests that the ZVI sample is also non-PAG.

3.1.2 Elemental Abundance

Elemental abundances for column test materials were compared to average upper continental crust concentrations (AUCCC; Rudnick and Gao, 2014) to evaluate the magnitude of solid-phase enrichment (Table 3-2). For the purpose of this assessment, enrichment is defined as being at least three times greater than the AUCCC. Metal enrichment does not necessarily indicate that the element will become problematic, since the leaching rate is highly dependent on other factors, including the metal-phase associations, grain size, the geochemistry of infiltrating waters and the depositional environment.

The ZVI sample shows the greatest metal enrichment relative to the other test materials. Specifically, metal concentrations for Ag, As, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Sb, Sn and W were found to be enriched relative to the AUCCC. The greatest magnitude of enrichment (at least 10x > AUCCC) was observed for Cd, Cr, Cu, Fe, Mo, Ni, Sb and Sn. By comparsion, only Cd was found to be notably above the AUCCC for the wood chip sample, while no metal parameters showed enriched levels in the gravel sample. Since the detection

limit for Se is greater than the AUCCC value, enrichment for this parameter cannot be confirmed.

Table 3-2:
Elemental Abundance by Aqua Regia Digestion of Column Materials

Parameter	Unit	*AUCCC*	Gravel Rock	Zero Valent Iron	Wood Chips
Ag	ppm	*0.053*	0.08	0.36	0.02
As	ppm	*4.8*	8	37	4
Cd	ppm	*0.09*	0.14	***1.4***	0.40
Co	ppm	*17*	10	62	0.3
Cr	ppm	*92*	100	***1,564***	15
Cu	ppm	*28*	27	***4,236***	9.6
Fe	%	*3.9*	2.8	85	0.08
Mn	ppm	*774*	429	3,647	53
Mo	ppm	*1.1*	2.0	***2,722***	0.38
Ni	ppm	*47*	18	***1,186***	1
Sb	ppm	*0.4*	0.41	***8.23***	0.1
Se	ppm	*0.09*	<1	<1	<1
Sn	ppm	*2.1*	0.5	***284***	0.3
W	ppm	*1.9*	0.2	13	0.1

Notes:
AUCCC- average upper continental crust concentrations (Rudnick and Gao, 2014)
Values shaded in grey are 3x greater than the AUCCC
Bolded italicized values are 10x greater than the AUCCC

3.1.3 Carbon, Nitrogen, Phosphorus and Sulphur

The composition of nutrient parameters, including total C, N, P and S are determined for the wood chip sample and presented in Table 3-3. Expectedly, the organic carbon content present in the wood chips sample far exceeds the composition of any other column materials. The C:N ratio is a common indicator used for characterization of organic material to determine its capacity to support nutrient mineralization as the biogeochemical cycling of C and N tend to be closely coupled in terrestrial ecosystems. A stochiometric C:N ratio of 3:1 to 24:1 is generally measured in soil microbial biomass across grassland and forest ecosystems, consistent with the typical range of nutrient requirements (Cleveland and Liptzin, 2007). A C:N ratio of 187:1 was measured for the wood chip sample, indicating a greater proportion of C and a relative deficit of N. With regard to P, the content measured in the wood chip sample is within the range of values observed for gravel (0.1 wt.%) and ZVI (0.03 wt.%), while total S content is up to two times greater than measured for the other column materials.

Table 3-3:
Carbon, Nitrogen, Phosphorus, Sulphur Content of Wood Chips

Parameter	Unit	Wood Chips
Total Organic C	wt.%	48
Total N	wt.%	0.30
Total P	wt.%	0.03
Total S	wt.%	0.26

Notes:
Total organic carbon derived as total carbon – total inorganic carbon
Total nitrogen and sulphur determined by infrared combustion
Total phosphorus determined by Aqua Regia digestion

3.1.4 Shake Flask Extractions

SFE leachate results for the column materials are presented in Table 3-4. Leachate quality are compared to the Canadian Council of Ministers of the Environment (CCME) water quality guidelines (WQG) for the protection of aquatic life. When available short-term guidelines were used, otherwise values represent long-term guidelines. Water quality guidelines generally apply at designated water quality monitoring stations in the receiving environment (*e.g.*, streams, lakes) and not to treated effluent chemistry. Therefore, guideline exceedances of SFE leachates are primarily useful for the preliminary evaluation of potential drainage chemistry associated with the column test materials.

Leachate results show circumneutral pH for gravel and zero valent iron (pH 7.4 and 6.6, respectively) and an acidic pH (4.5) for the wood chip sample. There is relatively limited alkalinity contributed by the gravel or ZVI with leachate for these samples showing concentrations <25 mg $CaCO_3$/L. Leachate for the wood chip sample notably shows elevated conductivity up to 20x greater than observed for the other test materials, owing to elevated K, Ca, Cl and sulphate levels. The discrepancy in the ion balance for this sample suggests that the sulphate concentration reported for this sample is likely an underestimation. Based on the leachable sulphur detected, the sulphate concentration is estimated to be an order of magnitude higher than the reported value. This sample could not be retested; however, these results are not expected to significantly alter the interpretation of results since the influent solution is the dominant source of elevated sulphate concentrations.

In general, the wood chip sample shows the highest concentrations of water-soluble parameters. For the gravel and ZVI samples, only Al and F show values above the WQGs, respectively. By comparison, the wood chip sample shows concentrations of Al, As, Cd, Cr, Cu, Fe, Pb and Zn above the CCME WQGs. Other parameters including Co and Ni also show elevated concentrations in the wood chip sample relative to the other test materials. The enhanced leachability of metal cations observed for wood chips is attributed to the

acidic nature of this sample. Although no guideline is presented for P, the wood chip sample also shows a particularly elevated concentration of 15 mg/L well above levels observed for the gravel and ZVI samples, which are below the detection limit (<0.003 mg/L).

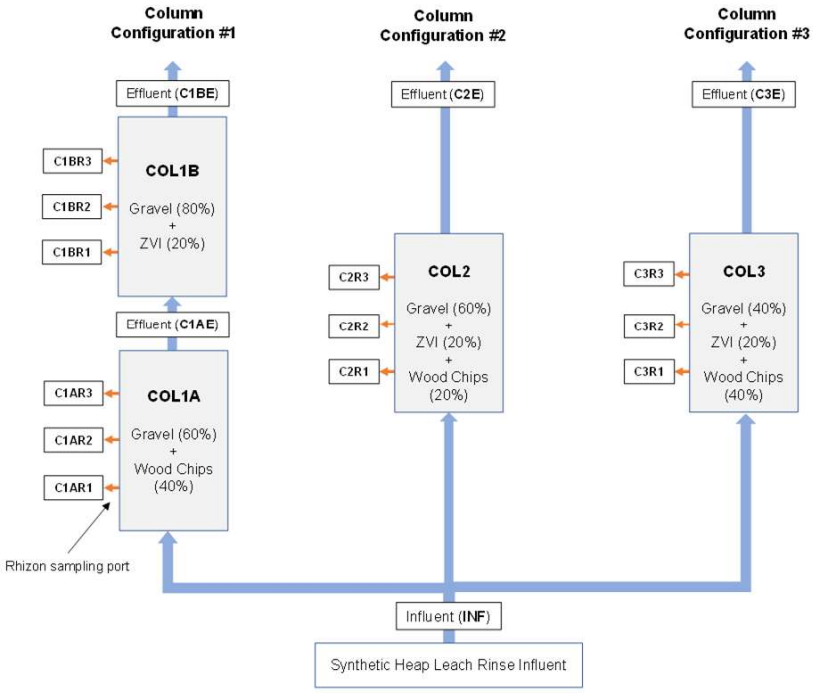
Table 3-4:
Shake Flask Extraction Results of Column Materials

Parameter	Units	*CCME*	Gravel Rock	Wood Chips	Zero Valent Iron
pH			7.4	4.5	6.6
Conductivity	µS/cm		68	1019	45
Total Acidity (to pH 8.3)	mg $CaCO_3$/L		2.5	299	3.1
Alkalinity	mg $CaCO_3$/L		25		2.9
Cl	mg/L	*640*	<2	37	8.5
F	mg/L	*0.12*	<0.06	<0.06	0.24
Total CN	mg/L		<0.01	<0.01	0.002
WAD CN	mg/L		<0.01	<0.01	<0.002
NO_3-N	mg/L	*124*		<0.6	
NO_2-N	mg/L	*0.06*		<0.75	
NH_3-N	mg/L	*84*		1.1	
SO_4-S	mg/L		2	4*	2
Dissolved Metals					
Al	mg/L	*0.005*	0.093	1.1	0.001
Sb	mg/L		<0.0009	<0.0009	<0.0009
As	mg/L	*0.005*	0.0019	0.18	0.0002
B	mg/L	*29*	0.012	0.43	0.41
Cd	mg/L	*0.00026*	0.000004	0.0034	0.000018
Cr	mg/L	*0.0089*	<0.00008	0.044	<0.00008
Co	mg/L		0.00010	0.0069	0.000009
Cu	mg/L	*0.002*	0.0011	0.12	<0.0002
Fe	mg/L	*0.3*	0.008	1.4	<0.007
Pb	mg/L	*0.001*	0.00002	0.0036	0.00001
Mn	mg/L		0.0078	1.9	0.016
Hg	mg/L	*0.000026*	<0.00001	<0.00001	<0.00001
Mo	mg/L	*0.073*	0.0014	0.0065	0.031
Ni	mg/L	*0.025*	0.0021	0.016	0.0003
P	mg/L		<0.003	15	<0.003
Se	mg/L	*0.001*	0.00012	0.00039	<0.00004
Ag	mg/L	*0.00025*	<0.00005	<0.00005	<0.00005
Tl	mg/L	*0.0008*	<0.000005	0.000070	<0.000005
U	mg/L	*0.033*	0.00015	0.00041	<0.000002
Zn	mg/L	*0.017*	<0.002	0.80	<0.002

Notes:
Values highlighted in blue are above the Canadian Council of Ministers of the Environment (CCME) water quality guidelines for the protection of aquatic life. Short-term guidelines are presented for Cl, NO_3-N, B, Cd, U and Zn; other values presented reflect long-term guidelines. Guidelines are for total metals with the exception of Zn. Hardness or pH dependent criteria are applicable for Al, Cd, Cu, Pb, Ni and Zn. Minimum hardness (13 mg $CaCO_3$/L), average pH (6.2) and an assumed DOC value of 2 mg/L was used to calculate guidelines values for conservatism.
*Based on the calculated discrepancy in the ion balance for this sample, it is inferred that the sulphate result (4 mg/L) underestimates the actual concentration in this sample

3.2 Column Effluent Results

The following sections present the results of the column experiments. Complete tabulated analytical results for column effluents are provided in Appendix C. Results are described for each column and the column configuration described in Section 2 is reproduced below for ease of reference when reviewing results discussion.



3.2.1 Flow Rates and Hydraulic Retention Time (HRT)

Effluent flow rates and corresponding HRTs are illustrated in Figure 3-1. The time series demonstrates that with few exceptions, a mean HRT of 4 days was maintained throughout the experimental period for all columns. Operational issues were occasionally encountered which contributed to fluctuations in flow rate resulting in inconsistencies in the frequency of sample collection. These issues were commonly related to blockage of or leakage from the rhizon samplers; cessation of flow to change tubing; and increasing flow rates during sample collection.

Greatest variability was observed for the C1 treatment configuration with HRTs ranging from 1.6 to 28 days. Specifically, in weeks 25 to 29, HRTs are notably extended ($\geq$ 10 days), resulting in distinct leachate chemistry for nitrogen species which will be discussed in Section 3.2.5.1. Flow rates in C2 remained relatively consistent with the exception of a peak HRT of 13 days observed in week 25. The target HRT was slightly exceeded for C3 during the first half of the test period, potentially due to overestimation of the pore volume

of this column. Higher HRTs were observed in weeks 18, 19 and 27 reaching a maximum of 8.3 days. In the latter half of the test period (weeks 20 to 37), the target HRT was achieved over most periods for C3.

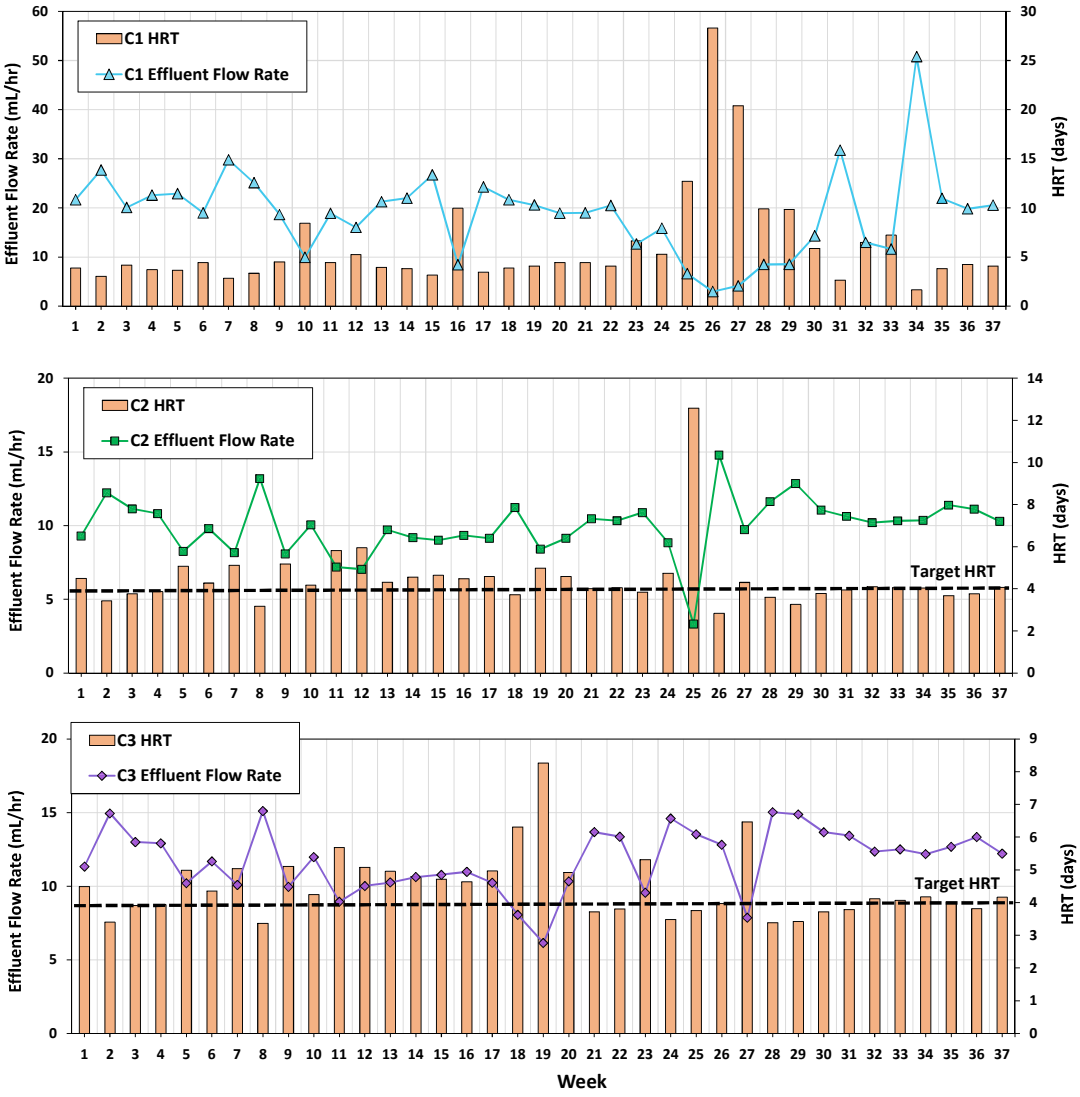


Figure 3-1: Weekly effluent flow rates and corresponding hydraulic retention times

3.2.2 Dissolved Organic Carbon

A time series for DOC concentrations in column leachates is presented in Figure 3-2. At the beginning of the test period, DOC levels show a flushing tendency in all columns, presumably associated with the rinsing of labile C from the wood chips to reach relatively stable levels of ~ 30 mg/L (Figure 3-2). Influent was amended with Na-acetate commencing in week 20 to help foster denitrification. In week 20, leachate concentrations in all columns initially reflect the composition of the DOC amended influent (~590 mg/L) but decline over weeks 20 to 32 to reach a minimum of 220 mg/L in week 26 in the effluent

from Column 1A (C1AE). DOC concentrations are mostly similar or lower in C1AE samples relative to corresponding C1BE samples which suggest that consumption of DOC is primarily occurring in the primary column (COL1A) containing no ZVI. Leachate from the mixed configurations (C2E and C3E) overall show lower carbon consumption reaching a minimum of 430 mg/L in week 24. Following termination of the DOC amendment, DOC levels readily decline in all column leachates to ~10 mg/L.

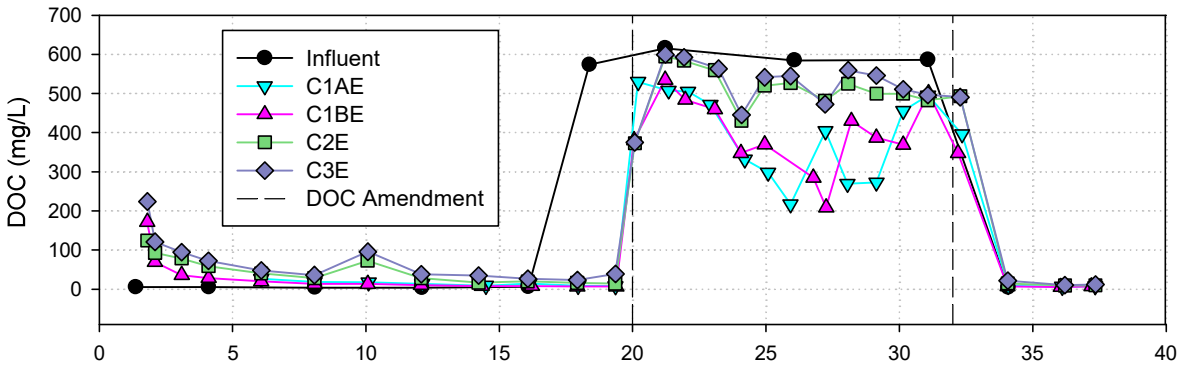


Figure 3-2: Time series profiles for DOC in column effluents over 37 weeks of operation. Note that a sample was collected for analy

3.2.3 pH

The influent water is characterized by circumneutral pH with values ranging from pH 6.6 to 8.1 over the experimental period (Figure 3-3). Fluctuations in influent pH may be partly associated with chemical artifacts from changes in sample storage conditions (*i.e.,* temperature) which can result in changes in CO_2 dissolution.

COL2 and COL3 containing ZVI had consistently higher pH effluent during the first 20 weeks of testing prior to the addition of Na-acetate amendment. COL2 and COL3 effluents (C2E and C3E) were ranged from 8.5 to 9.0 and reflect an increase in pH observed to occur through the iron corrosion process (Blowes *et al*., 2000). Leachate pH for C1AE (pH 6.5 to 8.4) are mostly below the pH observed in the ZVI columns. The SFE results indicated that the wood chips are a source of acidity and thus may account for the slightly lower pH observed in this column, as it lacks any ZVI.

Following the DOC amendment, pH measurements increase in all treatment columns particularly from week 25 to 32 reaching a peak of pH 9.2. C1AE and C1BE overall show the greatest variation in pH conditions. The increase in pH observed is postulated to result from increased alkalinity produced during decomposition of added DOC within the columns. Following termination of the DOC amendment (post week 32), pH levels return to previously observed conditions (pH 7.0 to 8.5).

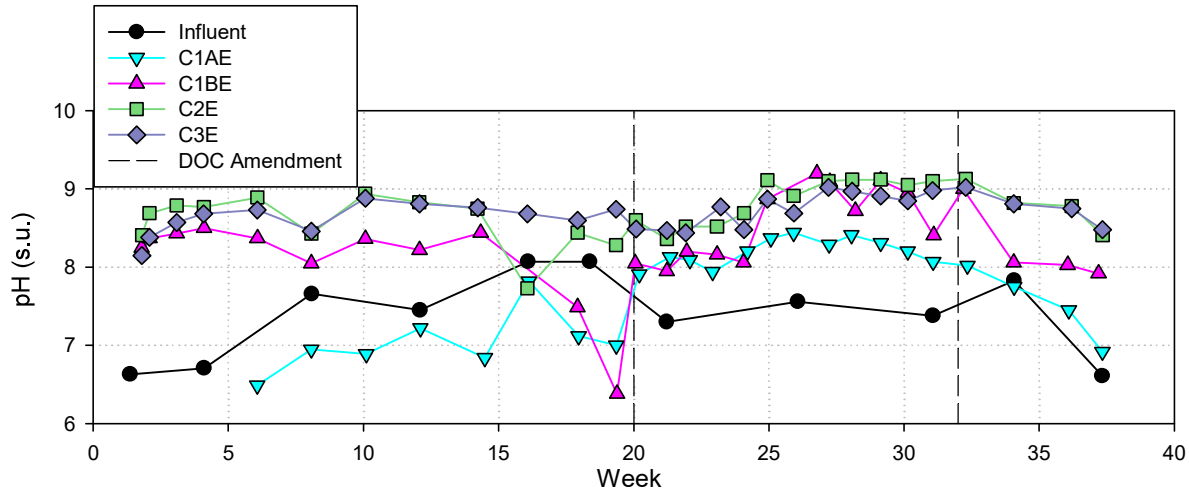


Figure 3-3: Time series profiles for pH in column effluents over 37 weeks of operation.

3.2.4 Major Ions

Conductivity and major ion concentrations remained relatively invariant with exception to leaching behaviour observed during the DOC amendment period. The addition of Na-acetate to the influent solution resulted in an increase in Na concentrations from 1,300 mg/L to 1,900 mg/L, as well as an increase in conductivity from ~6,600 µS/cm to ~7,400 µS/cm (Figure 3-4).

As noted above, during the DOC amendment period, alkalinity levels in column leachates show a 6x increase from approximately 150 mg $CaCO_3$/L to 900 $CaCO_3$/L due to the alkalinity generation during organic carbon decomposition (Figure 3-4). C1AE distinctly shows alkalinity levels above the influent composition (up to 1,600 mg/L), inferred to be related to the decomposition of added influent carbon, as illustrated by the associated decline in DOC concentrations in this column.

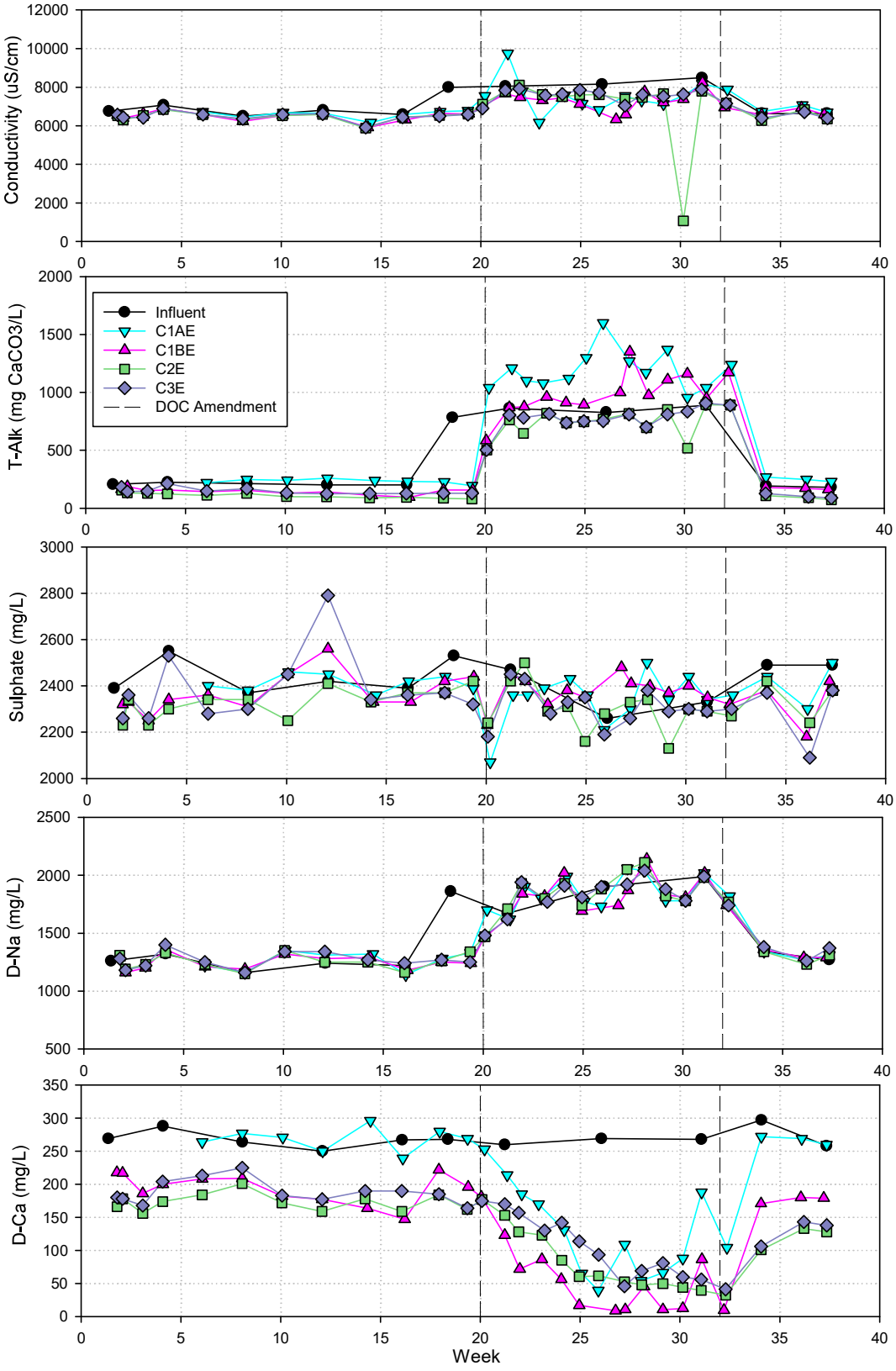


Figure 3-4: Time series profiles for conductivity, total alkalinity, sulphate and dissolved Na and Ca in column effluents over 37 weeks of operation.

Sulphate concentrations fluctuate throughout the experimental period, ranging from 2,100 mg/L to 2,800 mg/L. Sulphate removal is not expected as part of the treatment outcomes of this experiment given the redox state maintained in the columns. With the availability of a more optimal electron acceptor (*i.e.*, NO_3), denitrification rather than sulphate reduction is favoured to occur. Correspondingly, there is no evident removal of sulphate as sulphide concentrations are consistently non-detectable (<0.20 mg/L).

Calcium is consistently attenuated in columns containing ZVI, as demonstrated by lower leachate concentrations relative to the composition of the influent solution. For C1AE, Ca attenuation is only observed during the DOC amendment period. Overall, Ca levels decline from ~200 mg/L to ~100 mg/L, which is attributed to enhanced calcite formation ($CaCO_3$). Blowes *et al*., (2000) noted that waters moving through zero-valent iron, the precipitation of Ca and Mg carbonates and Fe and Al oxyhydroxides may occur due to the large decrease in Eh and increase in pH that results from the iron corrosion reaction. Alkalinity generation and precipitation of $CaCO_3$ during organic carbon decomposition also likely accounts for the decrease in dissolved Ca in all columns during week 20 to 32 while Na-acetate was amended to the column influent.

3.2.5 Parameters of Potential Concern

3.2.5.1 Nitrate

All treatment configurations show minimal nitrate removal prior to DOC amendment, with leachate concentrations ranging from 300 to 380 mg/L (Figure 3-5). At best, leachate concentrations show a <15% decline relative to influent composition (~350 mg/L). Relatively low temperatures of column operation likely inhibited microbial denitrification processes influencing both ZVI performance and the likelihood of microbial denitrification.

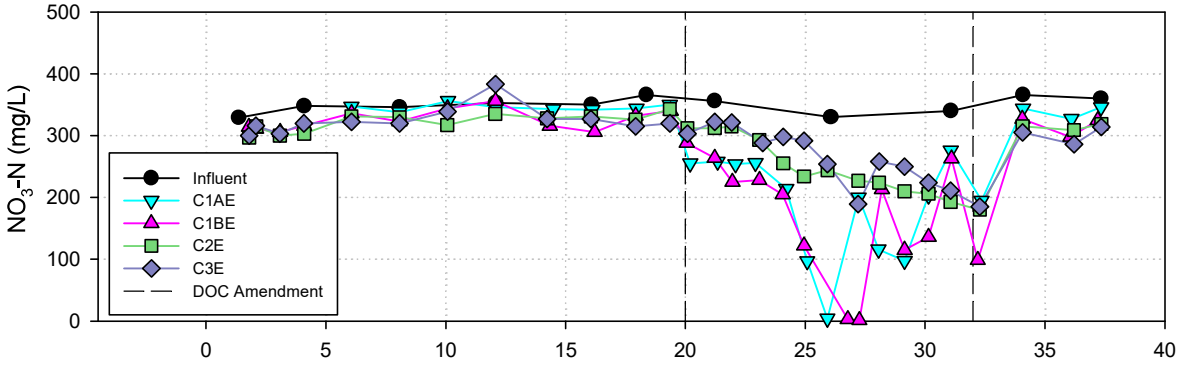


Figure 3-5: Time series profile for NO_3-N in column effluents over 37 weeks of operation.

In response to the observed limitations on treatment performance, Na-acetate was introduced to the columns to stimulate microbially-facilitated electron donating (oxidation of carbon) and accepting (denitrification) processes, illustrated by the equations below.

$$CH_3COO^- + 4H_2O \rightarrow 2HCO_3^- + 9H^+ + 8e^-$$

$$8e^- + 8/5NO_3^- + 48/5H^+ \rightarrow 4/5N_2 + 24/5H_2O$$

Based on the effluent chemistry observed, these redox reactions are inferred to be variably occurring in all treatment configurations. In particular, nitrate concentrations for the mixed treatment configurations, C2E and C3E, show a progressive decline reaching a minimum concentration of ~185 mg/L in week 32 (Figure 3-5). The greatest magnitude of nitrate removal was observed in C1AE with levels reaching <5 mg/L in week 26. Of note, the C1AE time series profile for DOC shows a decreasing trend (Figure 3-2) which parallels the reduction in nitrate concentrations through denitrification (Figure 3-5). Nitrate concentrations are relatively unchanged in C1BE, indicating minimal to no additional removal of nitrate in the presence of ZVI for the sequential treatment configuration.

The effective removal of nitrate in C1AE was also found to be notably influenced by HRT. In Figure 3-6, a proportional decline in nitrate concentrations during weeks 25 to 29 coinciding with elevated HRTs ranging from 10 to 28 days is illustrated. Specifically, nitrate levels only decline below 100 mg/L (in week 26) when the target treatment HRT (*e.g.,* 4 days) was increased 7-fold to roughly 28 days.

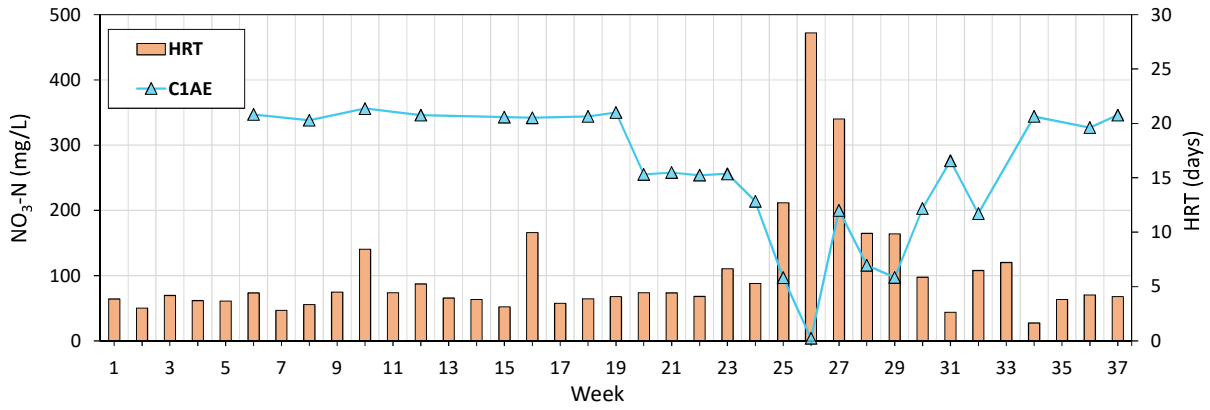


Figure 3-6: Time series profile for NO_3-N in C1AE and HRT for the C1 configuration over 37 weeks of operation.

Elevated HRTs are also observed for Column C2 and C3 during this period (13 and 6.5 days for C2E and C3E, respectively) but are not sustained over several weeks (refer to Figure 3-1). As such, a proportional decline in nitrate levels corresponding to HRT was not observed for these column experiments. These results demonstrate that the provision of a

labile carbon source at the operational temperature tested (4ºC) was insufficient for significant nitrate removal without greatly increasing the treatment HRT.

3.2.5.2 Arsenic

Arsenic is a redox sensitive parameter typically present in two valence states in aqueous environments, As(III) and As(V). Under more oxidizing conditions, As(V) is dominant and present in various hydrated forms (*i.e.,* H_3AsO_4, $H_2AsO_4^-$, $HAsO_4^{2-}$, AsO_4^3). In its reduced form, As (0), As is insoluble. Owing to its sensitivity to redox conditions, manipulation of the As redox state can reduce its overall solubility.

Figure 3-7 provides time series profiles for As in all columns. These data demonstrate immediate and effective removal in all columns containing ZVI throughout 37 weeks of testing. No removal is observed in C1AE, providing clear indication that removal is facilitated by the ZVI. Column effluents show As concentrations ranging from <0.003 to 0.097 mg/L reflecting >96% reduction in concentration relative to influent levels (median of 2.2 mg/L).

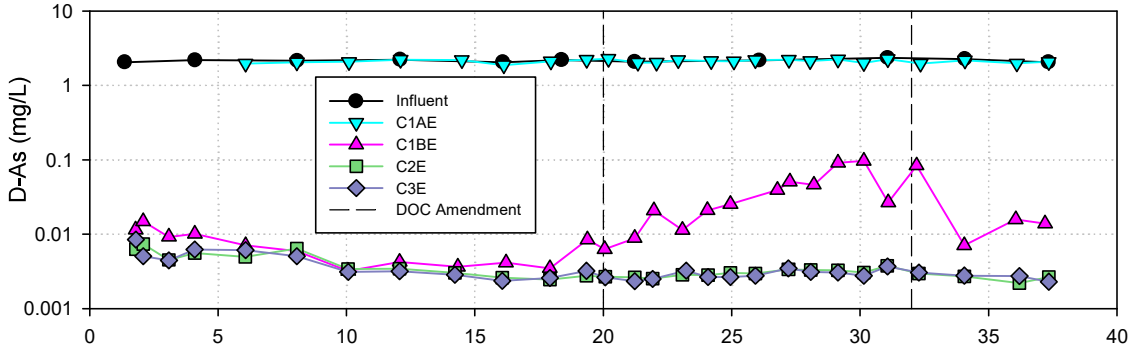


Figure 3-7: Time series profile for nitrate in column effluents over 37 weeks of operation. (Note that results are presented on a logarithmic scale).

Reduced attenuation of As in C1BE is observed during the DOC amendment period, with concentrations reaching a peak in week 32 and declining shortly after. Note that the magnitude of increased concentrations is relatively minor compared to the attenuation observed. Leachates for C2E and C3E, contrastingly, show no change in As concentrations during this period. There is no obvious discernable explanation for the decreased attenuation observed in C1BE; however, pH conditions in this column show greater fluctuations than in C2E and C3E, (Figure 3-3), which may indirectly contribute to variability in As solubility.

The exact mechanism for As attenuation in these columns remains to be investigated. Potential mechanisms for As removal which may be singularly or co-occurring include:

- reduction of oxidized As species to As(0) resulting in immobilization;

- complexation or co-precipitation of As with the ZVI surface; and
- adsorption onto corrosion products of ZVI, including iron hydroxides, oxyhydroxides, and mixed valance Fe(II)-Fe(III) green rusts (USEPA, 2008; Lien and Wilkin, 2005; Su and Puls, 2001).

3.2.5.3 Uranium

In aqueous environments U may be present in three valence states: U(IV), U(V) and U(VI). For oxic waters within a pH range of 5.0 to 9.0, U is dominantly present as U(VI) and may speciate as uranyl $(UO_2)^{2+}$, UO_2OH^+ or U complexed with carbonate and/or hydroxide depending on the availability of these compounds and the pH range observed (Markich, 2002; Gorman-Lewis et. al., 2008; Stewart *et al*., 2010).

The time series profiles for dissolved U shows progressive removal in all columns containing ZVI with maximum removal observed in weeks 10 to 20 (Figure 3-8). Prior to week 10, U concentrations ranged from 0.0016 mg/L to 0.035 mg/L. During the optimal treatment period, U concentrations consistently declined to <0.002 mg/L. Similar to As, the exact mechanism of U attenuation, while not determined, is inferred to be related adsorption or precipitation of U(VI) onto the ZVI surface resulting in immobilization. For example, Fiedor, *et al*., (1998) observed, in a groundwater treatment study using ZVI to remove U, that under aerobic conditions U(VI) was rapidly and strongly sorbed to hydrous ferric oxide particulates on the surfaces of ZVI.

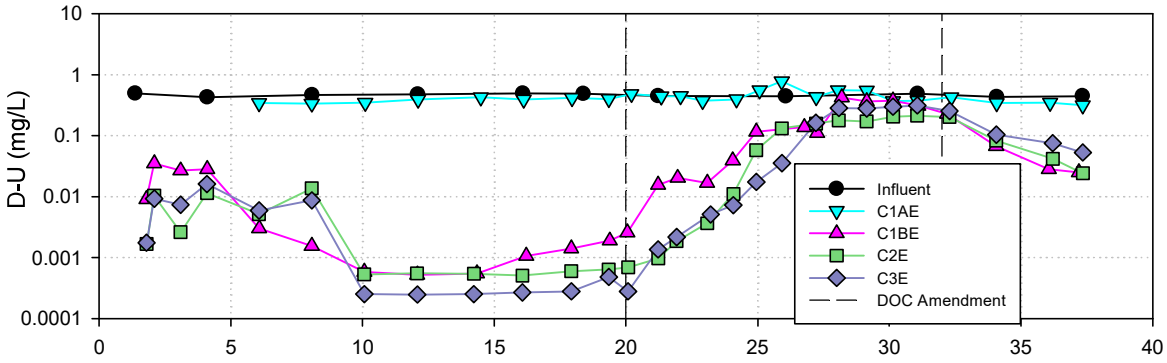


Figure 3-8: Time series profile for U in column effluents over 37 weeks of operation. (Note that results are presented on a logarithmic scale).

Interestingly, upon addition of DOC, there was an immediate decline in U attenuation within those columns containing ZVI as concentrations increased to approach influent levels (0.46 mg/L), reaching a maximum concentration of 0.42 mg/L in C1BE in week 28. Due to the nature of U species complexation, it is postulated that the reduced attenuation observed in weeks 20 to 32 is associated with the increase in alkalinity generated from carbon decomposition and the attendant increase of carbonate ions in solution. Carbonate

ions act as a competing complexing agent to ZVI. Uranyl carbonate complexes ($UO_2(CO_3)_2^{2-}$, $UO_2(CO_3)_3^{4-}$) are known to be stable and soluble in aqueous environments across the neutral to slightly alkaline pH range (8 to 9) observed during this period (Markich, 2002; Gorman-Lewis et. al., 2008; Stewart *et al*., 2010). Results for U and alkalinity in the ZVI columns provide some supporting evidence for this hypothesis as the occurrence of elevated U concentrations (>0.10 mg/L) in column effluent are only observed at alkalinity levels >500 mg $CaCO_3$/L (Figure 3-9). Moreover, U attenuation was observed following termination of the DOC amendment which resulted in a reduction in alkalinity levels and a concomitant decrease in dissolved U in all columns to <0.05 mg/L by the end of the test period (Figure 3-8).

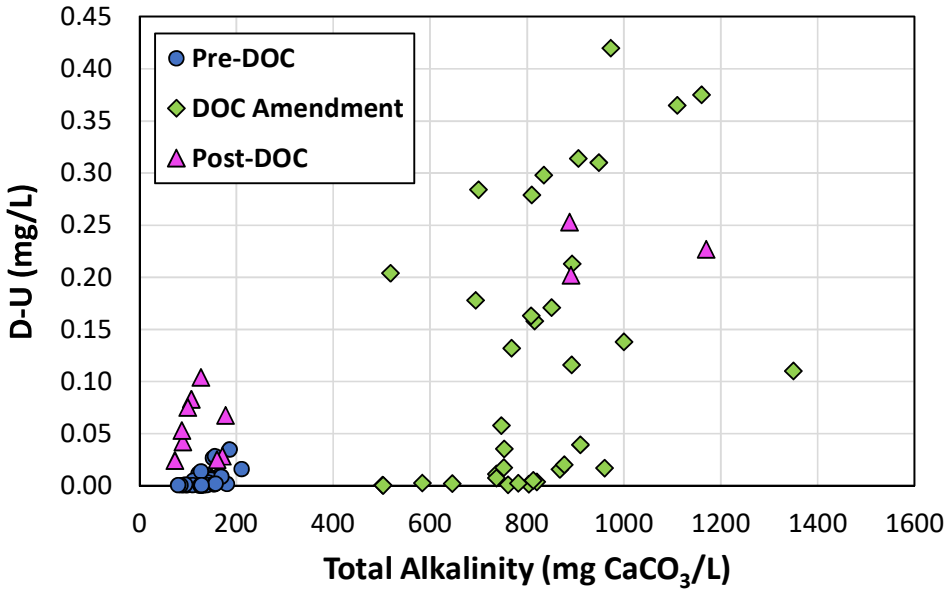


Figure 3-9: Dissolved U versus alkalnity measured in C1B, C2 and C3.

3.2.6 Contaminant Removal

3.2.6.1 Removal Rates

Water quality measured at the rhizon samplers demonstrate contaminant removal along the vertical flow path in the treatment columns (Figure 3-10, Figure 3-11, Figure 3-12). The greatest magnitude of decline in nitrate, As and U concentrations was observed between the inlet to the column and R1. Generally, there is an additional decline in concentrations between R1 and R2 and only minor additional removal observed at R3 despite the availability of reactive media (see Figure 3-11 for As).

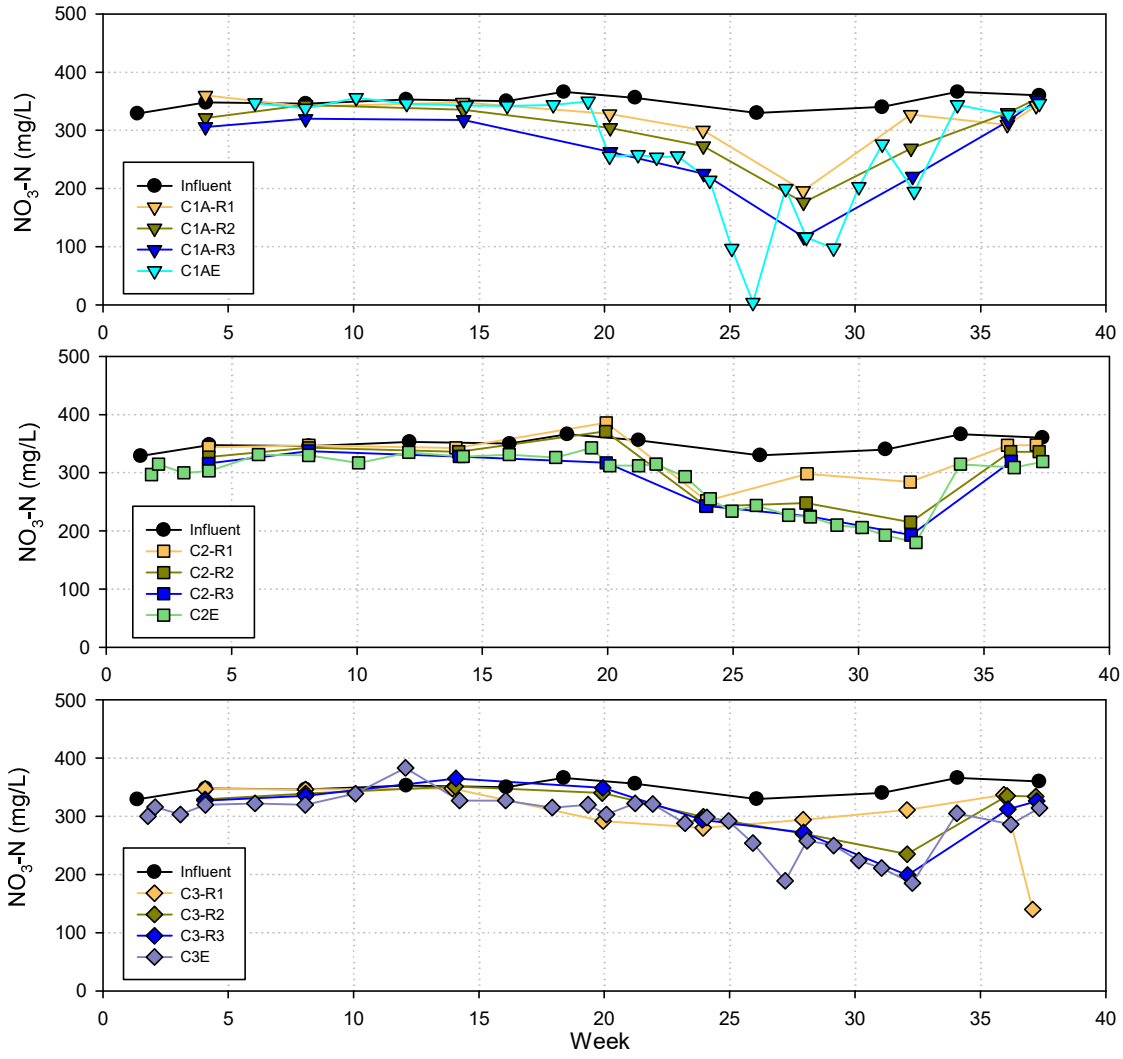


Figure 3-10: Time series profiles for NO_3-N measured in rhizon samples in C1A, C2 and C3 (top to bottom) over 37 weeks of operation.

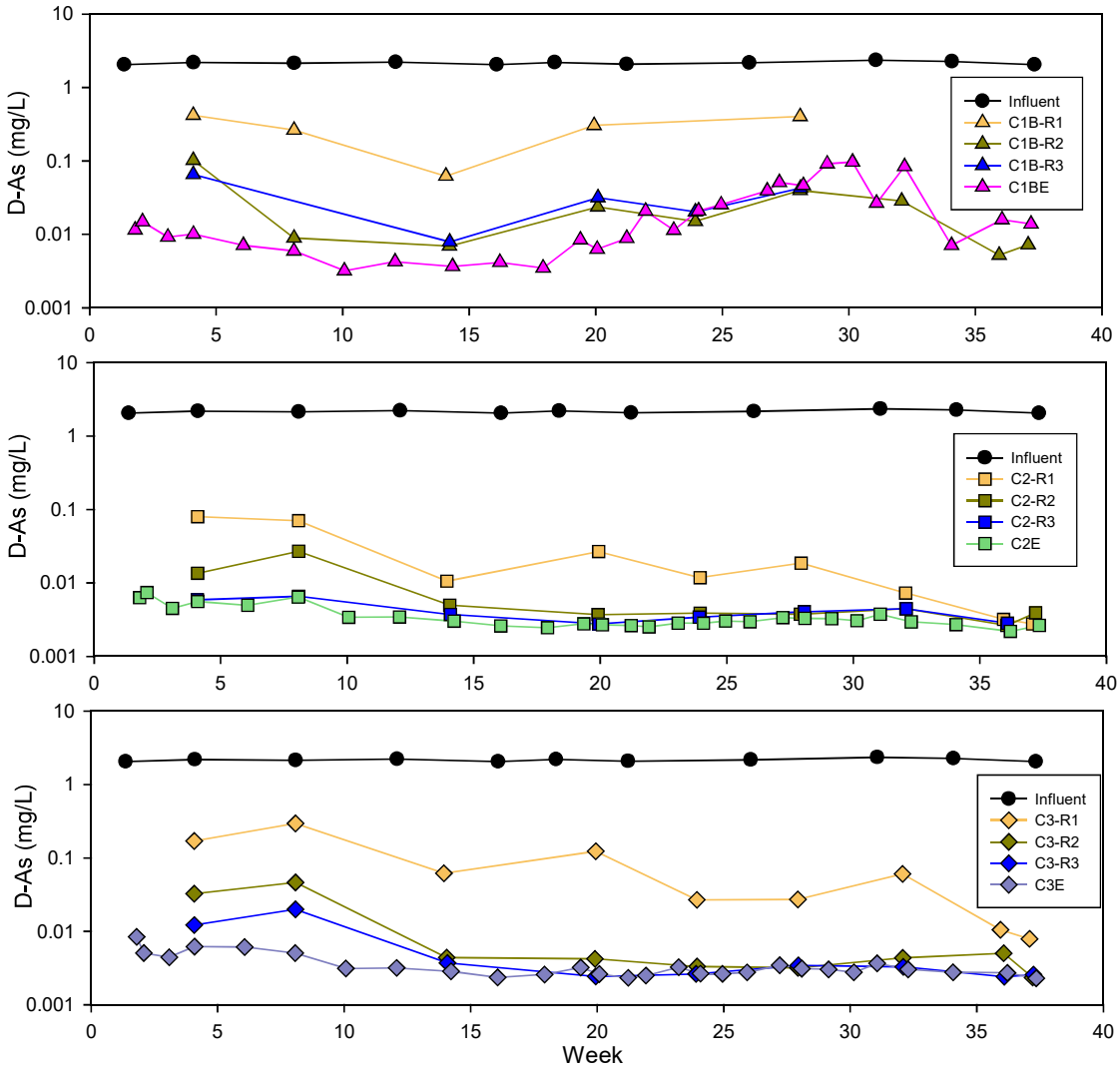


Figure 3-11: Time series profiles for dissolved As measured in rhizon samples in C1B, C2 and C3 (top to bottom) over 37 weeks of operation. (Note that results are presented on a logarithmic scale).

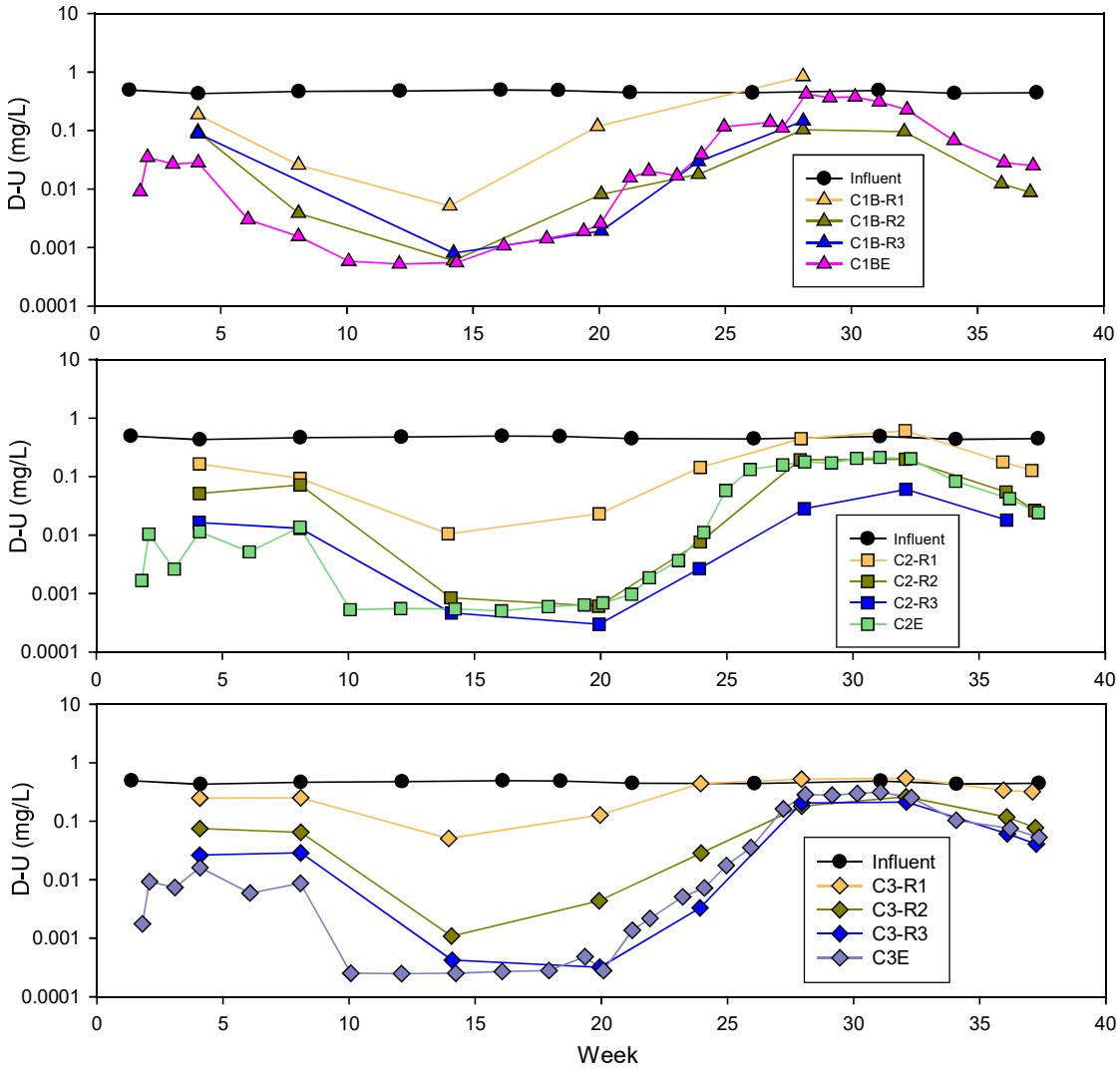


Figure 3-12: Time series profiles for dissolved U measured in rhizon samples in C1B, C2 and C3 (top to bottom) over 37 weeks of operation. (Note that results are presented on a logarithmic scale).

Removal rates for POPCs were calculated based on the dominant removal observed between the inlet and R1 for weeks during which rhizon samples were collected. The equation used to calculate removal rates presents an example for nitrate below.

(Influent [NO_3-N *mg/L*] - R1[NO_3-N *mg/L*]) x [Weekly effluent flow rate *L/day*] / [Volume of column material between inlet and R1 m^3]

Time to removal was then estimated based the equation below.

[Pore volume between inlet and R1 m^3]/ ([Weekly effluent flow rate *L/day*]/ 24,000)

Due to the sequential nature of the C1 configuration, these calculations were applied to removal observed in C1A for nitrate and to C1B for As and U. The rationale for this is to provide a direct comparison with rates observed in the mixed configurations.

Calculated weekly removal rates are shown for NO_3-N, As and U in Figure 3-13, Figure 3-15 and Figure 3-16, respectively.

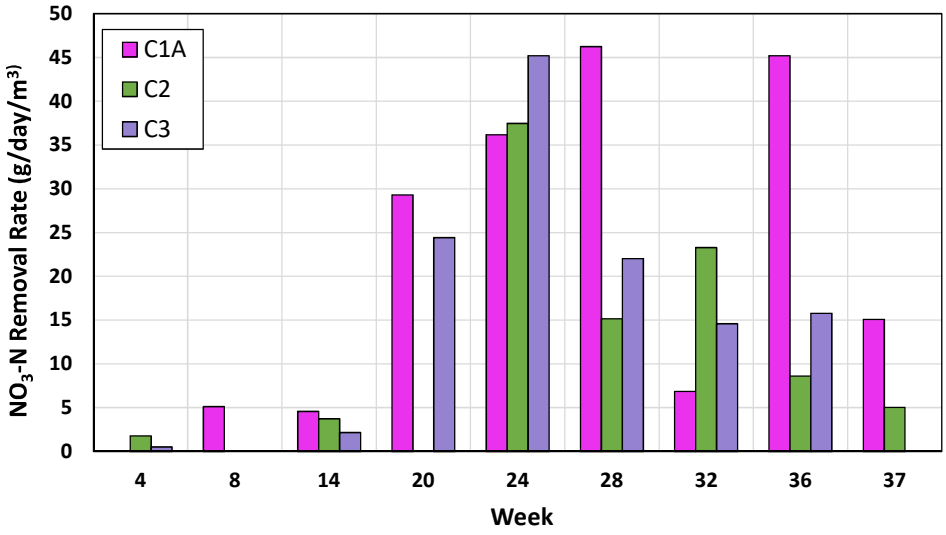


Figure 3-13: NO_3-N removal rates measured between the column inlet and R1 for weeks corresponding to rhizon sample collection

Nitrate removal rates were low in all column configurations during the initial 15 weeks of testing and generally were less than 5 g/day/m^3 (Figure 3-13). Removal rates increase upon introduction of DOC in week 20 but remain variable between configurations. Peak removal rates for C1 (*e.g.*, >35 g/day/m^3) were observed in week 24, 28 and 36. Observed removal rates during week 24 and 28 appear to be explainable by the increased HRT during this period in C1 (Figure 3-14) although the peak rate in week 36 does not appear to be related to HRT.

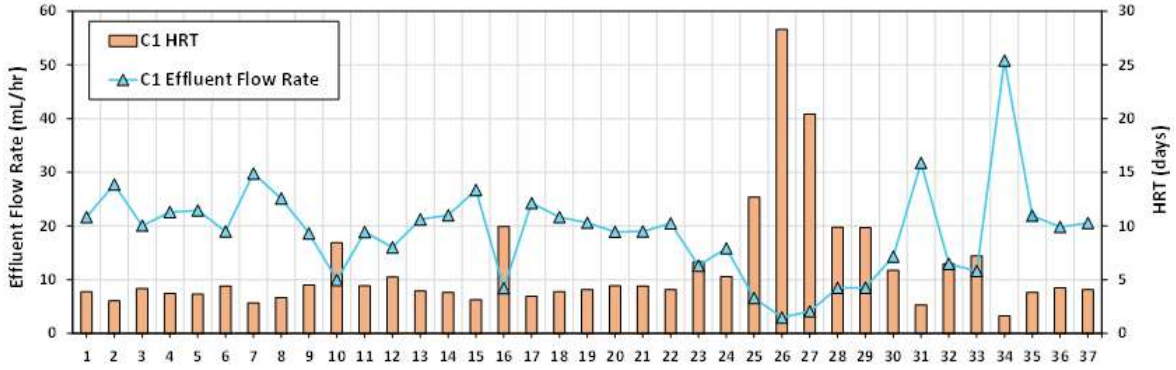


Figure 3-14: Weekly effluent flow rates and corresponding hydraulic retention time for C1.

Similar peak rates occurred only in week 24 for C2 and C3 (Figure 3-13).

For As and U, the data are incomplete C1 for the period after week 20. Greater removal rates are measured for C1 relative to C2 and C3 in weeks 4 to 20 and removal rates remain relatively stable throughout the entire test period. Conversely, U removal rates decline by up to a factor of 2 lower for C3 in week 32 relative to pre-DOC conditions. This is consistent with the reduced U attenuation observed in all ZVI columns during this period. In week 36 and 37, U removal rates approach pre-DOC conditions in C2 and C3.

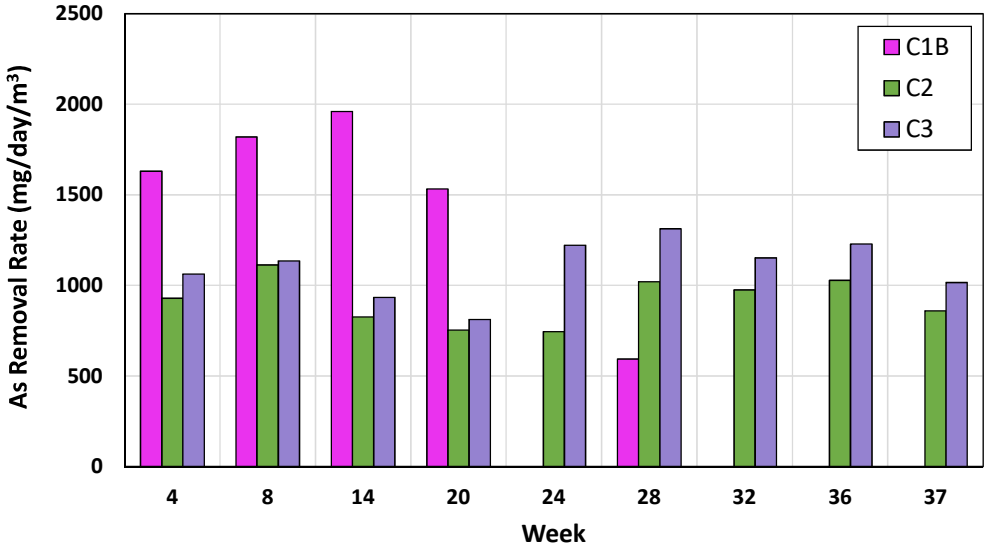


Figure 3-15: Arsenic removal rates measured between the column inlet and R1 for weeks corresponding to rhizon sample collection.

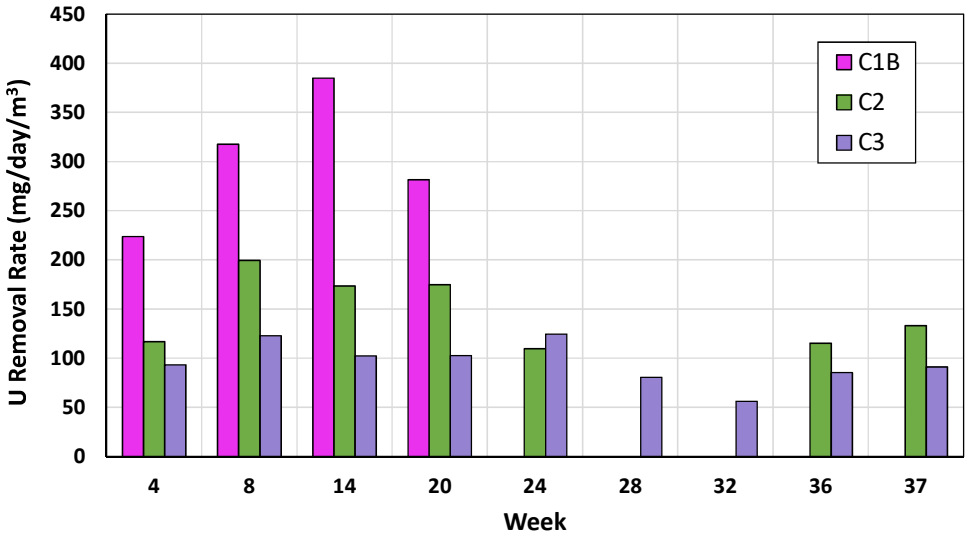


Figure 3-16: Uranium removal rates measured between the column inlet and R1 for weeks corresponding to rhizon sample collection.

Median removal rates and time to removal were calculated for each column configuration over the entire treatment period (*e.g.,* 37 weeks) as summarized in Table 3-5. Across

treatment configurations, median removal rates for nitrate range from 8.6 to 28 g/day/m^3. Nitrate removal rate for C1A is approximately 3x and 2x higher than in C2 and C3, respectively, and occurs in nearly half the time. The results also demonstrate that for similar treatment durations, nitrate removal rates were nearly 2x higher in C3 relative to C2.

Table 3-5:
Median Removal Rates and Time to Removal for Nitrate, As and U

Treatment Column	Median NO_3-N Removal	
	Removal Rate	Time to Removal
	g/day/m^3	Hours
C1A	28	14
C2	8.6	24
C3	16	23
Treatment Column	Median As Removal	
	Removal Rate	Time to Removal
	mg/day/m^3	Hours
C1B	1,630	9.9
C2	930	24
C3	1,136	23
Treatment Column	Median U Removal	
	Removal Rate	Time to Removal
	mg/day/m^3	Hours
C1B	300	9.9
C2	133	24
C3	95	23

Median removal rates for As range from 930 to 1630 mg/day/m^3 and from 95 to 300 mg/day/m^3 rates for U. Due to the limited rhizon data available for C1B, the rate presented is biased high as it primarily reflects pre-DOC conditions. Specifically, C1B shows removal rates for As and U up to 1.8x and 2.3x greater than observed for C2 and C3 as well as a shorter time to removal. The median removal rate for As and U are similar for mixed configurations, C2 and C3.

3.2.6.2 Contaminant Mass Removal

A summary of POPC mass removal during various periods of experimental testing is presented in Table 3-6. The results reflect minimum and maximum percentages of weekly mass removal calculated for the three treatment configurations.

For nitrate, contaminant mass removal was low (<15%) in all configurations in weeks 0 to 19 and prior to the addition of labile DOC. Once carbon was added to the system, % removal improved in all configurations and was highest in C1, reaching a maximum value

of ~100% in weeks 26 and 27 and remaining below 49% in C2 and C3. After week 32, % removal approached pre-DOC levels, with a greater range of removal observed in C1.

Table 3-6:
Minimum and Maximum Percentages of Contaminant Mass Removal

Period of Column Testing	Week	Median Effluent (mg/L)	Statistic	C1	C2	C3
				% mass removed	% mass removed	% mass removed
NO_3						
Pre-DOC	0 to 19	350	Min	0%	2%	0%
			Max	13%	15%	14%
DOC Amendment	20 to 32		Min	18%	10%	8%
			Max	100%	49%	47%
Post-DOC	33 to 37		Min	7%	9%	10%
			Max	72%	49%	47%
As						
Pre-DOC	0 to 19	2.17	Min	99%	100%	100%
			Max	100%	100%	100%
DOC Amendment	20 to 32		Min	96%	100%	100%
			Max	100%	100%	100%
Post-DOC	33 to 37		Min	96%	100%	100%
			Max	100%	100%	100%
U						
Pre-DOC	0 to 19	0.46	Min	92%	97%	97%
			Max	100%	100%	100%
DOC Amendment	20 to 32		Min	9%	54%	32%
			Max	99%	100%	100%
Post-DOC	33 to 37		Min	51%	56%	45%
			Max	95%	95%	89%

Notes:
Removal rates for C1 are based on final effluent chemistry observed for C1BE

Compared to nitrate, removal of As and U was effective for all treatment configurations throughout the entire treatment period. Arsenic was negligibly influenced by differences in column configuration and/or changes to treatment conditions (*e.g.*, DOC addition), showing consistently >96% removal across all columns. Alternatively, % removal for U declined to a minimum of 9% for C1 in week 28. By comparison, % removal during this period remained greater than 54% and 32% for C2 and C3, respectively. Following termination of the DOC amendment, % removal increased for C1 and C3 to greater than 45%. A similar range of % removal is observed for C2 during and post DOC amendment; however, the median value shows an increase from 72% to 82%, consistent with observations for the other treatment configurations.

3.2.7 Treatment By-Products

3.2.7.1 Nitrite and Ammonia

Nitrite and ammonia are undesirable reduced nitrogen species produced throughout the experimental period, as illustrated by the stepwise equations below for the denitrification of nitrate by ZVI.

$$Fe^0 + NO_3^- + 2H^+ \rightarrow Fe^{2+} + NO_2^- + H_2O$$

$$3Fe^0 + NO_2^- + 8H^+ \rightarrow 3Fe^{2+} + NH_4^+ + 2H_2O$$

Nitrite, prior to the DOC amendment, was consistently detected in all columns at concentrations <3.5 mg/L (Figure 3-17). Starting in week 20, levels in C2E and C3E progressively increase to reach a peak of 45 mg/L in week 32. For C1BE, nitrite levels fluctuate and mostly remain <20 mg/L. The overall increased production of nitrite is likely a response to enhanced denitrification as nitrite is an intermediary reduction product. Considerably lower nitrite concentrations (mostly < 3 mg/L) are observed in C1AE during this period, which is consistent with more complete denitrification (to N_2) occurring in this column. Following termination of the DOC amendment, nitrite levels decline by nearly 10x to < 5 mg/L by week 36.

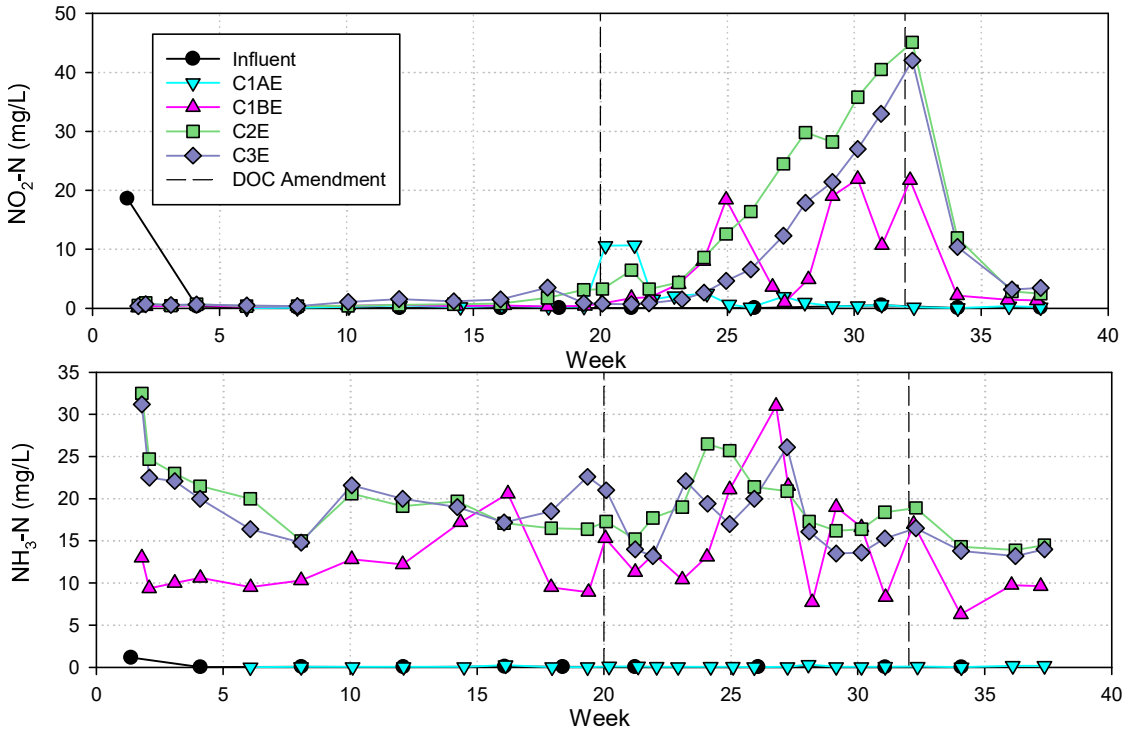


Figure 3-17: Time series profiles for NO2-N and NH3-N in column effluents over 37 weeks of operation.

For ammonia, concentrations are consistently detected in leachates from columns containing ZVI at levels ranging from 6.3 to 33 mg/L (Figure 3-17). Conversely, ammonia was observed at much lower (*e.g.*, <0.30 mg/L) in the absence of ZVI in C1AE, which indicate that ammonia production is associated with the presence of ZVI. Apart from the DOC amendment period when ammonia concentrations are similar across all leachates from ZVI columns, levels observed in the C1BE column are generally lower compared to the mixed configurations (C2E and C3E).

Poor nitrate removal by ZVI coincides with the production of ammonia in the treatment columns. Under the circumneutral conditions observed (pH 6.4 to 9.2), studies have shown that formation of iron oxides on the surface of ZVI tends to inhibit electron transfer from ZVI to nitrate, thus constraining the efficacy of chemical denitrification (Liu and Wang, 2019; Westherhoff and James, 2003; Cheng *et al*., 1997). As a result, in these instances, ammonia has been found to be the dominant reduction product.

3.2.7.2 Cyanide

Throughout the experimental period, weak acid dissociable cyanide (WAD-CN) was consistently detected at low levels (<0.15 mg/L) in leachates from all columns containing ZVI, while concentrations of WAD-CN were generally below the detection limit (<0.02 mg/L) in the influent solution and in C1AE (Figure 3-18). The SFE testwork conducted on the individual column test materials (Section 3.1.4) showed that total and WAD-CN levels in gravel and wood chips were below the detection limit (0.01 mg/L) and were at or below the detection limit for ZVI (0.002 mg/L). Overall, the results suggest that CN production may be associated with the presence of ZVI.

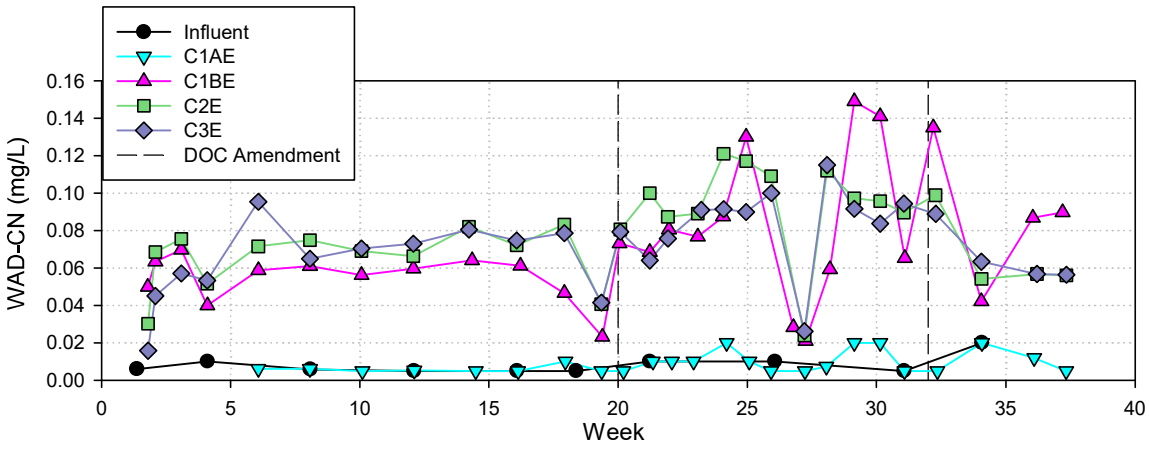


Figure 3-18: Time series profiles for WAD-CN in column effluents over 37 weeks of operation.

In response to the column results, an additional independent bench-scale leach test was performed on the ZVI material at the liquid to solid ratio (0.64:1) measured in the column tests to evaluate the leaching potential of WAD-CN. Leachate samples were collected periodically from 48 hours to 14 days from a sample containing ZVI and the synthesized drain down solution and a corresponding control with ZVI and deionized water. For the entirety of the batch test, concentrations of WAD-CN remained below the detection limit (<0.02 mg/L) in all samples.

Although the bench scale test have not been able to elucidate the source of CN detected in column leachates, the results provide supporting evidence that the chemical conditions unique to the column experiments facilitate the release of CN. Review of literature on other ZVI column studies were unable to provide a supporting hypothesis for CN release.

3.2.7.3 Trace Metals

Apart from the POPCs, other trace elements introduced via the influent solution or released from the column materials were also found to be influenced by the treatment process. Metal parameters which demonstrated a tendency for attenuation or release are presented in Figure 3-19 and Figure 3-20, respectively.

Trace metals including Al, Co, Cu, Sb and Se show attenuation primarily in the ZVI columns with concentrations declining by up to 5x relative to levels observed in the influent (Figure 3-19). Attenuation may be facilitated directly by adsorption onto the ZVI and enhanced as the ZVI undergoes corrosion and Fe oxides form on the surface of the material. Presumably, the gravel present in all columns could also provide supplemental adsorption capacity, and thus may account for parameters which show attenuation in C1AE namely Al and Cu. Since Se is a redox sensitive parameter, attenuation may be partially related to the formation of less soluble reduced species as Se reduction occurs at a similar redox potential to nitrate.

Lower attenuation was observed during the DOC amendment period, particularly for Al, Co and Cu, which reached maximum concentrations of 0.018 mg/L, 0.060 mg/L and 0.028 mg/L, respectively. Increased solubility of Cu and Co may be related to the formation of metal-organic complexes during excess DOC additions which limited their sorption to ZVI surfaces. For Al, the increased concentrations observed in all columns during DOC addition could be a function of the increase in pH that occurred during that period and the amphoteric behaviour of Al (*e.g.,* increased solubility at both low and high pH). The metalloid Sb exhibited somewhat reduced attenuation during DOC amendment and may also be associated with more alkaline pH conditions and lower sorption of Sb onto Fe-oxide surfaces of the ZVI.

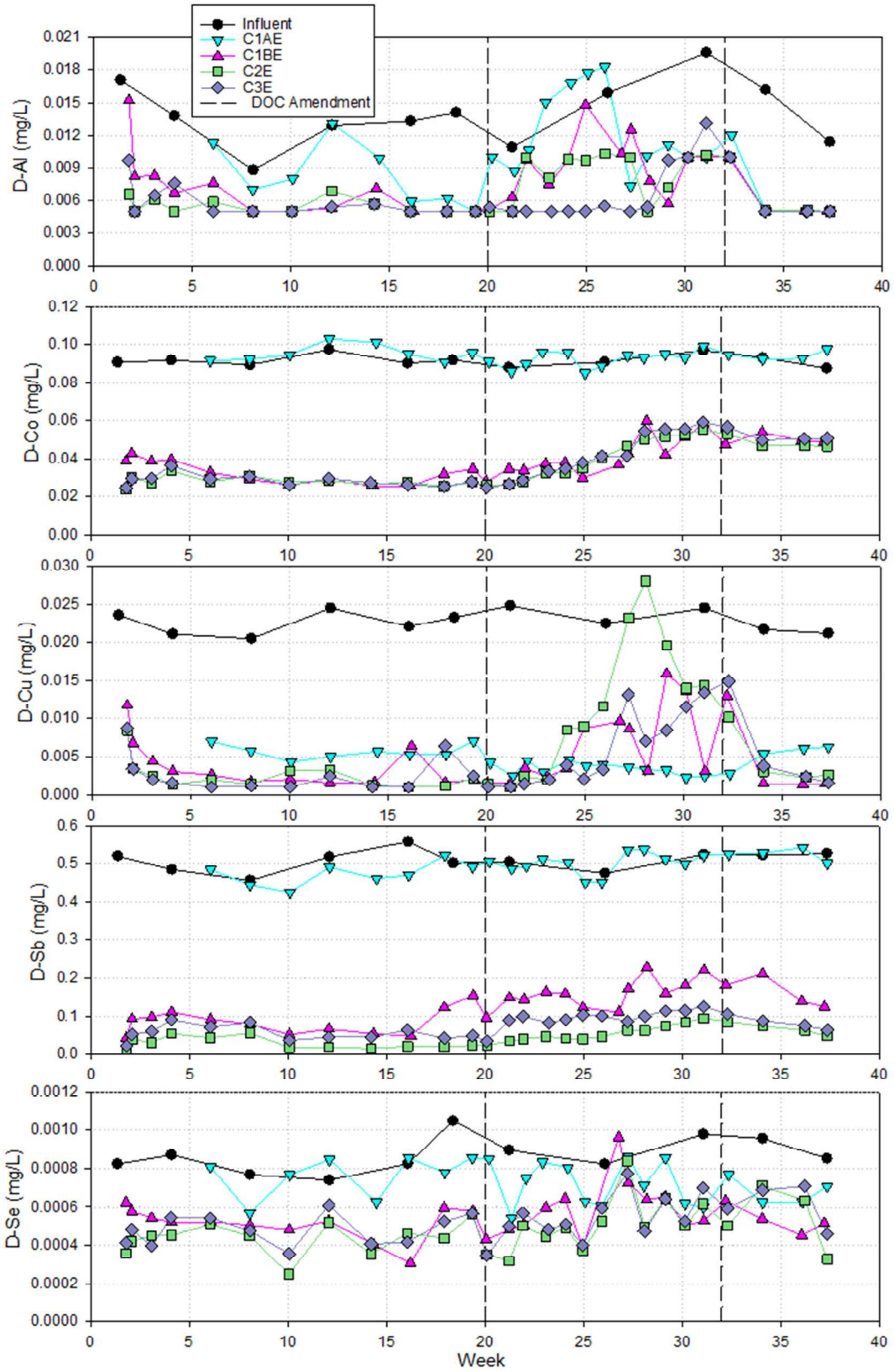


Figure 3-19: Time series profiles for dissolved Al, Co, Cu, Sb and Se in column effluents over 37 weeks of operation.

As a result of the treatment process, release of Fe, Mn, Mo, Ni and Zn are also observed primarily in columns containing ZVI (Figure 3-20) and were measured at concentrations in excess of that present in the influent prior to treatment. Concentrations of Fe are initially elevated reaching a peak of 5.9 mg/L, consistent with the rinsing of ZVI surfaces, and reach relatively stable levels (<0.5 mg/L) by week 10. The other metal parameters similarly show a flushing tendency followed by relatively stable concentrations approaching or remaining above influent levels by weeks 5 to 10.

Zn concentrations elevated above influent levels persist in CIAE until week 20, with concentrations ranging between 0.014 to 0.026 mg/L. Given that Zn was observed to be leachable from the wood chip sample (Section 3.1.4), this along with the absence of ZVI may account for the persistence of detectable levels in C1AE. By comparison, following the initial flush, Zn is slightly attenuated in all columns containing ZVI.

During the DOC amendment period, release of Mo and Ni is enhanced in C1BE to a maximum of 2.5 mg/L and 0.030 mg/L, respectively. Similar to previous observations, the enhanced solubility of Mo and Ni may be influenced by the increased presence of dissolved organic species or by the change in pH conditions. For Mn, the opposite is observed as concentrations decrease particularly for C1AE which show levels below the influent composition.

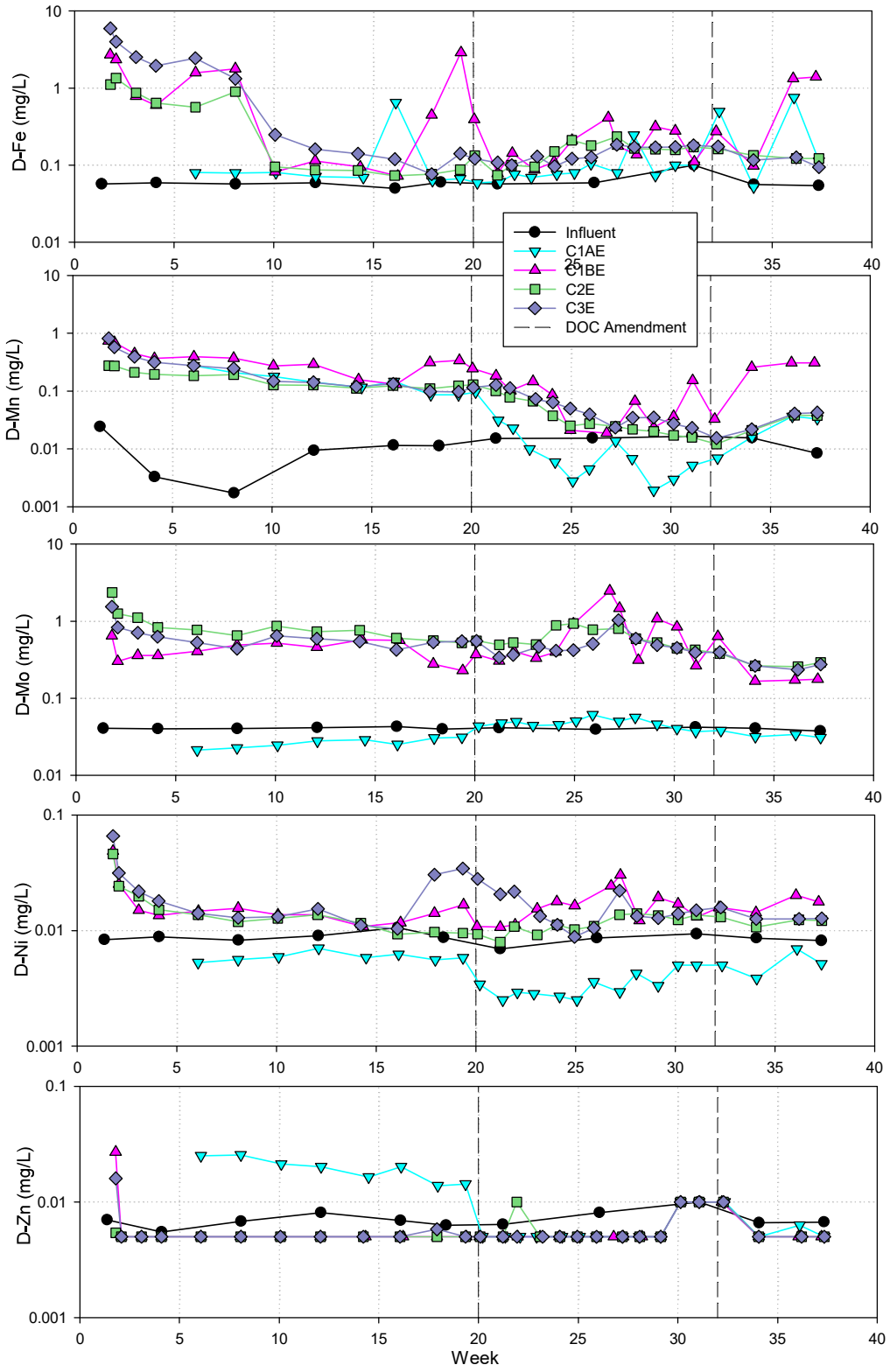


Figure 3-20: Time series profiles for dissolved Fe, Mn, Mo, Ni and Zn in column effluents over 37 weeks of operation. (Note that results are presented on a logarithmic scale).

4. Conclusions and Recommendations

Newmont™

4. Conclusions and Recommendations

4.1 Summary of Key Findings

The following outlines the most salient conclusions from the ZVI column testwork.

- Leachate results show circumneutral pH for gravel and ZVI and an acidic pH (4.5) for the wood chip sample. The latter exhibited the highest concentrations of water soluble parameters in SFE with Al, As, Cd, Cr, Cu, Fe, Pb and Zn levels above the CCME. By comparison, the gravel and ZVI samples show Al and F values above the WQGs, respectively.
- With few exceptions, a median HRT of 4 days was maintained throughout the operational period. Greatest variability was observed for C1 with HRTs ranging from 1.6 sto 28 days. A peak HRT of 13 days observed in week 25 for C2, while the target HRT was slightly exceeded for C3 during the first half of the test period, and reached a maximum of 8.3 days.
- Denitrification and nitrate removal did not occur to any significant extent in all columns during the first 19 weeks of testing.
- In response to the poor nitrate removal observed in week 0 to 19, a DOC amendment of Na-acetate (2:1 dose of C:N) was initiated in weeks 20 to 32. Microbial decomposition of added DOC is inferred from the decline of influent DOC in the columns and concomitant increases in alkalinity measured in effluents during the DOC amendment period. Similarly, Ca concentrations were observed to decrease during this period and is attributed to calcite precipitation.
- Sulphate concentrations remained elevated (>2,000 mg/L) throughout the test period as removal is not expected as part of the treatment outcomes of this experiment. Correspondingly, sulphide concentrations are consistently non-detectable (<0.20 mg/L).
- Initially (in weeks 0 to 19), leachate concentrations show a <15% decline in nitrate relative to influent concentration. It is postulated that temperature (maintained at 4ºC) was a key limiting factor influencing microbial denitrification.
- Nitrate concentrations declined following DOC addition, reaching minimum concentrations of ~185 mg/L for C2E and C3E and <5 mg/L for C1AE. Maximum denitrification only occurred with addition of more labile carbon and a significant increase in the treatment HRT from 4 days to 28 days.
- Arsenic demonstrated immediate removal in all columns containing ZVI throughout the test period. Column effluents show As concentrations ranging from <0.003 to 0.097 mg/L reflecting >96% reduction in concentration relative to influent levels.

- Uranium showed progressive attenuation in all columns containing ZVI with maximum removal to <0.002 mg/L observed in weeks 10 to 20. Upon addition of DOC, U concentrations increased to approach influent levels; however, concentrations declined after week 32 to <0.05 mg/L.
- Due to the nature of U species complexation, it is posited that the reduced attenuation observed in weeks 20 to 32 is associated with the enhanced presence of carbonate ions which acts as a complexing agent to form stable soluble uranyl carbonate complexes.
- Ammonia was consistently detected in leachates from columns containing ZVI at levels ranging from 6.3 to 33 mg/L and is consistent with observations in the literature that nitrate is reduced to ammonia in the presence of ZVI.
- Nitrite concentrations increased in all columns containing ZVI during the DOC amendment period from <3.5 mg/L to a peak of 45 mg/L and indicate incomplete denitrifiation during this period in the presence of ZVI. Conversely, considerably lower nitrite concentrations (mostly < 3 mg/L) were observed in C1AE throughout the entire experimental period including during DOC amendment and consistent with more complete denitrification (to N_2) occurring in this column.
- WAD-CN was consistently detected at low levels (<0.15 mg/L) in leachates from all ZVI columns. Independent bench scale testing of the ZVI sample did not show detectable WAD-CN levels. No plausible explanation for the release of CN in the ZVI columns is available at this time.
- Trace metals including Al, Co, Cu, Sb and Se were attenuated relative to influent concentrations, primarily in the ZVI columns. This is attributed to adsorption by the ZVI surface.

4.2 Conclusions and Future Work

The bench-scale column testing of a semi-passive treatment system for the Coffee Mine Project highlighted some successful treatment strategies as well as challenges. It is clear from the bench-scale testing that a semi-passive treatment configuration would require an initial denitrification step to remove nitrate from heap leach effluent and prior to passing through the proposed ZVI-matrix for arsenic and uranium removal. In the absence of nitrate removal, the ZVI-matrix has shown that reduction of nitrate to ammonium occurs and produces elevated ammonium in post-ZVI effluent which is undesirable. These findings are consistent with results described in the primary literature.

With the wood chips used in this bench-scale testwork, and the low temperatures (*e.g.*, 4ºC) employed throughout the testing, denitrification did not proceed at a sufficient rate to effect complete nitrate removal without the addition of a more labile carbon source and an

extended hydraulic residence time, at least within the denitrification treatment step. The carbon addition favoured microbial decomposition but with a concomitant generation of excess alkalinity resulting in increased uranium solubility and poor removal efficiency. Conversely, increased alkalinity had no effect on As removal which was effectively >99% in all materials tested and throughout the duration of testing. Future testing of semi-passive treatment configurations will need to evaluate a balance between improving carbon availability - to support microbial decomposition - without generating excess alkalinity in the treated effluent as this results in poor uranium removal. Therefore, the areas of future focus will include:

- Identification of a natural carbon source capable of supporting sufficient microbial decomposition to supply electrons for nitrate reduction via denitrification;
    - Possible carbon sources to evaluate would be:
        - Composted wood chips and bark – composting could provide for breakdown of cellulitic material and generation of more readily available carbon by-products. It may be possible to generate this material as part of clearing conducted during construction phase;
        - Hay or grasses – these materials are used in other semi-passive treatment systems (*e.g.,* Biochemical Reactors) used to promote denitrification of mine contact waters. This material would need to be imported to Coffee.
- Optimization of the hydraulic residence time for denitrification. The target HRT of less than 5 days was not sufficient for denitrification; however, As and U removal occurred rapidly and the removal was satisfactory with the relatively short HRT.

Further bench-scale testing is not recommended at this time given the constraints on the availability of representative heap leach solution and quantities necessary to support test durations required to address the questions outlined above.

There is an opportunity to capitalize on reclamation research that is being proposed for Coffee, commencing once Phase 1 of heap leach stacking and leaching has concluded in Yr-5 of the mine life. Specifically, a test pad is contemplated using Coffee ore, leaching the ore and rinsing the ore in order to generate heap leach material to assess cover options and revegetation strategies. The heap leach rinsing period on the test pad can likely generate representative solution as well as sufficient volumes to support further evaluations of viable carbon sources and optimum hydraulic retention times to support acceptable denitrification rates while limiting excessive alkalinity production. A detailed testing program will be provided in Yr-3 and circulated to First Nations and regulators for review and comment. External review will serve to refine the experimental design well in advance of testwork initiation.

5. Closure

Newmont™

5. Closure

This report was prepared by Lorax Environmental Services Ltd. for Pure Gold Mining Inc. Should you have any questions or comments, please do not hesitate to contact the undersigned.

Sincerely,

LORAX ENVIRONMENTAL SERVICES LTD.

Prepared by:



Gladys Oka, M.Sc.
Environmental Scientist

Reviewed by:



David Flather, M.Sc.
Principal, Senior Environmental Scientist

References

Newmont™

References

Amoako-Nimako, G.K., Yang, X. and Chen, F. (2021). Denitrification using permeable reactive barriers with organic substate or zero-valent iron fillers: controlling mechanisms, challenges, and future perspectives. *Environmental Science and Pollution Research*, 28: 21045-21064.

Belansky, T. (2021). Semi-passive treatment of column technology to treat mine impacted water under cold conditions. Prepared for Newmont Goldcorp by Yukon College in May 2021.

Blowes, D.W., Ptacek C., Benner S.G., McRae C.W.T., Bennett T.A. and Puls R.W. (2000). Treatment of inorganic contaminants using permeable reactive barriers. Journal of Contaminant Hydrology, 45:123-137.

Calderer, M., Gilbert, O., Marti, V., Rovira, M., de Pablo, J., Jordana, S., Duro, L., Guimera, J., and Bruno, J. (2010). Denitrification in the presence of acetate and glucose for bioremediation of nitrate-contaminated groundwater, *Environmental Technology*, 3: 799-814.

Cuervo-Lopez. F.M, Martinez, F., Gutierrez-Rojas, M., Noyola, R.A. and J. Gomez. (1999). Effect of nitrogen loading rate and carbon source on denitrification and sludge settleability in upflow anaerobic sludge blanket (UASB) reactors. *Water Science Technology,* 40: 123-130.

Cheng, F, Muftikian, R., Fernando, Q., and Korte, N. (1997). Reduction of nitrate to ammonia by zero-valent iron. *Chemosphere,* 35(11): 2689-2695.

Cleveland, C.C. and Liptzin, D. (2007). C:N:P stoichiometry in soil: is there a "Redfield ratio" for the microbial biomass. *Biogeochemistry*, 85: 235-252.

Fiedor, J. N., Bostick, W. D., Jarabek, R. J., Farrell, J. 1998. Understanding the Mechanism of Uranium Removal from Groundwater by Zero-Valent Iron Using X-ray Photoelectron Spectroscopy. *Environ. Sci. Technol*, 32(10): 1466-1473.

Flather, D.H. and E.G. Beauchamp, 1992. Inhibition of the fermentation process in soil by acetylene. *Soil Biology and Biochemistry*. 24(9): 905-911

Gorman-Lewis, D, Burns, P.C. and Fein, J.B. (2008). Review of uranyl mineral solubility measurements. *Journal of Chemical Thermodynamics,* 40:335-352.

Lawrence, R. W., & Wang, Y. (1996). Determination of Neutralization Potential for Acid Rock Drainage Prediction. Prepared for Environment Canada and Hudson Bay Mining and Smelting, July 1996.

Lien, H.S. and Wilkin, R.T. (2005). High-level arsenite removal from groundwater by zero-valent iron. *Chemosphere,* 59: 377-386.

Liu, Y. and Wang, J. (2019). Reduction of nitrate by zero valent iron (ZVI)- based materials: A review. *Science of the Total Environment,* 671:288-403.

Lorax. 2020. Updated work plan and standard operating procedures for passive treatment column study. Prepared for Newmont Goldcorp. January 2020.

Lorax. 2022. Coffee Mine Project – Geochemical Source Term Report. Prepared for Newmont Goldcorp. July 2022.

Markich, S.J. Uranium speciation and bioavailability in aquatic systems: An overview. *The Scientific World Journal,* 2:707-729.

MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. Prepared by W.A. Price on behalf of Mine Effluent Neutral Drainage (MEND Report 1.20.1), December 2009.

Rudnick, R.L. and S. Gao. 2014. Composition of the Continental Crust. In: Holland, H. and Turekian, K. (eds). Treatise on Geochemistry 2nd Edition, Vol. 4, pp. 1-51. Oxford, UK, Elsevier Ltd.

Srinandan, C.S., D'Souza, G., Srivastava, N., Nayak, B.B. and Nerurkar, A.S. (2012). Carbon sources influence the nitrate removal activity, community structure and biofilm architecture. *Bioresource Technology*, 117: 292-299.

Stewart, B.D., Mayes, M.A. and Fendorf, S. (2010). Impact of urany-calcium-carbonato complexes on uranium (VI) adsorption to synthetic and natural sediments. *Environmental Science Technology,* 22: 928-934.

Su, C. and Puls, R.W. (2001). Arsenate and arsenite removal by zerovalent iron: Kinetics, redox, transformation and implications for in situ groundwater remediation. *Environmental Science Technology,* 35: 1487-1492.

U.S. Environmental Protection Agency (USEPA). (2008). Field Application of a Permeable Reactive Barrier for Treatment of Arsenic in Ground Water. http://permanent.access.gpo.gov/LPS112931/600r08093.pdf.

Westherhoff, P. and James, J. (2003). Nitrate removal in zero-valent iron packed columns. *Water Research,* 37:1818-1830.

Appendix A: Updated Work Plan and Standard Operating Procedures for Passive Treatment Column Study

Newmont™

Coffee Gold Project

Updated Work Plan & Standard Operating Procedures for Passive Treatment Column Study

Prepared by:
Lorax Environmental Services Ltd.
2289 Burrard St. Vancouver, BC, V6J 3H9

Prepared for:
Yukon Research Centre
Yukon College
Whitehorse, YK

Project No. A362-1

23 August 2022

Table of Contents

TABLE OF CONTENTS I

1. INTRODUCTION 1-1

2. SUBSTRATE SPECIFICATIONS AND SOLID-PHASE TEST WORK 2-1

3. COLUMN CONSTRUCTION AND START-UP 3-1
3.1 COLUMN CONSTRUCTION 3-1
3.2 COLUMN START-UP 3-1

4. OPERATIONAL MONITORING 4-1
4.1 MONITORING PLAN AND SAMPLE COLLECTION 4-1
4.2 QUALITY ASSURANCE AND QUALITY CONTROL 4-1
4.3 LEACHATE ANALYTICAL TESTWORK 4-3

5. RECORD-KEEPING 5-1

APPENDIX A: EQUIPMENT & MATERIALS LIST FOR COLUMN STUDY

APPENDIX B: STANDARD OPERATING PROCEDURES FOR COLUMN STUDY

LIST OF FIGURES

FIGURE 1-1 COLUMN STUDY CONFIGURATION 1-2

LIST OF TABLES

TABLE 2-1 SUBSTRATE MATERIAL SPECIFICATIONS 2-1

TABLE 4-1 COLUMN MONITORING PLAN 4-2

TABLE 4-2 SUMMARY OF ANALYTICAL METHODS 4-3

TABLE 5-1 SUMMARY OF REQUIRED RECORD-KEEPING ACTIVITIES 5-1

1. Introduction

The Coffee Gold Project (the Project) is evaluating the use of semi-passive treatment at closure to treat drain down seepage water from the decommissioned heap leach facility (HLF). Parameters of potential concern (POPCs) have been identified as arsenic (As), nitrate (NO_3) and uranium (U). Nitrate represents a residual product of cyanide degradation while As and U represent leached components from the ore. A semi-passive treatment system, based on the combined principles of permeable reactive barrier (PRB) technology and biological reactor (BR) technology, is being considered for the closure phase of the Project. In PRB/BR systems, a permeable matrix (*e.g.*, gravel) is amended with one or more materials to create a reactive medium for contaminant removal.

As part of the pre-feasibility testwork program, column experiments will be conducted at the Yukon Research Center, Yukon College, under the oversight of Guillaume Nielsen, Ph.D. The column experiments will be used to:

- Demonstrate proof of principle (*i.e.*, can the technology reduce POPC concentrations in heap leach seepage solutions to acceptable levels?);
- Determine POPC removal rates, which in turn have relevance to HRT requirements and treatment system dimensions;
- Evaluate the risks and merits associated with various reactive media, including wood chips and ZVI;
- Identify the nature of secondary minerals that may clog the system over time (relevance to the potential for hydraulic failure and system longevity); and
- Identify any potentially-problematic by-products that may be generated within the treatment system (*e.g.*, nitrite, ammonia, ferrous iron, hydrogen sulfide).

To address these objectives, three column configurations are proposed (Figure 1-1). The first column configuration encompasses two columns in series. The first column (gravel + wood chips) is used to promote denitrification (reduction of nitrate to nitrogen gas), while the second column (gravel + ZVI) is designed to reduce arsenic and uranium concentrations. Some arsenic and uranium removal may also occur in the first column in the presence of wood chips alone (Figure 1-1).

Column configurations #2 and #3 comprise single reaction cells, containing gravel + wood chips + ZVI (Figure 1-1). In the presence of ZVI, the reduction of nitrate to nitrogen gas can be favoured (*i.e.*, the potential for ammonia generation can be theoretically minimized) with sufficient organic carbon present, which is required to nourish denitrifying microbial

assemblages (David Blowes, Pers. Comm.). Accordingly, it is possible that desired treatment outcomes may be achieved with a singular bioremediation design (*i.e.*, single stage). To test this combined matrix, column configurations #2 and #3 have been designed with varying proportions of gravel + wood chips + ZVI (Figure 1-1).

Columns will be operated under fully saturated conditions over a period of 6 to 12 months, commencing in the first quarter of 2020.

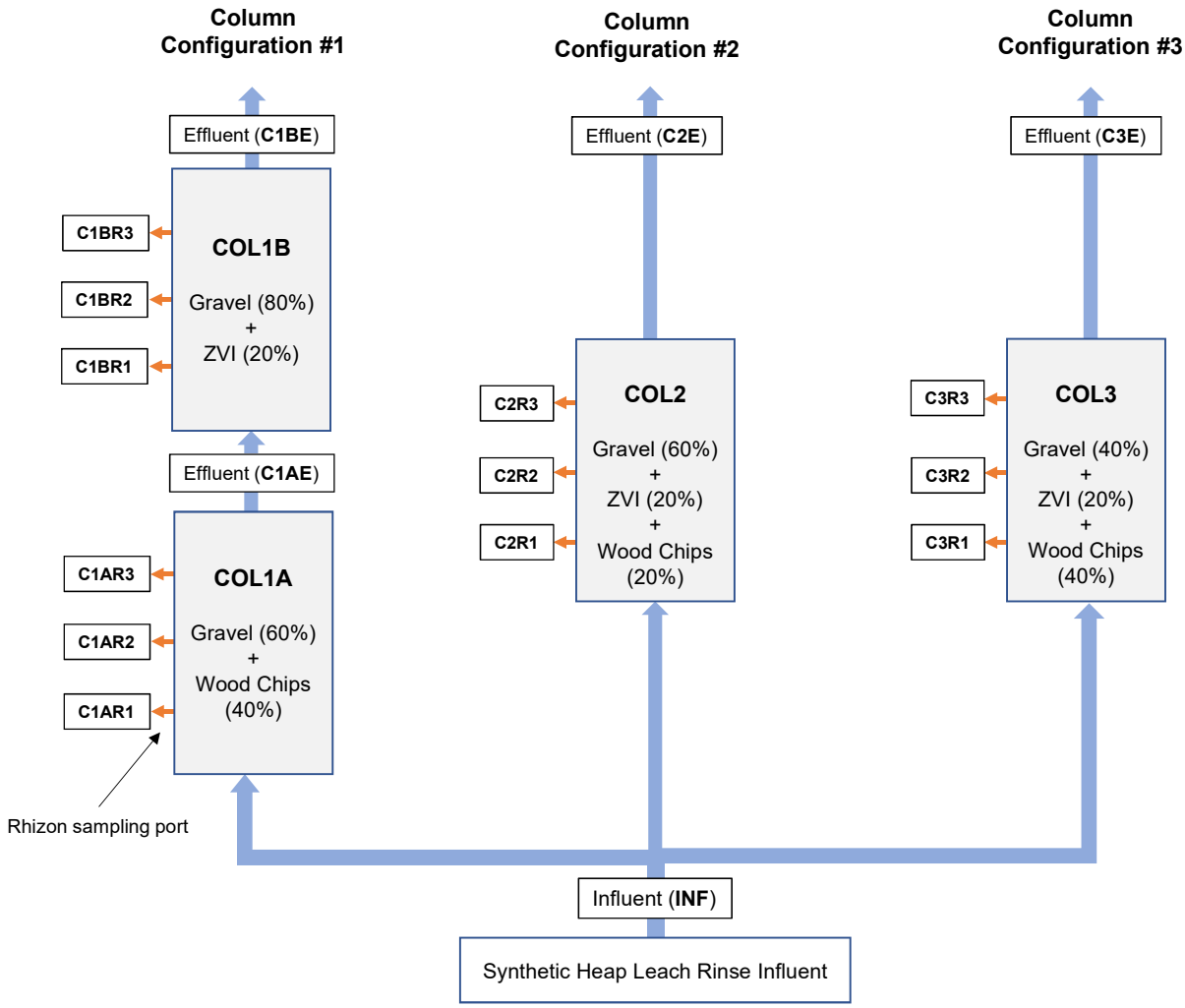


Figure 1-1: Column Study Configuration

This updated work plan presents information regarding column substrates and their characterization (Section 2), column construction and start-up activities (Section 3), the operational monitoring plan (Section 4), and record-keeping activities (Section 5). Equipment and materials required for the column study are outlined in Appendix A. Standard operating procedures (SOPs) for operating the columns are provided in Appendix B.

2. Substrate Specifications and Solid-Phase Test Work

The reactive medium for the column study will comprise a mixture of gravel and amendments (*e.g.*, organic carbon and/or ZVI) to promote conditions conducive to the removal of nitrate, arsenic and uranium. Wood chips represent an ideal source of organic carbon given their local availability and successful application in bioremediation systems. Specifications for these column substrates are presented in Table 2-1 below.

Table 2-1:
Substrate Material Specifications

Column Substrate	Specifications
Wood Chips	50% wood chunks shredded by the Wiley Mill + 50% splintered wood collected directly from the bucket
Gravel	¼"to ½" grain size
Zero Valent Iron	Connelly-GPM ETI CC-1004 (-8 + 50 mesh)

All substrate materials (gravel, wood chips, zero valent iron) will be characterized for solid-phase properties. Sample analysis will be conducted at SGS Laboratories in Burnaby, B.C. and will include:

- Acid-base-accounting (ABA), which includes neutralization potential, total-sulfur (S), sulfate-S, total inorganic carbon and total carbon (C).
    - Total S and C will be determined by infrared (IR) combustion (LECO).
    - Sulfate-S will be determined by acid leach (25% HCL) and analysis by inductively coupled mass spectrometry (ICP-MS).
- Aqua regia digestible metals analysis, which will determine solid-phase metal abundance by ICP-MS.
- Shake flask extraction (SFE) will be conducted using a 24-hour NanoPure water leach extraction test at a 3:1 liquid:solid ratio to provide a measure of readily soluble metals that will be immediately available for leaching upon exposure to infiltrating water.
- Total nitrogen (N) and phosphorus analysis (wood chips only).
    - Total N will be determined by infrared (IR) combustion (LECO).
    - Total phosphorus content will be determined by sodium peroxide flux and analysis by ICP-MS.

3. Column Construction and Start-Up

3.1 Column Construction

The columns will be constructed and operated at the Yukon Research Center laboratory in Whitehorse. The columns are Plexiglass cylinders (inner diameter = 10 cm, length = 30 cm, total volume = 2.36 L) with an inlet at the base and terminus (top) of each column. Three outlet ports for rhizon installation are pre-drilled along the length of each column (6-7 cm apart) and reinforced with 1 inch of plexiglass. The columns are designed such that influent enters from the bottom of the column and flows upward to reduce the potential of preferential pathway formation.

Saturated columns will be constructed with varying combinations of wood chips and gravel and a constant proportion of zero valent iron (Figure 1-1). Prior to packing the columns with the substrates, the bottom of each column is lined with a dispersion plate (*i.e.*, perforated disk), a sheet of non-reactive polyester fabric, and a layer of silica sand to allow for the even distribution of influent over the bottom of the column. Gravel will be rinsed with deionized water prior to use in column construction to remove fines or other residue on material surfaces. The density of wood chips, gravel and zero valent iron will be determined to convert column proportions to equivalents in substrate mass. Substrates will be manually mixed and transferred to the columns in 2-3 cm lifts to minimize heterogeneity and segregation. Each lift will be packed by hand to a similar density.

Rhizon samplers will be installed at intermediate distances along the columns by placing the packed columns on their side and inserting rhizons into the pre-drilled outlet ports. Outlet ports will be sealed with two-part epoxy and left to cure for one week. Epoxy will only be applied to the acrylic exterior of the column to ensure that effluent chemistry is not affected.

A list of equipment and materials for column construction and operations is presented in Appendix A.

3.2 Column Start-Up

Columns will be operated in the fridge at 4˚C. Influent to be used for column operation will be stored in in the fridge (at 4˚C) at least 3 days prior to being added to the influent container for refill; this will ensure that the temperature of influent is consistent with the temperature of the water within the columns to limit any potential disturbance to microbial populations.

The porosity of each column must be verified to determine the operational flow rate (based on a target hydraulic residence time of 4 days at the start of the experiment). The flow rate will be calculated by dividing the porosity by the target HRT. The porosity of the columns will be determined by measuring the volume of influent added to saturate the column substrates upon initiation of the experiment. This volume is subject to change slightly as the materials absorb water and slowly degas over the subsequent 7 days.

4. Operational Monitoring

4.1 Monitoring Plan and Sample Collection

The monitoring plan for the column study is presented in Table 4-1. Specific details regarding column operation and effluent and rhizon sampling procedures are outlined in SOP A through J (Appendix B).

4.2 Quality Assurance and Quality Control

Quality control protocols include monthly method blank samples collected from a blank column operated at the Lorax laboratory in Vancouver, and one blank sample collected during each sample collection week at the Yukon College laboratory. The method blank column is a column built with identical materials to the one used for this experiment and filled with deionized water. The corresponding sample is a full-suite analysis which captures leaching from column construction materials. The blank sample collected during a sampling week will be analyzed for only dissolved metals and anions to capture environmental variability or subsampling error as these parameters are most commonly subject to contamination.

Table 4-1:
Column Monitoring Plan

Parameter Group		Flow	General Chemistry	Dissolved Metals	Dissolved Mercury	Anions	Cyanide	Sulphide	Nutrients
Parameters		Flow Rate (Q)	EC, pH, Total Alkalinity	Full Suite (*e.g.*, D-Al, D-Sb, D-As, D-Se, D-Cd, D-Cr, D-Co, D-Cu, D-Fe, D-Pb, D-Mn, D-Mo, D-Ni, D-Se, D-S, D-U, D-Zn)	D-Hg	F, Cl, Br, SO_4, NO_3, NO_2	WAD-CN	H_2S	DOC, NH_3, TD-P
Bottle		N/A	60 mL HDPE	60 mL HDPE	40 mL glass vial	60 mL HDPE	60 mL UV-inhibited HDPE	60 mL HDPE	120 mL amber glass bottle
Preservative		N/A	None	Nitric Acid	Hydrochloric Acid	None	Sodium Hydroxide	Zinc Acetate + Sodium Hydroxide	Sulfuric Acid
Minimum Sampling Volume Required (mL)		N/A	25	25	15	15	15	15	20
Sampling Week	0*	INF & EFF	INF	INF	INF	INF	INF	INF	INF
	1	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	2	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	3	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	4	INF & EFF	INF & EFF	INF & EFF & RHZ	INF & EFF	INF & EFF & RHZ	INF & EFF	INF & EFF & RHZ	INF & EFF
	5	INF & EFF							
	6	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	7	INF & EFF							
	8	INF & EFF	INF & EFF	INF & EFF & RHZ	INF & EFF	INF & EFF & RHZ	INF & EFF	INF & EFF & RHZ	INF & EFF
	9	INF & EFF							
	10	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	11	INF & EFF							
	12	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF
	13	INF & EFF							
	14	INF & EFF	EFF	EFF & RHZ	EFF	EFF & RHZ	EFF	EFF & RHZ	EFF
	15	INF & EFF							
	16**	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF
	17	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	18	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	19	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	20	INF & EFF	INF & EFF	INF & EFF & RHZ	INF & EFF	INF & EFF & RHZ	INF & EFF	INF & EFF & RHZ	INF & EFF
	21	INF & EFF							
	22	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	23	INF & EFF							
	24	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF	INF & EFF
	25	INF & EFF	EFF	EFF	EFF	EFF	EFF	EFF	EFF
	26***	INF & EFF	EFF	EFF & RHZ	EFF	EFF & RHZ	EFF	EFF & RHZ	EFF

Notes:
1. INF = influent; EFF = effluent; RHZ = rhizons
2. When applicable, effluent and rhizons should be sampled as close together as possible (*i.e.*, on consecutive days
3. Flow rate is measured by the change in influent and effluent volumes during influent refill events, to be conducted at least once per week. Flow rates should closely align with the rate set on the pump.
* Influent addition marks experiment start time. Substrates should be saturated (without flow into columns) for 7 days.
** A planned flow rate change will occur in Week 16. Sample should be collected before the flow rate is increased.
*** End date of experiment to be finalized as it proceeds.

4.3 Leachate Analytical Testwork

Saturated column leachate and influent samples will be sent to ALS Environmental Laboratories (ALS) in Burnaby, B.C. for analysis in accordance with Table 4-2 below.

Table 4-2:
Summary of Analytical Methods

Parameter Group	Standard Method	Method Description
Dissolved Metals	APHA 3030B/6020A (mod)	Analysis by CRC ICP-MS.
Dissolved Mercury	APHA 3030B/EPA 1631E (mod)	Cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analysis by CVAAS or CVAFS.
Anions (nitrate, nitrite, sulphate, chloride, bromide, fluoride)	EPA 300.1 (mod)	Ion chromatography with conductivity and/or UV detection.
Cyanide (WAD only)	APHA Method 4500-CN I	In-line sample distillation with final determination by colourimetric analysis.
Sulphide	APHA 4500 -S E-Auto-Colorimetry	A continuous flow manifold adds HCl to the sample which converts sulphide to a gas, then the sulphide is separated from the flow using a gas dialysis membrane. A Colorimetric reaction produces a methylene blue compound which is measured at 660 nm.
Dissolved Organic Carbon (DOC)	APHA 5310B TOTAL ORGANIC CARBON (TOC)	High temperature combustion to convert carbonaceous material to CO_2 which is then analyzed by IR spectroscopy.
Ammonia (NH_3)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC	Flow-injection analysis with fluorescence detection.
Total Dissolved Phosphorus (TD-P)	APHA 4500-P Phosphorous	Persulphate digestion followed by colourimetric analysis .

Alkalinity, pH and conductivity will be measured in-house at the Yukon Research Center laboratory.

5. Record-Keeping

A summary of required record-keeping activities is presented in Table 5-1 below.

Table 5-1:
Summary of Required Record-Keeping Activities

Record Type	Purpose	Frequency of Record Collection and Submission to Lorax	Information to be Included
Daily Records (hard copy only)	Daily records are collected in a notebook to be shared with lab analysts managing the columns. This is where information regarding column operation, refill events, and observations regarding appearance, odours, and incidents should be noted.	Notes will be collected regularly and reviewed as column operation progresses. Complete records do not need to be digitized but notable events *(i.e.*, incidents or any changes to column operation) should be summarized and relayed to Lorax to aid interpretation of effluent results.	• The time when flow is stopped • The time when flow is initiated • The time when nitrogen purge is initiated • The time when nitrogen purge is completed • The time and change in flow rate during sample collection • The time and change back to the regular column operation flow rate • The time when sample collection is initiated • The time when sample collection is completed • Observations of changes in column appearance or odours • A detailed account of any occurrence of incidents and steps taken to troubleshoot the issue • Mass of effluent before refill • Mass of influent before refill • Mass of influent after refill
Sampling Records (hard copy and digital)	Sampling records contain information on the general chemistry of effluent and rhizon samples. These parameters are measured in-house as indicators of changes to chemical conditions (*i.e.*, redox state) that may be occurring in the columns.	Information will be collected following each sampling event. A digital version of the sampling records should be submitted to Lorax within one week after sample collection.	• Mass of sample collected • pH and conductivity calibration results • Conductivity measurement • pH measurement • Alkalinity measurement
Flow Records (digital only)	Flow records are collected to ensure that the intended flow rate is being achieved, and to track total influent and effluent volumes going through the columns. If there are (substantial) losses from the columns, this should also be included as estimates to best account for the total volume treated by the columns.	Information from the daily records relevant to flow records will be digitized and reviewed weekly. Digitized records should be submitted to Lorax on a biweekly basis.	• The time that flow is stopped before refill • The time that flow is initiated after refill • Mass of effluent before refill • Mass of influent before refill • Mass of influent after refill
Photos (digital only)	Photos of the columns should be collected on a biweekly basis to monitor physical changes occurring in the column substrates.	Photos should be submitted to Lorax on a monthly basis, or sooner if a notable observation is made.	• An indication of when the photos were taken • A description of changes documented by the photos (*i.e.*, precipitate formation)

Templates for record-keeping (*i.e.*, Daily Records, Sampling Records and Flow Records) and the Chain of Custody (COC) form to be used for sample submissions will be provided by Lorax in Excel format.

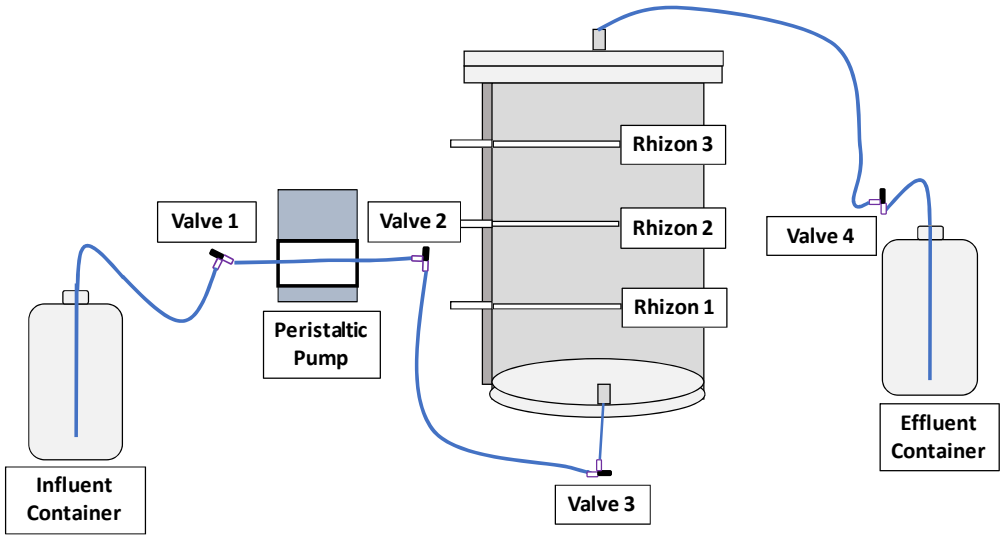
Appendix A: Equipment & Materials List for Column Study

Quantity	Item	Supplied By
Column Construction and Maintenance		
4	Acrylic columns (including dispersions plates, screws, nuts, gaskets)	Lorax
4	Polyester filter	Lorax
As required	Ottawa sand	Lorax
Extras to be included for maintenance	Tubing (PTFE and C-flex), valves, adapters, luers, port caps for column and sample bottle construction	Lorax
	Macrorhizon samplers (0.15 µm pore size) and two-way valves	Lorax
3	2-part epoxy for rhizon installation	Lorax
8	HDPE sample bottles (for bulk sampling)	Lorax
As needed	Plumber's (thread sealing) tape	Lorax
As needed	Cable zip-ties	Lorax
1	Power drill with bits	Lorax
1-2	Screwdriver and bits	Yukon College
1	Wrench (7/16")	Lorax
2	X-Acto (utility) knife	Yukon College
2	Lighter	Yukon College
1	Mallet	Lorax
2 packs	Nitrile gloves for column construction	Lorax
As needed	Plastic sheets for cone and quartering of column substrates	Yukon College
As needed	Equipment to mix the substrates before packing the column (*i.e.*, buckets or heavy-duty clear plastic bags)	Yukon College
Substrates for Column Construction		
1.5 kg	Wood chips	Lorax
12.3 kg	Gravel	Yukon College
4.6 kg	Zero Valent Iron	Yukon College
Column Operation		
As needed	HDPE drums (~200 L) to store bulk influent water	Yukon College
1	Peristaltic pump (high flow) to pump influent from drum containing bulk supply during refill events	Yukon College
6	HDPE influent and effluent containers with lids (4 L to 8 L capacity)	Yukon College
1-3	Peristaltic pump (low flow) for column operation	Yukon College

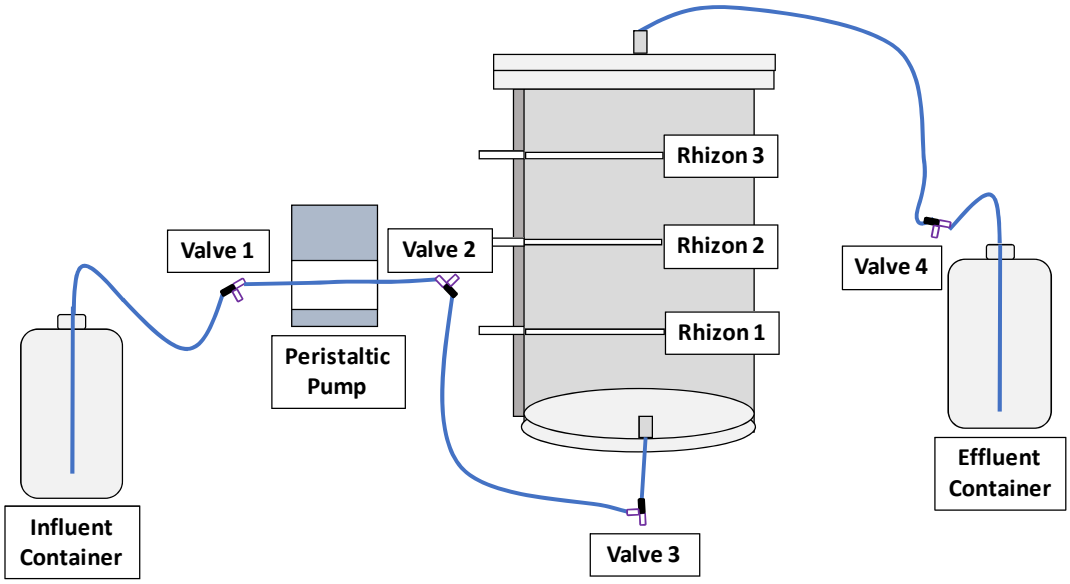
Quantity	Item	Supplied By
Extras to be included	Tubing for pump head	Yukon College
1	Scale (precision to at least 1 g) for influent refill and general sample collection	Yukon College
Effluent and Rhizon Sampling Equipment		
As needed	Nitrogen gas (industrial quality)	Yukon College
As needed	Regulator for nitrogen gas	Yukon College
As needed	Tubing to connect gas regulator to bulk sample bottles	Yukon College
As needed	0.45 µm cellulose acetate filter	ALS to YC
As needed	Sample containers (subsamples) for each suite of parameters	ALS to YC
As needed	Preservatives for each suite of parameters	ALS to YC
1	pH probe and meter	Yukon College
1	EC probe and meter	Yukon College
As needed	pH and EC calibration solutions to cover the range of effluent chemistry expected; recommended pH 4, 7 and 10 for pH measurements, and 84 and 1413 µS/cm for EC measurements	Yukon College
As needed	pH probe filling and storage solutions	Yukon College
1	Magnetic stirrer (for pH measurements)	Yukon College
2	Magnetic bars	Yukon College
As needed	Materials needed for alkalinity measurement (conducted by titration or using an indicator dye); standard method to be used throughout experimental period	Yukon College
1	Portable filter or in-situ ventilation *(TBD)*	Yukon College
General Labware and Other Materials		
As needed	Distilled water	ALS to YC
As needed	Mild acid (nitric or hydrochloric) for acid wash of non-disposable sampling equipment, according to standard method used in lab; recommended at least 0.1 M HCl and 3x rinse with DI water	Yukon College
2-3	Spray bottles	Yukon College
As needed	Standard labware/glassware (*i.e.*, clean weigh boats, beakers, volumetric flasks, burettes, *etc.*)	Yukon College
1-2	Pipettor (50 to 200 µL)	Yukon College
As needed	Pipette tips (clean but not sterile)	Yukon College
As needed	Vinyl gloves (for wet chemistry work)	Yukon College
As needed	Kimwipes (large size)	Yukon College
As needed	Parafilm	Yukon College
10 to start	Luer-lock syringes (50 mL)	ALS to YC
As needed	Pens and sharpie markers	Yukon College

Quantity	Item	Supplied By
As needed	Notebook(s)	Yukon College
As needed	Labels for columns and sample bottles	ALS to YC
1	Fridge to store in-house test samples for 1 month and potentially also influent water	Yukon College
As needed	Paper towels	Yukon College
As needed	Plastic bags for sample submission	Yukon College
As needed	Bubble wrap	ALS to YC
As needed	Coolers for sample submission	ALS to YC
As needed	Ice packs	ALS to YC
As needed	Packing tape	Yukon College

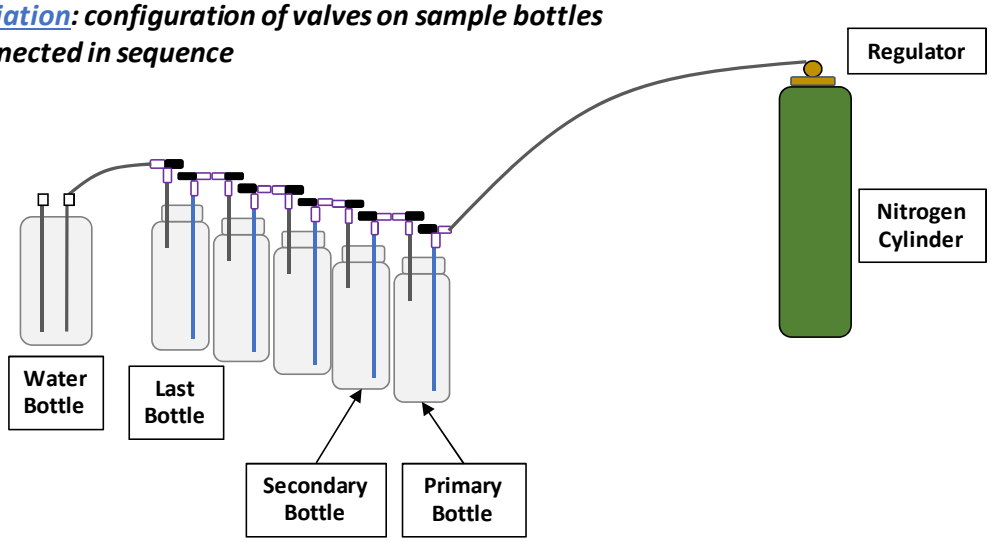
Appendix B:
Standard Operating Procedures for Column Study

A	**Initiating Flow through the Columns**
Purpose	To describe when and how flow through the columns should be initiated or re-initiated after a short- or long-term stop of flow.
Context	Initiating flow to the columns must be completed after stop of flow. When flow to the columns is stopped, valves along the tubing are closed off to prevent exposure of the column to oxidative conditions. Stop of flow is regularly conducted during influent refill or maintenance events (*i.e.*, replacement of tubing/luers/adapters/valves). The schematic shows the orientation of valves after flow has been initiated to the columns.
Procedure	1. Open the valve between the **Influent Container** and **Pump** (**Valve 1**) to allow flow through the tubing. 2. Start flow on the peristaltic pump at the designated pump rate. 3. Flush the valve after the **Pump** (**Valve 2**) by letting the influent overflow through the side port (the port not connected to the tubing), while the valve remains closed off in the direction of the column. This will allow any bubbles or precipitate built up in the lines to be flushed out and not introduced to the columns. Flow can be "maxed out" on the pump during flushing periods. 4. Once ~ 10 mL has been flushed through **Valve 2**, open the valve to allow flow in the direction of the column. 5. Flush **Valve 3** below the column. Once ~10 mL has been flushed through the side port, open **Valve 3** to allow flow into the column. 6. Once **Valves 1-3** have been opened, open **Valve 4** to allow effluent to collect in the **Effluent Container**. 7. Record the time when flow to the columns was initiated, and the flow rate applied in the daily records.
Schematic	 ***Three-way valve: Black indicates the direction to which flow is closed off***

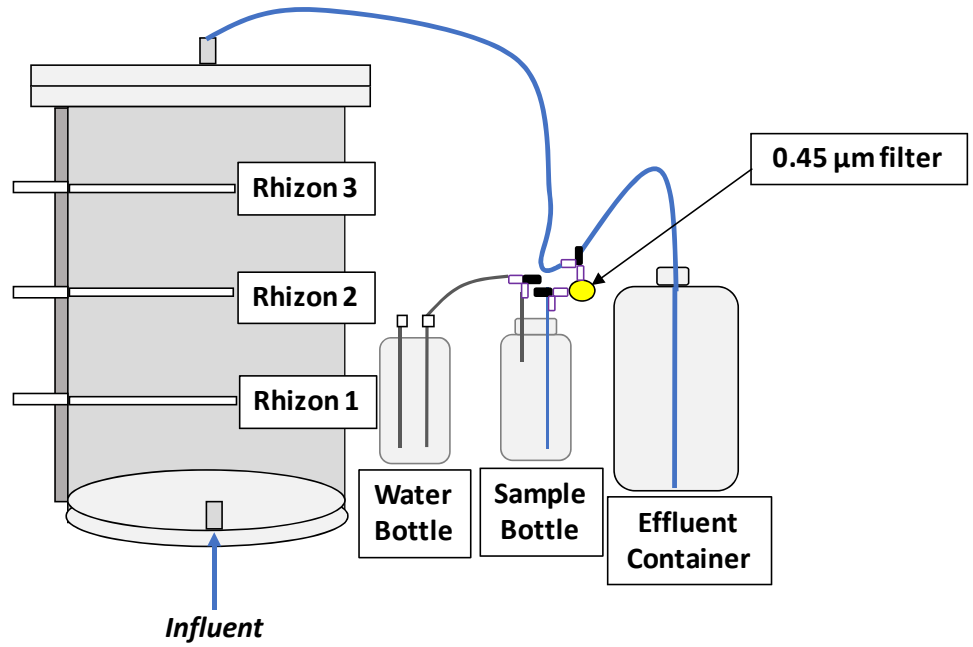
Record-Keeping	• Daily records:
	  ○ The time when flow was initiated to the columns.
	  ○ The flow rate applied to operate the columns.

B	**Stopping Flow through the Columns**
Purpose	To describe when and how flow to the columns should be stopped for an extended period of time (>5 minutes).
Context	Stopping flow to the columns will be done during influent refill events and if any column maintenance is needed. This is different from *pausing* the flow as this will be for an extended period of time, which will require valves along the tubing to be closed off to ensure that air is not introduced to the column. (If flow to the columns is stopped for <5 minutes, this can be achieved by pausing flow on the pump without closing off valves to the columns.) The schematic depicts the orientation of valves after flow to the columns has been stopped.
Procedure	1. Close off the valve between the column and the **Effluent Container** (**Valve 4**) in the direction of the column. 2. Close off **Valve 3** below the column in the direction of the column. 3. Close off **Valve 2** after the **Pump** in the direction of the column. 4. Pause flow on the **Pump**. 5. Close off **Valve 1** in the direction of the **Influent Container**. 6. Record the time when flow was stopped to the columns in the daily records.
Schematic	 ***Three-way valve: Black indicates the direction to which flow is closed off***
Record-Keeping	• Daily records: ○ The time when flow to the columns was stopped.

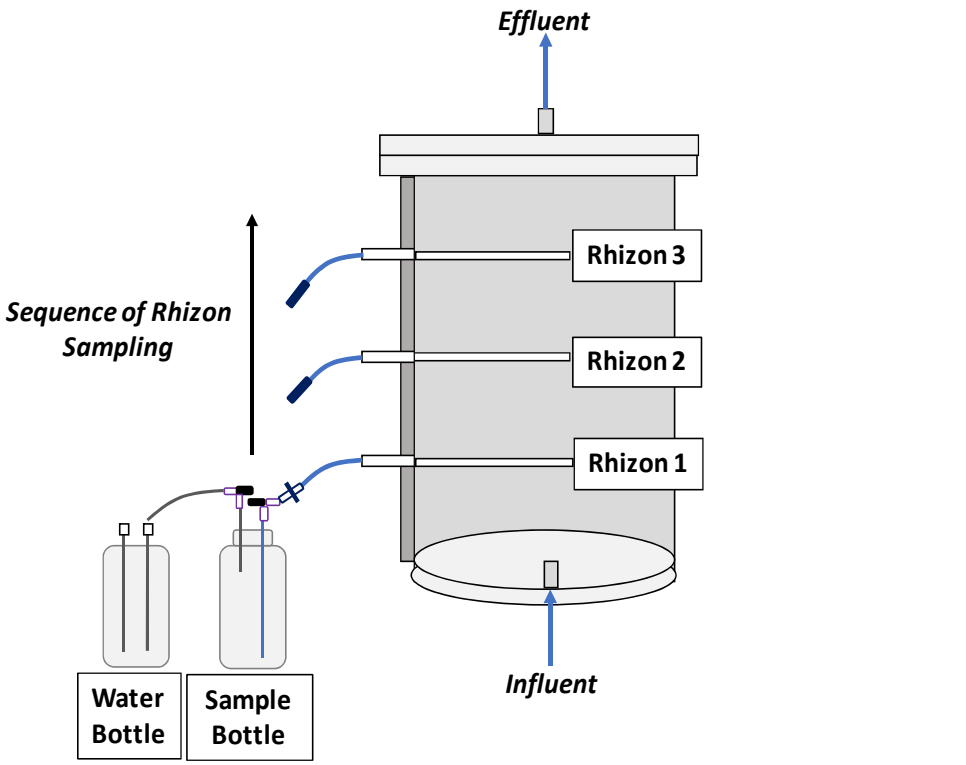
C	**Nitrogen-Purge of Sample Bottles**
Purpose	To describe how a nitrogen-purge of sample bottles is conducted prior to initiating effluent and rhizon sample collection. The nitrogen purge can be done on a single sample bottle, or on multiple bottles connected in sequence.
Context	The nitrogen-purge is conducted to remove oxygen from the sample bottles to limit the formation of oxidation artifacts during collection of effluent and rhizon samples from the columns. The schematic shows the orientation of the valves after the nitrogen purge has been initiated and terminated.
Procedure	<u>Initiation:</u> 1. Connect the long-tubing valve of the **Primary Bottle** in the sequence to the **Regulator**, as indicated in the schematic below. 2. Open the long-tubing valve of the **Primary Bottle** to allow gas into the bottle. 3. If the nitrogen purge is conducted for only one sample bottle, connect the short-tubing valve of the **Primary Bottle** to the **Water Bottle**, and open the valve. This will limit the introduction of oxygen through the short-tubing valve while allowing oxygen from the sample bottle to be vented as nitrogen gas is filling the bottle. If the nitrogen purge is conducted for multiple sample bottles, proceed to Step 4. Otherwise, proceed to Step 9. 4. Connect the long-tubing valve of the **Secondary Bottle** in the sequence to the short-tubing valve of the **Primary Bottle**. 5. Open the short tubing valve on the **Primary Bottle** to allow gas flow in the direction of the **Secondary Bottle.** 6. Open the long-tubing valve on the **Secondary Bottle** to allow gas flow into the sample bottle. 7. Repeat Steps 4 to 6 with all proceeding sample bottles connected in sequence. 8. Connect the short-tubing valve of the **Last Bottle** in the sequence to the **Water Bottle** and open the valve. 9. Check that all valves are opened in the right direction. 10. Open the **Regulator** to allow a steady stream of gas into the sample bottles. 11. Ensure that there are no leaks from the valves or lids of the sample bottles. Consistent bubbling from the **Water Bottle** will indicate that there is sufficient pressure coming through the sample bottles. 12. Continue the nitrogen-purge for 15 minutes per sample bottle 13. Record the start time of the nitrogen purge in the daily records. <u>Termination:</u> 1. Once the nitrogen purge is complete, disconnect the sample bottles from one another before closing off the **Regulator**. 2. Start with closing off the short-tubing valve of the **Last Bottle** in the sequence to the sample bottle. 3. Next, close off the long-tubing valve of the **Last Bottle** in the sequence to the sample bottle. Both short and long- tubing valves should be closed off to the bottle before disconnecting from the sequence. 4. Disconnect the long-tubing valve of the **Last Bottle** from the short-tubing valve of the preceding sample bottle. 5. Repeat Steps 2 to 4 until all sample bottles have been disconnected from each other, and the **Primary Bottle** has been disconnected from the **Regulator**.

C	**Nitrogen-Purge of Sample Bottles**
	6. Close off the **Regulator**. 7. Record the end time of the nitrogen purge in the daily records.
Schematic	***Initiation: configuration of valves on sample bottles connected in sequence***  ***Termination: Configuration of valves on a sample bottle, before it is disconnected from the sequence***  ***Three-way valve: Black indicates the direction to which flow is closed off***
Record-Keeping	• Daily records: o Start time of the nitrogen purge for the sample bottle(s). o End time of the nitrogen purge for the sample bottle(s).

D	**Effluent Sample Collection**
Purpose	To describe how effluent samples are to be collected through in-line filtration using a 0.45 µm cellulose acetate filter.
Context	If influent is already flowing through the columns, proceed with the following steps. If influent is not flowing through the columns, initiate flow per SOP A. Effluent sample collection should only be done following a nitrogen-purge of sample bottles as described in SOP C. The mass of the sample bottles are recorded on the bottles, allowing for the mass of the sample to be calculated by difference. Note that mass is used as a proxy for volume measurement. The schematic shows the orientation of valves after effluent sample collection has been initiated.
Procedure	1. If needed, increase the flow rate on the **Pump** during effluent sampling. Record the time for the change in flow rate along with the sampling flow rate in the daily records. 2. Once sample bottles have been disconnected from each other, following a nitrogen purge, take a **Sample Bottle** and 0.45 µm cellulose acetate **Filter** to the **Effluent Container** of the column designated for effluent collection. 3. Connect the **Filter** to the side port of the effluent valve (**Valve 4,** Schematic for SOP A). (The side port is the port that is not connected to the column or to the effluent container.) The filter should be attached ensuring that the reactive side of the filter is facing the direction that effluent will be passing into the **Sample Bottle**. 4. Turn **Valve 4** to allow flow from the column to enter the **Filter**, and closing off flow to the **Effluent Container**. 5. Connect the other side of the filter to the long-tubing valve of the **Sample Bottle**. 6. Connect the short-tubing valve of the **Sample Bottle** to the **Water Bottle** to allow nitrogen gas venting out of the sample bottle (during sample collection) to be released in water rather than open air to limit introduction of oxidation artifacts. 7. Repeat the set-up of **Filter** and **Sample Bottle** for all effluents to be sampled. 8. After set-up of the **Filter** and **Sample Bottle** are complete, wait until effluent has passed through the filter and the side port of the long-tubing valve of the sample bottle. This can take up to 10-20 minutes depending on the flow rate. 9. Once effluent is consistently passing through the side port of the long-tubing valve on the **Sample Bottle**, depressurize the sample bottle by first opening the short-tubing valve to allow gas to pass from the sample bottle to the **Water Bottle**. Then, open the long-tubing valve to allow effluent to enter the **Sample Bottle**. There is potential for filters to get clogged, particularly during the first few weeks of sampling when the columns have not reached equilibrium conditions. Troubleshooting a clogged filter is described in detail in SOP J. 10. Record the time when sample collection is initiated in the daily records. 11. Monitor the progress of effluent collection to ensure that the volume collected is consistent with the rate set by the pump. 12. Once sufficient volume of effluent has been collected (per the monitoring program in Table 4-1), disconnect the **Sample Bottle** by first closing off the short-tubing valve to the bottle, followed by closing off the long-tubing valve to the bottle. 13. Disconnect the **Sample Bottle** and **Filter** from **Valve 4.** Open up **Valve 4** to allow effluent to flow into the **Effluent Container**. Discard the filter. 14. Record the time when sample collection is completed in the daily records.

D	**Effluent Sample Collection**
	15. If the flow rate was changed during sampling, decrease the flow rate as needed for regular column operation. Record the time for the change in flow rate along with the column operation flow rate in the daily records. 16. Weigh the mass of sample bottle + effluent collected. Record the mass of effluent collected in the sampling records.
Schematic	 ***Three-way valve: Black indicates the direction to which flow is closed off***
Record-Keeping	• Daily records: o Start time of flow rate change and sampling flow rate. o End time of flow rate change and column operation flow rate. o Start time sample collection initiated. o End time sample collection completed. • Sampling records: o Mass of effluent sample collected.

E	**Rhizon Sample Collection**
Purpose	To describe how rhizon samples are to be collected without in-line filtration. The rhizon samplers are designed with porous glass fiber with a pore size of 0.15 µm.
Context	If influent is already flowing through the columns, proceed with the following steps. If influent is not flowing through the columns, initiate flow per SOP A. Rhizon sample collection should be conducted sequentially from the bottom to the top of the column. Rhizon sample collection can only be done following a nitrogen-purge of sample bottles as described in SOP C. The mass of the sample bottles are recorded on the bottles, allowing for the mass of the sample to be calculated by difference. Note that mass is used as a proxy for volume measurement. The schematic shows the orientation of valves on Rhizon 1 after sample collection has been initiated, while valves for Rhizons 2 and 3 remain closed.
Procedure	1. If needed, increase the flow rate on the **Pump** during effluent sampling. Record the time for the change in flow rate along with the sampling flow rate in the daily records. 2. Once sample bottles have been disconnected from each other, following a nitrogen purge, take a **Sample Bottle** to the rhizon port to be sampled. 3. Connect the (two-way valve) on the bottom-most rhizon (**Rhizon 1**) of the column to the long-tubing valve of the **Sample Bottle**. Open the two-way valve to allow flow out of the rhizon port. 4. Connect the short-tubing valve of the **Sample Bottle** to the **Water Bottle** to allow nitrogen gas venting out of the sample bottle (during sample collection) to be released in water rather than open air to limit introduction of oxidation artifacts. 5. Repeat the set-up for **Sample Bottle** for all Rhizons (on other columns) to be sampled. 6. After set-up of the **Sample Bottle** is complete, wait until effluent has passed through the side port of the long-tubing valve on the sample bottle. This can take up to 10-20 minutes depending on the flow rate. 7. Once effluent is consistently passing through the side port of the long-tubing valve on the **Sample Bottle**, depressurize the sample bottle by first opening the short-tubing valve to allow gas to pass from the sample bottle to the **Water Bottle**. Then, open the long-tubing valve to allow effluent to enter the **Sample Bottle**. 8. Record the time when sample collection is initiated in the daily records. 9. Monitor the progress of rhizon sample collection to ensure that the volume collected is consistent with the rate set by the pump. 10. Once sufficient volume of effluent has been collected (per the monitoring program in Table 4-1), disconnect the **Sample Bottle** by first closing off the short-tubing valve to the bottle, followed by closing off the long-tubing valve to the bottle. 11. Disconnect the **Sample Bottle** from the two-way rhizon valve. Close off the two-way valve. 12. Record the time when sample collection is completed in the daily records. 13. Weigh the mass of sample bottle + rhizon sample collected. Record the mass of rhizon sample collected in the sampling records. 14. Conduct a nitrogen purge of sample bottles for the next set of **Rhizon x** samples to be collected (per SOP C). 15. Repeat Steps 2-11 to collect **Rhizon x** samples. 16. At the end of the sampling event, if the flow rate was changed during sampling, decrease the flow rate as needed for regular column operation. Record the time for the change in flow rate along with the column operation flow rate in the daily records.

E	**Rhizon Sample Collection**
Schematic	 ***Three-way valve: Black indicates the direction to which flow is closed off*** ***Two-way valve: Vertical position of navy bar indicates that valve is closed*** ***Horizontal position of navy bar indicates that valve is open***
Record-Keeping	• Daily records: o Start time of flow rate change and sampling flow rate. o End time of flow rate change and column operation flow rate. o Start time sample collection was initiated (for set each Rhizon x). o End time sample collection was completed (for each set of Rhizon x). • Sampling records: o Mass of rhizon sample collected.

<table>
<tr><th>F</th><th>Subsampling and Sample Preservation</th></tr>
<tr><td>Purpose</td><td>To describe how effluent and rhizon samples should be subsampled and preserved prior to submission to ALS Laboratories.</td></tr>
<tr><td>Context</td><td>Subsampling is the process of portioning out the bulk volume collected from the columns to smaller volumes for analysis of specific groups of parameters. The subsamples are grouped according to the container and preservative needed to properly store the sample prior to analysis. These include dissolved metals, dissolved mercury, anions, cyanide, sulphide and nutrients.</td></tr>
<tr><td>Procedure</td><td>
1. Prepare sample labels with information regarding the sample ID, sample collection date, parameter(s) to be analyzed, and preservative added.
2. Prepare sample containers as advised by ALS. (Note that orders for sample containers should be done at least one week in advance as limited stock is available at ALS Whitehorse).
3. The following table describes the parameter groups, minimum volumes, sample container and preservative to be used for subsampling. It is recommended that preservatives be added to sample containers right before subsampling is conducted . Note that there are two parts to the sulphide preservative; the second part is to be added after the sample has been poured into the container.
<table>
<tr><th>Parameter Group</th><th>Minimum Volume</th><th>Sample Container</th><th>Preservative</th><th>Volume of Preservative (µL)</th></tr>
<tr><td>General Chemistry (pH, EC, alkalinity)</td><td>25</td><td>60 mL HDPE</td><td>None</td><td>N/A</td></tr>
<tr><td>Dissolved Metals</td><td>25</td><td>60 mL HDPE</td><td>Nitric Acid</td><td>100</td></tr>
<tr><td>Dissolved Mercury</td><td>15</td><td>40 mL glass vial</td><td>Hydrochloric Acid</td><td>100</td></tr>
<tr><td>Anions</td><td>15</td><td>60 mL HDPE</td><td>None</td><td>N/A</td></tr>
<tr><td>Cyanide (WAD only)</td><td>15</td><td>60 mL UV-inhibited HDPE</td><td>Sodium Hydroxide</td><td>200</td></tr>
<tr><td>Sulphide</td><td>15</td><td>60 mL HDPE</td><td>Zinc Acetate (first) + Sodium Hydroxide (second)</td><td>100 of each</td></tr>
<tr><td>Nutrients (DOC, NH_3, TD-P)</td><td>20</td><td>120 mL amber glass bottle</td><td>Sulfuric Acid</td><td>100</td></tr>
</table>
4. To set-up sample containers prior to subsampling, the following are recommended:
   - Order the samples in a consistent sequential manner to reduce chances of error.
   - Order the parameter groups in a consistent sequential manner to reduce chances of cross-contamination of preservatives.
   - Remove all lids for sample containers prior to subsampling to be able to subsample as quickly as possible. Cap the lids to the containers right after subsampling for an individual sample is completed.
5. Once preservative has been added to all sample containers, initiate subsampling. Invert the bulk sample bottle twice and pour out the recommended volume for each parameter group, ensuring that this process is completed within ~ 1 minute.
6. Pipet sodium hydroxide into the sulphide container. Close all sample containers.
7. Once subsampling has been completed, collect all General Chemistry subsamples and set them aside for in-house testing of pH, conductivity and alkalinity. This will be described in greater detail in SOP H.
</td></tr>
</table>

F	Subsampling and Sample Preservation
	8. Prepare all other parameter group subsamples to be packed up in coolers for submission to ALS. Ensure that all lids have been capped firmly, and that glass vials are wrapped in bubble wrap. The process of sample submission to ALS will be described in greater detail in SOP G. 9. Clean the sample bottles by using a mild acid rinse (hydrochloric or nitric) followed by three rinses of deionized water. Ensure that the long-tubing valve is also thoroughly rinsed. Air-dry the sample bottles. If any discolouration or precipitation is observed on the sample bottle, tubing or valves, replace the item prior to using the sample bottle for sample collection. Replacement of the sample bottle should be done every three months regardless of any observation of discolouration.

G	**Sample Submission to ALS Laboratories**
Purpose	To describe how samples and documentation should be prepared for sample submission to ALS Laboratories.
Context	A chain of custody form (COC) releases samples to ALS Laboratories upon submission and allows the client to track the samples submitted and analytical testwork requested. A complete and updated COC form is needed for each sample submission and is followed up with a Sample Receipt Confirmation (SRC) form once the samples have been logged into the ALS system.
Procedure	1. Prepare a Chain of Custody (COC) form to submit to ALS. The COC form should be updated as needed for the sampling event (*i.e.*, sample IDs, sample collection date and time, parameters to be analyzed, lab analyst ID, and release times, etc.). 2. Email the ALS Account Manager to schedule a time for sample pick-up. Note that samples should be picked up as soon as possible following preservation, as nutrient parameters (*i.e.*, nitrogen species) have short hold times of three days. It is recommended that samples be submitted to ALS Whitehorse on the same day that they are collected. Samples need to be in the lab by 3 pm to make the flight to YVR for pick-up the following morning. If this cut-off time is missed, samples can be dropped at the airport and the waybill and information regarding ETA to YVR can be relayed to the Account Manager. 3. If samples need to be kept for some time prior to submission, this should be done following preservation in the fridge at 4°C. 4. Once samples have been subsampled and preserved (per SOP F), place the COC form and samples in a cooler with ice packs. Double-check that the total number of sample containers to be submitted matches the COC form. 5. Ensure that samples are picked up by ALS at the scheduled time. 6. A Sample Receipt Confirmation (SRC) form will be emailed to you once the samples are formally logged into the ALS system. This may take 1-2 business days to receive. Review the SRC form to ensure that there are no issues with sample integrity—this will be explicitly indicated in the email and SRC form.
Record-Keeping	• A digital copy of the COC form

H	In-House Tests for pH, Conductivity and Alkalinity
Purpose	To describe how in-house tests for pH, conductivity (EC) and alkalinity should be conducted on the General Chemistry subsample.
Context	Measurements for pH, conductivity and alkalinity are done in-house to best capture effluent chemistry at the time of collection as these parameters are known to change quickly over time. Prior to measurement of these parameters, all equipment and glassware should be properly cleaned and calibrated for use. A specific procedure has not been included for alkalinity measurement as this can be done multiple ways, depending on whatever method is standard practice in the lab. It is recommended that whatever method is selected to measure alkalinity stay consistent throughout the duration of the experiment.
Procedure	1. Calibration of the pH and EC probes should be completed prior to every instance of conducting in-house tests. A three-point calibration at pH 4, 7 and 10 is recommended, and (at least) a two-point calibration for EC at 84 and 1413 µS/cm. 2. After calibration has been completed, take a pH and EC reading of one of the respective calibration solutions. Record the pH and EC readings in the sampling records. 3. If applicable, collect an alkalinity sample from the General Chemistry subsample prior to measuring pH and EC. 4. Conduct the EC measurement on the sample first by placing the probe into the effluent sample and waiting until a stable reading is shown on the meter. Record the EC measurement of the sample in the sampling records. 5. Measure pH on the sample by placing a magnetic stir bar into the container and waiting for a stable reading on the meter while the sample is stirred on the magnetic plate. Record the pH measurement of the sample in the sampling records. 6. Measure total alkalinity of the sample. Record the alkalinity measurement of the sample in the sampling records. 7. Repeat Steps 2-5 for all samples to be measured for in-house tests. 8. After all samples have been tested, collect the samples in a plastic bag and label the bag with the date and sample IDs. Place samples in the fridge at 4°C. Keep samples until the analytical results have been reviewed by Lorax. 9. Clean all glassware and equipment used to conduct the testwork. This can be done by using a mild acid rinse (hydrochloric or nitric) followed by three rinses of deionized water. Air dry the materials.
Record-Keeping	• Sampling records: o pH and EC calibration results. o EC measurement. o pH measurement. o Alkalinity measurement.

I	**Influent Refill and Flow Records**
Purpose	To describe how influent is refilled for column operation.
Context	Influent refill should be conducted at least once per week to ensure there is sufficient influent for column operation, and to have at least one flow rate measurement per week. Flow records are based on the volume of influent treated and on the volume of effluent generated over a set period of time. Accurate flow records are necessary to evaluate column performance and ensure that the design HRT is being met. The mass of influent and effluent containers are recorded on the containers prior to initiating the experiment, allowing for the mass of the sample to be calculated by difference. Note that mass is used as a proxy for volume measurement.
Procedure	1. Thoroughly mix the bulk influent supply prior to collecting the volume needed for refill to ensure that water chemistry of the influent collected is representative. 2. Collect the volume of influent needed and keep this volume in the fridge at the same temperature as the columns for at least three days prior to use. 3. Operation of columns will be stopped during a refill event. This should be done according to SOP B. Record the time that flow through the columns was stopped in the daily records. 4. Collect all effluent containers and weigh the mass of the container + effluent collected. Record the mass of effluent collected in the daily records. 5. Toss the collected effluent down the sink followed by copious amounts of tap water. Return the effluent containers. 6. Collect the influent container for a column and weigh the mass of the container + influent remaining. Record the mass of influent remaining in the daily records. 7. Fill the influent container to the top and weigh the mass of the container + total influent. Record the total mass of influent in the daily records. Return the influent containers. 8. Repeat Steps 6-7 for all columns. 9. Once the refill is complete, re-initiate flow to the columns per SOP A. 10. Record the time when flow was re-initiated to the columns in the daily records.
Record-Keeping	• Daily records to be used for calculation in flow records: o the time when flow to the columns was stopped. o the time when flow to the columns was re-initiated. o mass of effluent before refill. o mass of influent before refill. o mass of influent after refill.

<table>
<tr><th>J</th><th colspan="3">Column Maintenance and Troubleshooting</th></tr>
<tr><td>Purpose</td><td colspan="3">To outline common column maintenance issues and options for troubleshooting.</td></tr>
<tr><td>Context</td><td colspan="3">Column maintenance involves visual inspection of how flow is passing through the column and tubing to determine whether replacement of equipment is needed over time. As the experiment progresses, precipitate can form in the tubing and impede flow to the columns, influencing the design HRT for the experiment. Further, leaks and inadvertent introduction of air to the columns can occur if not carefully and actively prevented.</td></tr>
<tr><td>Procedure</td><td colspan="3">1. Make observations on column performance and note anything that may be occurring out of place. This includes regularly using pictures to document any visible changes to column substrates (i.e., the formation of precipitate or discolouration).
2. If a problem is encountered, locate the specific blockage or leak.
3. Address the problem by referring to the table below which lists common problems and corresponding options for troubleshooting:
<table>
<tr><th>Problem</th><th>Observation</th><th>Steps for Troubleshooting</th></tr>
<tr><td>Filter Clogging During Sample Collection</td><td>Effluent sample not passing through the filter after a significant amount of time has passed. Effluent volume collecting at a much slower rate in the sample bottle compared to the rate set on the pump.</td><td>Close off the short-tubing valve on the sample bottle, followed by the long-tubing valve on the sample bottle. Remove the filter and if effluent gushes out due to back pressure, this affirms that the filter was clogged. Replace the filter as quickly as possible and reconnect the filter to the long-tubing valve. Wait for effluent to pass through the side port of the long-tubing valve before opening the short-tubing valve to the water bottle, and opening the long-tubing valve to allow effluent to collect in the sample bottle.</td></tr>
<tr><td rowspan="2">Leaking</td><td>Effluent seeping through the sides of the column lid or ponding at the base of the adapter on the top of the lid.</td><td>Tighten the screws and adapter on the lid of the column.</td></tr>
<tr><td>Effluent dripping along the side of the column or at the tip of the rhizon port.</td><td>Ensure that the seal (between the rhizon and the column) made by the epoxy is holding. If not, flow will have to be stopped (per SOP B) and the column will have to be taken offline, placed on its side and epoxy will be applied and left to set for 24 hours. If the seal is holding, ensure that the lid of the rhizon port is capped tightly. If the lid has been compromised, replace it with a spare.</td></tr>
<tr><td>Kinking of the HDPE Tubing</td><td>Leaking or flow being impeded at a connection between the HDPE tubing and a luer.</td><td>Stop the flow per SOP B, cut off the section of tubing that is kinked and replace the luer as quickly as possible.</td></tr>
<tr><td>Influent Tubing Slipped out of Solution</td><td>Headspace filled with air may be evident in the column, or effluent volume generated</td><td>Stop flow per SOP B and fix placement of influent tubing or add more influent (depending on what is needed). Re-initiate</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>may be much less than typically observed.</td><td>flow to the column per SOP A after flushing air out of the lines.</td></tr>
<tr><td>Clogging in Valves/ Luers/ Adapters/ Tubing</td><td>Effluent volume may be less than typically observed. Leaking may also occur due to back pressure building up at the connectors.</td><td>Stop flow per SOP B, replace the column part as quickly as possible, and re-initiate flow per SOP A.</td></tr>
</table>
4. Record observations on the problem/incident in the daily records noting the time it occurred; a description of the problem/incident; potential impacts on the columns; the time when flow was stopped or initiated (if applicable); and an estimate of the volume of water lost from the system (if applicable).
</td></tr>
<tr><td>Record-Keeping</td><td>

Daily records:

The time when the issue or incident occurred or was noticed.
A description of the issue or incident and steps taken to troubleshoot the problem.
A description of any potential impact(s) on the column(s).
The time when flow stop and/or start occurred (if applicable).
Estimate of volume of water lost (if applicable).

Photos:

An indication of when the photos were taken.
A description of changes documented by the photos.

</td></tr>
</table>

Appendix B: Static Test Results for Column Materials

Newmont™

CLIENT : Lorax
PROJECT : Kaminak Coffee Gold (Lorax Project # A362-1)
SGS Project # : 1416
Test : Modified Acid-Base Accounting
Date : December 29, 2020 (revised 11 Apr 2022)

Sample ID	Paste	TIC	CaCO3	C(T)	N(T)	S(T)	S(SO4)	S(S-2)	Insoluble S	AP	Modified	Net Modified	Fizz Test
	pH	%	NP	%	%	%	%	%	%		NP	NP	
Method Code	Sobek	CSB02V	Calc.	CSA06V	AOAC 993.13	CSA06V	CSA07C1	CSA08C1	Calc.	Calc.	Modified	Calc.	Sobek
LOD	0.20	0.01	#N/A	0.005	0.20	0.005	0.01	0.01	#N/A	#N/A	0.5	#N/A	#N/A
Wood Chips	-	<0.01	<0.8	47.58	0.3	0.259	-	-	-	-	-	-	-
Gravel Rock	8.39	0.46	38.3	0.515		0.158	<0.01	0.11	0.05	3.4	48.5	45.1	Slight
Zero Valent Iron	7.40	<0.01	<0.8	3.022		0.101	<0.01	0.01	0.09	0.3	65.6	65.3	Slight
Duplicates													
Wood Chips		<0.01		47.75		0.275							
Gravel Rock	8.38										48.3		Slight
Zero Valent Iron							<0.01	0.01					
QC													
GS314-2				5.296		2.603							
OREAS 278								0.72					
RTS-3A							0.96						
SY4		0.9											
NBM-1											41.5		Slight
Expected Values		0.91		5.15		2.56	0.98	0.699			40.4		Slight
Tolerance +/-		0.07		0.27		0.14	0.12	0.060			2.2		

Note:

AP = Acid potential in tonnes CaCO3 equivalent per 1000 tonnes of material. AP is determined from the measured sulphide sulphur content.

NP = Neutralization potential in tonnes CaCO3 equivalent per 1000 tonnes of material.

NET Modified NP = Modified NP - AP

Carbonate NP is calculated from TIC originating from carbonate minerals and is expressed in kg CaCO3/tonne.

Sulphate Sulphur determined by 25% HCl Leach with S by ICP Finish.

Sulphide Sulphur determined by Sobek 1:7 Nitric Acid Leach with S by ICP Finish.

Insoluble S is acid insoluble S (Total S - (Sulphate S + Sulphide S)).

CLIENT : **Lorax**
PROJECT : **Kaminak Coffee Gold (Lorax Project # A362-1)**
SGS Project # : **1416**
Test : **Metals by Aqua Regia Digestion with ICP-MS Finish**
Date : **December 29, 2020 (revised 11 Apr 2022)**

Sample ID	Ag	Al	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Sr	Ti	V	Zn	Zr	As	Be	Bi	Cd	Ce
	mg/kg	%	ppm	%	ppm	ppm	%	%	ppm	%	ppm	%	ppm	%	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	ICP21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20
LOD	0.01	0.01	5	0.01	1	0.5	0.01	0.01	1	0.01	2	0.01	1	0.01	0.01	0.5	0.01	1	1	0.5	1	0.1	0.02	0.01	0.05
Wood Chips	0.02	0.03	23	0.31	15	9.6	0.08	0.12	<1	0.05	53	0.02	1	0.03	0.02	16.1	<0.01	1	57	<0.5	4	<0.1	<0.02	0.4	0.57
Gravel Rock	0.08	1.58	184	2.2	100	27.2	2.8	0.25	14	1.1	429	0.11	18	0.1	0.16	98.4	0.15	72	51	8.7	8	0.3	0.09	0.14	24.57
Zero Valent Iron	0.36	0.01	<5	0.03	1564	4236	85.14	<0.01	<1	0.02	3647	0.01	1186	0.03	0.05	1.7	0.01	136	24	<0.5	37	<0.1	0.2	1.35	22.91
Duplicate																									
Zero Valent Iron	0.36	0.01	<5	0.03	1470	4253	87.25	<0.01	<1	0.02	3516	<0.01	1176	0.03	0.05	1.7	0.01	133	27	0.7	36	<0.1	0.24	1.46	24.72
QC																									
OREAS 260	0.15	1.35	152	0.92	49	45.2	3.73	0.29	22	0.62	453	0.09	71	0.04	0.08	14.3	<0.01	24	129	14.1	16	1.1	0.52	0.23	57.7
Expected Values	0.146	1.33	151	0.885	49.2	46.5	3.73	0.285	21.5	0.593	450	0.082	75	0.04	0.077	14.8	BDL	22.0	125	12.6	12.5	1.24	0.54	0.21	55
Tolerance (%)	30.77	12.80	20.12	14.46	16.31	13.55	11.33	23.08	24.25	14.55	11.76	46.15	14.29	66.67	66.67	20.32	BDL	23.9	12.77	#N/A	35.29	35.07	20.41	27.03	#N/A

Sample ID	Co	Cs	Ga	Ge	Hf	Hg	In	La	Lu	Mo	Nb	Pb	Rb	Sb	Sc	Se	Sn	Ta	Tb	Te	Th	Tl	U	W	Y	Yb
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20	IMS21B20
LOD	0.1	0.05	0.1	0.1	0.05	0.01	0.02	0.1	0.01	0.05	0.05	0.2	0.2	0.05	0.1	1	0.3	0.05	0.02	0.05	0.1	0.02	0.05	0.1	0.05	0.1
Wood Chips	0.3	<0.05	0.4	<0.1	0.05	0.03	<0.02	0.3	<0.01	0.38	0.21	1.2	1	0.1	0.2	<1	<0.3	<0.05	<0.02	<0.05	0.1	<0.02	<0.05	<0.1	0.15	<0.1
Gravel Rock	10.3	1.4	6.4	0.3	0.3	0.01	<0.02	12.1	0.1	1.98	0.49	7.3	13.2	0.41	4.4	<1	0.5	<0.05	0.29	<0.05	5.5	0.14	1.17	0.2	8.29	0.7
Zero Valent Iron	62	<0.05	9.4	2.3	0.08	0.03	<0.02	12.1	<0.01	2722	20.58	44.5	<0.2	8.23	2.6	<1	284	<0.05	<0.02	0.89	<0.1	<0.02	<0.05	12.7	0.12	<0.1
Duplicate																										
Zero Valent Iron	65.6	<0.05	9.6	2.1	0.09	0.05	<0.02	14.2	<0.01	2549	17.23	20.5	<0.2	8.09	1.6	<1	286	<0.05	<0.02	0.62	<0.1	<0.02	<0.05	12.5	0.13	<0.1
QC																										
OREAS 260	34.9	3.2	4	0.3	0.39	0.04	0.03	28.9	0.14	0.38	<0.05	29.9	20.3	1.37	3.3	<1	0.6	<0.05	0.51	0.07	11.5	0.21	1.34	<0.1	12.47	0.9
Expected Values	32.10	3.12	5.05	BDL	0.33	0.047	0.027	28.1	0.140	0.43	BDL	30.7	21.2	1.32	3.39	BDL	0.62	BDL	0.52	0.081	11.30	0.22	1.29	BDL	11.7	0.99
Tolerance (%)	11.39	#N/A	16.04	BDL	#N/A	#N/A	90.91	#N/A	33.33	49.28	BDL	12.35	#N/A	21.85	19.06	BDL	#N/A	BDL	21.28	89.66	13.01	37.84	21.46	BDL	11.76	42.94

CLIENT : **Lorax**
PROJECT : **Kaminak Coffee Gold (Lorax Project # A362-1)**
SGS Project # : **1416**
Test : **24 Hour Nanopure Water Leach Extraction Test at 3:1 Liquid to Solid Ratio**
Date : **December 29, 2020**

Leachate Analysis

					Zero	
Sample ID			**Wood Chips**	**Gravel Rock**	**Valent**	**Blank**
					Iron	
Parameter	**Method**	**Units**				
Volume Nanopure Water		mL	1000	750	750	750
Sample Weight		g	250	250	250	-
pH	meter		4.50	7.44	6.62	6.02
Redox	meter	mV	331	360	375	-
Conductivity	meter	uS/cm	1019	68	45	1
Acidity (to pH 4.5)	titration	mg CaCO3/L	5.3	#N/A	#N/A	-
Total Acidity (to pH 8.3)	titration	mg CaCO3/L	298.9	2.5	3.1	-
Alkalinity	titration	mg CaCO3/L	#N/A	25.4	2.9	-
Chloride		mg/L	37	< 2	8.5	
Fluoride		mg/L	< 0.06	< 0.06	0.24	
Total CN		mg/L	< 0.01	< 0.01	< 0.01	-
WAD CN		mg/L	< 0.01	< 0.01	< 0.01	-
Nitrate (as N)		mg/L	< 0.6	-	-	
Nitrite (as N)		mg/L	< 0.75	-	-	
NH3+NH4 (as N)		mg/L	1.1	-	-	
Sulphate	Turbidity	mg/L	4	2	2	-
Ion Balance						
Major Anions	Calc	meq/L	2.61	0.55	0.35	#N/A
Major Cations	Calc	meq/L	13.39	0.74	0.54	#N/A
Difference	Calc	meq/L	-10.79	-0.19	-0.19	#N/A
Balance (%)	Calc	%	-67.4%	-15.0%	-21.4%	#N/A
Dissolved Metals						
Hardness CaCO3		mg/L	294	27.8	13.1	-
Aluminum Al	ICP-MS	mg/L	1.10	0.093	0.001	-
Antimony Sb	ICP-MS	mg/L	< 0.0009	< 0.0009	< 0.0009	-
Arsenic As	ICP-MS	mg/L	0.183	0.0019	0.0002	-
Barium Ba	ICP-MS	mg/L	0.269	0.00929	0.00328	-
Beryllium Be	ICP-MS	mg/L	0.000170	< 0.000007	< 0.000007	-
Bismuth Bi	ICP-MS	mg/L	< 0.000007	< 0.000007	< 0.000007	-
Boron B	ICP-MS	mg/L	0.433	0.012	0.413	-
Cadmium Cd	ICP-MS	mg/L	0.00342	0.000004	0.000018	-
Calcium Ca	ICP-MS	mg/L	75.3	9.59	3.85	-
Chromium Cr	ICP-MS	mg/L	0.04433	< 0.00008	< 0.00008	-
Cobalt Co	ICP-MS	mg/L	0.006890	0.000101	0.000009	-
Copper Cu	ICP-MS	mg/L	0.124	0.0011	< 0.0002	-
Iron Fe	ICP-MS	mg/L	1.41	0.008	< 0.007	-
Lead Pb	ICP-MS	mg/L	0.00364	0.00002	0.00001	-
Lithium Li	ICP-MS	mg/L	0.0058	0.0008	0.0008	-
Magnesium Mg	ICP-MS	mg/L	25.7	0.932	0.839	-
Manganese Mn	ICP-MS	mg/L	1.86	0.00775	0.0161	-
Mercury Hg	ICP-MS	ug/L	< 0.01	< 0.01	< 0.01	-
Molybdenum Mo	ICP-MS	mg/L	0.00648	0.00142	0.0314	-
Nickel Ni	ICP-MS	mg/L	0.0162	0.0021	0.0003	-
Phosphorus P	ICP-MS	mg/L	15.3	< 0.003	< 0.003	-
Potassium K	ICP-MS	mg/L	244	1.66	1.18	-
Selenium Se	ICP-MS	mg/L	0.00039	0.00012	< 0.00004	-
Silicon Si	ICP-MS	mg/L	1.81	0.72	0.44	-
Silver Ag	ICP-MS	mg/L	< 0.00005	< 0.00005	< 0.00005	-
Sodium Na	ICP-MS	mg/L	22.2	3.11	3.13	-
Strontium Sr	ICP-MS	mg/L	0.430	0.0465	0.00678	-
Sulphur (S)	ICP-MS	mg/L	26	3	3	-
Thallium Tl	ICP-MS	mg/L	0.000070	< 0.000005	< 0.000005	-
Tin Sn	ICP-MS	mg/L	0.00132	0.00006	< 0.00006	-
Titanium Ti	ICP-MS	mg/L	0.0178	0.00026	< 0.00005	-
Uranium U	ICP-MS	mg/L	0.000410	0.000147	< 0.000002	-
Vanadium V	ICP-MS	mg/L	0.00176	0.00053	0.00002	-
Zinc Zn	ICP-MS	mg/L	0.803	< 0.002	< 0.002	-
Zirconium Zr	ICP-MS	mg/L	0.003	< 0.002	< 0.002	-

Appendix C: Column Testwork Water Quality Results

Newmont™

Appendix C: Water Quality Results for Influent, Effluent and Rhizon Samples

Sample ID	ALS Sample Number	Collection Date	pH	Conductivity	DO	ORP	Total Alkalinity	Dissolved Organic Carbon	NH_3-N	NO_2-N	NO_3-N	Total Dissolved Phoshorus	D-Sulphide	SO_4	D-Br	D-Cl	D-F	Total CN	WAD CN	D-Ag	D-Al	D-As	D-B	D-Ba	D-Be	D-Bi	D-Ca
			s.u.	µS/cm	mg/L	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Influent	WR2000465-001	10-Jul-20	6.63	6,750		-44.8	205	5.26	1.14	18.6	329	0.148	<0.018	2,390	<2.50	<25.0	<1.00		0.0060	<0.000050	0.0171	2.05	0.070	0.0914	<0.000500	<0.000250	269
Influent	WR2000588-001	29-Jul-20	6.71	7,070	7.54	207.7	224	5.29	0.0072	0.317	348	<0.0020	0.107	2,550	<1.00	14.1	<0.400	0.0798	<0.0100	<0.000050	0.0138	2.19	0.073	0.101	<0.000500	<0.000250	288
Influent	WR2000774-001	26-Aug-20	7.66	6,500	6.71	214.1	212	4.32	0.0557	<0.0500	346	0.185	<0.180	2,370	<2.50	<25.0	<1.00		0.0058	<0.000050	0.0088	2.14	0.070	0.0659	<0.000500	<0.000250	264
Influent	WR2000941-001	23-Sep-20	7.45	6,800	8.94	261.2	202	3.97	0.0299	<0.0500	353	0.146	<0.090	2,420	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0129	2.22	0.067	0.0800	<0.000500	<0.000250	250
Influent	WR2001123-005	21-Oct-20	8.07	6,570	9.75	206.1	201	6.06	0.0672	<0.0500	350	0.122	<0.0015	2,390	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0133	2.05	0.068	0.0694	<0.000500	<0.000250	267
Influent	WR2001189-001	6-Nov-20	8.07	7,990	9.96	179.5	784	574	0.0384	<0.0500	366	0.131	<0.090	2,530	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0141	2.20	0.080	0.0686	<0.000500	<0.000250	268
Influent	WR2001262-005	26-Nov-20	7.3	8,040	8.82	214.8	865	616	0.0224	<0.0500	356	0.154	<0.018	2,470	<2.50	<25.0	<1.00		<0.0100	<0.000050	0.0109	2.08	0.069	0.0626	<0.000500	<0.000250	260
Influent	WR2001408-004	30-Dec-20	7.56	8,150	7.46	249.2	828	585	0.0225	<0.0500	330	0.154	<0.180	2,260	<2.50	<25.0	<1.00		<0.0100	<0.000050	0.0159	2.17	0.070	0.0601	<0.000500	<0.000250	269
Influent	WR2100095-005	3-Feb-21	7.38	8,490	8.61	234.1	889	587	0.0121	0.545	340	0.192	<0.180	2,330	<2.50	<25.0	<1.00		<0.0050	<0.000100	0.0196	2.35	<0.100	0.0606	<0.00100	<0.000500	268
Influent	WR2100156-005	24-Feb-21	7.83	6,630	8.65	193.4	192	4.66	0.0124	<0.0500	366	0.154	<0.180	2,490	<2.50	<25.0	<1.00		<0.0200	<0.000050	0.0162	2.27	0.062	0.0603	<0.000500	<0.000250	297
Influent	WR2100238-014	19-Mar-21	6.61	6,640	7.78	210.9	180			0.0811	360			2,490	<2.50	<25.0	<1.00			<0.000050	0.0114	2.05	0.065	0.0462	<0.000100	<0.000250	258
C1AE	WR2000677-001	12-Aug-20	6.49	6,720	7.25	119.4	220	26.6	0.0138	0.0598	347	0.206	<0.018	2,400	<2.50	65.8	<1.00	0.129	0.0061	<0.000050	0.0113	1.97	0.062	0.0985	<0.000500	<0.000250	264
C1AE	WR2000774-002	26-Aug-20	6.95	6,450	5.92	94.9	246	18.2	0.0341	0.0735	338	0.282	<0.180	2,380	<2.50	<25.0	<1.00		0.0061	<0.000050	0.0070	2.04	0.068	0.0881	<0.000500	<0.000250	277
C1AE	WR2000862-002	9-Sep-20	6.89	6,680	4.34	-1.0	241	17.3	0.0458	0.270	356	0.165	0.090	2,460	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0080	2.08	0.070	0.0832	<0.000500	<0.000250	271
C1AE	WR2000941-002	23-Sep-20	7.22	6,650	4.02	87.7	259	13.2	0.0408	0.474	346	0.144	<0.018	2,450	<1.00	14.1	<0.400		0.0053	<0.000050	0.0131	2.22	0.067	0.0779	<0.000500	<0.000250	250
C1AE	WR2001077-001	10-Oct-20	6.84	6,160	3.94	51.1	238	8.67	0.0353	0.236	343	0.312	<0.036	2,360	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0099	2.20	0.068	0.0698	<0.000500	<0.000250	296
C1AE	WR2001123-001	21-Oct-20	7.82	6,570	8.15	158.7	231	14.0	0.235	0.416	342	0.0528	<0.0015	2,420	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0059	1.88	0.061	0.0637	<0.000500	<0.000250	239
C1AE	WR2001185-001	3-Nov-20	7.12	6,730	8.12	136.0	226	8.67	0.0230	0.279	344	0.0328	<0.090	2,440	<2.50	<25.0	<1.00		<0.0100	<0.000050	0.0062	2.10	0.065	0.0633	<0.000500	<0.000250	280
C1AE	WR2001212-001	13-Nov-20	7.00	6,780	7.5	99.7	194	7.60	0.0208	0.306	350	0.0602	<0.180	2,390	<5.00	<50.0	<2.00		<0.0050	<0.000050	<0.0050	2.22	0.070	0.0637	<0.000500	<0.000250	269
C1AE	WR2001246-001	19-Nov-20	7.91	7,540		64.5	1040	530	0.0944	10.6	255	0.0718	<0.180	2,070	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0100	2.29	<0.050	0.0640	<0.000500	<0.000250	253
C1AE	WR2001262-001	27-Nov-20	8.13	9,740	3.33	54.0	1210	508	0.0880	10.7	258	0.0311	<0.036	2,360	<2.50	<25.0	<1.00		<0.0100	<0.000050	0.0087	2.03	<0.050	0.0489	<0.000500	<0.000250	214
C1AE	WR2001280-001	2-Dec-20	8.09	7,800	8.38	68.6	1100	505	0.0535	1.50	254	0.0776	<0.090	2,360	<2.50	<25.0	<1.00		<0.0100	<0.000050	0.0106	2.03	<0.050	0.0502	<0.000500	<0.000250	185
C1AE	WR2001308-001	8-Dec-20	7.94	6,160	2.99	77.0	1080	471	0.0350	2.08	256	0.0295	<0.090	2,390	<2.50	<25.0	<1.00		<0.0100	<0.000050	0.0150	2.19	<0.050	0.0438	<0.000500	<0.000250	170
C1AE	WR2001381-001	17-Dec-20	8.2	7,580	1.33	49.2	1120	332	0.0511	2.48	214	0.0545	<0.180	2,430	<2.50	<25.0	<1.00		<0.0200	<0.000050	0.0168	2.12	<0.050	0.0394	<0.000500	<0.000250	131
C1AE	WR2001400-004	23-Dec-20	8.37	7,150	2.24	19.4	1300	298	0.0586	0.645	97.0	0.0517	<0.180	2,360	<2.50	<25.0	<1.00		<0.0100	<0.000050	0.0177	2.10	<0.050	0.0289	<0.000500	<0.000250	65.3
C1AE	WR2001408-001	29-Dec-20	8.44	6,820	3.56	16.7	1600	217	0.0286	0.160	4.08	0.0479	<0.180	2,210	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0183	2.20	<0.050	0.0255	<0.000500	<0.000250	39.5
C1AE	WR2100018-004	7-Jan-21	8.29	7,550	2.52	31.7	1270	404	0.0488	1.98	200	0.0479	<0.180	2,300	<2.50	<25.0	<1.00		<0.0050	<0.000050	0.0073	2.21	<0.050	0.0468	<0.000500	<0.000250	109
C1AE	WR2100036-001	13-Jan-21	8.41	7,300	3.54	73.2	1170	269	0.302	0.951	116	0.0437	<0.180	2,500	<2.50	<25.0	<1.00		0.0073	<0.000050	0.0101	2.12	<0.050	0.0273	<0.000500	<0.000250	54.2
C1AE	WR2100069-003	21-Jan-21	8.31	7,120	1.75	59.7	1370	273	0.0470	0.376	97.4	0.0349	<0.018	2,340	<2.50	<25.0	<1.00		<0.0200	<0.000050	0.0111	2.24	0.063	0.0256	<0.000500	<0.000250	66.4
C1AE	WR2100088-003	28-Jan-21	8.2	7,560	2.24	53.7	955	456	0.0493	0.373	203	0.0344	<0.180	2,440	<2.50	<25.0	<1.00		<0.0200	<0.000100	<0.0100	2.01	<0.100	0.0284	<0.00100	<0.000500	87.9
C1AE	WR2100095-003	3-Feb-21	8.07	8,170	1.74	63.8	1040	495	0.0501	0.603	276	0.0298	<0.180	2,340	<2.50	<25.0	<1.00		<0.0050	<0.000100	<0.0100	2.27	<0.100	0.0401	<0.00100	<0.000500	188
C1AE	WR2100120-001	12-Feb-21	8.02	7,880	4.82	74.5	1240	396	0.0781	0.176	195	0.0459	<0.018	2,360	<2.50	<25.0	<1.00		<0.0050	<0.000100	0.0120	1.97	<0.100	0.0271	<0.00100	<0.000500	104
C1AE	WR2100156-003	24-Feb-21	7.75	6,730	3.71	100.7	268	8.29	0.0077	<0.0500	344	0.0082	<0.180	2,440	<2.50	<25.0	<1.00		<0.0200	<0.000050	<0.0050	2.18	0.082	0.0443	<0.000500	<0.000250	272
C1AE	WR2100205-001	10-Mar-21	7.45	7,070	1.47	-107.0	247	6.11	0.172	0.348	327	0.0085	<0.018	2,300	<2.50	<25.0	<1.00		0.0120	<0.000050	<0.0050	1.98	0.079	0.0426	<0.000500	<0.000250	269
C1AE	WR2100238-001	19-Mar-21	6.92	6,690		153.6	228	7.90	0.182	0.169	346	0.0352	<0.036	2,500	<1.00	14.4	<0.400		<0.0050	<0.000050	<0.0050	2.08	0.074	0.0402	<0.000500	<0.000250	260
C1A-R1	WR2000588-005	29-Jul-20		7,720			250			20.3	360		0.098	2,640	<2.50	<25.0	<1.00			<0.000050	0.0103	2.20	0.071	0.103	<0.000100	<0.000250	273
C1A-R1	WR2000774-006	26-Aug-20					159			0.100	341		<0.180	2,340	<2.50	<25.0	<1.00			<0.000050	<0.0050	2.17	0.071	0.0767	<0.000100	<0.000250	278
C1A-R1	WR2001077-005	9-Oct-20								<0.0500	348		<0.036	2,340	<2.50	<25.0	<1.00			<0.000050	0.0078	2.19	0.066	0.0688	<0.000100	<0.000250	284
C1A-R1	WR2001246-005	19-Nov-20								5.18	328		<0.180	2,360	<2.50	<25.0	<1.00			<0.000050	0.0075	2.19	0.055	0.0706	<0.000100	<0.000250	258
C1A-R1	WR2001381-005	15-Dec-20								1.12	300		<0.180	2,390	<2.50	<25.0	<1.00			<0.000050	0.0118	2.09	0.070	0.0521	<0.000100	<0.000250	228
C1A-R1	WR2100036-005	12-Jan-21								0.934	196		<0.180	2,350	<2.50	<25.0	<1.00			<0.000050	0.0090	2.29	0.068	0.0355	<0.000100	<0.000250	134
C1A-R1	WR2100120-005	11-Feb-21								0.818	327		<0.018	2,390	<2.50	<25.0	<1.00			<0.000100	<0.0100	2.15	<0.100	0.0411	<0.000200	<0.000500	235
C1A-R1	WR2100205-005	10-Mar-21								0.336	310		<0.018	2,120	<2.50	<25.0	<1.00			<0.000050	0.0061	2.16	0.070	0.0478	<0.000100	<0.000250	260
C1A-R1	WR2100238-005	18-Mar-21								<0.100	342		<0.018	2,330	<5.00	<50.0	<2.00			<0.000050	0.0064	2.25	0.070	0.0449	<0.000100	<0.000250	268
C1A-R2	WR2000588-006	29-Jul-20		7,660			270			16.3	321		0.090	2,510	<1.00	13.8	<0.400			<0.000050	0.0172	1.91	0.058	0.121	<0.000100	<0.000250	276
C1A-R2	WR2000774-007	26-Aug-20					164			0.122	344		<0.180	2,380	<2.50	<25.0	<1.00			<0.000050	0.0066	2.08	0.065	0.0917	<0.000100	<0.000250	271
C1A-R2	WR2001077-006	9-Oct-20								2.50	335		<0.036	2,380	<2.50	<25.0	<1.00			<0.000050	0.0089	2.07	0.058	0.0698	<0.000100	<0.000250	273
C1A-R2	WR2001246-006	19-Nov-20								8.10	304		<0.180	2,260	<2.50	<25.0	<1.00			<0.000050	0.0070	2.21	<0.050	0.0662	<0.000100	<0.000250	252
C1A-R2	WR2001381-006	15-Dec-20								0.904	273		<0.180	2,430	<2.50	<25.0	<1.00			<0.000050	0.0139	2.16	0.053	0.0495	<0.000100	<0.000250	188
C1A-R2	WR2100036-006	12-Jan-21								0.413	176		<0.180	2,470	<2.50	<25.0	<1.00			<0.000050	0.0075	2.20	0.053	0.0331	<0.000100	<0.000250	87.0
C1A-R2	WR2100120-006	11-Feb-21								0.0875	269		<0.018	2,310	<2.50	<25.0	<1.00			<0.000100	0.0116	2.06	<0.100	0.0334	<0.000200	<0.000500	172
C1A-R2	WR2100205-006	10-Mar-21								0.287	330		<0.036	2,360	<2.50	<25.0	<1.00			<0.000050	<0.0050	2.10	0.081	0.0406	<0.000100	<0.000250	259
C1A-R2	WR2100238-006	18-Mar-21								0.0620	354		<0.036	2,480	<1.00	14.9	<0.400			<0.000050	<0.0050	2.19	0.079	0.0403	<0.000100	<0.000250	266
C1A-R3	WR2000588-007	29-Jul-20		7,680			289			12.4	306		0.103	2,240	<2.50	<25.0	<1.00			<0.000050	0.0185	1.92	0.056	0.122	<0.000100	<0.000250	281
C1A-R3	WR2000774-008	26-Aug-20					173			0.120	320		<0.180	2,240	<1.00	13.2	<0.400			<0.000050	0.0068	2.04	0.066	0.0906	<0.000100	<0.000250	273
C1A-R3	WR2001077-007	9-Oct-20								1.20	318		<0.036	2,240	<2.50	<25.0	<1.00			<0.000050	0.0092	2.08	0.058	0.0717	<0.000100	<0.000250	289
C1A-R3	WR2001246-007	19-Nov-20								12.4	263		<0.180	2,140	<2.50	<25.0	<1.00			<0.000050	0.0078	2.24	<0.050	0.0663	<0.000100	<0.000250	259
C1A-R3	WR2001381-007	15-Dec-20								3.84	226		<0.180	2,270	<2.50	<25.0	<1.00			<0.000050	0.0148	2.16	<0.050	0.0433	<0.000100	<0.000250	158
C1A-R3	WR2100036-007	12-Jan-21								0.846	117		<0.180	2,360	<2.50	<25.0	<1.00			<0.000050	0.0102	2.19	<0.050	0.0292	<0.000100	<0.000250	60.6

Appendix C: Water Quality Results for Influent, Effluent and Rhizon Samples

Sample ID	ALS Sample Number	Collection Date	pH	Conductivity	DO	ORP	Total Alkalinity	Dissolved Organic Carbon	NH_3-N	NO_2-N	NO_3-N	Total Dissolved Phoshorus	D-Sulphide	SO_4	D-Br	D-Cl	D-F	Total CN	WAD CN	D-Ag	D-Al	D-As	D-B	D-Ba	D-Be	D-Bi	D-Ca
			s.u.	µS/cm	mg/L	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C1A-R3	WR2100120-007	12-Feb-21								0.123	221		<0.018	2,460	<2.50	<25.0	<1.00			<0.000100	<0.0100	2.03	<0.100	0.0290	<0.000200	<0.000500	126
C1A-R3	WR2100205-007	10-Mar-21								0.304	316		<0.036	2,250	<2.50	<25.0	<1.00			<0.000050	<0.0050	2.17	0.077	0.0452	<0.000100	<0.000250	256
C1A-R3	WR2100238-007	18-Mar-21								0.0541	352		<0.036	2,480	<1.00	14.7	<0.400			<0.000050	<0.0050	2.13	0.076	0.0424	<0.000100	<0.000250	268
C1BE	WR2000481-001	13-Jul-20	8.25	6,550	7.75	-36.0	164	172	13.0	0.164	314	0.0845	<0.018	2,320	<2.50	<25.0	<1.12		0.0499	<0.000050	0.0152	0.0115	0.165	0.0794	<0.000500	<0.000250	218
C1BE	WR2000505-001	15-Jul-20	8.37	6,390	7.47	38.4	186	69.4	9.35	0.339	311	0.0206	<0.036	2,330	<2.50	<25.0	<1.00	0.105	0.0633	<0.000050	0.0082	0.0149	0.088	0.0797	<0.000500	<0.000250	217
C1BE	WR2000552-001	22-Jul-20	8.43	6,610	7.56	12.2	152	35.9	10.0	0.352	306	0.0325	0.026	2,250	<2.50	<25.0	<1.00	0.130	0.0698	<0.000050	0.0083	0.00921	0.105	0.0571	<0.000500	<0.000250	186
C1BE	WR2000588-002	29-Jul-20	8.5	6,890	7.39	27.2	156	27.9	10.6	0.520	316	0.0194	0.094	2,340	<2.50	<25.0	<1.00	0.0946	<0.0400	<0.000050	0.0067	0.0101	0.091	0.0491	<0.000500	<0.000250	200
C1BE	WR2000677-002	12-Aug-20	8.37	6,580	7.47	85.7	142	19.9	9.50	0.281	336	0.0163	<0.018	2,360	<2.50	<25.0	<1.00	0.139	0.0587	<0.000050	0.0076	0.00708	0.085	0.0411	<0.000500	<0.000250	208
C1BE	WR2000774-003	26-Aug-20	8.05	6,230	5.06	86.5	153	12.9	10.3	0.353	323	0.0318	<0.180	2,310	<2.50	<25.0	<1.00		0.0610	<0.000050	<0.0050	0.00593	0.091	0.0389	<0.000500	<0.000250	209
C1BE	WR2000862-001	9-Sep-20	8.36	6,530	8.06	113.0	130	12.8	12.8	0.429	344	0.0307	<0.090	2,450	<2.50	<25.0	<1.00		0.0562	<0.000050	<0.0050	0.00319	0.098	0.0303	<0.000500	<0.000250	182
C1BE	WR2000941-003	23-Sep-20	8.22	6,630	6.49	203.6	139	10.1	12.2	0.614	356	0.0341	<0.018	2,560	<2.50	<25.0	<1.00		0.0597	<0.000050	0.0053	0.00424	0.095	0.0297	<0.000500	<0.000250	177
C1BE	WR2001077-002	9-Oct-20	8.44	5,910	5.83	27.7	110	7.71	17.2	0.384	316	0.0533	<0.036	2,330	<2.50	<25.0	<1.00		0.0640	<0.000050	0.0071	0.00366	0.093	0.0215	<0.000500	<0.000250	164
C1BE	WR2001123-002	22-Oct-20		6,310			94.4	7.76	20.6	0.482	306	0.0346	<0.0015	2,330	<2.50	<25.0	<1.00		0.0611	<0.000050	<0.0050	0.00416	0.092	0.0197	<0.000500	<0.000250	147
C1BE	WR2001185-002	3-Nov-20	7.49	6,640	8.99	126.2	155	6.74	9.48	0.332	332	0.0118	<0.090	2,420	<2.50	<25.0	<1.00		0.0465	<0.000050	<0.0050	0.00349	0.080	0.0268	<0.000500	<0.000250	222
C1BE	WR2001212-002	12-Nov-20	6.38	6,610	6.23	-165.8	157	6.52	8.91	0.417	340	0.0128	<0.180	2,440	<5.00	<50.0	<2.00		0.0231	<0.000050	<0.0050	0.00842	0.077	0.0275	<0.000500	<0.000250	196
C1BE	WR2001246-002	18-Nov-20	8.05	7,000	6.45	117.7	584	381	15.3	0.804	288	0.0052	<0.180	2,230	<2.50	<25.0	<1.00		0.0731	<0.000050	0.0052	0.00628	0.085	0.0236	<0.000500	<0.000250	181
C1BE	WR2001262-002	26-Nov-20	7.95	7,660	6.17	136.2	868	535	11.3	1.72	264	0.0118	<0.036	2,450	<2.50	<25.0	<1.00		0.0686	<0.000050	0.0063	0.00886	0.074	0.0196	<0.000500	<0.000250	123
C1BE	WR2001280-002	1-Dec-20	8.2	7,470	3.26	84.2	877	484	13.4	1.90	225	0.0225	<0.090	2,420	<2.50	<25.0	<1.00		0.0804	<0.000050	0.0098	0.0208	0.071	0.0180	<0.000500	<0.000250	72.1
C1BE	WR2001308-002	9-Dec-20	8.16	7,320	5.15	72.1	960	460	10.4	4.10	228	0.0080	<0.090	2,320	<2.50	<25.0	<1.00		0.0767	<0.000050	0.0075	0.0114	0.066	0.0168	<0.000500	<0.000250	86.6
C1BE	WR2001381-002	16-Dec-20	8.06	7,440	3.24	108.8	910	348	13.1	8.00	205	0.0088	<0.180	2,380	<2.50	<25.0	<1.00		0.0874	<0.000050	0.0097	0.0209	0.071	0.0158	<0.000500	<0.000250	56.4
C1BE	WR2001400-001	22-Dec-20	8.87	7,120	2.86	27.3	892	370	21.1	18.4	122	0.0125	<0.180	2,350	<2.50	<25.0	<1.00		0.130	<0.000050	0.0148	0.0254	0.075	0.0104	<0.000500	<0.000250	16.8
C1BE	WR2100018-001	4-Jan-21	9.2	6,330	3.01	80.1	1000	285	31.0	3.61	3.04	0.0528	<0.180	2,480	<2.50	<25.0	<1.00		0.0284	<0.000050	0.0103	0.0392	0.150	0.00467	<0.000500	<0.000250	9.01
C1BE	WR2100018-005	7-Jan-21	9.09	6,580	2.48	58.4	1350	209	21.5	0.998	1.48	0.0722	<0.180	2,410	<2.50	<25.0	<1.00		0.0209	<0.000050	0.0125	0.0508	0.132	0.0102	<0.000500	<0.000250	10.7
C1BE	WR2100036-002	14-Jan-21	8.72	7,760	4.03	60.7	973	430	7.70	4.91	213	0.0151	<0.018	2,400	<2.50	<25.0	<1.00		0.0593	<0.000050	0.0078	0.0463	0.072	0.0248	<0.000500	<0.000250	45.7
C1BE	WR2100069-004	21-Jan-21	9.11	7,200	2.17	20.9	1110	387	19.0	19.0	115	0.0155	<0.018	2,370	<2.50	<25.0	<1.00		0.149	<0.000050	0.0057	0.0916	0.091	0.00940	<0.000500	<0.000250	10.8
C1BE	WR2100088-004	28-Jan-21	8.95	7,370	3.4	30.5	1160	369	16.6	21.9	136	0.0063	<0.180	2,400	<2.50	<25.0	<1.00		0.141	<0.000100	<0.0100	0.0966	<0.100	0.0102	<0.00100	<0.000500	12.4
C1BE	WR2100095-004	3-Feb-21	8.41	8,230	3.76	93.7	948	501	8.32	10.7	263	0.0084	<0.180	2,350	<2.50	<25.0	<1.00		0.0652	<0.000100	<0.0100	0.0266	<0.100	0.0176	<0.00100	<0.000500	86.6
C1BE	WR2100120-002	11-Feb-21	9.00	6,940	2.73		1170	348	17.0	21.7	99.0	0.0137	<0.018	2,320	<2.50	<25.0	<1.00		0.135	<0.000100	<0.0100	0.0836	<0.100	0.00742	<0.00100	<0.000500	9.95
C1BE	WR2100156-004	24-Feb-21	8.06	6,560	6.63	146.1	178	6.96	6.28	2.18	327	0.0020	<0.180	2,380	<2.50	<25.0	<1.00		0.0422	<0.000050	<0.0050	0.00708	0.067	0.0247	<0.000500	<0.000250	171
C1BE	WR2100205-002	10-Mar-21	8.03	6,920	1.19	-216.0	171	5.27	9.75	1.44	298	0.0036	<0.018	2,180	<2.50	<25.0	<1.00		0.0868	<0.000050	<0.0050	0.0158	0.073	0.0206	<0.000500	<0.000250	180
C1BE	WR2100238-002	18-Mar-21	7.92	6,570	1.06	-171.0	160	6.86	9.61	1.34	325	0.0063	<0.036	2,420	<1.00	14.5	<0.400		0.0898	<0.000050	<0.0050	0.0138	0.074	0.0185	<0.000500	<0.000250	179
C1B-R1	WR2000588-008	29-Jul-20		8,380			244			7.08	328		<0.090	2,500	<1.00	13.9	<0.400			<0.000050	<0.0050	0.418	0.065	0.109	<0.000100	<0.000250	268
C1B-R1	WR2000774-009	26-Aug-20					224			0.300	339		<0.180	2,380	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.263	0.070	0.0830	<0.000100	<0.000250	251
C1B-R1	WR2001077-008	7-Oct-20								0.172	336		<0.018	2,380	<2.50	<25.0	<1.00			<0.000050	0.0053	0.0623	0.062	0.0444	<0.000100	<0.000250	238
C1B-R1	WR2001246-008	17-Nov-20								0.929	280		<0.180	2,110	<2.50	<25.0	<1.00			0.000109	0.0163	0.304	0.052	0.0327	<0.000100	<0.000250	187
C1B-R1	WR2100036-008	13-Jan-21								6.83	99.7		<0.180	2,310	<2.50	<25.0	<1.00			<0.000050	0.0055	0.402	0.057	0.0105	<0.000100	<0.000250	25.4
C1B-R2	WR2000588-009	29-Jul-20		7,660			232			3.83	328		<0.090	2,570	<1.00	14.7	<0.400			<0.000050	<0.0050	0.102	0.104	0.0670	<0.000100	<0.000250	221
C1B-R2	WR2000774-010	26-Aug-20					120			0.272	327		<0.180	2,350	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00892	0.108	0.0399	<0.000100	<0.000250	198
C1B-R2	WR2001077-009	8-Oct-20								0.195	311		<0.036	2,300	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00692	0.087	0.0276	<0.000100	<0.000250	155
C1B-R2	WR2001246-009	18-Nov-20								0.277	290		<0.180	2,220	<2.50	<25.0	<1.00			<0.000050	0.0052	0.0237	0.084	0.0325	<0.000100	<0.000250	175
C1B-R2	WR2001381-008	15-Dec-20								0.421	210		<0.180	2,290	<2.50	<25.0	<1.00			<0.000050	0.0096	0.0150	0.110	0.0194	<0.000100	<0.000250	64.5
C1B-R2	WR2100036-009	13-Jan-21								2.88	105		<0.180	2,380	<2.50	<25.0	<1.00			<0.000050	0.0067	0.0396	0.128	0.00803	<0.000100	<0.000250	11.4
C1B-R2	WR2100120-008	10-Feb-21								7.76	123		<0.180	2,430	<2.50	<25.0	<1.00			<0.000100	<0.0100	0.0284	0.129	0.0106	<0.000200	<0.000500	14.8
C1B-R2	WR2100205-008	9-Mar-21								0.888	322		<0.090	2,360	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00521	0.090	0.0490	<0.000100	<0.000250	152
C1B-R2	WR2100238-008	17-Mar-21											<0.036							<0.000050	<0.0050	0.00721	0.090	0.0405	<0.000100	<0.000250	159
C1B-R3	WR2000588-010	29-Jul-20		7,520			241			2.58	321		<0.090	2,460	<1.00	14.3	<0.400			<0.000050	0.0050	0.0656	0.089	0.0682	<0.000100	<0.000250	220
C1B-R3	WR2001077-010	8-Oct-20								0.371	312		<0.036	2,270	<2.50	<25.0	<1.00			<0.000050	0.0058	0.00789	0.083	0.0273	<0.000100	<0.000250	166
C1B-R3	WR2001246-010	18-Nov-20								0.300	310		0.219	2,220	<2.50	<25.0	<1.00			<0.000050	0.0051	0.0316	0.083	0.0306	<0.000100	<0.000250	179
C1B-R3	WR2001381-009	15-Dec-20								3.84	182		<0.180	3,490	<2.50	<25.0	<1.00			<0.000050	0.0080	0.0202	0.089	0.0177	<0.000100	<0.000250	61.7
C1B-R3	WR2100036-010	13-Jan-21											<0.180							<0.000050	0.0063	0.0426	0.134	0.00793	<0.000100	<0.000250	12.4
C2E	WR2000481-002	13-Jul-20	8.41	6,520	7.46		155	124	32.5	0.492	297	0.0829	<0.018	2,230	<2.50	<25.0	<1.00		0.0303	<0.000050	0.0066	0.00629	0.263	0.0576	<0.000500	<0.000250	166
C2E	WR2000505-002	15-Jul-20	8.69	6,300	6.60	16.0	132	92.8	24.7	0.918	315	0.0456	<0.036	2,340	<2.50	<25.0	<1.00	0.100	0.0686	<0.000050	<0.0050	0.00740	0.163	0.0579	<0.000500	<0.000250	178
C2E	WR2000552-002	22-Jul-20	8.79	6,520	7.48	1.5	128	78.5	23.0	0.451	300	0.0239	<0.018	2,230	<2.50	<25.0	<1.00	0.120	0.0755	<0.000050	0.0061	0.00452	0.175	0.0471	<0.000500	<0.000250	156
C2E	WR2000588-003	29-Jul-20	8.77	6,840	7.70	14.4	122	58.7	21.5	0.672	303	0.0126	0.098	2,300	<1.00	14.3	<0.400	0.0988	0.0516	<0.000050	<0.0050	0.00558	0.146	0.0423	<0.000500	<0.000250	174
C2E	WR2000677-003	12-Aug-20	8.89	6,570	7.63	64.1	112	40.1	20.0	0.362	331	0.0486	<0.018	2,340	<2.50	<25.0	<1.00	0.135	0.0715	<0.000050	0.0059	0.00497	0.131	0.0392	<0.000500	<0.000250	184
C2E	WR2000774-004	26-Aug-20	8.43	6,330	6.48	128.8	127	27.8	15.0	0.391	330	0.0476	<0.180	2,340	<2.50	<25.0	<1.00		0.0749	<0.000050	<0.0050	0.00644	0.117	0.0394	<0.000500	<0.000250	201
C2E	WR2000862-003	9-Sep-20	8.94	6,520	8.39	60.0	99.0	72.7	20.6	0.418	317	0.0528	<0.090	2,250	<2.50	<25.0	<1.00		0.0691	<0.000050	<0.0050	0.00341	0.145	0.0302	<0.000500	<0.000250	172
C2E	WR2000941-004	23-Sep-20	8.83	6,580	7.05	125.6	97.4	28.0	19.1	0.566	335	0.0425	<0.018	2,410	<2.50	<25.0	<1.00		0.0664	<0.000050	0.0069	0.00344	0.134	0.0280	<0.000500	<0.000250	159
C2E	WR2001077-003	8-Oct-20	8.75	5,880	4.08	91.4	89.2	16.4	19.7	0.708	328	0.0626	<0.018	2,330	<2.50	<25.0	<1.00		0.0820	<0.000050	0.0057	0.00302	0.135	0.0245	<0.000500	<0.000250	178

Appendix C: Water Quality Results for Influent, Effluent and Rhizon Samples

Sample ID	ALS Sample Number	Collection Date	pH	Conductivity	DO	ORP	Total Alkalinity	Dissolved Organic Carbon	NH_3-N	NO_2-N	NO_3-N	Total Dissolved Phoshorus	D-Sulphide	SO_4	D-Br	D-Cl	D-F	Total CN	WAD CN	D-Ag	D-Al	D-As	D-B	D-Ba	D-Be	D-Bi	D-Ca
			s.u.	µS/cm	mg/L	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C2E	WR2001123-003	21-Oct-20	7.73	6,450	9.68	134.3	92.3	19.7	17.1	0.786	331	0.0287	<0.0015	2,370	<2.50	<25.0	<1.00		0.0721	<0.000050	<0.0050	0.00260	0.118	0.0222	<0.000500	<0.000250	159
C2E	WR2001185-003	3-Nov-20	8.44	6,530	9.22	94.3	84.9	16.0	16.5	1.79	326	0.0091	<0.090	2,370	<2.50	<25.0	<1.00		0.0832	<0.000050	<0.0050	0.00246	0.115	0.0227	<0.000500	<0.000250	184
C2E	WR2001212-003	13-Nov-20	8.28	6,600	7.73	36.9	79.7	14.2	16.4	3.12	343	0.0116	<0.180	2,420	<5.00	<50.0	<2.00		0.0407	<0.000050	<0.0050	0.00278	0.117	0.0240	<0.000500	<0.000250	162
C2E	WR2001246-003	18-Nov-20	8.6	7,110	8.27	111.3	502	373	17.3	3.27	312	0.0137	<0.180	2,240	<2.50	<25.0	<1.00		0.0806	<0.000050	<0.0050	0.00269	0.124	0.0238	<0.000500	<0.000250	177
C2E	WR2001262-003	26-Nov-20	8.36	7,770	5.86	108.2	761	595	15.2	6.48	312	0.0160	<0.018	2,420	<2.50	<25.0	<1.00		0.100	<0.000050	<0.0050	0.00262	0.105	0.0231	<0.000500	<0.000250	153
C2E	WR2001280-003	1-Dec-20	8.52	8,100	6.2	83.2	646	584	17.7	3.26	315	0.0260	<0.018	2,500	<2.50	<25.0	<1.00		0.0873	<0.000100	<0.0100	0.00252	0.122	0.0216	<0.00100	<0.000500	128
C2E	WR2001308-003	9-Dec-20	8.52	7,610	5.54	63.7	820	560	19.0	4.39	293	0.0175	<0.090	2,290	<2.50	<25.0	<1.00		0.0891	<0.000050	0.0081	0.00284	0.107	0.0200	<0.000500	<0.000250	123
C2E	WR2001381-003	16-Dec-20	8.69	7,500	3.22	86.5	737	430	26.5	8.62	255	0.0101	<0.180	2,310	<2.50	<25.0	<1.00		0.121	<0.000050	0.0098	0.00283	0.122	0.0166	<0.000500	<0.000250	85.1
C2E	WR2001400-002	22-Dec-20	9.11	7,600	3.35	52.0	747	520	25.7	12.6	234	0.0148	<0.180	2,160	<2.50	<25.0	<1.00		0.117	<0.000050	0.0097	0.00303	0.116	0.0116	<0.000500	<0.000250	60.2
C2E	WR2001408-002	29-Dec-20	8.91	7,610	3.61	114.8	768	527	21.4	16.4	244	0.0059	<0.180	2,280	<2.50	<25.0	<1.00		0.109	<0.000050	0.0103	0.00296	0.122	0.0118	<0.000500	<0.000250	61.8
C2E	WR2100018-002	7-Jan-21	9.1	7,380	3.48	94.6	816	482	20.9	24.5	227	0.0082	<0.180	2,330	<2.50	<25.0	<1.00		0.0240	<0.000050	<0.0100	0.00336	0.130	0.0127	<0.000500	<0.000250	52.8
C2E	WR2100036-003	13-Jan-21	9.12	7,470	2.99	32.9	694	525	17.3	29.8	224	0.0080	<0.180	2,340	<2.50	<25.0	<1.00		0.112	<0.000050	<0.0050	0.00330	0.124	0.0113	<0.000500	<0.000250	47.9
C2E	WR2100069-001	21-Jan-21	9.12	7,660	1.88	56.6	851	500	16.2	28.2	210	0.0088	<0.018	2,130	<2.50	<25.0	<1.00		0.0972	<0.000050	0.0072	0.00326	0.143	0.0105	<0.000500	<0.000250	50.0
C2E	WR2100088-001	28-Jan-21	9.05	1,060		98.4	518	500	16.4	35.8	206	0.0069	<0.180	2,300	<2.50	<25.0	<1.00		0.0958	<0.000100	<0.0100	0.00306	0.123	0.0104	<0.00100	<0.000500	44.2
C2E	WR2100095-001	3-Feb-21	9.1	7,780	4.61	54.5	893	483	18.4	40.5	193	0.0085	<0.180	2,290	<2.50	<25.0	<1.00		0.0895	<0.000100	0.0102	0.00375	0.110	0.00983	<0.00100	<0.000500	39.7
C2E	WR2100120-003	12-Feb-21	9.13	7,170	5.54	46.3	891	493	18.9	45.1	180	0.0091	<0.018	2,270	<2.50	<25.0	<1.00		0.0989	<0.000100	<0.0100	0.00295	0.123	0.00797	<0.00100	<0.000500	32.5
C2E	WR2100156-001	24-Feb-21	8.82	6,270	6.7	112.2	107	14.4	14.3	11.9	315	0.0077	<0.180	2,420	<2.50	<25.0	<1.00		0.0542	<0.000050	0.0051	0.00271	0.081	0.0147	<0.000500	<0.000250	101
C2E	WR2100205-003	11-Mar-21	8.78	6,830	2.67	63.5	89.3	9.17	13.9	2.86	309	0.0062	<0.018	2,240	<2.50	<25.0	<1.00		0.0568	<0.000050	0.0051	0.00219	0.073	0.0167	<0.000500	<0.000250	133
C2E	WR2100238-003	19-Mar-21	8.41	6,350	5.2	107.6	73.1	9.74	14.5	2.49	319	0.0081	<0.036	2,380	<1.00	14.5	<0.400		0.0560	<0.000050	<0.0050	0.00265	0.077	0.0149	<0.000500	<0.000250	128
C2-R1	WR2000588-011	29-Jul-20		7,620			217			3.61	344		<0.090	2,580	<1.00	14.3	<0.400			<0.000050	<0.0050	0.0798	0.089	0.0528	<0.000100	<0.000250	233
C2-R1	WR2000774-011	26-Aug-20					143			0.196	347		<0.180	2,400	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.0704	0.078	0.0442	<0.000100	<0.000250	258
C2-R1	WR2001077-011	6-Oct-20								0.232	343		<0.018	2,320	<2.50	<25.0	<1.00			<0.000050	0.0054	0.0106	0.068	0.0315	<0.000100	<0.000250	249
C2-R1	WR2001246-011	17-Nov-20								0.268	386		<0.180	2,290	<2.50	<25.0	<1.00			0.000206	<0.0050	0.0267	0.068	0.0327	<0.000100	<0.000250	236
C2-R1	WR2001381-010	15-Dec-20								3.45	252		<0.180	2,100	<2.50	<25.0	<1.00			<0.000050	0.0132	0.0118	0.086	0.0192	<0.000100	<0.000250	145
C2-R1	WR2100036-011	12-Jan-21								9.85	298		<0.180	2,270	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.0186	0.086	0.0162	<0.000100	<0.000250	181
C2-R1	WR2100120-009	10-Feb-21								20.8	284		<0.180	2,220	<2.50	<25.0	<1.00			<0.000100	<0.0100	0.00731	<0.100	0.00896	<0.000200	<0.000500	139
C2-R1	WR2100205-009	9-Mar-21								2.12	347		<0.090	2,450	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00319	0.064	0.0125	<0.000100	<0.000250	202
C2-R1	WR2100238-009	17-Mar-21								1.60	348		<0.036	2,460	<1.00	14.6	<0.400			<0.000050	<0.0050	0.00277	0.067	0.0111	<0.000100	<0.000250	202
C2-R2	WR2000588-012	29-Jul-20		6,940			163			2.21	327		<0.090	2,420	<1.00	14.5	<0.400			<0.000050	<0.0050	0.0136	0.158	0.0386	<0.000100	<0.000250	205
C2-R2	WR2000774-012	26-Aug-20								0.294	343		<0.180	2,390	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.0270	0.117	0.0334	<0.000100	<0.000250	214
C2-R2	WR2001077-012	7-Oct-20								0.228	336		<0.018	2,350	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00498	0.089	0.0222	<0.000100	<0.000250	189
C2-R2	WR2001246-012	17-Nov-20								0.430	371		<0.180	2,300	<2.50	<25.0	<1.00			0.000377	0.0066	0.00371	0.083	0.0294	<0.000100	<0.000250	196
C2-R2	WR2001381-011	15-Dec-20								2.95	242		<0.180	2,100	<2.50	<25.0	<1.00			<0.000050	0.0119	0.00389	0.105	0.0195	<0.000100	<0.000250	98.5
C2-R2	WR2100036-012	12-Jan-21								19.0	248		<0.180	2,260	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00376	0.109	0.0126	<0.000100	<0.000250	76.9
C2-R2	WR2100120-010	10-Feb-21								27.4	215		<0.180	2,250	<2.50	<25.0	<1.00			<0.000100	<0.0100	0.00445	0.108	0.00847	<0.000200	<0.000500	42.5
C2-R2	WR2100205-010	10-Mar-21								2.72	336		<0.036	2,440	<2.50	<25.0	<1.00			<0.000050	0.0068	0.00263	0.068	0.0173	<0.000100	<0.000250	142
C2-R2	WR2100238-010	18-Mar-21								1.62	336		<0.036	2,430	<1.00	14.7	<0.400			<0.000050	<0.0050	0.00393	0.068	0.0175	<0.000100	<0.000250	146
C2-R3	WR2000588-013	29-Jul-20		7,000			136			1.21	316		<0.090	2,310	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00589	0.225	0.0278	<0.000100	<0.000250	172
C2-R3	WR2000774-013	26-Aug-20								0.276	337		<0.180	2,380	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00658	0.172	0.0274	<0.000100	<0.000250	204
C2-R3	WR2001077-013	7-Oct-20								0.336	328		<0.036	2,330	<2.50	<25.0	<1.00			<0.000050	0.0055	0.00372	0.143	0.0177	<0.000100	<0.000250	166
C2-R3	WR2001246-013	17-Nov-20								0.416	317		<0.180	2,270	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00277	0.120	0.0204	<0.000100	<0.000250	193
C2-R3	WR2001381-012	15-Dec-20								4.09	243		<0.180	2,090	<2.50	<25.0	<1.00			<0.000050	0.0090	0.00343	0.158	0.0147	<0.000100	<0.000250	94.6
C2-R3	WR2100036-013	13-Jan-21								17.6	225		<0.180	2,230	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00406	0.158	0.00784	<0.000100	<0.000250	44.1
C2-R3	WR2100120-011	10-Feb-21								29.8	193		<0.180	2,290	<2.50	<25.0	<1.00			<0.000100	<0.0100	0.00446	0.157	0.00516	<0.000200	<0.000500	28.1
C2-R3	WR2100205-011	10-Mar-21								2.12	320		<0.018	2,320	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00282	0.094	0.0130	<0.000100	<0.000250	105
C3E	WR2000481-003	13-Jul-20	8.15	6,560	7.74	-59.7	181	224	31.2	0.377	300	0.117	<0.018	2,260	<2.50	<25.0	<1.00		0.0158	<0.000050	0.0097	0.00842	0.240	0.0690	<0.000500	<0.000250	180
C3E	WR2000505-003	15-Jul-20	8.38	6,420	3.94	45.4	142	121	22.5	0.690	316	0.0562	0.053	2,360	<2.50	<25.0	<1.00	0.0624	0.0450	<0.000050	<0.0050	0.00508	0.123	0.0633	<0.000500	<0.000250	178
C3E	WR2000552-003	22-Jul-20	8.57	6,420	4.16	1.4	148	94.5	22.1	0.557	303	0.0695	<0.018	2,260	<2.50	<25.0	<1.00	0.0827	0.0570	<0.000050	0.0065	0.00445	0.134	0.0503	<0.000500	<0.000250	168
C3E	WR2000588-004	29-Jul-20	8.68	6,880	6.70	10.6	211	72.4	20.0	0.642	320	0.0522	<0.090	2,530	<1.00	14.6	<0.400	0.0961	0.0534	<0.000050	0.0076	0.00621	0.131	0.0467	<0.000500	<0.000250	204
C3E	WR2000677-004	12-Aug-20	8.73	6,580	2.92	44.2	148	47.7	16.4	0.456	322	0.0343	<0.018	2,280	<2.50	<25.0	<1.00	0.107	0.0954	<0.000050	<0.0050	0.00612	0.104	0.0448	<0.000500	<0.000250	213
C3E	WR2000774-005	26-Aug-20	8.46	6,350	6.23	119.4	169	35.8	14.8	0.393	320	0.0446	<0.180	2,300	<2.50	<25.0	<1.00		0.0649	<0.000050	<0.0050	0.00506	0.104	0.0417	<0.000500	<0.000250	225
C3E	WR2000862-004	9-Sep-20	8.88	6,570	8.1	56.7	132	95.8	21.6	1.07	339	0.0479	<0.090	2,450	<2.50	<25.0	<1.00		0.0704	<0.000050	<0.0050	0.00312	0.116	0.0320	<0.000500	<0.000250	183
C3E	WR2000941-005	23-Sep-20	8.81	6,610	6.5	90.3	123	37.6	20.0	1.56	383	0.0366	<0.018	2,790	<2.50	<25.0	<1.00		0.0730	<0.000050	0.0054	0.00318	0.121	0.0309	<0.000500	<0.000250	177
C3E	WR2001077-004	8-Oct-20	8.76	5,920	7.21	62.4	127	34.5	19.0	1.20	327	0.0598	<0.018	2,340	<2.50	<25.0	<1.00		0.0805	<0.000050	0.0057	0.00285	0.104	0.0244	<0.000500	<0.000250	190
C3E	WR2001123-004	21-Oct-20	8.68	6,440		26.4	126	26.3	17.2	1.51	327	0.0287	<0.0015	2,360	<2.50	<25.0	<1.00		0.0747	<0.000050	<0.0050	0.00236	0.095	0.0246	<0.000500	<0.000250	190
C3E	WR2001185-004	3-Nov-20	8.6	6,500	6.19	128.4	128	23.4	18.5	3.51	315	0.0116	<0.090	2,370	<2.50	<25.0	<1.00		0.0786	<0.000050	<0.0050	0.00259	0.108	0.0223	<0.000500	<0.000250	185
C3E	WR2001212-004	13-Nov-20	8.74	6,580	4.52	27.2	128	38.6	22.6	0.887	320	0.0307	<0.180	2,320	<5.00	<50.0	<2.00		0.0415	<0.000050	<0.0050	0.00322	0.107	0.0227	<0.000500	<0.000250	164
C3E	WR2001246-004	18-Nov-20	8.49	6,900	5.35	86.1	503	375	21.0	0.769	303	0.0286	0.198	2,180	<2.50	<25.0	<1.00		0.0793	<0.000050	0.0054	0.00262	0.118	0.0234	<0.000500	<0.000250	175
C3E	WR2001262-004	26-Nov-20	8.47	7,830	6.58	106.6	804	600	14.0	0.685	322	0.0291	<0.018	2,450	<2.50	<25.0	<1.00		0.0640	<0.000050	<0.0050	0.00233	0.091	0.0225	<0.000500	<0.000250	170

Appendix C: Water Quality Results for Influent, Effluent and Rhizon Samples

Sample ID	ALS Sample Number	Collection Date	pH	Conductivity	DO	ORP	Total Alkalinity	Dissolved Organic Carbon	NH_3-N	NO_2-N	NO_3-N	Total Dissolved Phoshorus	D-Sulphide	SO_4	D-Br	D-Cl	D-F	Total CN	WAD CN	D-Ag	D-Al	D-As	D-B	D-Ba	D-Be	D-Bi	D-Ca
			s.u.	µS/cm	mg/L	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C3E	WR2001280-004	1-Dec-20	8.44	7,910	6.07	84.8	782	593	13.2	0.848	321	0.0306	<0.090	2,430	<2.50	<25.0	<1.00		0.0758	<0.000050	<0.0050	0.00250	0.099	0.0236	<0.000500	<0.000250	157
C3E	WR2001308-004	10-Dec-20	8.77	7,570	3.22	90.0	813	564	22.1	1.54	288	0.0292	<0.090	2,280	<2.50	<25.0	<1.00		0.0910	<0.000050	<0.0050	0.00325	0.092	0.0199	<0.000500	<0.000250	130
C3E	WR2001381-004	16-Dec-20	8.48	7,640	3.34	86.7	737	445	19.4	2.66	298	0.0169	<0.180	2,330	<2.50	<25.0	<1.00		0.0914	<0.000050	0.0050	0.00266	0.101	0.0210	<0.000500	<0.000250	142
C3E	WR2001400-003	22-Dec-20	8.87	7,850	3.28	55.7	752	542	17.0	4.64	292	0.0128	<0.180	2,350	<2.50	<25.0	<1.00		0.0899	<0.000050	<0.0050	0.00265	0.088	0.0174	<0.000500	<0.000250	114
C3E	WR2001408-003	29-Dec-20	8.69	7,710	2.83	107.9	753	545	20.0	6.59	254	0.0057	<0.180	2,190	<2.50	<25.0	<1.00		0.100	<0.000050	0.0055	0.00276	0.098	0.0157	<0.000500	<0.000250	93.5
C3E	WR2100018-003	7-Jan-21	9.02	7,040	3.82	74.4	809	473	26.1	12.3	189	0.0140	<0.180	2,260	<2.50	<25.0	<1.00		0.0262	<0.000050	<0.0050	0.00346	0.109	0.0116	<0.000500	<0.000250	45.8
C3E	WR2100036-004	13-Jan-21	8.97	7,610	4.57	53.3	700	560	16.1	17.9	258	0.0092	<0.180	2,380	<2.50	<25.0	<1.00		0.115	<0.000050	0.0054	0.00311	0.108	0.0157	<0.000500	<0.000250	69.0
C3E	WR2100069-002	21-Jan-21	8.91	7,510	2.23	15.0	810	546	13.5	21.4	250	0.0087	<0.018	2,290	<2.50	<25.0	<1.00		0.0916	<0.000050	0.0097	0.00305	0.116	0.0139	<0.000500	<0.000250	80.8
C3E	WR2100088-002	28-Jan-21	8.85	7,620		88.5	835	511	13.6	27.0	224	0.0100	<0.180	2,300	<2.50	<25.0	<1.00		0.0837	<0.000100	<0.0100	0.00276	0.103	0.0117	<0.00100	<0.000500	59.5
C3E	WR2100095-002	3-Feb-21	8.98	7,870	5.51	53.3	906	497	15.3	33.0	211	0.0086	<0.180	2,290	<2.50	<25.0	<1.00		0.0944	<0.000100	0.0131	0.00368	0.104	0.0111	<0.00100	<0.000500	56.2
C3E	WR2100120-004	12-Feb-21	9.02	7,150	6.16	41.8	888	491	16.5	42.0	185	0.0100	<0.018	2,300	<2.50	<25.0	<1.00		0.0889	<0.000100	<0.0100	0.00305	0.115	0.00827	<0.00100	<0.000500	41.3
C3E	WR2100156-002	24-Feb-21	8.81	6,390	6.36	93.9	127	21.3	13.8	10.4	305	<0.0100	<0.180	2,370	<2.50	<25.0	<1.00		0.0633	<0.000050	<0.0050	0.00278	0.083	0.0148	<0.000500	<0.000250	106
C3E	WR2100205-004	11-Mar-21	8.75	6,710	3.3	54.6	99.6	10.5	13.2	3.20	286	0.0055	<0.018	2,090	<2.50	<25.0	<1.00		0.0568	<0.000050	<0.0050	0.00273	0.074	0.0165	<0.000500	<0.000250	143
C3E	WR2100238-004	19-Mar-21	8.48	6,380	5.28	99.1	87.9	11.6	14.0	3.45	314	0.0121	0.039	2,380	<1.00	14.4	<0.400		0.0564	<0.000050	<0.0050	0.00230	0.072	0.0142	<0.000500	<0.000250	138
C3-R1	WR2000588-014	29-Jul-20		7,640			230			2.57	347		<0.090	2,560	<1.00	14.5	<0.400			<0.000050	<0.0050	0.170	0.079	0.0517	<0.000100	<0.000250	247
C3-R1	WR2000774-014	26-Aug-20								0.147	346		<0.180	2,400	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.295	0.073	0.0512	<0.000100	<0.000250	268
C3-R1	WR2001077-014	6-Oct-20								0.227	348		<0.036	2,360	<2.50	<25.0	<1.00			<0.000050	0.0052	0.0620	0.063	0.0396	<0.000100	<0.000250	272
C3-R1	WR2001246-014	17-Nov-20								0.297	292		<0.180	1,970	<2.50	<25.0	<1.00			0.000230	<0.0050	0.123	0.068	0.0430	<0.000100	<0.000250	245
C3-R1	WR2001381-013	15-Dec-20								5.12	280		<0.180	1,990	<2.50	<25.0	<1.00			<0.000050	0.0052	0.0269	0.084	0.0306	<0.000100	<0.000250	258
C3-R1	WR2100036-014	12-Jan-21								17.7	294		<0.180	2,230	<2.50	<25.0	<1.00			<0.000050	0.0116	0.0272	0.077	0.0263	<0.000100	<0.000250	224
C3-R1	WR2100120-012	10-Feb-21								18.6	311		<0.180	2,390	<2.50	<25.0	<1.00			<0.000100	<0.0100	0.0606	<0.100	0.0254	<0.000200	<0.000500	233
C3-R1	WR2100205-012	9-Mar-21								2.42	337		<0.090	2,320	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.0105	0.064	0.0256	<0.000100	<0.000250	254
C3-R1	WR2100238-011	17-Mar-21								0.906	140		<0.036	972	<1.00	<10.0	<0.400			<0.000050	<0.0050	0.00789	0.066	0.0217	<0.000100	<0.000250	253
C3-R2	WR2000588-015	29-Jul-20		7,540			205			1.26	329		0.090	2,440	<1.00	14.2	<0.400			<0.000050	<0.0050	0.0325	0.122	0.0500	<0.000100	<0.000250	205
C3-R2	WR2000774-015	26-Aug-20								0.261	339		<0.180	2,380	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.0465	0.103	0.0462	<0.000100	<0.000250	234
C3-R2	WR2001077-015	7-Oct-20								0.303	351		<0.018	2,430	<2.50	<25.0	<1.00			<0.000050	0.0053	0.00440	0.090	0.0349	<0.000100	<0.000250	211
C3-R2	WR2001246-015	17-Nov-20								0.394	340		<0.180	2,250	<2.50	<25.0	<1.00			0.000414	0.0075	0.00423	0.082	0.0333	<0.000100	<0.000250	211
C3-R2	WR2001381-014	15-Dec-20								2.64	299		<0.180	2,280	<2.50	<25.0	<1.00			<0.000050	0.0055	0.00332	0.102	0.0278	<0.000100	<0.000250	160
C3-R2	WR2100036-015	12-Jan-21								14.6	270		<0.180	2,440	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00320	0.116	0.0147	<0.000100	<0.000250	69.4
C3-R2	WR2100120-013	10-Feb-21								26.6	235		<0.180	2,340	<2.50	<25.0	<1.00			<0.000100	<0.0100	0.00435	0.101	0.0114	<0.000200	<0.000500	67.8
C3-R2	WR2100205-013	10-Mar-21								3.27	335		<0.036	2,420	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00503	0.068	0.0195	<0.000100	<0.000250	160
C3-R2	WR2100238-012	18-Mar-21								2.62	334		<0.036	2,430	<1.00	14.6	<0.400			<0.000050	<0.0050	0.00235	0.070	0.0184	<0.000100	<0.000250	165
C3-R3	WR2000588-016	29-Jul-20		6,890			252			0.950	327		0.090	2,460	<1.00	14.5	<0.400			<0.000050	<0.0050	0.0122	0.129	0.0431	<0.000100	<0.000250	192
C3-R3	WR2000774-016	26-Aug-20								0.355	335		<0.180	2,390	<1.00	14.4	<0.400			<0.000050	<0.0050	0.0200	0.114	0.0390	<0.000100	<0.000250	229
C3-R3	WR2001077-016	7-Oct-20								0.317	365		<0.036	2,320	<2.50	<25.0	<1.00			<0.000050	0.0062	0.00372	0.094	0.0251	<0.000100	<0.000250	186
C3-R3	WR2001246-016	17-Nov-20								0.397	349		<0.180	2,460	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00244	0.089	0.0254	<0.000100	<0.000250	199
C3-R3	WR2001381-015	15-Dec-20								1.58	294		<0.180	2,270	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00263	0.108	0.0232	<0.000100	<0.000250	141
C3-R3	WR2100036-016	12-Jan-21								13.2	272		<0.180	2,350	<2.50	<25.0	<1.00			<0.000050	0.0066	0.00344	0.105	0.0163	<0.000100	<0.000250	95.6
C3-R3	WR2100120-014	10-Feb-21								34.8	199		<0.180	2,290	<2.50	<25.0	<1.00			<0.000100	<0.0100	0.00330	0.104	0.00888	<0.000200	<0.000500	42.7
C3-R3	WR2100205-014	10-Mar-21								2.80	312		<0.018	2,270	<2.50	<25.0	<1.00			<0.000050	<0.0050	0.00240	0.066	0.0190	<0.000100	<0.000250	140
C3-R3	WR2100238-013	18-Mar-21								2.52	326		<0.036	2,420	<1.00	14.7	<0.400			<0.000050	<0.0050	0.00258	0.069	0.0201	<0.000100	<0.000250	133

Notes

Effluent samples are denoted by "E" following the column ID (C1A, C1B, C2 and C3)

Rhizon samples are denoted by "-R1/R2/R3" following the column ID (C1A, C1B, C2 and C3)

Appendix C: Water Quality Results for Influent, Effluent and Rhizon Samples

Sample ID	D-Cd	D-Co	D-Cr	D-Cs	D-Cu	D-Fe	D-Hg	D-K	D-Li	D-Mg	D-Mn	D-Mo	D-Na	D-Ni	D-P	D-Pb	D-Rb	D-S	D-Sb	D-Se	D-Si	D-Sn	D-Sr	D-Te	D-Th	D-Ti	D-Tl	D-U	D-V	D-W	D-Zn	D-Zr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Influent	<0.0000450	0.0906	<0.00050	0.000103	0.0236	0.057	0.0000628	11.2	<0.0050	145	0.0244	0.0406	1,260	0.00835	<0.250	<0.000250	0.00617	864	0.520	0.000823	9.49	<0.00050	0.329	<0.00100	<0.00050	<0.00150	0.000151	0.492	<0.00250	0.00777	0.0070	<0.00100
Influent	<0.0000400	0.0918	<0.00050	0.000101	0.0211	0.059	0.000120	12.5	<0.0050	142	0.00329	0.0401	1,320	0.00884	<0.250	<0.000250	0.00592	904	0.485	0.000871	10.1	<0.00050	0.323	<0.00100	<0.00050	<0.00150	0.000153	0.429	<0.00250	0.00792	0.0055	<0.00100
Influent	<0.0000450	0.0894	<0.00050	0.000099	0.0205	0.057	0.000108	12.1	<0.0050	137	0.00173	0.0402	1,160	0.00824	<0.250	<0.000250	0.00578	896	0.456	0.000767	8.40	<0.00050	0.298	<0.00100	<0.00050	<0.00150	0.000142	0.464	<0.00250	0.00724	0.0068	<0.00100
Influent	<0.0000300	0.0974	<0.00050	0.000117	0.0245	0.059	0.0000876	12.8	<0.0050	147	0.00944	0.0416	1,240	0.00902	<0.250	<0.000250	0.00631	916	0.518	0.000738	9.16	<0.00050	0.330	<0.00100	<0.00050	<0.00150	0.000136	0.474	<0.00250	0.00856	0.0081	<0.00100
Influent	0.0000386	0.0902	<0.00050	0.000118	0.0221	<0.050	0.0000855	12.3	<0.0050	134	0.0116	0.0428	1,220	0.0106	<0.250	<0.000250	0.00583	863	0.558	0.000824	8.43	<0.00050	0.342	<0.00100	<0.00050	<0.00150	0.000155	0.492	<0.00250	0.00784	0.0069	<0.00100
Influent	<0.0000400	0.0919	<0.00050	0.000121	0.0233	0.060	0.0000537	12.9	<0.0050	141	0.0113	0.0397	1,860	0.00871	<0.250	0.000356	0.00627	930	0.502	0.00105	9.47	<0.00050	0.319	<0.00100	<0.00050	<0.00150	0.000151	0.486	<0.00250	0.00764	0.0063	<0.00100
Influent	0.0000390	0.0880	<0.00050	0.000124	0.0248	0.057	0.0000825	12.3	<0.0050	128	0.0152	0.0413	1,670	0.00694	<0.250	<0.000250	0.00592	952	0.505	0.000895	9.62	<0.00050	0.304	<0.00100	<0.00050	<0.00150	0.000154	0.447	<0.00250	0.00791	0.0064	<0.00100
Influent	<0.0000500	0.0909	<0.00050	0.000107	0.0225	0.059	0.0000538	12.7	<0.0050	153	0.0154	0.0393	1,900	0.00860	<0.250	<0.000250	0.00612	977	0.475	0.000823	10.2	<0.00050	0.321	<0.00100	<0.00050	<0.00150	0.000138	0.443	<0.00250	0.00783	0.0081	<0.00100
Influent	0.0000514	0.0970	<0.00100	0.000124	0.0245	<0.100	0.0000818	13.8	<0.0100	151	0.0167	0.0422	1,990	0.00936	<0.500	<0.000500	0.00655	957	0.524	0.000980	9.79	<0.00100	0.344	<0.00200	<0.00100	<0.00300	0.000136	0.485	<0.00500	0.00853	<0.0100	<0.00200
Influent	0.0000511	0.0932	<0.00050	0.000112	0.0217	0.056	0.0000717	12.8	0.0050	153	0.0156	0.0406	1,340	0.00859	<0.250	<0.000250	0.00566	928	0.522	0.000957	9.91	<0.00050	0.336	<0.00100	<0.00050	<0.00150	0.000141	0.432	<0.00250	0.00806	0.0066	<0.00100
Influent	<0.0000350	0.0875	<0.00250	0.000103	0.0212	0.054		12.0	<0.0050	138	0.00845	0.0374	1,270	0.00819	<0.250	<0.000250	0.00640	883	0.527	0.000852	9.00	<0.00050	0.314	<0.00100	<0.00050	<0.00150	0.000110	0.444	<0.00250	0.00718	0.0067	<0.00150
C1AE	0.000306	0.0916	<0.00050	<0.000050	0.00698	0.080	0.0000814	13.1	<0.0050	140	0.275	0.0213	1,220	0.00529	<0.250	<0.000250	0.00458	830	0.485	0.000808	9.69	<0.00050	0.375	<0.00100	<0.00050	<0.00150	<0.000050	0.343	<0.00250	0.00200	0.0251	<0.00100
C1AE	0.000295	0.0922	<0.00050	<0.000050	0.00576	0.079	0.0000796	12.9	<0.0050	133	0.208	0.0227	1,160	0.00559	<0.250	<0.000250	0.00462	883	0.444	0.000567	9.08	<0.00050	0.336	<0.00100	<0.00050	<0.00150	<0.000050	0.336	<0.00250	0.00161	0.0255	<0.00100
C1AE	0.000256	0.0946	<0.00050	<0.000050	0.00428	0.080	0.0000469	14.2	<0.0050	146	0.180	0.0245	1,350	0.00591	<0.250	<0.000250	0.00546	987	0.425	0.000767	10.2	<0.00050	0.362	<0.00100	<0.00050	<0.00150	<0.000050	0.348	<0.00250	0.00146	0.0213	<0.00100
C1AE	0.000250	0.103	<0.00050	<0.000050	0.00502	0.071	0.0000637	13.7	<0.0050	154	0.144	0.0279	1,310	0.00703	<0.250	<0.000250	0.00594	980	0.491	0.000846	9.67	<0.00050	0.381	<0.00100	<0.00050	<0.00150	<0.000050	0.392	<0.00250	0.00194	0.0202	<0.00100
C1AE	0.000225	0.101	<0.00050	<0.000050	0.00566	0.069	0.0000226	13.2	0.0054	153	0.116	0.0289	1,320	0.00583	<0.250	<0.000250	0.00547	931	0.461	0.000625	9.50	<0.00050	0.366	<0.00100	<0.00050	<0.00150	0.000055	0.425	<0.00250	0.00186	0.0164	<0.00100
C1AE	0.000166	0.0950	<0.00050	<0.000050	0.00528	0.651	0.0000236	11.4	<0.0050	129	0.148	0.0252	1,140	0.00623	<0.250	<0.000250	0.00498	911	0.470	0.000854	9.42	<0.00050	0.341	<0.00100	<0.00050	<0.00150	<0.000050	0.393	<0.00250	0.00133	0.0202	<0.00100
C1AE	0.000151	0.0908	0.00055	<0.000050	0.00526	0.063	0.0000657	12.2	<0.0050	144	0.0867	0.0305	1,280	0.00557	<0.250	<0.000250	0.00542	842	0.522	0.000779	9.18	<0.00050	0.359	<0.00100	<0.00050	<0.00150	0.000071	0.416	<0.00250	0.00239	0.0138	<0.00100
C1AE	0.000162	0.0955	<0.00050	<0.000050	0.00702	0.067	0.0000635	12.9	<0.0050	146	0.0869	0.0312	1,330	0.00581	<0.250	<0.000250	0.00504	939	0.492	0.000855	9.67	<0.00050	0.337	<0.00100	<0.00050	<0.00150	0.000056	0.399	<0.00250	0.00236	0.0143	<0.00100
C1AE	<0.0000750	0.0910	<0.00050	<0.000050	0.00420	0.059	0.0000152	12.9	<0.0050	130	0.0963	0.0432	1,700	0.00342	<0.250	<0.000250	0.00541	907	0.506	0.000850	9.32	<0.00050	0.344	<0.00100	<0.00050	<0.00150	<0.000050	0.483	<0.00250	0.00276	<0.0050	<0.00100
C1AE	<0.0000350	0.0859	<0.00050	<0.000050	0.00244	0.061	0.0000437	12.2	<0.0050	122	0.0315	0.0478	1,620	<0.00250	<0.250	<0.000250	0.00463	910	0.487	0.000542	9.25	<0.00050	0.289	<0.00100	<0.00050	<0.00150	<0.000050	0.439	<0.00250	0.00307	<0.0050	<0.00100
C1AE	<0.0000250	0.0896	<0.00050	<0.000050	0.00446	0.076	0.0000287	13.2	<0.0050	135	0.0230	0.0495	1,900	0.00292	<0.250	<0.000250	0.00492	962	0.494	0.000748	9.23	<0.00050	0.285	<0.00100	<0.00050	<0.00150	<0.000050	0.444	<0.00250	0.00324	<0.0050	<0.00100
C1AE	<0.0000450	0.0959	<0.00050	<0.000050	0.00291	0.069	0.0000182	12.3	<0.0050	136	0.0100	0.0442	1,800	0.00284	<0.250	<0.000250	0.00545	926	0.512	0.000832	9.86	<0.00050	0.267	<0.00100	<0.00050	<0.00150	0.000065	0.371	<0.00250	0.00338	<0.0050	<0.00100
C1AE	<0.0000350	0.0958	<0.00050	<0.000050	0.00455	0.076	0.0000202	12.9	<0.0050	144	0.00598	0.0451	1,990	0.00269	<0.250	<0.000250	0.00563	944	0.503	0.000805	9.53	<0.00050	0.244	<0.00100	<0.00050	<0.00150	<0.000050	0.395	<0.00250	0.00293	<0.0050	<0.00100
C1AE	<0.0000450	0.0851	<0.00050	<0.000050	0.00376	0.079	0.0000293	11.5	<0.0050	113	0.00278	0.0506	1,770	<0.00250	<0.250	<0.000250	0.00451	938	0.451	0.000628	9.05	<0.00050	0.156	<0.00100	<0.00050	<0.00150	<0.000050	0.554	<0.00250	0.00330	<0.0050	<0.00100
C1AE	<0.0000600	0.0887	<0.00050	<0.000050	0.00400	0.104	0.0000454	10.8	<0.0050	106	0.00451	0.0611	1,730	0.00360	<0.250	<0.000250	0.00441	922	0.451	0.000604	9.02	<0.00050	0.125	<0.00100	<0.00050	<0.00150	<0.000050	0.777	<0.00250	0.00382	<0.0050	0.00109
C1AE	<0.0000450	0.0943	<0.00050	<0.000050	0.00358	0.080	0.0000367	13.5	<0.0050	165	0.0137	0.0502	2,060	0.00294	<0.250	<0.000250	0.00498	985	0.536	0.000864	9.40	<0.00050	0.251	<0.00100	<0.00050	<0.00150	<0.000050	0.431	<0.00250	0.00340	<0.0050	<0.00100
C1AE	<0.0000450	0.0930	<0.00050	<0.000050	0.00333	0.245	0.0000056	12.9	<0.0050	141	0.00683	0.0565	2,040	0.00426	<0.250	<0.000250	0.00511	886	0.537	0.000710	8.86	<0.00050	0.190	<0.00100	<0.00050	<0.00150	<0.000050	0.554	<0.00250	0.00338	<0.0050	<0.00100
C1AE	<0.0000250	0.0949	<0.00050	0.000051	0.00318	0.073	0.0000284	12.3	<0.0050	114	0.00192	0.0461	1,780	0.00333	<0.250	<0.000250	0.00499	916	0.512	0.000854	9.61	<0.00050	0.169	<0.00100	<0.00050	<0.00150	<0.000050	0.548	<0.00250	0.00330	<0.0050	<0.00100
C1AE	<0.0000500	0.0930	<0.00100	<0.000100	0.00221	<0.100	0.0000436	12.0	<0.0100	140	0.00298	0.0404	1,780	<0.00500	<0.500	<0.000500	0.00503	874	0.500	0.000617	8.86	<0.00100	0.225	<0.00200	<0.00100	<0.00300	<0.000100	0.369	<0.00500	0.00239	<0.0100	<0.00200
C1AE	<0.0000500	0.0993	<0.00100	<0.000100	0.00249	<0.100	0.0000573	14.1	<0.0100	154	0.00520	0.0370	2,020	<0.00500	<0.500	<0.000500	0.00578	986	0.522	0.000598	9.77	<0.00100	0.323	<0.00200	<0.00100	<0.00300	<0.000100	0.373	<0.00500	0.00318	<0.0100	<0.00200
C1AE	<0.0000500	0.0948	<0.00100	<0.000100	0.00274	0.497	0.0000444	11.6	<0.0100	140	0.00696	0.0381	1,820	<0.00500	<0.500	<0.000500	0.00555	870	0.525	0.000767	8.91	<0.00100	0.247	<0.00200	<0.00100	<0.00300	<0.000100	0.429	<0.00500	0.00241	<0.0100	<0.00200
C1AE	0.0000501	0.0923	<0.00050	<0.000050	0.00537	0.052	0.0000275	12.8	0.0051	150	0.0162	0.0317	1,340	0.00385	<0.250	<0.000250	0.00523	897	0.528	0.000623	9.82	<0.00050	0.346	<0.00100	<0.00050	<0.00150	0.000073	0.343	<0.00250	0.00341	<0.0050	<0.00100
C1AE	0.0000778	0.0927	<0.00050	<0.000050	0.00608	0.755	0.0000277	12.5	<0.0050	147	0.0368	0.0338	1,270	0.00694	<0.250	0.000265	0.00561	881	0.542	0.000624	9.42	<0.00050	0.354	<0.00100	<0.00050	<0.00150	0.000095	0.345	<0.00250	0.00300	0.0063	<0.00100
C1AE	0.000411	0.0975	<0.00050	<0.000050	0.00629	0.113	0.0000370	12.6	<0.0050	142	0.0335	0.0309	1,310	0.00516	<0.250	<0.000250	0.00544	922	0.501	0.000706	9.80	<0.00050	0.337	<0.00100	<0.00050	<0.00150	0.000078	0.315	<0.00250	0.00235	<0.0050	<0.00100
C1A-R1	0.000201	0.0973	<0.00250	<0.000050	0.00912	0.068		13.6	<0.0050	146	0.107	0.0398	1,360	0.00749	<0.250	<0.000250	0.00630	923	0.484	0.000776	9.98	<0.00050	0.356	<0.00100	<0.00050	<0.00150	0.000085	0.402	<0.00250	0.00537	0.0234	<0.00150
C1A-R1	<0.0000900	0.0894	<0.00250	0.000057	0.00983	0.057		12.1	<0.0050	133	0.0152	0.0409	1,120	0.00562	<0.250	<0.000250	0.00628	884	0.481	0.000741	8.76	<0.00050	0.321	<0.00100	<0.00050	<0.00150	0.000099	0.441	<0.00250	0.00694	0.0209	<0.00150
C1A-R1	0.0000956	0.0998	<0.00250	<0.000050	0.0104	0.055		12.2	0.0053	152	0.0527	0.0375	1,320	0.00745	<0.250	<0.000250	0.00620	910	0.530	0.000793	9.35	<0.00050	0.331	<0.00100	<0.00050	<0.00150	0.000098	0.462	<0.00250	0.00441	0.0096	<0.00150
C1A-R1	<0.0000450	0.0924	<0.00250	0.000075	0.0121	<0.050		12.5	<0.0050	132	0.0415	0.0457	1,780	0.00432	<0.250	<0.000250	0.00573	949	0.505	0.000587	9.72	<0.00050	0.314	<0.00100	<0.00050	<0.00150	0.000129	0.433	<0.00250	0.00735	<0.0050	<0.00150
C1A-R1	<0.0000500	0.0929	<0.00250	0.000069	0.00740	0.063		12.9	<0.0050	153	0.00915	0.0459	1,910	0.00345	<0.250	<0.000250	0.00613	960	0.530	0.000615	9.72	<0.00050	0.308	<0.00100	<0.00050	<0.00150	0.000076	0.424	<0.00250	0.00794	<0.0050	<0.00150
C1A-R1	<0.0000550	0.0985	<0.00250	0.000082	0.00580	0.070		13.4	<0.0050	155	0.00468	0.0446	2,040	0.00392	<0.250	0.000262	0.00665	913	0.567	0.000796	10.0	<0.00050	0.262	<0.00100	<0.00050	<0.00150	0.000075	0.582	<0.00250	0.00821	<0.0050	<0.00150
C1A-R1	<0.0000500	0.0950	<0.00500	<0.000100	0.00635	<0.100		12.1	<0.0100	152	0.00802	0.0412	1,820	<0.00500	<0.500	<0.000500	0.00663	905	0.545	0.000734	9.22	<0.00100	0.338	<0.00200	<0.00100	<0.00300	0.000116	0.447	<0.00500	0.00704	<0.0100	<0.00300
C1A-R1	0.0000567	0.0935	<0.00250	0.000070	0.00948	0.057		12.3	<0.0050	145	0.0198	0.0402	1,240	0.00865	<0.250	<0.000250	0.00593	863	0.551	0.000715	9.55	<0.00050	0.350	<0.00100	<0.00050	<0.00150	0.000150	0.414	<0.00250	0.00569	0.0052	<0.00150
C1A-R1	0.0000706	0.0981	<0.00250	0.000076	0.00966	0.060		12.8	<0.0050	145	0.0176	0.0381	1,370	0.00834	<0.250	0.000320	0.00574	924	0.534	0.000622	10.0	<0.00050	0.326	<0.00100	<0.00050	<0.00150	0.000136	0.387	<0.00250	0.00555	0.0054	<0.00150
C1A-R2	0.000471	0.0939	<0.00250	0.000056	0.00706	0.081		16.4	<0.0050	136	0.691	0.0216	1,290	0.00687	0.387	<0.000250	0.00520	879	0.438	0.000705	10.0	<0.00050	0.462	<0.00100	<0.00050	<0.00150	<0.000050	0.256	<0.00250	0.00162	0.0410	<0.00150
C1A-R2	0.000264	0.0900	<0.00250	<0.000050	0.00772	0.060		12.9	<0.0050	132	0.201	0.0315	1,130	0.00494	<0.250	<0.000250	0.00484	865	0.456	0.000666	8.90	<0.00050	0.342	<0.00100	<0.00050	<0.00150	<0.000050	0.361	<0.00250	0.00339	0.0233	<0.00150
C1A-R2	0.000256	0.0994	<0.00250	<0.000050	0.00440	0.063		12.5	<0.0050	144	0.183	0.0224	1,260	0.00553	<0.250	<0.000250	0.00514	900	0.425	0.000722	9.38	<0.00050	0.341	<0.00100	<0.00050	<0.00150	<0.000050	0.376	<0.00250	0.00132	0.0335	<0.00150
C1A-R2	<0.0000800	0.0908	<0.00250	0.000055	0.00610	0.055		12.9	<0.0050	130	0.0761	0.0428	1,740	0.00311	<0.250	<0.000250	0.00613	912	0.490	0.000710	9.34	<0.00050	0.325	<0.00100	<0.00050	<0.00150	0.000060	0.429	<0.00250	0.00384	<0.0050	<0.00150
C1A-R2	<0.0000550	0.0957	<0.00250	<0.000050	0.00286	0.061		13.6	<0.0050	154	0.00840	0.0448	2,020	0.00265	<0.250	<0.000250	0.00580	973	0.521	0.000670	9.82	<0.00050	0.284	<0.00100	<0.00050	<0.00150	<0.000050	0.391	<0.00250	0.00447	0.0051	<0.00150
C1A-R2	<0.0000350	0.0965	<0.00250	0.000065	0.00317	0.071		13.4	<0.0050	154	0.00478	0.0454	2,070	0.00254	<0.250	<0.000250	0.00574	886	0.541	0.000669	9.64	<0.00050	0.237	<0.00100	<0.00050	<0.00150	<0.000050	0.523	<0.00250	0.00463	<0.0050	<0.00150
C1A-R2	<0.0000500	0.0946	<0.00500	<0.000100	0.00295	<0.100		11.9	<0.0100	144	0.00504	0.0375	1,770	<0.00500	<0.500	<0.000500	0.00587	867	0.518	0.000883	9.09	<0.00100	0.282	<0.00200	<0.00100	<0.00300	<0.000100	0.420	<0.00500	0.00444	<0.0100	<0.00300
C1A-R2	0.0000781	0.0937	<0.00250	<0.000050	0.00507	0.054		12.4	<0.0050	150	0.0312	0.0276	1,270	0.00397	<0.250	0.000329	0.00532	851	0.530	0.000725	9.53	<0.00050	0.355	<0.00100	<0.00050	<0.00150	0.000073	0.334	<0.00250	0.00246	<0.0050	<0.00150
C1A-R2	0.0000685	0.0977	<0.00250	<0.000050	0.00609	0.058		13.3	<0.0050	146	0.0328	0.0262	1,390	0.00390	<0.250	<0.000250	0.00609	918	0.510	0.000499	10.1	<0.00050	0.350	<0.00100	<0.00050	<0.00150	0.000068	0.304	<0.00250	0.00197	0.0054	<0.00150
C1A-R3	0.000413	0.0968	<0.00250	<0.000050	0.00682	0.085		16.7	<0.0050	139	0.760	0.0192	1,300	0.00657	0.372	<0.000250	0.00516	907	0.450	0.000938	10.4	<0.00050	0.492	<0.00100	<0.00050	<0.00150	<0.000050	0.248	<0.00250	0.00141	0.0391	<0.00150
C1A-R3	0.000257	0.0910	<0.00250	<0.000050	0.00737	0.067		13.2	<0.0050	132	0.300	0.0282	1,140	0.00494	<0.250	<0.000250	0.00496	866	0.448	0.000506	9.21	<0.00050	0.378	<0.00100	<0.00050	<0.00150	<0.000050	0.347	<0.00250	0.00265	0.0228	<0.00150
C1A-R3	0.000192	0.102	<0.00250	<0.000050	0.00354	0.064		13.0	<0.0050	150	0.261	0.0226	1,280	0.00611	<0.250	<0.000250	0.00476	908	0.452	0.000706	9.41	<0.00050	0.388	<0.00100	<0.00050	<0.00150	<0.000050	0.383	<0.00250	0.00110	0.0201	<0.00150
C1A-R3	<0.0000700	0.0914	<0.00250	<0.000050	0.00434	0.073		13.0	<0.0050	131	0.116	0.0424	1,720	0.00354	<0.250	<0.000250	0.00484	908	0.498	0.000858	9.27	<0.00050	0.350	<0.00100	<0.00050	<0.00150	<0.000050	0.440	<0.00250	0.00296	0.0138	<0.00150
C1A-R3	<0.0000700	0.0972	<0.00250	<0.000050	0.00325	0.150		13.5	<0.0050	151	0.0102	0.0473	2,000	0.00265	<0.250	<0.000250	0.00543	1000	0.514	0.000941	9.97	<0.00050	0.262	<0.00100	<0.00050	<0.00150	<0.000050	0.397	<0.00250	0.00331	<0.0050	<0.00150
C1A-R3	<0.0000500	0.0937	<0.00250	0.000064	0.00225	0.068		12.9	<0.0050	145	0.00525	0.0518	1,970	0.00297	<0.250	<0.000250	0.00525	875	0.577	0.000630	9.30	<0.00050	0.194	<0.00100	<0.00050	<0.00150	<0.000050	0.509	<0.00250	0.00343	<0.0050	<0.00150

Appendix C: Water Quality Results for Influent, Effluent and Rhizon Samples

Sample ID	D-Cd	D-Co	D-Cr	D-Cs	D-Cu	D-Fe	D-Hg	D-K	D-Li	D-Mg	D-Mn	D-Mo	D-Na	D-Ni	D-P	D-Pb	D-Rb	D-S	D-Sb	D-Se	D-Si	D-Sn	D-Sr	D-Te	D-Th	D-Ti	D-Tl	D-U	D-V	D-W	D-Zn	D-Zr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C1A-R3	<0.0000500	0.0944	<0.00500	<0.000100	0.00215	<0.100		12.2	<0.0100	143	0.00357	0.0354	1,790	<0.00500	<0.500	<0.000500	0.00544	877	0.517	0.000521	9.10	<0.00100	0.250	<0.00200	<0.00100	<0.00300	<0.000100	0.408	<0.00500	0.00255	<0.0100	<0.00300
C1A-R3	0.0000698	0.0972	<0.00250	<0.000050	0.00498	0.060		13.0	<0.0050	158	0.0301	0.0292	1,330	0.00449	<0.250	<0.000250	0.00563	876	0.552	0.000515	9.88	<0.00050	0.358	<0.00100	<0.00050	<0.00150	0.000067	0.345	<0.00250	0.00256	<0.0050	<0.00150
C1A-R3	0.0000937	0.0970	<0.00250	<0.000050	0.00601	0.072		13.1	<0.0050	148	0.0340	0.0258	1,350	0.00400	<0.250	0.000427	0.00564	922	0.514	0.000612	10.0	<0.00050	0.344	<0.00100	<0.00050	<0.00150	0.000058	0.293	<0.00250	0.00190	0.0056	<0.00150
C1BE	<0.000125	0.0387	0.00064	0.000121	0.0117	2.71	0.0000122	34.6	<0.0050	133	0.743	0.645	1,290	0.0487	<0.500	<0.000250	0.00713	943	0.0416	0.000622	3.11	0.00121	0.803	<0.00100	<0.00050	<0.00150	<0.000050	0.00906	0.00737	0.00120	0.0270	<0.00100
C1BE	<0.000145	0.0427	<0.00050	0.000110	0.00676	2.35	0.0000170	25.2	<0.0050	132	0.699	0.301	1,160	0.0252	<0.250	<0.000250	0.00617	799	0.0918	0.000576	2.71	0.00068	0.677	<0.00100	<0.00050	<0.00150	<0.000050	0.0349	0.00311	0.00129	<0.0050	<0.00100
C1BE	<0.0000850	0.0386	<0.00050	0.000099	0.00438	0.782	0.0000237	19.0	<0.0050	124	0.444	0.360	1,200	0.0150	<0.250	<0.000250	0.00546	832	0.0964	0.000542	2.43	<0.00050	0.485	<0.00100	<0.00050	<0.00150	<0.000050	0.0267	<0.00250	0.00105	<0.0050	<0.00100
C1BE	<0.0000850	0.0396	<0.00050	0.000112	0.00303	0.597	0.0000161	18.2	<0.0050	138	0.368	0.359	1,360	0.0135	<0.250	<0.000250	0.00547	914	0.110	0.000518	2.60	<0.00050	0.455	<0.00100	<0.00050	<0.00150	<0.000050	0.0283	<0.00250	0.00105	<0.0050	<0.00100
C1BE	<0.000120	0.0328	<0.00050	0.000106	0.00260	1.58	0.0000248	14.2	<0.0050	136	0.394	0.405	1,210	0.0147	<0.250	<0.000250	0.00490	828	0.0904	0.000521	2.29	<0.00050	0.408	<0.00100	<0.00050	<0.00150	<0.000050	0.00300	<0.00250	0.00135	<0.0050	<0.00100
C1BE	<0.000180	0.0292	<0.00050	0.000105	0.00171	1.78	0.0000200	14.1	<0.0050	132	0.370	0.490	1,190	0.0156	<0.250	<0.000250	0.00493	866	0.0792	0.000504	2.05	<0.00050	0.344	<0.00100	<0.00050	<0.00150	<0.000050	0.00155	<0.00250	0.00082	<0.0050	<0.00100
C1BE	<0.000105	0.0264	<0.00050	0.000126	0.00202	0.082	0.0000085	14.5	<0.0050	140	0.274	0.519	1,320	0.0137	<0.250	<0.000250	0.00507	959	0.0514	0.000479	1.81	<0.00050	0.341	<0.00100	<0.00050	<0.00150	<0.000050	0.000582	<0.00250	0.00072	<0.0050	<0.00100
C1BE	<0.000180	0.0289	<0.00050	0.000139	0.00154	0.114	0.0000108	14.4	<0.0050	145	0.291	0.457	1,280	0.0137	<0.250	<0.000250	0.00574	948	0.0659	0.000526	1.72	<0.00050	0.330	<0.00100	<0.00050	<0.00150	<0.000050	0.000522	<0.00250	0.00080	<0.0050	<0.00100
C1BE	<0.000200	0.0257	<0.00050	0.000137	0.00166	0.095	<0.0000050	12.9	<0.0050	136	0.158	0.573	1,290	0.0108	<0.250	<0.000250	0.00552	920	0.0532	0.000405	1.40	<0.00050	0.287	<0.00100	<0.00050	<0.00150	<0.000050	0.000552	<0.00250	0.00071	<0.0050	<0.00100
C1BE	<0.0000600	0.0256	<0.00050	0.000137	0.00636	0.072	0.0000056	12.1	<0.0050	117	0.131	0.564	1,180	0.0117	<0.250	<0.000250	0.00492	948	0.0481	0.000306	1.46	<0.00050	0.250	<0.00100	<0.00050	<0.00150	<0.000050	0.00107	<0.00250	0.00072	<0.0050	<0.00100
C1BE	<0.000195	0.0320	<0.00050	0.000105	0.00160	0.445	0.0000141	12.4	<0.0050	142	0.314	0.279	1,250	0.0141	<0.250	<0.000250	0.00503	847	0.123	0.000594	2.28	<0.00050	0.303	<0.00100	<0.00050	<0.00150	<0.000050	0.00141	<0.00250	0.00083	<0.0050	<0.00100
C1BE	<0.0000950	0.0346	<0.00050	0.000102	0.00196	2.88	0.0000186	12.7	<0.0050	132	0.340	0.229	1,240	0.0167	<0.250	<0.000250	0.00467	896	0.154	0.000580	2.42	<0.00050	0.300	<0.00100	<0.00050	<0.00150	<0.000050	0.00190	<0.00250	0.00095	<0.0050	<0.00100
C1BE	<0.0000900	0.0280	<0.00050	0.000138	0.00154	0.392	0.0000128	13.8	<0.0050	136	0.247	0.370	1,460	0.0108	<0.250	<0.000250	0.00547	898	0.0951	0.000430	1.90	<0.00050	0.270	<0.00100	<0.00050	<0.00150	<0.000050	0.00258	<0.00250	0.00086	<0.0050	<0.00100
C1BE	<0.0000750	0.0346	<0.00050	0.000133	0.00155	0.078	0.0000216	13.2	<0.0050	121	0.184	0.304	1,630	0.0107	<0.250	<0.000250	0.00522	926	0.148	0.000479	2.23	<0.00050	0.190	<0.00100	<0.00050	<0.00150	<0.000050	0.0156	<0.00250	0.00149	<0.0050	<0.00100
C1BE	<0.0000600	0.0338	<0.00050	0.000127	0.00347	0.143	0.0000139	13.4	<0.0050	120	0.102	0.406	1,840	0.0112	<0.250	<0.000250	0.00534	983	0.144	0.000504	2.46	<0.00050	0.124	<0.00100	<0.00050	<0.00150	<0.000050	0.0202	<0.00250	0.00165	<0.0050	<0.00100
C1BE	<0.0000800	0.0375	<0.00050	0.000114	0.00235	0.087	0.0000054	12.8	<0.0050	132	0.147	0.332	1,820	0.0154	<0.250	<0.000250	0.00492	913	0.163	0.000596	2.52	<0.00050	0.148	<0.00100	<0.00050	<0.00150	<0.000050	0.0168	<0.00250	0.00154	<0.0050	<0.00100
C1BE	<0.000305	0.0380	<0.00050	0.000115	0.00342	0.110	0.0000101	13.3	<0.0050	139	0.0869	0.397	2,020	0.0178	<0.250	<0.000250	0.00504	948	0.158	0.000641	2.40	<0.00050	0.0930	<0.00100	<0.00050	<0.00150	<0.000050	0.0392	<0.00250	0.00192	<0.0050	<0.00100
C1BE	<0.000595	0.0299	<0.00050	0.000146	0.00867	0.209	0.0000301	11.8	<0.0050	88.1	0.0209	0.923	1,690	0.0164	<0.250	<0.000250	0.00484	897	0.122	0.000389	1.55	<0.00050	0.0348	<0.00100	<0.00050	<0.00150	<0.000050	0.116	<0.00250	0.00323	<0.0050	<0.00100
C1BE	<0.00112	0.0368	<0.00050	0.000173	0.00965	0.412	0.0000329	11.6	<0.0050	60.6	0.0188	2.47	1,740	0.0243	<0.250	<0.000250	0.00504	949	0.110	0.000962	1.50	<0.00050	0.0267	<0.00100	<0.00050	<0.00180	<0.000050	0.138	<0.00250	0.00561	<0.0050	<0.00100
C1BE	<0.000680	0.0430	<0.00050	0.000156	0.00863	0.176	0.0000167	11.7	<0.0050	87.5	0.0232	1.47	1,870	0.0303	<0.250	<0.000250	0.00467	1040	0.172	0.000723	2.08	<0.00050	0.0270	<0.00100	<0.00050	<0.00150	<0.000050	0.110	<0.00250	0.00533	<0.0050	<0.00100
C1BE	<0.000185	0.0598	<0.00050	0.000106	0.00306	0.136	0.0000052	13.7	<0.0050	173	0.0670	0.312	2,140	0.0122	<0.250	<0.000250	0.00467	874	0.228	0.000636	2.91	<0.00050	0.101	<0.00100	<0.00050	<0.00150	<0.000050	0.420	<0.00250	0.00292	<0.0050	<0.00100
C1BE	<0.000200	0.0422	<0.00050	0.000146	0.0159	0.316	0.0000061	12.7	<0.0050	93.6	0.0236	1.08	1,830	0.0193	<0.250	<0.000250	0.00502	959	0.160	0.000653	1.86	<0.00050	0.0219	<0.00100	<0.00050	<0.00150	<0.000050	0.365	<0.00250	0.00411	<0.0050	<0.00100
C1BE	<0.000225	0.0512	<0.00100	0.000127	0.0136	0.278	0.0000363	12.1	<0.0100	117	0.0365	0.841	1,810	0.0170	<0.500	<0.000500	0.00520	878	0.181	<0.000500	2.00	<0.00100	0.0234	<0.00200	<0.00100	<0.00300	<0.000100	0.375	<0.00500	0.00351	<0.0100	<0.00200
C1BE	<0.0000500	0.0586	<0.00100	0.000134	0.00308	0.110	0.0000276	14.4	<0.0100	160	0.153	0.264	2,020	0.0131	<0.500	<0.000500	0.00504	963	0.220	0.000527	3.29	<0.00100	0.129	<0.00200	<0.00100	<0.00300	<0.000100	0.310	<0.00500	0.00228	<0.0100	<0.00200
C1BE	<0.000260	0.0475	<0.00100	0.000128	0.0130	0.274	0.0000194	11.5	<0.0100	108	0.0327	0.635	1,740	0.0158	<0.500	<0.000500	0.00529	877	0.182	0.000631	2.04	<0.00100	0.0156	<0.00200	<0.00100	<0.00300	<0.000100	0.227	<0.00500	0.00364	<0.0100	<0.00200
C1BE	<0.0000500	0.0540	<0.00050	0.000077	0.00147	0.098	0.0000063	12.7	<0.0050	155	0.259	0.166	1,360	0.0143	<0.250	<0.000250	0.00505	892	0.211	0.000537	3.45	<0.00050	0.206	<0.00100	<0.00050	<0.00150	<0.000050	0.0676	<0.00250	0.00147	<0.0050	<0.00100
C1BE	<0.0000600	0.0494	<0.00050	0.000106	0.00135	1.33	0.0000057	12.9	<0.0050	148	0.310	0.172	1,290	0.0202	<0.250	<0.000250	0.00597	870	0.139	0.000452	2.75	<0.00050	0.208	<0.00100	<0.00050	<0.00150	<0.000050	0.0282	<0.00250	0.00088	<0.0050	<0.00100
C1BE	<0.0000350	0.0489	<0.00050	0.000097	0.00145	1.40	0.0000075	12.6	<0.0050	138	0.308	0.176	1,290	0.0177	<0.250	<0.000250	0.00518	906	0.124	0.000513	2.62	<0.00050	0.209	<0.00100	<0.00050	<0.00150	<0.000050	0.0250	<0.00250	0.00067	<0.0050	<0.00100
C1B-R1	<0.0000600	0.0784	<0.00250	<0.000050	0.00183	12.6		15.8	<0.0050	137	0.742	0.0814	1,280	0.0270	<0.250	<0.000250	0.00480	899	0.337	0.000676	7.27	<0.00050	0.430	<0.00100	<0.00050	<0.00150	<0.000050	0.186	<0.00250	0.00160	<0.0050	<0.00150
C1B-R1	<0.0000700	0.0638	<0.00250	<0.000050	0.00114	16.5		12.8	<0.0050	136	0.480	0.0936	1,140	0.0308	<0.250	<0.000250	0.00442	873	0.312	0.000629	5.11	<0.00050	0.340	<0.00100	<0.00050	<0.00150	<0.000050	0.0258	<0.00250	0.00197	<0.0050	<0.00150
C1B-R1	<0.0000400	0.0417	<0.00250	<0.000050	<0.00100	6.01		13.4	<0.0050	148	0.316	0.154	1,320	0.0217	<0.250	<0.000250	0.00598	895	0.212	0.000781	2.45	<0.00050	0.298	<0.00100	<0.00050	<0.00150	<0.000050	0.00514	<0.00250	0.00187	<0.0050	<0.00150
C1B-R1	<0.0000500	0.0478	<0.00250	<0.000050	0.00241	2.92		11.5	<0.0050	115	0.200	0.0815	1,370	0.0175	<0.250	0.000293	0.00496	766	0.277	0.000521	3.47	<0.00050	0.254	<0.00100	<0.00050	<0.00150	0.000629	0.118	<0.00250	0.00179	<0.0050	<0.00150
C1B-R1	<0.000230	0.0557	<0.00250	0.000092	0.00598	0.687		13.3	<0.0050	139	0.0605	0.260	2,100	0.0162	<0.250	0.000391	0.00504	894	0.364	0.000546	2.81	<0.00050	0.0640	<0.00100	<0.00050	<0.00150	<0.000050	0.840	<0.00250	0.00559	<0.0050	<0.00150
C1B-R2	<0.0000600	0.0551	<0.00250	0.000077	<0.00100	4.07		16.8	<0.0050	140	0.449	0.297	1,300	0.0156	<0.250	<0.000250	0.00529	910	0.179	0.000486	4.69	<0.00050	0.465	<0.00100	<0.00050	<0.00150	<0.000050	0.0945	<0.00250	0.00138	<0.0050	<0.00150
C1B-R2	<0.000180	0.0288	<0.00250	0.000084	<0.00100	2.08		13.6	<0.0050	128	0.270	0.500	1,110	0.0116	<0.250	<0.000250	0.00452	850	0.0560	0.000405	1.98	<0.00050	0.355	<0.00100	<0.00050	<0.00150	<0.000050	0.00386	<0.00250	0.00087	<0.0050	<0.00150
C1B-R2	<0.000175	0.0257	<0.00250	0.000115	<0.00100	0.728		13.5	<0.0050	129	0.169	0.532	1,260	0.00884	<0.250	<0.000250	0.00585	899	0.0432	0.000331	1.43	<0.00050	0.282	<0.00100	<0.00050	<0.00150	<0.000050	0.000596	<0.00250	0.00071	0.140	<0.00150
C1B-R2	<0.0000650	0.0320	<0.00250	0.000102	<0.00100	3.34		14.1	<0.0050	142	0.286	0.315	1,580	0.0136	<0.250	<0.000250	0.00598	900	0.0950	0.000712	2.12	<0.00050	0.286	<0.00100	<0.00050	<0.00150	0.000166	0.00814	<0.00250	0.00081	<0.0050	<0.00150
C1B-R2	<0.000395	0.0374	<0.00250	0.000104	0.00175	0.626		13.6	<0.0050	140	0.170	0.578	1,990	0.0105	<0.250	<0.000250	0.00525	988	0.0943	0.000466	2.42	<0.00050	0.120	<0.00100	<0.00050	<0.00150	<0.000050	0.0179	<0.00250	0.00149	<0.0050	<0.00150
C1B-R2	<0.000240	0.0348	<0.00250	0.000106	0.00117	0.471		11.3	<0.0050	86.6	0.0928	1.15	1,750	0.0150	<0.250	<0.000250	0.00502	873	0.0921	0.000408	1.66	<0.00050	0.0274	<0.00100	<0.00050	<0.00150	<0.000050	0.103	<0.00250	0.00324	<0.0050	<0.00150
C1B-R2	<0.000260	0.0449	<0.00500	0.000116	0.00240	0.441		11.6	<0.0100	110	0.120	0.970	1,760	0.00963	<0.500	<0.000500	0.00502	876	0.105	<0.000500	2.00	<0.00100	0.0382	<0.00200	<0.00100	<0.00300	<0.000100	0.0956	<0.00500	0.00220	<0.0100	<0.00300
C1B-R2	<0.000310	0.0409	<0.00250	0.000098	0.00110	0.814		12.7	<0.0050	151	0.337	0.349	1,240	0.00944	<0.250	0.00190	0.00533	821	0.0779	0.000438	2.38	<0.00050	0.220	<0.00100	<0.00050	<0.00150	<0.000050	0.0123	<0.00250	0.00061	<0.0050	<0.00150
C1B-R2	<0.000115	0.0399	<0.00250	0.000101	0.00119	0.697		13.3	<0.0050	148	0.279	0.355	1,360	0.00784	<0.250	0.000322	0.00575	922	0.0546	0.000374	2.08	<0.00050	0.190	<0.00100	<0.00050	<0.00150	<0.000050	0.00878	<0.00250	<0.00050	<0.0050	<0.00150
C1B-R3	<0.0000700	0.0544	<0.00250	0.000093	0.00132	4.59		17.8	<0.0050	136	0.480	0.248	1,310	0.0177	<0.250	<0.000250	0.00522	896	0.191	0.000626	4.32	<0.00050	0.453	<0.00100	<0.00050	<0.00150	<0.000050	0.0886	<0.00250	0.00113	0.0079	<0.00150
C1B-R3	<0.000200	0.0258	<0.00250	0.000113	<0.00100	1.64		13.3	<0.0050	134	0.209	0.546	1,270	0.0123	<0.250	<0.000250	0.00511	880	0.0590	0.000348	1.52	<0.00050	0.277	<0.00100	<0.00050	<0.00150	<0.000050	0.000806	<0.00250	0.00077	<0.0050	<0.00150
C1B-R3	<0.0000800	0.0277	<0.00250	0.000121	<0.00100	4.47		14.3	<0.0050	145	0.317	0.331	1,490	0.0157	<0.250	<0.000250	0.00576	892	0.102	0.000480	2.11	<0.00050	0.273	<0.00100	<0.00050	<0.00150	0.000186	0.00192	<0.00250	0.00084	<0.0050	<0.00150
C1B-R3	<0.000325	0.0363	<0.00250	0.000104	0.00296	1.05		13.5	<0.0050	138	0.141	0.435	1,970	0.0147	<0.250	<0.000250	0.00501	1000	0.141	0.000523	2.46	<0.00050	0.106	<0.00100	<0.00050	<0.00150	<0.000050	0.0296	<0.00250	0.00178	<0.0050	<0.00150
C1B-R3	<0.000265	0.0377	<0.00250	0.000127	0.00341	0.378		11.3	<0.0050	92.7	0.0442	1.12	1,760	0.0164	<0.250	<0.000250	0.00467	886	0.113	0.000431	1.74	<0.00050	0.0274	<0.00100	<0.00050	<0.00150	<0.000050	0.146	<0.00250	0.00380	<0.0050	<0.00150
C2E	<0.000475	0.0237	<0.00050	0.000164	0.00841	1.11	0.0000113	31.3	<0.0050	111	0.276	2.35	1,310	0.0459	<0.250	<0.000250	0.00877	918	0.0136	0.000356	1.97	<0.00050	0.533	<0.00100	<0.00050	<0.00150	<0.000050	0.00167	<0.00250	0.00187	0.0054	<0.00100
C2E	<0.000505	0.0301	<0.00050	0.000156	0.00341	1.34	0.0000176	19.3	<0.0050	125	0.272	1.25	1,190	0.0242	<0.250	<0.000250	0.00739	803	0.0386	0.000419	1.81	<0.00050	0.468	<0.00100	<0.00050	<0.00150	<0.000050	0.0104	<0.00250	0.00233	<0.0050	<0.00100
C2E	<0.000230	0.0274	<0.00050	0.000148	0.00245	0.866	0.0000150	16.8	<0.0050	116	0.212	1.11	1,230	0.0198	<0.250	<0.000250	0.00741	827	0.0303	0.000450	1.66	<0.00050	0.416	<0.00100	<0.00050	<0.00150	<0.000050	0.00262	<0.00250	0.00198	<0.0050	<0.00100
C2E	<0.000220	0.0336	<0.00050	0.000154	0.00132	0.640	0.0000098	15.7	<0.0050	130	0.196	0.830	1,330	0.0151	<0.250	<0.000250	0.00651	880	0.0538	0.000452	1.99	<0.00050	0.377	<0.00100	<0.00050	<0.00150	<0.000050	0.0114	<0.00250	0.00239	<0.0050	<0.00100
C2E	<0.000255	0.0279	<0.00050	0.000137	0.00196	0.564	0.0000128	13.6	<0.0050	134	0.185	0.771	1,230	0.0137	<0.250	<0.000250	0.00629	833	0.0424	0.000507	1.85	<0.00050	0.381	<0.00100	<0.00050	<0.00150	<0.000050	0.00515	<0.00250	0.00243	<0.0050	<0.00100
C2E	<0.000250	0.0310	<0.00050	0.000118	0.00139	0.895	0.0000180	13.2	<0.0050	128	0.194	0.651	1,150	0.0119	<0.250	<0.000250	0.00622	880	0.0557	0.000449	1.67	<0.00050	0.335	<0.00100	<0.00050	<0.00150	<0.000050	0.0137	<0.00250	0.00184	<0.0050	<0.00100
C2E	<0.000180	0.0277	<0.00050	0.000156	0.00310	0.095	0.0000103	14.7	<0.0050	135	0.128	0.865	1,350	0.0127	<0.250	<0.000250	0.00637	977	0.0172	<0.000250	1.45	<0.00050	0.350	<0.00100	<0.00050	<0.00150	<0.000050	0.000532	<0.00250	0.00154	<0.0050	<0.00100
C2E	<0.000230	0.0285	<0.00050	0.000144	0.00328	0.086	0.0000087	13.5	<0.0050	139	0.127	0.732	1,250	0.0137	<0.250	<0.000250	0.00685	931	0.0176	0.000517	1.36	<0.00050	0.353	<0.00100	<0.00050	<0.00150	<0.000050	0.000554	<0.00250	0.00150	<0.0050	<0.00100
C2E	<0.000275	0.0265	<0.00050	0.000144	0.00124	0.085	<0.0000050	12.7	<0.0050	136	0.113	0.760	1,250	0.0116	<0.250	<0.000250	0.00574	899	0.0141	0.000354	1.23	<0.00050	0.325	<0.00100	<0.00050	<0.00150	<0.000050	0.000547	<0.00250	0.00706	<0.0050	<0.00100

Appendix C: Water Quality Results for Influent, Effluent and Rhizon Samples

Sample ID	D-Cd	D-Co	D-Cr	D-Cs	D-Cu	D-Fe	D-Hg	D-K	D-Li	D-Mg	D-Mn	D-Mo	D-Na	D-Ni	D-P	D-Pb	D-Rb	D-S	D-Sb	D-Se	D-Si	D-Sn	D-Sr	D-Te	D-Th	D-Ti	D-Tl	D-U	D-V	D-W	D-Zn	D-Zr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C2E	<0.0000600	0.0278	<0.00050	0.000123	<0.00100	0.073	<0.0000050	11.4	<0.0050	124	0.124	0.602	1,160	0.00930	<0.250	<0.000250	0.00550	948	0.0200	0.000461	1.53	<0.00050	0.316	<0.00100	<0.00050	<0.00150	<0.000050	0.000509	<0.00250	0.00131	<0.0050	<0.00100
C2E	<0.0000335	0.0255	<0.00050	0.000145	0.00113	0.076	<0.0000050	12.3	<0.0050	138	0.111	0.561	1,260	0.00969	<0.250	<0.000250	0.00535	832	0.0189	0.000437	1.40	<0.00050	0.314	<0.00100	<0.00050	<0.00150	<0.000050	0.000600	<0.00250	0.00134	<0.0050	<0.00100
C2E	<0.0000190	0.0276	<0.00050	0.000136	0.00215	0.087	0.0000058	13.1	<0.0050	137	0.123	0.522	1,340	0.00950	<0.250	<0.000250	0.00597	930	0.0223	0.000559	1.46	<0.00050	0.303	<0.00100	<0.00050	<0.00150	<0.000050	0.000641	<0.00250	0.00125	<0.0050	<0.00100
C2E	<0.0000130	0.0262	<0.00050	0.000154	0.00140	0.133	<0.0000050	13.1	<0.0050	133	0.129	0.556	1,470	0.00930	<0.250	<0.000250	0.00561	910	0.0226	0.000351	1.53	<0.00050	0.319	<0.00100	<0.00050	<0.00150	<0.000050	0.000696	<0.00250	0.00130	<0.0050	<0.00100
C2E	<0.0000115	0.0266	<0.00050	0.000167	<0.00100	0.074	0.0000083	13.5	<0.0050	124	0.101	0.493	1,710	0.00792	<0.250	<0.000250	0.00654	938	0.0337	0.000319	1.56	<0.00050	0.268	<0.00100	<0.00050	<0.00150	<0.000050	0.000974	<0.00250	0.00156	<0.0050	<0.00100
C2E	<0.0000650	0.0281	<0.00100	0.000171	0.00242	<0.100	0.0000064	13.7	<0.0100	132	0.0784	0.527	1,930	0.0108	<0.500	<0.000500	0.00704	936	0.0401	<0.000500	1.51	<0.00100	0.250	<0.00200	<0.00100	<0.00300	<0.000100	0.00187	<0.00500	0.00178	<0.0100	<0.00200
C2E	<0.0000165	0.0328	<0.00050	0.000157	0.00195	0.095	<0.0000050	13.0	<0.0050	130	0.0669	0.498	1,800	0.00918	<0.250	<0.000250	0.00670	908	0.0463	0.000446	1.60	<0.00050	0.253	<0.00100	<0.00050	<0.00150	<0.000050	0.00365	<0.00250	0.00201	<0.0050	<0.00100
C2E	<0.0000540	0.0323	<0.00050	0.000185	0.00852	0.150	<0.0000050	13.5	<0.0050	121	0.0373	0.880	1,930	0.0112	<0.250	<0.000250	0.00725	932	0.0408	0.000492	1.39	<0.00050	0.206	<0.00100	<0.00050	<0.00150	<0.000050	0.0111	<0.00250	0.00292	<0.0050	<0.00100
C2E	<0.0000590	0.0351	<0.00050	0.000171	0.00901	0.210	<0.0000050	13.5	<0.0050	104	0.0250	0.928	1,740	0.0102	<0.250	<0.000250	0.00655	894	0.0390	0.000374	1.26	<0.00050	0.145	<0.00100	<0.00050	<0.00150	<0.000050	0.0578	<0.00250	0.00368	<0.0050	<0.00100
C2E	<0.0000400	0.0406	<0.00050	0.000159	0.0116	0.179	<0.0000050	12.5	<0.0050	132	0.0273	0.776	1,880	0.0109	<0.250	<0.000250	0.00617	917	0.0467	0.000523	1.36	<0.00050	0.164	<0.00100	<0.00050	<0.00150	<0.000050	0.132	<0.00250	0.00342	<0.0050	<0.00100
C2E	<0.0000405	0.0466	<0.00050	0.000159	0.0232	0.234	0.0000120	13.3	<0.0050	136	0.0246	0.798	2,050	0.0137	<0.250	<0.000250	0.00655	965	0.0624	0.000838	1.43	<0.00050	0.162	<0.00100	<0.00050	<0.00150	<0.000050	0.158	<0.00250	0.00413	<0.0050	<0.00100
C2E	<0.0000405	0.0501	<0.00050	0.000154	0.0281	0.164	<0.0000050	13.6	<0.0050	143	0.0218	0.592	2,110	0.0140	<0.250	<0.000250	0.00627	896	0.0627	0.000492	1.56	<0.00050	0.168	<0.00100	<0.00050	<0.00150	<0.000050	0.178	<0.00250	0.00444	<0.0050	<0.00100
C2E	<0.0000100	0.0517	<0.00050	0.000163	0.0196	0.160	<0.0000050	12.6	<0.0050	119	0.0201	0.528	1,820	0.0135	<0.250	<0.000250	0.00586	925	0.0742	0.000642	1.60	<0.00050	0.158	<0.00100	<0.00050	<0.00150	<0.000050	0.171	<0.00250	0.00384	<0.0050	<0.00100
C2E	<0.0000105	0.0531	<0.00100	0.000139	0.0140	0.158	0.0000222	11.7	<0.0100	121	0.0172	0.446	1,780	0.0124	<0.500	<0.000500	0.00568	851	0.0830	<0.000500	1.40	<0.00100	0.129	<0.00200	<0.00100	<0.00300	<0.000100	0.204	<0.00500	0.00471	<0.0100	<0.00200
C2E	<0.0000500	0.0552	<0.00100	0.000148	0.0144	0.172	0.0000177	13.3	<0.0100	124	0.0159	0.423	1,980	0.0136	<0.500	<0.000500	0.00613	946	0.0938	0.000617	1.58	<0.00100	0.127	<0.00200	<0.00100	<0.00300	<0.000100	0.213	<0.00500	0.00579	<0.0100	<0.00200
C2E	<0.0000160	0.0531	<0.00100	0.000136	0.0102	0.162	0.0000111	11.4	<0.0100	114	0.0122	0.380	1,770	0.0131	<0.500	<0.000500	0.00521	830	0.0844	<0.000500	1.50	<0.00100	0.100	<0.00200	<0.00100	<0.00300	<0.000100	0.202	<0.00500	0.00549	<0.0100	<0.00200
C2E	<0.0000650	0.0470	<0.00050	0.000133	0.00304	0.134	0.0000058	12.2	<0.0050	142	0.0210	0.263	1,340	0.0107	<0.250	<0.000250	0.00539	855	0.0740	0.000709	1.58	<0.00050	0.235	<0.00100	<0.00050	<0.00150	<0.000050	0.0829	<0.00250	0.00246	<0.0050	<0.00100
C2E	<0.0000800	0.0469	<0.00050	0.000128	0.00225	0.122	<0.0000050	12.4	<0.0050	144	0.0382	0.257	1,230	0.0124	<0.250	<0.000250	0.00536	832	0.0624	0.000633	1.50	<0.00050	0.285	<0.00100	<0.00050	<0.00150	<0.000050	0.0420	<0.00250	0.00159	<0.0050	<0.00100
C2E	<0.0000500	0.0465	<0.00050	0.000133	0.00262	0.122	<0.0000050	12.9	<0.0050	139	0.0380	0.291	1,310	0.0122	<0.250	<0.000250	0.00595	877	0.0468	0.000328	1.53	<0.00050	0.273	<0.00100	<0.00050	<0.00150	<0.000050	0.0241	<0.00250	0.00134	<0.0050	<0.00100
C2-R1	<0.0000500	0.0706	<0.00250	0.000057	0.00385	3.82		13.5	<0.0050	145	0.345	0.163	1,330	0.0180	<0.250	<0.000250	0.00587	903	0.267	0.000617	5.52	<0.00050	0.335	<0.00100	<0.00050	<0.00150	<0.000050	0.164	<0.00250	0.00447	<0.0050	<0.00150
C2-R1	<0.0000600	0.0619	<0.00250	<0.000050	0.00368	6.48		12.0	<0.0050	135	0.306	0.126	1,120	0.0210	<0.250	<0.000250	0.00544	879	0.236	0.000580	4.46	<0.00050	0.300	<0.00100	<0.00050	<0.00150	<0.000050	0.0930	<0.00250	0.00352	<0.0050	<0.00150
C2-R1	<0.0000600	0.0464	<0.00250	<0.000050	<0.00100	4.71		12.4	<0.0050	148	0.298	0.178	1,270	0.0243	<0.250	<0.000250	0.00594	882	0.150	0.000486	2.34	<0.00050	0.323	<0.00100	<0.00050	<0.00150	<0.000050	0.0105	<0.00250	0.00216	<0.0050	<0.00150
C2-R1	<0.0000550	0.0475	<0.00250	0.000056	0.00260	7.39		12.9	<0.0050	135	0.295	0.135	1,800	0.0257	<0.250	0.000883	0.00631	877	0.220	0.000612	2.97	<0.00050	0.316	<0.00100	<0.00050	<0.00150	0.000737	0.0231	<0.00250	0.00320	0.0091	<0.00150
C2-R1	<0.0000290	0.0354	<0.00250	0.000117	0.00213	1.11		13.6	<0.0050	131	0.0876	0.444	1,940	0.0134	<0.250	<0.000250	0.00751	966	0.144	0.000429	2.10	<0.00050	0.222	<0.00100	<0.00050	<0.00150	<0.000050	0.143	<0.00250	0.00414	<0.0050	<0.00150
C2-R1	<0.0000450	0.0569	<0.00250	0.000062	0.00547	1.58		11.8	<0.0050	139	0.131	0.166	1,720	0.0119	<0.250	<0.000250	0.00596	885	0.249	0.000589	3.40	<0.00050	0.272	<0.00100	<0.00050	<0.00150	<0.000050	0.444	<0.00250	0.00472	<0.0050	<0.00150
C2-R1	<0.0000600	0.0611	<0.00500	<0.000100	0.0119	0.606		11.9	<0.0100	147	0.0609	0.145	1,770	0.0109	<0.500	<0.000500	0.00588	846	0.184	0.000543	2.77	<0.00100	0.272	<0.00200	<0.00100	<0.00300	<0.000100	0.609	<0.00500	0.00492	<0.0100	<0.00300
C2-R1	<0.0000600	0.0558	<0.00250	0.000065	0.00157	0.364		12.2	<0.0050	146	0.0979	0.130	1,250	0.0109	<0.250	<0.000250	0.00542	842	0.129	0.000380	2.61	<0.00050	0.317	<0.00100	<0.00050	<0.00150	<0.000050	0.178	<0.00250	0.00214	<0.0050	<0.00150
C2-R1	<0.0000350	0.0542	<0.00250	0.000071	0.00137	0.242		12.8	<0.0050	144	0.0903	0.134	1,350	0.00963	<0.250	<0.000250	0.00590	954	0.102	0.000746	2.20	<0.00050	0.293	<0.00100	<0.00050	<0.00150	<0.000050	0.127	<0.00250	0.00179	<0.0050	<0.00150
C2-R2	<0.0000150	0.0498	<0.00250	0.000104	0.00326	1.50		14.6	<0.0050	135	0.301	0.568	1,290	0.0150	<0.250	<0.000250	0.00627	894	0.118	0.000458	3.50	<0.00050	0.417	<0.00100	<0.00050	<0.00150	<0.000050	0.0513	<0.00250	0.00319	<0.0050	<0.00150
C2-R2	<0.0000140	0.0499	<0.00250	0.000071	0.00198	2.35		12.2	<0.0050	135	0.244	0.366	1,110	0.0117	<0.250	<0.000250	0.00523	913	0.133	0.000592	3.11	<0.00050	0.333	<0.00100	<0.00050	<0.00150	<0.000050	0.0719	<0.00250	0.00280	<0.0050	<0.00150
C2-R2	<0.0000200	0.0284	<0.00250	0.000101	<0.00100	0.611		12.4	<0.0050	142	0.164	0.462	1,260	0.00976	<0.250	<0.000250	0.00549	901	0.0168	0.000474	1.38	<0.00050	0.306	<0.00100	<0.00050	<0.00150	<0.000050	0.000845	<0.00250	0.00107	<0.0050	<0.00150
C2-R2	<0.0000650	0.0295	<0.00250	0.000113	0.00356	1.78		13.6	<0.0050	142	0.212	0.317	1,770	0.0128	<0.250	0.00109	0.00644	885	0.0496	0.000592	1.78	<0.00050	0.311	<0.00100	<0.00050	<0.00150	0.00220	0.000608	<0.00250	0.00125	0.0118	<0.00150
C2-R2	<0.0000520	0.0303	<0.00250	0.000137	0.00151	0.494		13.9	<0.0050	124	0.0672	0.679	1,970	0.0101	<0.250	<0.000250	0.00729	970	0.0414	0.000457	1.61	<0.00050	0.205	<0.00100	<0.00050	<0.00150	<0.000050	0.00762	<0.00250	0.00234	<0.0050	<0.00150
C2-R2	<0.0000100	0.0476	<0.00250	0.000098	0.00784	0.597		11.9	<0.0050	128	0.0475	0.448	1,760	0.00878	<0.250	<0.000250	0.00557	874	0.0734	0.000586	1.65	<0.00050	0.173	<0.00100	<0.00050	<0.00150	<0.000050	0.194	<0.00250	0.00363	<0.0050	<0.00150
C2-R2	<0.0000120	0.0542	<0.00500	<0.000100	0.00913	0.523		12.1	<0.0100	129	0.0183	0.331	1,780	0.0106	<0.500	<0.000500	0.00606	830	0.0894	<0.000500	1.62	<0.00100	0.114	<0.00200	<0.00100	<0.00300	<0.000100	0.198	<0.00500	0.00546	<0.0100	<0.00300
C2-R2	<0.0000100	0.0504	<0.00250	0.000102	0.00249	0.238		12.6	<0.0050	152	0.0409	0.243	1,270	0.0105	<0.250	<0.000250	0.00598	808	0.0689	0.000507	1.66	<0.00050	0.319	<0.00100	<0.00050	<0.00150	<0.000050	0.0548	<0.00250	0.00185	<0.0050	<0.00150
C2-R2	<0.0000110	0.0496	<0.00250	0.000102	0.00256	0.234		13.5	<0.0050	153	0.0393	0.246	1,420	0.00909	<0.250	<0.000250	0.00667	936	0.0452	0.000547	1.55	<0.00050	0.321	<0.00100	<0.00050	<0.00150	<0.000050	0.0262	<0.00250	0.00142	<0.0050	<0.00150
C2-R3	<0.0000210	0.0376	<0.00250	0.000128	0.00103	0.883		15.9	<0.0050	128	0.244	0.980	1,290	0.0166	<0.250	<0.000250	0.00653	875	0.0576	0.000583	2.39	<0.00050	0.436	<0.00100	<0.00050	<0.00150	<0.000050	0.0164	<0.00250	0.00238	<0.0050	<0.00150
C2-R3	<0.0000210	0.0374	<0.00250	0.000098	<0.00100	1.04		12.9	<0.0050	129	0.237	0.657	1,140	0.0116	<0.250	<0.000250	0.00557	872	0.0532	0.000497	1.98	<0.00050	0.382	<0.00100	<0.00050	<0.00150	<0.000050	0.0130	<0.00250	0.00193	0.0066	<0.00150
C2-R3	<0.0000300	0.0286	<0.00250	0.000118	<0.00100	0.439		12.7	<0.0050	137	0.149	0.755	1,260	0.0104	<0.250	<0.000250	0.00611	875	0.00796	<0.000250	1.20	<0.00050	0.337	<0.00100	<0.00050	<0.00150	<0.000050	0.000467	<0.00250	0.00108	1.63	<0.00150
C2-R3	<0.0000700	0.0252	<0.00250	0.000147	<0.00100	0.316		14.6	<0.0050	153	0.154	0.497	1,670	0.00756	<0.250	<0.000250	0.00610	882	0.0108	0.000543	1.38	<0.00050	0.370	<0.00100	<0.00050	<0.00150	<0.000050	0.000300	<0.00250	0.00105	<0.0050	<0.00150
C2-R3	<0.0000675	0.0307	<0.00250	0.000174	0.00681	0.430		14.3	<0.0050	130	0.0814	0.959	2,000	0.00949	<0.250	<0.000250	0.00692	979	0.0142	0.000328	1.52	<0.00050	0.233	<0.00100	<0.00050	<0.00150	<0.000050	0.00266	<0.00250	0.00197	<0.0050	<0.00150
C2-R3	<0.0000150	0.0440	<0.00250	0.000108	0.00642	0.580		11.7	<0.0050	114	0.0448	0.650	1,740	0.00799	<0.250	<0.000250	0.00554	840	0.0268	0.000601	1.39	<0.00050	0.125	<0.00100	<0.00050	<0.00150	<0.000050	0.0282	<0.00250	0.00355	<0.0050	<0.00150
C2-R3	<0.0000150	0.0508	<0.00500	0.000123	0.00833	0.459		11.8	<0.0100	110	0.0226	0.437	1,740	0.0111	<0.500	<0.000500	0.00577	823	0.0447	0.000557	1.42	<0.00100	0.0775	<0.00200	<0.00100	<0.00300	<0.000100	0.0605	<0.00500	0.00591	<0.0100	<0.00300
C2-R3	<0.0000100	0.0446	<0.00250	0.000117	0.00353	0.174		12.6	<0.0050	155	0.0375	0.314	1,270	0.00894	<0.250	<0.000250	0.00562	802	0.0318	0.000329	1.45	<0.00050	0.268	<0.00100	<0.00050	<0.00150	<0.000050	0.0181	<0.00250	0.00182	<0.0050	<0.00150
C3E	<0.0000320	0.0246	<0.00050	0.000110	0.00877	5.92	0.0000094	40.6	<0.0050	118	0.819	1.54	1,280	0.0657	<0.250	<0.000250	0.0130	906	0.0208	0.000411	2.60	<0.00050	0.567	<0.00100	<0.00050	<0.00150	<0.000050	0.00176	<0.00250	0.00245	0.0160	<0.00100
C3E	<0.0000370	0.0295	<0.00050	0.000106	0.00336	4.00	0.0000121	20.9	<0.0050	129	0.575	0.827	1,180	0.0315	<0.250	<0.000250	0.00843	793	0.0514	0.000480	2.19	<0.00050	0.446	<0.00100	<0.00050	<0.00150	<0.000050	0.00927	<0.00250	0.00258	<0.0050	<0.00100
C3E	<0.0000185	0.0297	<0.00050	0.000113	0.00198	2.53	0.0000123	16.4	<0.0050	118	0.394	0.706	1,220	0.0218	<0.250	<0.000250	0.00692	829	0.0595	0.000398	2.04	<0.00050	0.382	<0.00100	<0.00050	<0.00150	<0.000050	0.00735	<0.00250	0.00267	<0.0050	<0.00100
C3E	<0.0000150	0.0365	<0.00050	0.000118	0.00155	1.94	0.0000096	16.7	<0.0050	138	0.316	0.629	1,400	0.0180	<0.250	<0.000250	0.00757	937	0.0900	0.000544	2.45	<0.00050	0.400	<0.00100	<0.00050	<0.00150	<0.000050	0.0161	<0.00250	0.00312	<0.0050	<0.00100
C3E	<0.0000130	0.0294	<0.00050	0.000099	0.00101	2.44	0.0000161	12.7	<0.0050	134	0.277	0.526	1,250	0.0141	<0.250	<0.000250	0.00685	997	0.0717	0.000541	2.16	<0.00050	0.362	<0.00100	<0.00050	<0.00150	<0.000050	0.00592	<0.00250	0.00265	<0.0050	<0.00100
C3E	<0.0000180	0.0308	<0.00050	0.000092	0.00114	1.32	0.0000203	13.0	<0.0050	128	0.246	0.438	1,160	0.0129	<0.250	<0.000250	0.00592	866	0.0827	0.000475	1.91	<0.00050	0.332	<0.00100	<0.00050	<0.00150	<0.000050	0.00866	<0.00250	0.00242	<0.0050	<0.00100
C3E	<0.0000150	0.0262	<0.00050	0.000109	<0.00100	0.248	0.0000073	14.4	<0.0050	136	0.149	0.644	1,340	0.0132	<0.250	<0.000250	0.00673	981	0.0359	0.000355	1.59	<0.00050	0.346	<0.00100	<0.00050	<0.00150	<0.000050	0.000253	<0.00250	0.00222	<0.0050	<0.00100
C3E	<0.0000230	0.0296	<0.00050	0.000119	0.00241	0.160	0.0000073	14.2	<0.0050	148	0.142	0.590	1,340	0.0154	<0.250	<0.000250	0.00598	1010	0.0442	0.000608	1.56	<0.00050	0.355	<0.00100	<0.00050	<0.00150	<0.000050	0.000248	<0.00250	0.00240	<0.0050	<0.00100
C3E	<0.0000175	0.0274	<0.00050	0.000105	<0.00100	0.140	<0.0000050	12.6	<0.0050	138	0.120	0.544	1,270	0.0111	<0.250	<0.000250	0.00638	895	0.0447	0.000406	1.33	<0.00050	0.340	<0.00100	<0.00050	<0.00150	<0.000050	0.000252	<0.00250	0.00199	<0.0050	<0.00100
C3E	<0.0000800	0.0262	<0.00050	0.000100	<0.00100	0.119	<0.0000050	12.6	<0.0050	132	0.133	0.426	1,240	0.0104	<0.250	<0.000250	0.00604	877	0.0632	0.000417	1.39	<0.00050	0.343	<0.00100	<0.00050	<0.00150	<0.000050	0.000270	<0.00250	0.00212	<0.0050	<0.00100
C3E	<0.0000310	0.0255	<0.00050	0.000114	0.00639	0.076	<0.0000050	12.7	<0.0050	140	0.0992	0.531	1,270	0.0304	<0.250	<0.000250	0.00673	835	0.0415	0.000522	1.44	<0.00050	0.328	<0.00100	<0.00050	<0.00150	<0.000050	0.000281	<0.00250	0.00213	0.0058	<0.00100
C3E	<0.0000200	0.0280	<0.00050	0.000118	0.00242	0.141	0.0000102	13.3	<0.0050	126	0.0978	0.548	1,250	0.0344	<0.250	<0.000250	0.00691	892	0.0487	0.000568	1.39	<0.00050	0.298	<0.00100	<0.00050	<0.00150	<0.000050	0.000484	<0.00250	0.00231	<0.0050	<0.00100
C3E	<0.0000125	0.0250	<0.00050	0.000125	<0.00100	0.121	<0.0000050	13.7	<0.0050	143	0.116	0.552	1,480	0.0280	<0.250	<0.000250	0.00577	889	0.0336	0.000346	1.45	<0.00050	0.360	<0.00100	<0.00050	<0.00150	<0.000050	0.000281	<0.00250	0.00205	<0.0050	<0.00100
C3E	<0.0000750	0.0265	<0.00050	0.000118	<0.00100	0.108	0.0000103	12.6	<0.0050	122	0.128	0.338	1,620	0.0206	<0.250	<0.000250	0.00596	929	0.0885	0.000498	1.81	<0.00050	0.289	<0.00100	<0.00050	<0.00150	<0.000050	0.00137	<0.00250	0.00262	<0.0050	<0.00100

Appendix C: Water Quality Results for Influent, Effluent and Rhizon Samples

Sample ID	D-Cd	D-Co	D-Cr	D-Cs	D-Cu	D-Fe	D-Hg	D-K	D-Li	D-Mg	D-Mn	D-Mo	D-Na	D-Ni	D-P	D-Pb	D-Rb	D-S	D-Sb	D-Se	D-Si	D-Sn	D-Sr	D-Te	D-Th	D-Ti	D-Tl	D-U	D-V	D-W	D-Zn	D-Zr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C3E	<0.0000550	0.0288	<0.00050	0.000110	0.00142	0.100	0.0000074	14.0	0.0051	136	0.113	0.366	1,940	0.0217	<0.250	<0.000250	0.00696	986	0.0986	0.000568	1.97	<0.00050	0.277	<0.00100	<0.00050	<0.00150	<0.000050	0.00218	<0.00250	0.00261	<0.0050	<0.00100
C3E	<0.0000125	0.0334	<0.00050	0.000123	0.00195	0.129	<0.0000050	12.8	<0.0050	122	0.0728	0.467	1,770	0.0133	<0.250	<0.000250	0.00635	874	0.0815	0.000481	1.59	<0.00050	0.264	<0.00100	<0.00050	<0.00150	<0.000050	0.00510	<0.00250	0.00294	<0.0050	<0.00100
C3E	<0.000305	0.0349	<0.00050	0.000126	0.00385	0.096	<0.0000050	13.4	<0.0050	143	0.0640	0.414	1,910	0.0112	<0.250	<0.000250	0.00666	938	0.0906	0.000508	1.71	<0.00050	0.269	<0.00100	<0.00050	<0.00150	<0.000050	0.00724	<0.00250	0.00320	<0.0050	<0.00100
C3E	<0.000285	0.0377	<0.00050	0.000109	0.00208	0.121	0.0000065	13.5	<0.0050	130	0.0502	0.422	1,810	0.00882	<0.250	<0.000250	0.00623	950	0.102	0.000401	1.72	<0.00050	0.220	<0.00100	<0.00050	<0.00150	<0.000050	0.0175	<0.00250	0.00381	<0.0050	<0.00100
C3E	<0.000280	0.0413	<0.00050	0.000122	0.00332	0.126	<0.0000050	12.8	<0.0050	134	0.0397	0.508	1,900	0.0105	<0.250	<0.000250	0.00644	942	0.100	0.000593	1.68	<0.00050	0.206	<0.00100	<0.00050	<0.00150	<0.000050	0.0354	<0.00250	0.00454	<0.0050	<0.00100
C3E	<0.000455	0.0415	<0.00050	0.000155	0.0131	0.184	0.0000076	12.9	<0.0050	104	0.0234	1.03	1,920	0.0221	<0.250	<0.000250	0.00663	925	0.0852	0.000772	1.58	<0.00050	0.130	<0.00100	<0.00050	<0.00150	<0.000050	0.163	<0.00250	0.00606	<0.0050	<0.00100
C3E	<0.000400	0.0544	<0.00050	0.000130	0.00703	0.170	<0.0000050	13.6	<0.0050	150	0.0347	0.590	2,040	0.0133	<0.250	<0.000250	0.00650	875	0.0995	0.000472	1.69	<0.00050	0.218	<0.00100	<0.00050	<0.00150	<0.000050	0.284	<0.00250	0.00503	<0.0050	<0.00100
C3E	<0.000100	0.0555	<0.00050	0.000116	0.00844	0.170	<0.0000050	13.2	0.0052	133	0.0351	0.488	1,880	0.0128	<0.250	<0.000250	0.00591	932	0.114	0.000641	1.85	<0.00050	0.193	<0.00100	<0.00050	<0.00150	<0.000050	0.279	<0.00250	0.00452	<0.0050	<0.00100
C3E	<0.000150	0.0554	<0.00100	<0.000100	0.0115	0.172	0.0000258	11.8	<0.0100	127	0.0274	0.450	1,780	0.0139	<0.500	<0.000500	0.00628	855	0.114	0.000525	1.58	<0.00100	0.153	<0.00200	<0.00100	<0.00300	<0.000100	0.298	<0.00500	0.00548	<0.0100	<0.00200
C3E	<0.0000500	0.0593	<0.00100	0.000110	0.0134	0.180	0.0000153	13.4	<0.0100	133	0.0231	0.393	1,990	0.0150	<0.500	<0.000500	0.00620	937	0.125	0.000697	1.62	<0.00100	0.155	<0.00200	<0.00100	<0.00300	<0.000100	0.314	<0.00500	0.00633	<0.0100	<0.00200
C3E	<0.000140	0.0566	<0.00100	<0.000100	0.0149	0.174	0.0000093	11.5	<0.0100	116	0.0154	0.394	1,740	0.0158	<0.500	<0.000500	0.00613	848	0.105	0.000592	1.66	<0.00100	0.112	<0.00200	<0.00100	<0.00300	<0.000100	0.253	<0.00500	0.00651	<0.0100	<0.00200
C3E	<0.0000650	0.0498	<0.00050	0.000099	0.00376	0.116	0.0000054	12.7	<0.0050	144	0.0220	0.264	1,380	0.0126	<0.250	<0.000250	0.00602	870	0.0868	0.000685	1.68	<0.00050	0.231	<0.00100	<0.00050	<0.00150	<0.000050	0.104	<0.00250	0.00306	<0.0050	<0.00100
C3E	<0.000110	0.0506	<0.00050	0.000093	0.00235	0.126	<0.0000050	12.4	<0.0050	147	0.0410	0.234	1,260	0.0126	<0.250	0.000268	0.00608	844	0.0747	0.000707	1.52	<0.00050	0.289	<0.00100	<0.00050	<0.00150	<0.000050	0.0752	<0.00250	0.00184	<0.0050	<0.00100
C3E	<0.000100	0.0506	<0.00050	0.000100	0.00155	0.094	<0.0000050	13.3	<0.0050	144	0.0426	0.274	1,370	0.0127	<0.250	<0.000250	0.00651	912	0.0634	0.000458	1.66	<0.00050	0.274	<0.00100	<0.00050	<0.00150	<0.000050	0.0530	<0.00250	0.00177	<0.0050	<0.00100
C3-R1	<0.0000350	0.0767	<0.00250	0.000054	0.00394	9.91		13.0	<0.0050	144	0.295	0.0912	1,300	0.0255	<0.250	<0.000250	0.00568	910	0.350	0.000605	6.95	<0.00050	0.327	<0.00100	<0.00050	<0.00150	<0.000050	0.249	<0.00250	0.00535	<0.0050	<0.00150
C3-R1	<0.0000400	0.0764	<0.00250	0.000057	0.00903	8.57		12.2	<0.0050	135	0.196	0.0692	1,120	0.0208	<0.250	<0.000250	0.00521	898	0.340	0.000581	6.06	<0.00050	0.291	<0.00100	<0.00050	<0.00150	<0.000050	0.251	<0.00250	0.00511	<0.0050	<0.00150
C3-R1	<0.0000450	0.0604	<0.00250	<0.000050	0.00211	8.88		12.2	<0.0050	149	0.223	0.107	1,260	0.0241	<0.250	<0.000250	0.00606	888	0.284	0.000572	3.48	<0.00050	0.326	<0.00100	<0.00050	<0.00150	<0.000050	0.0508	<0.00250	0.00376	0.0202	<0.00150
C3-R1	<0.0000350	0.0590	<0.00250	0.000050	0.00310	8.63		12.8	<0.0050	140	0.233	0.0881	1,850	0.0332	<0.250	0.000416	0.00602	901	0.360	0.000903	4.31	<0.00050	0.310	<0.00100	<0.00050	<0.00150	0.000747	0.128	<0.00250	0.00518	0.0086	<0.00150
C3-R1	<0.0000600	0.0625	<0.00250	0.000068	0.00710	1.30		13.5	<0.0050	161	0.138	0.116	2,000	0.0160	<0.250	<0.000250	0.00586	988	0.334	0.000712	4.31	<0.00050	0.332	<0.00100	<0.00050	<0.00150	<0.000050	0.440	<0.00250	0.00604	<0.0050	<0.00150
C3-R1	<0.0000750	0.0705	<0.00250	0.000064	0.00811	1.78		11.8	<0.0050	138	0.137	0.100	1,730	0.0177	<0.250	0.000359	0.00576	866	0.355	0.000741	4.63	<0.00050	0.302	<0.00100	<0.00050	<0.00150	<0.000050	0.525	<0.00250	0.00564	<0.0050	<0.00150
C3-R1	<0.0000500	0.0824	<0.00500	<0.000100	0.0122	1.26		11.9	<0.0100	140	0.0911	0.0846	1,750	0.0204	<0.500	<0.000500	0.00630	870	0.396	0.000708	5.61	<0.00100	0.306	<0.00200	<0.00100	<0.00300	<0.000100	0.541	<0.00500	0.00666	<0.0100	<0.00300
C3-R1	<0.0000600	0.0759	<0.00250	0.000069	0.00430	1.40		12.2	<0.0050	144	0.128	0.0750	1,220	0.0203	<0.250	0.000474	0.00544	821	0.349	0.000687	4.92	<0.00050	0.321	<0.00100	<0.00050	<0.00150	<0.000050	0.338	<0.00250	0.00441	<0.0050	<0.00150
C3-R1	0.0000942	0.0787	<0.00250	0.000064	0.00351	1.11		13.0	<0.0050	147	0.122	0.0734	1,380	0.0197	<0.250	0.000819	0.00618	948	0.288	0.000528	4.64	<0.00050	0.302	<0.00100	<0.00050	<0.00150	<0.000050	0.318	<0.00250	0.00405	<0.0050	<0.00150
C3-R2	<0.000115	0.0478	<0.00250	0.000093	0.00154	4.07		14.4	<0.0050	136	0.427	0.416	1,280	0.0190	<0.250	<0.000250	0.00637	905	0.151	0.000640	3.69	<0.00050	0.418	<0.00100	<0.00050	<0.00150	<0.000050	0.0749	<0.00250	0.00394	<0.0050	<0.00150
C3-R2	<0.000140	0.0477	<0.00250	0.000079	0.00190	4.57		12.8	<0.0050	133	0.366	0.299	1,160	0.0155	<0.250	<0.000250	0.00559	870	0.170	0.000495	3.36	<0.00050	0.362	<0.00100	<0.00050	<0.00150	<0.000050	0.0644	<0.00250	0.00338	<0.0050	<0.00150
C3-R2	<0.000150	0.0314	<0.00250	0.000098	<0.00100	1.41		13.1	<0.0050	149	0.267	0.394	1,330	0.0138	<0.250	<0.000250	0.00676	900	0.0529	0.000304	1.52	<0.00050	0.369	<0.00100	<0.00050	<0.00150	<0.000050	0.00109	<0.00250	0.00199	<0.0050	<0.00150
C3-R2	<0.0000700	0.0299	<0.00250	0.000086	0.00363	1.97		13.4	<0.0050	146	0.283	0.234	1,710	0.0306	<0.250	0.000820	0.00594	879	0.0966	0.000811	1.91	<0.00050	0.353	<0.00100	<0.00050	<0.00150	0.00206	0.00437	<0.00250	0.00217	0.0110	<0.00150
C3-R2	<0.000270	0.0385	<0.00250	0.000111	0.00391	0.582		13.4	<0.0050	147	0.137	0.328	1,970	0.0109	<0.250	<0.000250	0.00639	974	0.0934	0.000499	1.99	<0.00050	0.292	<0.00100	<0.00050	<0.00150	<0.000050	0.0285	<0.00250	0.00343	<0.0050	<0.00150
C3-R2	<0.000115	0.0493	<0.00250	0.000134	0.00526	0.487		11.9	<0.0050	127	0.0638	0.574	1,750	0.0115	<0.250	<0.000250	0.00620	864	0.0838	0.000578	1.47	<0.00050	0.168	<0.00100	<0.00050	<0.00150	<0.000050	0.180	<0.00250	0.00458	<0.0050	<0.00150
C3-R2	<0.000100	0.0587	<0.00500	<0.000100	0.00638	0.416		11.9	<0.0100	128	0.0370	0.283	1,720	0.0126	<0.500	<0.000500	0.00579	837	0.117	0.000558	1.88	<0.00100	0.165	<0.00200	<0.00100	<0.00300	<0.000100	0.262	<0.00500	0.00787	<0.0100	<0.00300
C3-R2	<0.0000700	0.0526	<0.00250	0.000097	0.00260	0.199		12.4	<0.0050	148	0.0563	0.204	1,220	0.0110	<0.250	<0.000250	0.00536	814	0.102	0.000618	1.93	<0.00050	0.328	<0.00100	<0.00050	<0.00150	<0.000050	0.118	<0.00250	0.00353	<0.0050	<0.00150
C3-R2	<0.0000850	0.0542	<0.00250	0.000096	0.00186	0.159		13.4	<0.0050	152	0.0647	0.209	1,420	0.0107	<0.250	0.000287	0.00655	942	0.0745	0.000636	1.81	<0.00050	0.320	<0.00100	<0.00050	<0.00150	<0.000050	0.0774	<0.00250	0.00280	<0.0050	<0.00150
C3-R3	<0.000120	0.0407	<0.00250	0.000150	<0.00100	2.86		15.2	<0.0050	132	0.366	0.481	1,270	0.0176	<0.250	<0.000250	0.00657	891	0.111	0.000541	3.01	<0.00050	0.408	<0.00100	<0.00050	<0.00150	<0.000050	0.0264	<0.00250	0.00324	<0.0050	<0.00150
C3-R3	<0.000140	0.0405	<0.00250	0.000107	0.00135	3.02		13.1	<0.0050	135	0.306	0.329	1,150	0.0144	<0.250	<0.000250	0.00597	888	0.116	0.000431	2.65	<0.00050	0.333	<0.00100	<0.00050	<0.00150	<0.000050	0.0287	<0.00250	0.00273	<0.0050	<0.00150
C3-R3	<0.000150	0.0275	<0.00250	0.000137	<0.00100	0.610		12.8	<0.0050	141	0.167	0.507	1,260	0.0115	<0.250	<0.000250	0.00642	876	0.0362	0.000411	1.34	<0.00050	0.348	<0.00100	<0.00050	<0.00150	<0.000050	0.000422	<0.00250	0.00173	0.0222	<0.00150
C3-R3	<0.0000800	0.0252	<0.00250	0.000144	0.00146	0.306		14.2	<0.0050	162	0.189	0.352	1,620	0.0272	<0.250	<0.000250	0.00619	883	0.0397	0.000466	1.50	<0.00050	0.377	<0.00100	<0.00050	<0.00150	<0.000050	0.000319	<0.00250	0.00164	<0.0050	<0.00150
C3-R3	<0.000285	0.0339	<0.00250	0.000168	0.00248	0.423		14.0	<0.0050	146	0.123	0.440	1,980	0.0114	<0.250	<0.000250	0.00641	991	0.0638	0.000480	1.73	<0.00050	0.285	<0.00100	<0.00050	<0.00150	<0.000050	0.00329	<0.00250	0.00270	<0.0050	<0.00150
C3-R3	<0.0000950	0.0513	<0.00250	0.000101	0.00312	0.464		12.0	<0.0050	136	0.0725	0.422	1,740	0.0104	<0.250	<0.000250	0.00640	851	0.104	0.000483	1.84	<0.00050	0.199	<0.00100	<0.00050	<0.00150	<0.000050	0.206	<0.00250	0.00599	<0.0050	<0.00150
C3-R3	<0.000100	0.0567	<0.00500	0.000126	0.00937	0.392		11.8	<0.0100	118	0.0297	0.344	1,710	0.0128	<0.500	<0.000500	0.00615	803	0.107	0.000728	1.58	<0.00100	0.117	<0.00200	<0.00100	<0.00300	<0.000100	0.213	<0.00500	0.00630	<0.0100	<0.00300
C3-R3	<0.0000650	0.0477	<0.00250	0.000112	0.00169	0.138		12.3	0.0051	142	0.0571	0.211	1,340	0.0107	<0.250	<0.000250	0.00608	866	0.0725	0.000608	1.54	<0.00050	0.276	<0.00100	<0.00050	<0.00150	<0.000050	0.0610	<0.00250	0.00190	<0.0050	<0.00150
C3-R3	<0.0000850	0.0476	<0.00250	0.000119	0.00148	0.071		13.1	<0.0050	147	0.0614	0.243	1,350	0.0113	<0.250	<0.000250	0.00690	898	0.0572	0.000611	1.57	<0.00050	0.282	<0.00100	<0.00050	<0.00150	<0.000050	0.0406	<0.00250	0.00161	<0.0050	<0.00150

Notes

Effluent samples are denoted by "E" following the column ID (C1A, C1B, C2 and C3)

Rhizon samples are denoted by "-R1/R2/R3" following the column ID (C1A, C1B, C2 and C3)

Appendix C: QA/QC Water Quality Results for Method (Column) Blank Samples

Sample ID	ALS Sample Number	Collection Date	pH	Conductivity	Total Alkalinity	Dissolved Organic Carbon	NH_3-N	NO_2-N	NO_3-N	Total Dissolved Phoshorus	D-Sulphide	SO_4	D-Br	D-Cl	D-F	D-Ag	D-Al	D-As	D-B
			s.u.	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
COL100-3.0	VA20A9621-001	2-Jul-20	6.46	30.8	23	4.46	<0.005	<0.001	<0.005	0.0333	<0.0015	<0.3	<0.05	<0.5	0.033	<0.000005	0.0018	0.00103	0.0110
COL100-3.0	VA20B1658-001	30-Jul-20	6.58	30.6	19	4.46	<0.005	<0.001	<0.005	0.0431	<0.0015	<0.3	<0.05	<0.5	0.053	<0.000005	0.0014	0.00110	0.0115
COL100-3.0	VA20B3782-001	27-Aug-20	6.37	26.65	21	4.80	<0.005	<0.001	<0.005	0.0526	<0.0015	<0.3	<0.05	<0.5	0.053	<0.000005	0.0015	0.00115	0.0115
COL100-3.0	VA20B6232-001	24-Sep-20	6.33	25.79	17	4.42	<0.005	<0.001	<0.005	0.0637	<0.0015	<0.3	<0.05	<0.5	0.043	<0.000005	0.0014	0.00115	0.0109
COL100-3.0	VA20B8890-001	22-Oct-20	6.4	30.20	14	4.28	<0.005	<0.001	<0.005	0.0638	<0.0015	<0.3	<0.05	<0.5	0.051	<0.000005	0.0026	0.00109	0.0116
COL100-3.0	VA20C1279-001	19-Nov-20	6.56	25.06	16	3.86	<0.005	<0.001	<0.005	0.0814	<0.0015	<0.3	<0.05	<0.5	0.050	<0.00001	<0.002	0.000891	0.0107
COL100-3.0	VA20C3681-001	17-Dec-20	6.38	23.43	15	3.24	<0.005	<0.001	<0.005	0.0767	<0.0015	<0.3	<0.05	0.72	0.054	<0.00001	0.0024	0.00105	<0.01
COL100-3.0	VA21A0726-001	14-Jan-21	6.14	21.96	15	2.76	<0.005	<0.001	<0.005	0.0879	<0.0015	<0.3	<0.05	<0.5	0.049	<0.00001	0.0046	0.00112	0.0110
COL100-3.0	VA21A2570-001	11-Feb-21	6.19	20.76	14	2.91	<0.005	<0.001	<0.005	0.0916	<0.0015	<0.3	<0.05	<0.5	0.049	<0.00001	0.0045	0.00108	0.0106
COL100-3.0	VA21A4547-001	11-Mar-21	6.35	21.76	14	2.20	<0.005	<0.001	<0.005	0.0920	<0.0015	<0.3	<0.05	<0.5	0.059	<0.00001	0.0030	0.00102	0.0113

Sample ID	ALS Sample Number	D-Ba	D-Be	D-Bi	D-Ca	D-Cd	D-Co	D-Cr	D-Cs	D-Cu	D-Fe	D-Hg	D-K	D-Li	D-Mg	D-Mn	D-Mo	D-Na	D-Ni
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
COL100-3.0	VA20A9621-001	0.00633	1.27E-05	<0.000005	3.63	0.0000224	0.000201	<0.0001	<5E-06	<0.00005	0.0051	<0.000005	0.211	<0.0005	1.32	0.0736	0.000085	0.130	0.000381
COL100-3.0	VA20B1658-001	0.00586	1.36E-05	<0.000005	3.41	0.0000287	0.000207	<0.0001	<5E-06	<0.00005	0.0060	<0.000005	0.204	<0.0005	1.20	0.0722	0.000076	0.120	0.000415
COL100-3.0	VA20B3782-001	0.00635	1.33E-05	<0.000005	3.34	0.0000316	0.000222	<0.0001	<5E-06	<0.00005	0.0074	<0.000005	0.190	<0.0005	1.14	0.0723	0.000076	0.112	0.000462
COL100-3.0	VA20B6232-001	0.00667	1.32E-05	<0.000005	3.02	0.0000326	0.000237	<0.0001	<5E-06	<0.00005	0.0105	<0.000005	0.173	<0.0005	1.07	0.0734	0.000057	0.120	0.000486
COL100-3.0	VA20B8890-001	0.00610	1.63E-05	<0.000005	2.91	0.0000335	0.000242	<0.0001	<5E-06	<0.00005	0.0107	<0.000005	0.181	<0.0005	1.02	0.0729	<0.00005	0.106	0.000532
COL100-3.0	VA20C1279-001	0.00507	1.57E-05	<0.00001	2.62	0.0000268	0.000214	<0.0002	<0.00001	<0.0001	0.0125	<0.000005	0.157	<0.001	0.883	0.0617	<0.0001	0.098	0.000465
COL100-3.0	VA20C3681-001	0.00616	1.53E-05	<0.00001	2.52	0.0000290	0.000222	<0.0002	<0.00001	<0.0001	0.0146	<0.000005	0.143	<0.001	0.805	0.0628	<0.0001	0.078	0.000515
COL100-3.0	VA21A0726-001	0.00580	1.74E-05	<0.00001	2.47	0.0000326	0.000239	<0.0002	<0.00001	<0.0001	0.0170	<0.000005	0.145	<0.001	0.802	0.0625	<0.0001	0.085	0.000528
COL100-3.0	VA21A2570-001	0.00568	1.73E-05	<0.00001	2.39	0.0000316	0.000244	<0.0002	<0.00001	<0.0001	0.0217	<0.000005	0.130	<0.001	0.786	0.0634	<0.0001	0.084	0.000530
COL100-3.0	VA21A4547-001	0.00554	2.06E-05	<0.00001	2.53	0.0000311	0.000240	<0.0002	<0.00001	<0.0001	0.0217	<0.000005	0.132	<0.001	0.719	0.0593	<0.0001	0.130	0.000614

Sample ID	ALS Sample Number	D-P	D-Pb	D-Rb	D-S	D-Sb	D-Se	D-Si	D-Sn	D-Sr	D-Te	D-Th	D-Ti	D-Tl	D-U	D-V	D-W	D-Zn	D-Zr
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
COL100-3.0	VA20A9621-001	<0.05	0.000018	0.000184	<0.5	0.000066	<0.00004	1.34	<0.00002	0.00733	<0.00002	<0.000005	<0.00005	<0.000005	0.0000064	0.000252	<0.00001	<0.0005	<0.00001
COL100-3.0	VA20B1658-001	0.052	<0.00001	0.000178	<0.5	0.000068	<0.00004	1.34	<0.00002	0.00716	<0.00002	<0.000005	<0.00005	<0.000005	0.0000060	0.000239	<0.00001	<0.0005	<0.00001
COL100-3.0	VA20B3782-001	0.052	<0.00001	0.000173	<0.5	0.000066	<0.00004	1.29	<0.00002	0.00718	<0.00002	<0.000005	<0.00005	<0.000005	0.0000061	0.000204	<0.00001	<0.0005	<0.00001
COL100-3.0	VA20B6232-001	0.066	<0.00001	0.000170	<0.5	0.000071	<0.00004	1.34	<0.00002	0.00694	<0.00002	<0.000005	<0.00005	<0.000005	0.0000050	0.000207	<0.00001	<0.0005	<0.00001
COL100-3.0	VA20B8890-001	0.078	<0.00001	0.000167	<0.5	0.000059	<0.00004	1.19	<0.00002	0.00588	<0.00002	<0.000005	<0.00005	<0.000005	0.0000047	0.000209	<0.00001	<0.0005	<0.00001
COL100-3.0	VA20C1279-001	<0.1	<0.00002	0.000148	<1	0.000078	<0.00008	1.24	<0.00004	0.00587	<0.00004	<0.00001	<0.0001	<0.00001	0.0000054	0.000169	<0.00002	<0.001	<0.00002
COL100-3.0	VA20C3681-001	<0.1	<0.00002	0.000124	<1	0.000067	<0.00008	1.17	<0.00004	0.00604	<0.00004	<0.00001	<0.0001	<0.00001	0.0000054	0.000157	<0.00002	<0.001	<0.00002
COL100-3.0	VA21A0726-001	<0.1	<0.00002	0.000149	<1	0.000070	<0.00008	1.07	<0.00004	0.00537	<0.00004	<0.00001	<0.0001	<0.00001	0.0000049	0.000167	<0.00002	<0.001	<0.00002
COL100-3.0	VA21A2570-001	<0.1	<0.00002	0.000142	<1	0.000055	<0.00008	1.13	<0.00004	0.00567	<0.00004	<0.00001	<0.0001	<0.00001	0.0000054	0.000201	<0.00002	<0.001	<0.00002
COL100-3.0	VA21A4547-001	0.100	<0.00002	0.000136	<1	0.000065	<0.00008	1.07	<0.00004	0.00558	<0.00004	<0.00001	<0.0001	<0.00001	0.0000064	0.000160	<0.00002	<0.001	<0.00002

APPENDIX 2-H

Fall 2017 Testpitting Program, Coffee Mine Site

Fall 2017 Testpitting Program, Coffee Mine Site
Phase 1: Proposed Infrastructure Footprints
Phase 2: Proposed Open Pit Areas



PRESENTED TO

JDS ENERGY & MINING INC.

DECEMBER 18, 2017
ISSUED FOR USE
FILE: ENG.EARC03094-01.004

Tetra Tech Canada Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

This page intentionally left blank.

EXECUTIVE SUMMARY

Tetra Tech Canada Inc. was retained by JDS ENERGY & MINING INC. to provide geotechnical consulting services for Phases 1 and 2 of a testpitting program in the Coffee Mine site area. Phase 1 of the testpitting program focused on excavation of testpits with a CAT 336E excavator and description of surficial materials within various proposed mine site infrastructure footprints. Representative samples were collected for analysis during Phase 1. Phase 2 involved testpitting in the proposed open pit areas, with accompanying overburden logging, but no sample collection.

Surficial materials exposed in the testpits at the Coffee Mine Site revealed several surficial units which were described in detail and sampled. The testpits were infilled immediately following logging and sampling. A total of fifty seven testpits were logged and representative samples of various overburden types were collected during Phase 1 for analysis in Tetra Tech Canada Inc.'s geotechnical laboratory in Whitehorse. Thirty additional samples of surficial deposits and fractured bedrock from selected testpits were taken during Phase 1 for Lorax Environmental Services Ltd. These were sent to ALS laboratories in Vancouver, B.C., for geochemical analysis. Phase 2 commenced upon completion of Phase 1.

Various types of overburden were identified within the testpits. These include loess, weathered bedrock, colluvium, peat, and surface moss cover. Approximate volumes of each were calculated for various site facilities. Permafrost conditions, including ground ice, were identified in many of the testpits.

TABLE OF CONTENTS

EXECUTIVE SUMMARY I

1.0 INTRODUCTION 1

2.0 METHODS 1
2.1 Fieldwork 1
2.2 Overburden Material Volumes 2

3.0 RESULTS 3
3.1 Surficial Materials 3
3.1.1 Loess 3
3.1.2 Weathered Bedrock 3
3.1.3 Colluvium 4
3.1.4 Peat 4
3.1.5 Surface Moss Cover 4
3.2 Testpit Data Summary 4
3.3 Overburden Material Volumes 7
3.4 Permafrost 8
3.5 Diggability 8
3.6 Aggregate Potential 8

4.0 CLOSURE 10

REFERENCES 11

LIST OF TABLES IN TEXT

Table 1: Testpit Information Summary 5
Table 2: Summary of Offsite Geotechnical Laboratory Results 7
Table 3: Summary of Overburden Material Volumes 7

APPENDIX SECTIONS

FIGURES

Figure 1 Site Location
Figure 2 Testpit Location and Ice Content
Figure 3 Peat and Thick Organics Content in Testpits and 2017 Boreholes

PHOTOGRAPHS

APPENDICES

Appendix A Limitations on the Use of this Document
Appendix B Testpit Logs
Appendix C Geotechnical Laboratory Soil Test Results

GLOSSARY

Acronyms/Abbreviations	Definition
Active Layer	The top layer of ground subject to annual thawing and freezing in areas underlain by permafrost.
Aggregate Resource	Sand, gravel, or crushed stone used for construction and other industrial purposes.
Clast	An individual constituent or fragment of a sediment or rock, produced by the weathering of a larger rock mass. Synonyms include stone and fragment.
Colluvium	Materials deposited as a result of downslope movements due to gravity, such as rock fall and debris slides.
Cryoturbation	Heaving, churning, and sorting of soil and surficial materials due to repeated freezing and thawing (frost action); results in the development of convoluted structures in the soil, and patterned ground such as stone stripes and sorted polygons.
Debris Slide	A shallow slide consisting of a mass of soil, vegetation, and surficial material; initial displacement is along one or several surfaces of rupture. Composed of comparatively dry and largely unconsolidated earthy material and results in an irregular, hummocky deposit.
Eolian	Well sorted materials, predominantly silt and fine to medium sand, which have been eroded, transported, and deposited by wind.
Fibric	The least decomposed state of organic materials – large amounts of weakly decomposed fibres whose botanical origins are readily identifiable are visible. Fibric material has 40% or more by volume of fibre that retains its character upon rubbing.
Frost Jacking	Cumulative upward displacement of objects embedded in the ground, caused by frost action.
Humic	The greatest decomposed state of organic materials. It has the lowest amount of fiber, the highest bulk density, and the lowest saturated water-holding capacity of the organic materials. It is physically and chemically stable over time, unless drained. Fibres can be easily destroyed by rubbing.
Loess	A homogeneous massive deposit formed by wind, consisting mainly of silt.
Mesic	Organic material in a stage of decomposition that is intermediate between fibric and humic. Fibre remaining after rubbing constitutes greater than 10% and less than 40% of the volume of the material.
Peat	Unconsolidated compressible material consisting largely of undecomposed, or slightly decomposed, organic matter accumulated under water-saturated conditions. Peat is commonly formed by the slow decay of successive layers of aquatic and semi-aquatic plants in swampy or water-logged areas, where oxygen is absent.
Permafrost	Ground, soil, or rock that remains at or below 0˚C for at least two consecutive years.

Acronyms/Abbreviations	Definition
Rock Fall	The process, associated deposits or resultant landform characterized by very rapid downslope movement of newly detached pieces of bedrock that fall freely from a cliff or cascade down a steep slope.
Weathered Bedrock	The chemical and physical decomposition and disintegration of bedrock due to exposure to air, moisture, organic matter, and temperature change.

ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
4WD	Four wheel drive
ALT	Active Layer Thickness
JDS	JDS ENERGY & MINING INC.
WRSF	Waste Rock Storage Facility

SITE INVESTIGATION WAIVER STATEMENT

To minimize the risk of damage to underground utilities, locating and marking of all underground services will be completed by an independent utility locator service, along with any information provided by the property owner (or their representative) prior to any intrusive field investigation operations. The property owner (or their representative) is responsible for ensuring that any private utilities, such as storm sewers or buried power and gas lines, are identified and located within the investigation areas before the start of any field investigation program. Because Tetra Tech cannot verify or rely on the accuracy of this information, Tetra Tech will not accept responsibility for damage, or cause for delay, to any party for private or public utilities not properly identified and or located. Any and all costs resulting from the damaged utility, and/or utilities, as a result of our investigation will be the responsibility of JDS ENERGY & MINING INC.

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of JDS ENERGY & MINING INC. and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than JDS ENERGY & MINING INC., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by JDS ENERGY & MINING INC. (JDS) to provide geotechnical consulting services for Phases 1 and 2 of a testpitting program in the Coffee Mine site area. A location map is shown in Figure 1.The objective of the testpitting program was to investigate the composition, diggability, and thickness of the overburden in the mine site area.

Phase 1 of the testpitting program focused on excavation of testpits, and logging and sampling of surficial materials overlying bedrock throughout various mine site infrastructure footprints. Representative samples of overburden were collected for index testing in Tetra Tech's geotechnical laboratory in Whitehorse.

The data acquired is intended to aid in developing a material inventory and a plan for storage and management of excavated materials. The data can also be used to manage surficial materials during the pre-stripping program.

After the field program commenced, Mr. John Dockrey of Lorax Environmental Services Ltd. (Lorax) requested that additional samples of overburden and bedrock be taken for geochemical analysis at particular testpit locations. This was approved by Mr. James Scott of Goldcorp Inc. (Goldcorp) and additional samples of surficial deposits and fractured bedrock were collected from selected testpits during Phase 1. The samples were sent to ALS laboratories in Vancouver, B.C., for geochemical analysis.

Phase 1 of the program was finished earlier than initially planned, allowing Phase 2 to be completed as well. Phase 2 consisted of testpitting in the proposed open pit areas with no sample collection.

After submission of the initial Issued for Review report, JDS requested volume calculations for the various types of overburden surficial materials. These calculations have been included in this Issued for Use report.

2.0 METHODS

2.1 Fieldwork

To achieve the objectives of the testpitting program, surficial materials were exposed in testpits with a CAT 336E excavator (Photo 1). The surficial material (overburden) units were described in detail by Dr. Shirley McCuaig, Ph.D., P.Geo., Senior Terrain Geologist, between October 6 and 14, 2017. A side by side all-terrain vehicle was used to access the testpit areas from the mine laydown area and to scout out locations of testpits to determine the least environmentally damaging path to be taken by the excavator to mobilize to the pit locations. Mr. Dan Tulp of JDS provided assistance for a number of testpits, mainly in areas where travelling by side by side all-terrain vehicle to the site was more treacherous than usual. Mr. Jason Thompson, Mr. Dan Tulp, and Mr. Larry Berg of JDS all provided excellent operation of the excavator on various days as per their availability. Accommodation for all was provided at Goldcorp's Coffee camp and access to the mine site area was provided by JDS by 4WD pickup.

The testpits were infilled immediately following logging and sampling. Organic cover was removed first and set aside; it was replaced last to help insulate the disturbed overburden material and prevent permafrost thaw. Photos were taken of the soils and bedrock encountered, as well as of the infilled excavations to record the reclamation efforts.

Information recorded included bedrock and clast general rock types, depth to bedrock, presence of peat/organic soil, grain size and composition of deposits, frozen/unfrozen state, diggability, groundwater level where encountered, active layer thickness (ALT), and amount and type of ground ice, if present.

Testpit TP17-14 was not completed as it was expected to be very similar to TP17-13 and TP17-15. The ground was too bouldery for the excavator to access TP17-03 (some of the boulders in this area are large enough to be seen on the air photos).

Phase 2 commenced upon completion of Phase 1. No samples were collected during this phase. This program was completed with the exception of three testpits in distant parts of the proposed open pit areas, and the testpits in the Alpha WRSF, which must be completed at a later date, when the soft ground of that slope is frozen.

Daily Field Reports were compiled at the end of each field day and sent to interested parties at Goldcorp, JDS, and Tetra Tech. Weather, work undertaken, names and numbers of testpits described and samples taken, preliminary information acquired from the testpits, safety and environmental information, and delays/breakdowns were described in the daily reports.

Laboratory testing of a limited number of representative soil samples of various overburden types were taken during Phase 1 for analysis in Tetra Tech's geotechnical laboratory in Whitehorse. Particle size distribution and moisture contents were determined.

Thirty additional samples of surficial deposits and bedrock from selected testpits were taken during Phase 1 for Lorax. These were sent to ALS laboratories in Vancouver, B.C., for geochemical analysis. Additional information on level of bedrock weathering was recorded for these samples. Results of these analyses will be reported under separate cover by Lorax.

Testpit locations were plotted in ArcGIS and overlain on the previously completed permafrost mapping (Figure 2). The permafrost mapping was updated with the frozen/unfrozen and ice content information obtained from the testpits, and also from the summer 2017 drilling program.

Peat and thick organics were also plotted (Figure 3) to see if there were any relationships to the permafrost mapping.

2.2 Overburden Material Volumes

Overburden material volumes were estimated by taking unit thickness values from the testpit logs, importing that data into AutoCAD Civil 3D software, and performing both computed and hand calculations of volumes. The overburden materials were separated into the main overburden types described in Section 3.1, but with peat and surface moss cover combined into a single organics layer. The remaining layers for which volumes were calculated are the upper silt/gravel, the lower gravel/sand, and weathered bedrock. Volumes were calculated for each mine facility site where testpits were dug: the Heap Leach facility, Kona Pit, the Organics Stockpile, the Event Ponds, the Plant Site, the Crusher area, the Frozen Soil Stockpile, and the Pit Areas (Supremo, Double Double, and Latte Open Pit Areas).

Ground contour data, provided by Mr. Joel Griffen of JDS, was used where possible to help determine the most accurate three dimensional material volumes. In smaller locations like Kona Pit, hand volume calculations were used by multiplying the surface area by average material thickness from the testpits. For larger facilities, material volumes were calculated by taking the surveyed testpit point elevations and adjusting them to the corresponding elevations of the top and bottom of each unit at each testpit. The observed unit thicknesses measured at each testpit were used to determine these elevations. Interpolated hand-drawn contours were completed for each unit at each pit. This information was used for areas between and outside of the testpits, which were used to fill in data gaps that were required to complete the calculations in AutoCAD Civil 3D, so that the most accurate surfaces could be built.

Unfortunately, the provided existing ground contour data has much finer detail than the surfaces which can be created using the testpit unit elevation data and the interpolated hand-drawn thickness contours. As a result, the AutoCAD software linearly interpolates the spaces between the testpit location points and the hand-drawn contours when creating surfaces, which creates holes or errors in the data. This makes it difficult to accurately compare the existing ground surface with the created surfaces at some locations. The volume calculations provided herein therefore should be considered to be the best estimates obtainable by the method described above, and not necessarily a true depiction of the material volumes at all locations. Local topographic features such as depressions, outcrops, and rockfall areas will all affect actual material volumes.

3.0 RESULTS

Various types of overburden were identified within the testpits. These include loess, weathered bedrock, colluvium, peat, and surface moss cover. Permafrost conditions were evident and ground ice was encountered in many areas. The materials encountered in all testpits (both Phase 1 and Phase 2 testpits) are summarized below. The data is shown in detail in the testpit logs provided in Appendix B and the locations of the testpits are shown in Figure 2. Phase 1 testpits include TP17-01 to TP17-30, while Phase 2 testpits range from TP17-49 to TP17-79.

3.1 Surficial Materials

3.1.1 Loess

The Coffee Creek Mine Site lies within the unglaciated portion of the Dawson Range. According to Bond and Lipovsky (2011), loess was blown into the area from terraces flanking the Donjek, White, and Yukon Rivers. Loess generally forms uniform, unstratified silt deposits of eolian origin. However, in the project region, it tends to infill and become mixed with weathered bedrock, and it is generally thicker on the southwest (windward) side of the mountains (Bond and Lipovsky 2011). The testpit data confirms the latter – on average, the upper silt-rich deposits are 30 cm thicker on slopes of southwesterly aspect[1].

Silt in the testpits was generally observed in the uppermost portion of the overburden units, but it is mixed with varying amounts of pebbles, cobbles, and boulders, as well as trace amounts of clay, forming a well graded or gap graded unit (hereafter referred to as the upper silt/gravel unit) (Photos 2 and 3). Silt is also present in the underlying surficial materials, but in much smaller quantities, and is more likely a product of long-term physical weathering at these levels within the overburden.

Taken together, these data are consistent with a surficial geology history for the mine site area comprising bedrock weathering to gravel and sand over long periods of time and later becoming infilled with wind-blown loess.

3.1.2 Weathered Bedrock

In general, the mine site infrastructure and pit areas are covered with weathered bedrock, represented by schist in the east and granitoid rocks in the west. These range from slightly to completely weathered, the completely weathered varieties forming a soft mica sand in schist areas and an easily crumbled sand to pea-size gravel in granitic areas (Photos 4, 5a, 5b, 6, and 7). Refusal commonly occurred on more competent bedrock, but it was generally fractured by frost shattering (Photo 8).

[1] Testpits where the excavator met refusal on frozen ground were excluded from these calculations, as the deposits are likely thicker than recorded at these locations.

The frost-shattered bedrock is overlain by gravel or gravel/sand made up of bedrock that has been more physically and/or chemically weathered (and contains small amounts of silt), hereafter referred to as the lower gravel/sand. The granitoid rocks break down to angular fragments of all sizes, but these are more equidimensional than the elongated or slab-like blocks of schist (Photos 4, 5a, 5b, 9, and 10).

3.1.3 Colluvium

Colluvium is present on steeper slopes. It was confirmed in several testpits by the presence of void spaces between angular cobbles and boulders and a lack of finer material, both occurring in the uppermost portions of the surficial units (Photo 11). Inversion of the upper silt/gravel and lower gravel/sand (forming an upper gravel/sand and lower silt/gravel) may also indicate that colluvium is present, as these stratigraphic relationships are found in some of the testpits located on colluvial slopes. A buried soil at Testpit TP17-32 confirms a colluvial origin for the granular material overlying the soil at that location (Photo 12), despite the gentle slope (the material may have been moved by solifluction or soil creep). Colluvium can probably be assumed to be present on steeper slopes, no matter what their aspect, but it may also be present on some of the gentler slopes, where creep or solifluction may be occurring or may have happened in the past.

3.1.4 Peat

A thin peat layer 10 cm to 35 cm thick is present locally (Photo 13). Its distribution is very patchy – as a rule, it was identified within the overburden on one side of a testpit, but not the other (it forms lenses of limited extent). The insulation value of peat is high – frozen ground and visible ice were commonly found 0 to 50 cm below it in testpits where peat was present (Photo 14). The peat is dark brown and generally fibric to mesic. Charcoal was identified within the peat at Testpit TP17-29 (Photo 15).

Frost-jacked granitic boulders overlying the peat in the western part of the mine site (see testpit logs for TP17-05 and TP17-10, Appendix B), indicate that the peat is very old. The boulders obscure the peat from view at surface, both in the field and on the air photos. This makes its presence or absence very difficult to determine. However, if peat is encountered, it is highly likely that frozen ground with visible ice is present below it.

3.1.5 Surface Moss Cover

Moss and rootlets cover the deposits and range from 10 cm to 30 cm thick (Photos 2, 3, and 8). Moss is generally thicker over peat deposits (Photo 13).

3.2 Testpit Data Summary

A total of 57 testpits were excavated and logged. The coordinates, depth to bedrock, permafrost condition observed, and completion depth for each of the testpits are summarized in Table 1 below and are shown in greater detail on the testpit logs in Appendix B. Testpit locations are also presented on Figure 2.

Table 1: Testpit Information Summary

Site Infrastructure	Testpit	UTM ZONE 7			Depth to Weathered Bedrock (m)	Completion Depth (m)	Permafrost Condition
		Easting (m)	Northing (m)	Elevation (m)			
Organics Stockpile	TP17-01	580,141	6,972,769	1,226	-	1.2	Vc, Vr 5-10%
	TP17-02	580,450	6,972,685	1,245	-	2.0	Nbn
HLF	TP17-04	580,101	6,972,489	1,276	-	1.3	Nbn
	TP17-05	580,740	6,972,380	1,250	-	1.0	Vr, Vs 10-40%
	TP17-06	580,064	6,971,889	1,237	0.8	1.1	Vc, Vx 5-15%
	TP17-07	580,093	6,972,177	1,315	1.0	1.2	Visible ice in fractures 10%
	TP17-08	580,693	6,972,155	1,315	1.3	2.1	Unfrozen
	TP17-09	581,285	6,972,105	1,256	1.0	1.5	Unfrozen
	TP17-10	580,064	6,971,889	1,293	-	1.7	Vs, Vc 20-40%
	TP17-11	580,681	6,971,911	1,260	1.8	2.7	Unfrozen
	TP17-12	581,289	6,971,944	1,240	1.8	2.4	Unfrozen
Event Ponds	TP17-13	581,537	6,972,432	1,223	-	1.5	Vx 5%
	TP17-15	581,689	6,972,306	1,221	-	1.4	Unfrozen
	TP17-16	581,779	6,972,462	1,213	-	1.9	Unfrozen
Plant Site	TP17-17	582,115	6,972,615	1,190	1.2	1.7	Unfrozen
	TP17-18	582,115	6,972,615	1,184	-	3.1	Unfrozen
	TP17-18a	582,243	6,972,630	1,187	1.3	2.9	Unfrozen
	TP17-18b	582,251	6,972,374	1,185	1.5	2.8	Unfrozen
	TP17-20	582,294	6,972,678	1,176	-	2.6	Nbn
	TP17-21	582,448	6,972,662	1,178	1.5	1.7	Unfrozen
	TP17-22	582,365	6,972,709	1,175	0.8	0.9	Unfrozen
	TP17-23	582,483	6,972,750	1,171	1.2	1.7	Visible ice between fissility planes 5%
Fuel Tanks	TP17-19	582,341	6,972,582	1,176	-	2.0	Unfrozen
Crusher Area	TP17-24	582,916	6,972,826	1,122	1.1	1.1	Nbn, Vx, Vs
Run of Mine Stockpile	TP17-25	582,885	6,972,922	1,137	1.7	1.7	Unfrozen
	TP17-26	583,266	6,972,926	1,128	1.4	1.4	Unfrozen
Frozen Soil Stockpile	TP17-27	583,471	6,973,567	1,159	2.8	2.8	Unfrozen
	TP17-28	583,349	6,973,863	1,177	1.2	1.6	Unfrozen
	TP17-29	583,227	6,974,142	1,189	1.7	1.7	Unfrozen
Explosives Storage	TP17-30	585,831	6,974,399	1,279	3.0	3.0	Unfrozen
Kona Pit	TP17-31	579,621	6,973,029	1,276	-	1.8	Nbn
	TP17-32	579,723	6,973,038	1,265	1.3	1.5	Unfrozen

Table 1: Testpit Information Summary

Site Infrastructure	Testpit	UTM ZONE 7			Depth to Weathered Bedrock (m)	Completion Depth (m)	Permafrost Condition
		Easting (m)	Northing (m)	Elevation (m)			
Latte Pit	TP17-49	583,210	6,973,460	1,129	0.9	1.4	Unfrozen
	TP17-52	583,066	6,973,296	1,104	-	1.8	Vx 10-20 %
	TP17-53	583,358	6,973,315	1,122	0.6	1.6	Unfrozen
	TP17-55a	583,060	6,973,183	1,110	-	0.9	Vc 20%
	TP17-55b	583,060	6,973,183	1,110	-	1.5	Unfrozen
	TP17-56	583,337	6,973,160	1,111	-	1.6	Unfrozen
Supremo Pit	TP17-58	584,454	6,975,143	1,155	-	1.9	Vs 5%
	TP17-59	584,083	6,974,824	1,249	-	1.7	Vc 5%
	TP17-62	583,859	6,974,691	1,249	-	1.8	Vs, Vc 5-20%
	TP17-63	584,090	6,974,524	1,296	2.0	2.7	Unfrozen
	TP17-64	584,396	6,974,545	1,263	-	1.7	Vc, Vx 5%
	TP17-65	584,915	6,974,573	1,192	-	1.4	Vc 1%
	TP17-66	583,784	6,974,249	1,274	-	1.9	Unfrozen
	TP17-67	584,058	6,974,267	1,287	-	2.5	Unfrozen
	TP17-68	584,389	6,974,247	1,267	1.9	1.9	Unfrozen
	TP17-69	584,924	6,974,282	1,238	1.1	1.7	Unfrozen
	TP17-71	584,619	6,973,937	1,216	2.6	3.1	Unfrozen
	TP17-72	584,949	6,973,970	1,241	1.3	1.6	Unfrozen
	TP17-73	584,416	6,973,804	1,161	-	0.9	Vc, Vs 20-40%
	TP17-75	584,679	6,973,669	1,148	1.0	1.0	Unfrozen
	TP17-78	584,758	6,973,337	1,082	-	1.3	Vc, Vs, Vr 10-20%
	TP17-70	584,088	6,973,963	1,186	1.2	2.0	Vc, Vs 20-40%
	TP17-74	584,079	6,973,600	1,092	-	0.8	Vc, Vs 10%
	TP17-76	584,309	6,973,471	1,071	-	1.6	Vc, Vs 10-20%
	TP17-77	584,091	6,973,370	1,017	4.0		Vc 1%
	TP17-79	584,997	6,973,268	1,106	1.4	2.3	Unfrozen

Weathered bedrock is considered to be bedrock broken into large and small blocks by physical weathering as described in Section 3.1.2. It may or may not be diggable. Where it was not diggable, it formed the base of the testpit and a thickness was generally not obtained. No unweathered bedrock was encountered.

The geotechnical laboratory soil testing results are summarized in Table 2 below, are shown on the testpit logs in Appendix B, and are presented fully in Appendix C.

Table 2: Summary of Offsite Geotechnical Laboratory Results

Testpit	Depth		Moisture Content (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)
	From (m)	To (m)						
TP17-04	1.3	1.4	19.5	7	44	30	20	-
TP17-05	0.9	1.0	35.4	11	34	28	28	-
TP17-07	0.7	0.8	3.7	5		25	71	0
TP17-10	1.3	1.4	47.9	17	46	26	11	-
TP17-13	0.8	0.9	10	6	26	28	40	-
TP17-16	0.3	0.4	7.4	6	26	37	31	-
TP17-18a	1.2	1.3	5.6	18		27	45	11
TP17-18b	1.1	1.2	5.3	12		23	65	0
TP17-21	0.9	1.0	15.0	3	22	55	20	-
TP17-24	0.7	0.8	20.1	9	20	37	35	-
TP17-25a	0.4	0.5	9.8	9	23	21	48	-
TP17-25b	1.1	1.2	10.9	16		35	49	0
TP17-26	0.8	0.9	8.7	5		86	8	0
TP17-27	0.5	0.6	19.7	59		35	6	0
TP17-29	0.9	1.0	8.5	24		24	53	0
TP17-30	0.7	0.8	2.4	3		2	94	0

3.3 Overburden Material Volumes

Table 3 summarizes the estimated material volumes at each facility. Note that weathered bedrock volumes must be considered minimum estimates only due to diggability issues.

Table 3: Summary of Overburden Material Volumes

Mine Facility	Surface Area (m^2)	Organic Material Volume (m^3)	Upper Silt/Gravel Volume (m^3)	Lower Sand/Gravel Volume (m^3)	Weathered Bedrock Volume (m^3)	Total Overburden Volume (m^3)
Heap Leach Facility	886,800	236,500	473,700	475,000	341,900	1,527,100
Kona Pit	100,600	22,800	101,900	110,700	15,100	250,500
Organics Stockpile	159,800	47,900	159,800	60,000	8,900	276,600
Event Ponds	101,500	20,300	50,700	53,300	6,400	130,700
Plant Site	77,900	15,600	47,500	59,500	47,800	170,400
Crusher	12,300	5,000	-	7,400	-	12,400
Pit Areas	1,820,100	364,000	445,100	985,300	263,400	2,057,800
Frozen Soil Stockpile	208,300	48,600	187,500	125,000	-	316,100

3.4 Permafrost

Frozen ground was encountered in many of the testpits. Ice lenses, coatings, and crystals (Vs, Vc, and Vx on the testpit logs) were identified in several testpits and frozen overburden material well-bonded by nonvisible pore ice (Nbn) was present in a few more testpits (Appendix B, Photos 16 to 18).

The active layer averages 1.3 m thick, except where peat is present. Beneath peat, the ALT was 0.7 m on average.

Cryoturbation has likely played a role in mixing some of the non-colluvial materials. However, the contact between upper silt/gravel and the lower gravel/sand is generally sharp or gradational, so there is a limit to the amount of mixing that occurs between the two over most of the study area.

Frost jacking of boulders over millennia has resulted in a layer of boulders at the surface in many areas (Photos 3 and 10). The boulder layer is especially common in the areas underlying the Proposed Heap Leach Facility, Organics Stockpile, Event Ponds, and Plant Site footprints.

Permafrost mapping completed by Tetra Tech in 2016 for the mine site was updated using the testpit information. The updated locations of unfrozen ground, ice-poor and ice-rich terrain are shown on Figure 2. The same information is given as point data for each testpit[2]. Some interpolation was necessary to update the mapping, so not every testpit point is a perfect match for the mapping. This shows that there is some minor variability within the mapped permafrost units, as explained on the legend of Figure 2.

The locations of peat and organics (peat, moss, organic soil) greater than 30 cm thick were also plotted to see if there were any relationships between organics, peat, and permafrost. Drilling data from 2017 was added and the results are shown on Figure 3. It is evident from Figure 3 that peat and thick organics are generally, but not always, associated with frozen ground. 67% of these are associated with ice-rich terrain, 25% with ice-poor terrain, and 8% with unfrozen ground. It does not appear to matter whether the organic cover is peat or thick organics.

3.5 Diggability

JDS requested a measure of diggability for the testpits, to help with future overburden removal and construction planning. To this end, a diggability range of 1 to 10 was established to compare testpit materials, with 10 being the most difficult to dig and 1 being the easiest.

Refusal occurred either on frozen ground or fractured bedrock, but the excavator was generally able to rip 20 cm to 50 cm into these materials, despite a lack of ripping teeth. The upper silt/gravel units almost always had a diggability rating of 1, the lower gravel/sand units 1 to 3, and frozen ground and fractured bedrock were rated at 9 to 10. There were some variations across the study area, but these diggability relationships are the most common. For details on diggability, please refer to the testpit logs in Appendix B.

3.6 Aggregate Potential

Granitoid rocks produce a reasonable quality sand composed mainly of feldspar, quartz, and granite, but the pebble/cobble gravel in these areas is likely too weak to be considered a good aggregate source. Completely weathered granite crumbles to sand in the hand. Schist gravel is a better, albeit not good, potential aggregate source.

[2] Testpits where bedrock was found close to surface or that met refusal at depths of less than 1.4 m are considered to have uncertain active layer depths. The frozen/unfrozen condition is mapped as “Uncertain” on Figure 2.

In the schist zone, potentially good aggregate was identified at Testpit TP17-18. Here, at least 1.7 m of moderately well graded gravel with some sand, trace silt, and trace clay underlies a thin layer of the upper silt/gravel (Photo 19). Pebbles and cobbles dominate and the material is very diggable. Two testpits were dug nearby to assess the size of the potential aggregate resource. Unfortunately, the gravel is only 30 cm thick at TP17-18a. Testpit TP17-18b is more promising, containing 1 m of sandy gravel with some silt and trace clay, but the micaceous sand derived from completely weathered schist may be problematic (Photo 20). However, the fractured bedrock at all three sites is quite diggable and could potentially provide more aggregate with some crushing (Photo 21).

4.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

Prepared by:
Shirley McCuaig, Ph.D., P.Geol. (AB, NT/NU)
Senior Terrain Geologist, Geotechnical Engineering
Direct Line: 587.460.3569
Shirley.Mccuaig@tetratech.com

Prepared by:
Ernest Palczewski, B.Sc., P.Geo. (AB, NT/NU)
Geologist, Arctic Group
Direct Line: 587.460.3595
Ernest.Palczewski@tetratech.com

Reviewed by:
Vladislav Roujanski. Ph.D., P.Geol. (AB, NT/NU)
Senior Geologist-Geocryologist, Arctic Region
Direct Line: 587.460.3610
Vladislav.Roujanski@tetratech.com

/jf

Reviewed by:
Derek C. Cathro M.Eng., P.Eng. (AB, NT/NU, YK)
Senior Vice President
Direct Line: 587.460.3477
Derek.Cathro@tetratech.com

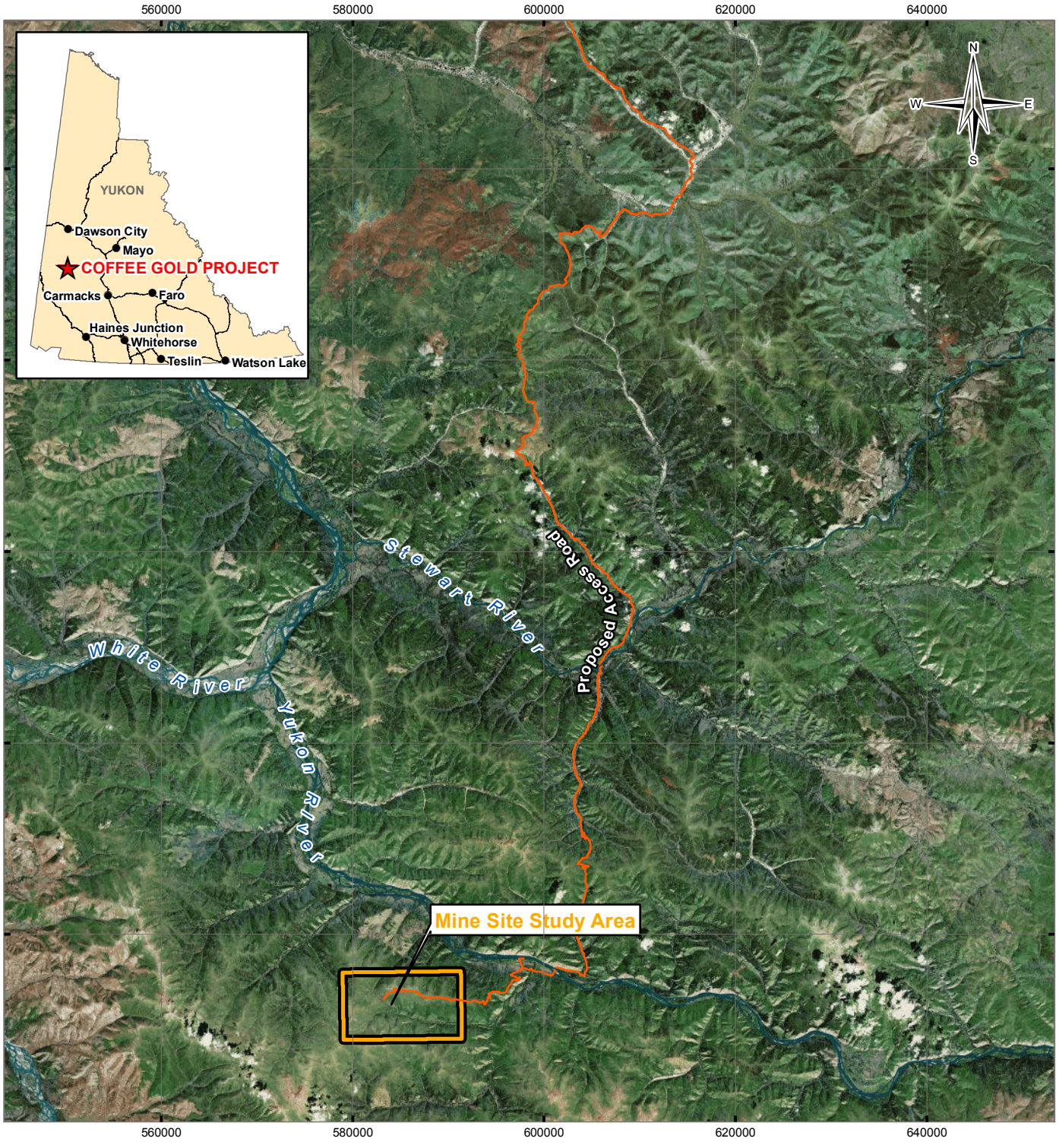
PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date Dec 18/17
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

REFERENCES

Bond, J.D. and Lipovsky, P.S., 2011. Surficial geology, soils and permafrost of the northern Dawson Range. In: Yukon Exploration and Geology 2010, K.E. MacFarlane, L.H. Weston and C. Relf (eds.), Yukon Geological Survey, p. 19-32.

FIGURES

Figure 1 Site Location
Figure 2 Testpit Location and Ice Content
Figure 3 Peat and Thick Organics Content in Testpits and 2017 Boreholes



LEGEND

- Mine Site Study Area
- Proposed Access Road

NOTES
Base data source:
Imagery from ESRI;
Earthstar Geographics (1999)
Road data from Kaminak (February 2016)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
TESTPIT PROGRAM

Site Location

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	JDS Energy & Mining Inc.

Scale: 1:600,000
10 5 0 10
Kilometres

TETRA TECH

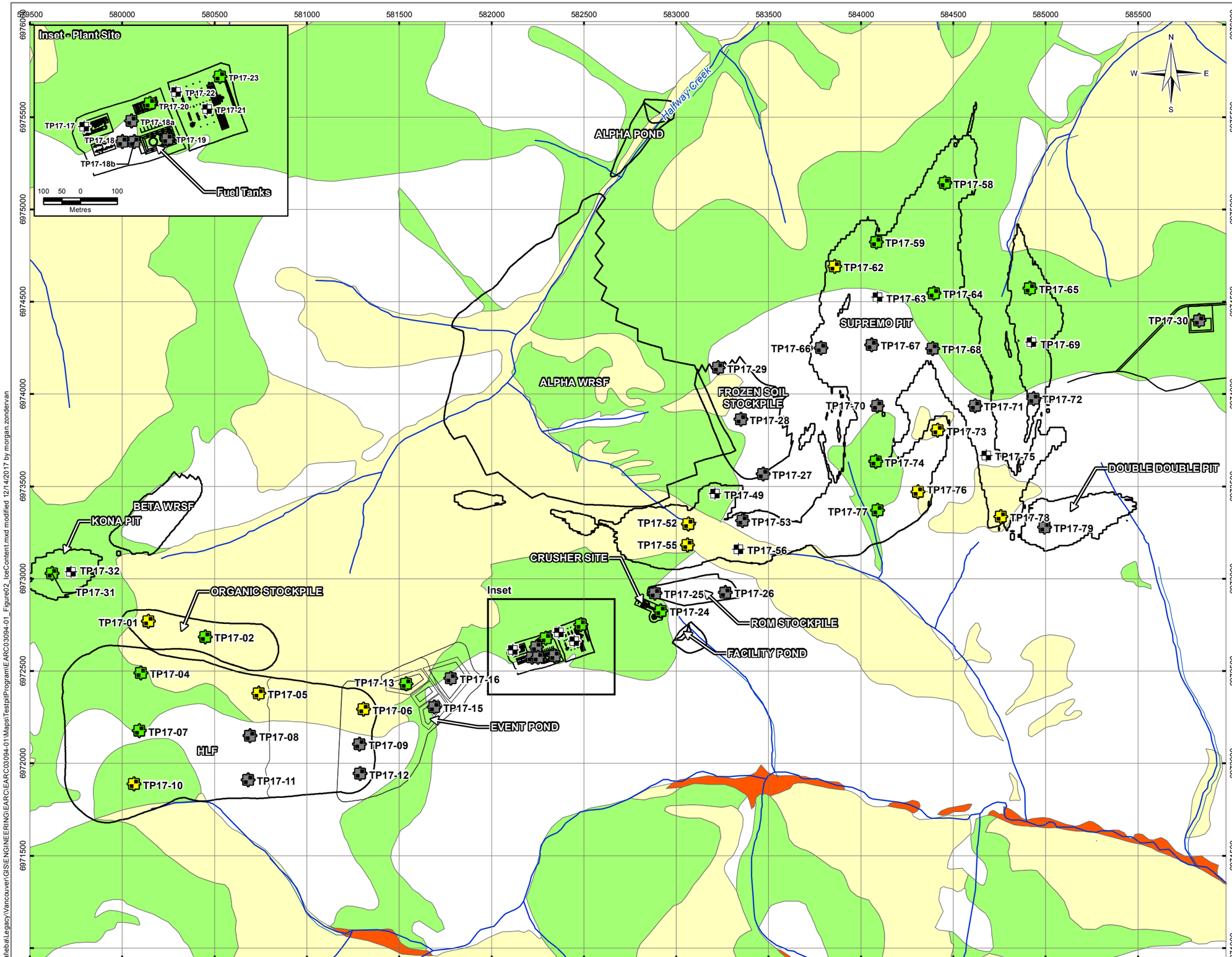
FILE NO. EARC03094-01_Figure01_SiteLocation.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03094-01	MEZ	SL	VER	0

OFFICE	DATE
Tt EBA-VANC	December 14, 2017

Figure 1

\\tt.local\eba\Legacy\Vancouver\GIS\ENGINEERING\EARC\EARC03094-01\Maps\TestpitProgram\EARC03094-01_Figure01_SiteLocation.mxd modified 12/14/2017 by morgan.zondervan



\\ttlocalfeba\Legacy\Vancouver\GIS\ENGINEERING\EARC\EARC03094-01\Maps\TestpitProgram\EARC03094-01_Figure02_IceContent.mxd modified 12/14/2017 by morgan.zondervan

LEGEND

Testpit (TT, Sumer 2017)

Ice Content

- Ice-Rich
- Ice-Poor
- Unfrozen
- Uncertain

- Perennially frozen ground – predominantly very ice-rich with ground ice content locally exceeding 50% by volume of visible ice
- Perennially frozen ground – predominantly ice-rich with ground ice content generally ranging between 10% and 50% by volume of visible ice. May include patches of ice-poor permafrost and/or unfrozen ground
- Perennially frozen ground – predominantly ice-poor with ground ice content generally less than 10% by volume of visible ice or not visible ground ice. May include patches of ice-rich permafrost and/or unfrozen ground
- Proposed Mine Footprint
- Watercourse

NOTES

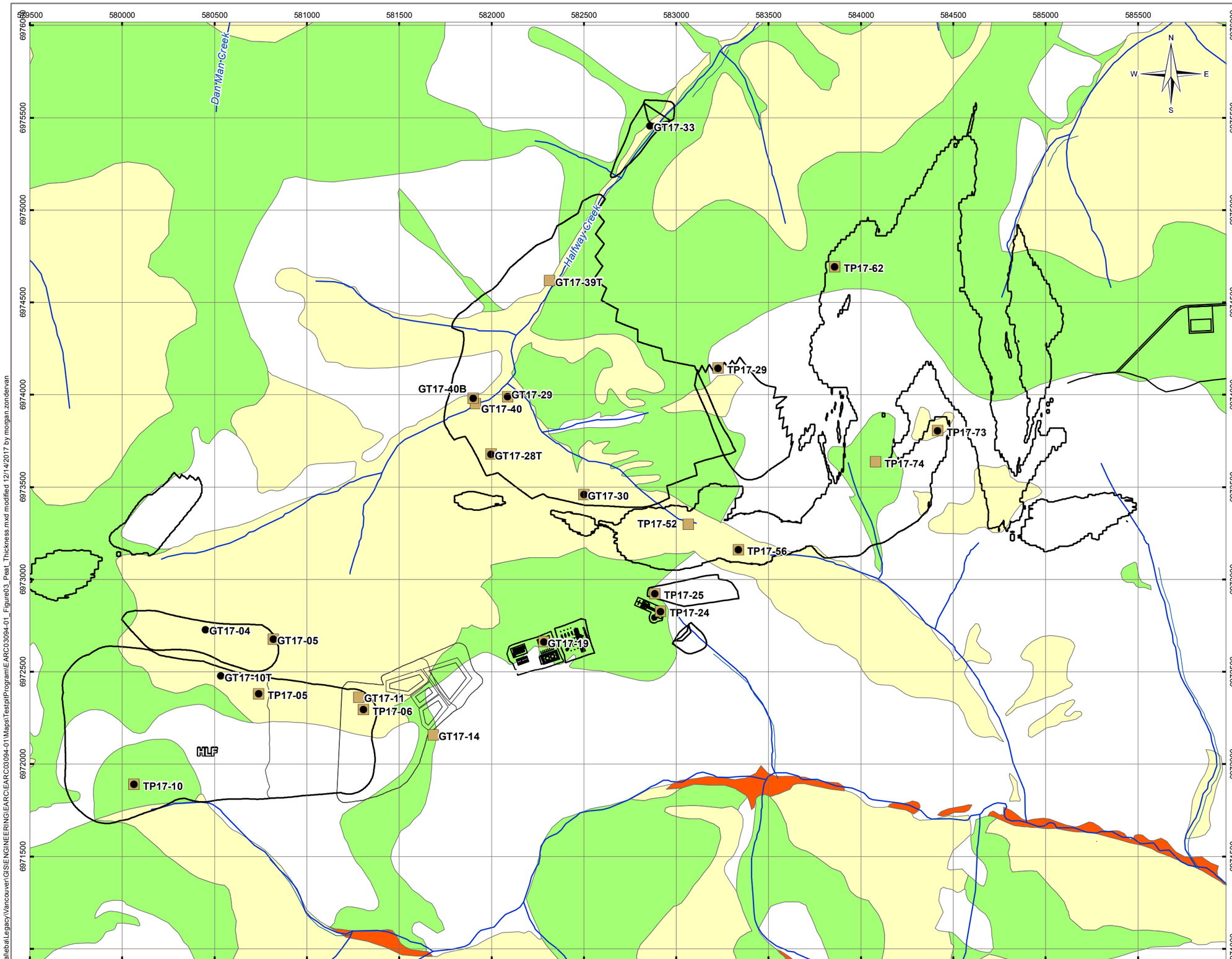
1. Facility footprint layout as of Year 9 (the end of mine life).
2. Base Data Source: Project Footprint provided by Hemerra (March 17, 2017). CanVec 1:50,000

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
2017 TESTPIT PROGRAM

Testpit Location and Ice Content

PROJECTION UTM Zone 7			**DATUM** NAD83		**CLIENT**
Scale: 1:20,000 — 400 200 0 400 — Metres					
FILE NO. EARC03094-01_Figure02_IceContent.mxd					TETRA TECH
OFFICE Tt-VANC	**DWN** MEZ	**CKD** SL	**APVD** SMC	**REV** 0	**Figure 2**
DATE December 14, 2017	**PROJECT NO.** ENG.EARC03094-01				



\\tt\calgary\Legacy\Vancouver\GIS\ENGINEERING\EARC\EARC03094-01\Maps\TestpitProgram\EARC03094-01_Figure03_Peat_Thickness.mxd modified 12/14/2017 by morgan.zondervan

LEGEND

- Testpit/Borehole Containing Thick Organics
- Testpit/Borehole Containing Peat
- Perennially frozen ground – predominantly very ice-rich with ground ice content locally exceeding 50% by volume of visible ice
- Perennially frozen ground – predominantly ice-rich with ground ice content generally ranging between 10% and 50% by volume of visible ice. May include patches of ice-poor permafrost and/or unfrozen ground
- Perennially frozen ground – predominantly ice-poor with ground ice content generally less than 10% by volume of visible ice or not visible ground ice. May include patches of ice-rich permafrost and/or unfrozen ground
- Proposed Mine Footprint
- Watercourse

NOTES
1. See Figure 2 for infrastructure names.
2. Facility footprint layout as of Year 9 (the end of mine life).
3. Base Data Source: Project Footprint provided by Hemerra (March 17, 2017). CanVec 1:50,000

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
2017 TESTPIT PROGRAM

Peat and Thick Organics Content in Testpits and 2017 Boreholes

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	

Scale: 1:20,000

400 200 0 400

Metres

TETRA TECH

FILE NO. EARC03094-01_Figure03_Peat_Thickness.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	MEZ	SL	SMC	0

DATE December 14, 2017

PROJECT NO. ENG.EARC03094-01

Figure 3

PHOTOGRAPHS



Photo 1: Excavating a testpit, site TP17-07.



Photo 2: Typical overburden relationships of the infrastructure and pit areas shown at TP17-18b. Upper silt/gravel (vertical upper portion of cut face) overlying lower gravel/sand (sloping portion).



Photo 3: Upper silt/gravel with only small quantities of gravel at TP17-17. Note presence of boulders at surface on the left.



Photo 4: Granitic pea gravel, TP17-11. Hammer is 33 cm long.



Photo 5a: Moderately to completely weathered granitoid bedrock, TP17-16. See photo 5b for close-up.



Photo 5b: Close-up of granitoid bedrock completely weathered to coarse sand.



Photo 6: Schist weathering to micaceous sand, TP17-53. White portion of tape is 20 cm long.



Photo 7: Mica sand (completely weathered schist), TP17-26.



Photo 8: Fractured bedrock at base of testpit in foreground at TP17-17. Red and white sections of tape are each 20 cm long.



Photo 9: Angular, platy schist gravel in lower gravel/sand unit at TP17-27. Tape is open to 1 m (at black mark).



Photo 10: Granitoid surface boulders at TP17-20. Coloured tape measure sections are in 20 cm increments.



Photo 11: Angular clasts of colluvium containing air voids, TP17-63. Red part of tape measure is 20 cm long.



Photo 12: Buried soil between 1 and 2 on tape measure at TP17-32. Overlying material is colluvium.



Photo 13: Peat is 50 cm thick at TP17-24. Hammer is 33 cm long. Some peat from the upper face is covering the silt/gravel deposit below from the cleaning of the cut face.



Photo 14: Refusal on shallow permafrost, where 40 cm of peat and moss is present at surface at TP17-62.



Photo 15: Charcoal from peat above at TP17-29.



Photo 16: Ice lenses at TP17-10.

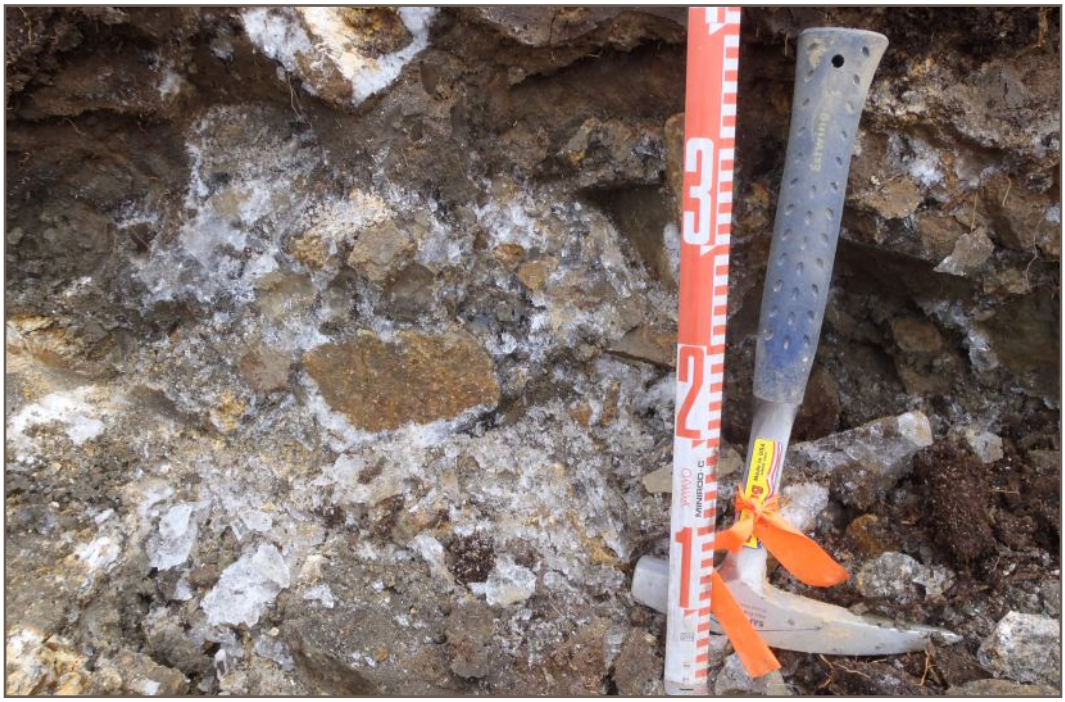


Photo 17: Ice coating on pebbles and cobbles at TP17-06.



Photo 18: Ice lenses and layers at TP17-05.



Photo 19: Potential aggregate deposit at TP17-18.



Photo 20: Schist and micaceous sand, TP17-18b.



Photo 21: Fractured bedrock at TP17-18b. This rock is quite diggable.

APPENDIX A

LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

APPENDIX B

TESTPIT LOGS

BOREHOLE KEYSHEET

Water Level Measurement

 Measured in standpipe, piezometer or well

 Inferred

Sample Types

 A-Casing

 Core

 Disturbed, Bag, Grab

 HQ Core

 Jar

 Jar and Bag

 NQ Core

 No Recovery

 Split Spoon/SPT

 Tube

Backfill Materials

 Asphalt

 Bentonite

 Cement/ Grout

 Drill Cuttings

 Grout

 Gravel

 Sand

 Slough

 Topsoil Backfill

Lithology - Graphical Legend[1]

 Asphalt

 Bedrock

 Cobbles/Boulders

 Clay

 Coal

 Concrete

 Fill

 Gravel

 Limestone

 Mudstone

 Organics

 Peat

 Sand

 Sandstone

 Shale

 Silt

 Siltstone

 Till

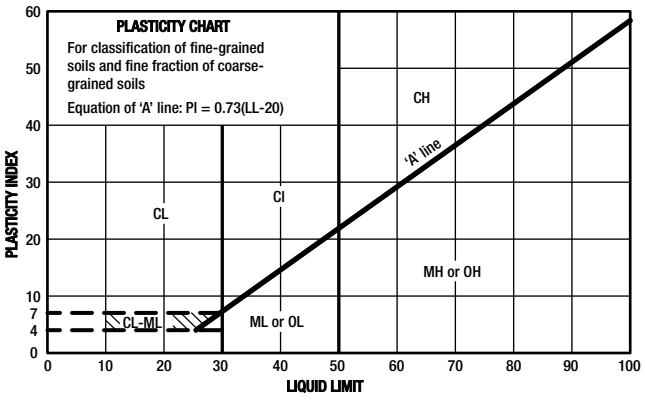
 Topsoil

1. The graphical legend is an approximation and for visual representation only. Soil strata may comprise a combination of the basic symbols shown above. Particle sizes are not drawn to scale

TETRA TECH

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols	$C_U = D_{60} / D_{10}$ Greater than 4 $C_c = \frac{(D_{30})2}{D_{10} \times D_{60}}$ Between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above "A" line or plasticity index greater than 7 Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	Less than 5% Pass 75 µm sieve More than 12% Pass 75 µm sieve 5% to 12% Pass 75 µm sieve	$C_U = D_{60}/D_{10}$ Greater than 6 $C_c = \frac{(D_{30})2}{D_{10} \times D_{60}}$ Between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
			SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above "A" line or plasticity index greater than 7 Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS Liquid limit <50		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity		
	SILTS Liquid limit >50		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit <30		CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit 30-50		CI	Inorganic clays of medium plasticity, silty clays		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit >50		CH	Inorganic clays of high plasticity, fat clays		
	ORGANIC SILTS AND CLAYS Liquid limit <50		OL	Organic silts and organic silty clays of low plasticity		
	ORGANIC SILTS AND CLAYS Liquid limit >50		OH	Organic clays of medium to high plasticity		
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils		



* Based on the material passing the 75 mm sieve

† ASTM Designation D 2487, for identification procedure see D 2488 USC as modified by PFRA

SOIL COMPONENTS

FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS	
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR
GRAVEL				
coarse	75 mm	19 mm	>35 %	"and"
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"
SAND				
coarse	4.75 mm	2.00 mm	11 to 20 %	"some"
medium	2.00 mm	425 µm		
fine	425 µm	75 µm	>0 to 10 %	"trace"
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior	

OVERSIZE MATERIAL

Rounded or subrounded

COBBLES	75 mm to 300 mm
BOULDERS	> 300 mm

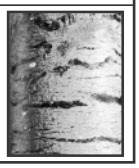
Not rounded

ROCK FRAGMENTS	>75 mm
ROCKS	> 0.76 cubic metre in volume

TETRA TECH

GROUND ICE DESCRIPTION

VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
V	Vx	Individual ice crystals or inclusions		
	Vc	Ice coatings on particles		
	Vr	Random or irregularly oriented ice formations		
	Vs	Stratified or distinctly oriented ice formations		

VISIBLE ICE GREATER THAN 50% BY VOLUME

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
ICE	ICE + Soil Type	Ice with soil inclusions		
	ICE	Ice without soil inclusions (greater than 25 mm thick		

ICE NOT VISIBLE

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
N	Nf	Poorly-bonded or friable		
	Nbn	No excess ice, well-bonded		
	Nbe	Excess ice, well-bonded		

LEGEND: Soil ☐ Ice ■

NOTES:

1. Dual symbols are used to indicate borderline or mixed ice classifications.
2. Visual estimates of ice contents indicated on borehole logs ± 5%
3. This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes.

TETRA TECH

Testpit No: **TP17-01**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Organics Stockpile	Ground Elev: 1226 m
Coffee Creek, Yukon	UTM: 580141 E; 6972769 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1226
		MOSS - rootlets, dark brown	Thawed (Active layer)					
	Excavated	GRAVEL (WEATHERED BEDROCK) - silty, sandy, trace clay, moist, brown, angular granitoid cobbles disseminated throughout			01O			
		- at 0.70 m, 20 mm thick light brown silt layer						
1								1225
		- at 1.1 m, DIGGABILITY 9-10	Frozen, Vc,Vr 5-10%, reticulate structure		01			
		END OF TESTPIT (1.2 metres) Note: Stopped due to refusal on frozen ground at 1.2 metres						
2								1224
3								1223
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type: Excavator	Start Date: 2017 October 9
Logged By: SM	Completion Date: 2017 October 9
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-02**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Organics Stockpile	Ground Elev: 1245 m
Coffee Creek, Yukon	UTM: 580450 E; 6972685 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1245
	Excavated	MOSS - large granite boulders at surface, rootlets, dense at base, dark brown, one boulder >2.5 m in diameter	Thawed (Active layer)					
		GRAVEL (WEATHERED BEDROCK) - silty, sandy, moist, brown, mainly pea sized gravel, occasional cobbles and boulders disseminated throughout			02O			
1		SILT - gravelly (WEATHERED BEDROCK), sandy, trace clay, wet, brown to orange brown - more bouldery with depth						1244
			Frozen, Nbn					
2		END OF TESTPIT (2.0 metres) Note: Stopped due to refusal on large boulders						1243
3								1242
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 2 m
Drilling Rig Type: Excavator	Start Date: 2017 October 9
Logged By: SM	Completion Date: 2017 October 9
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-04**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1276 m
Coffee Creek, Yukon	UTM: 580101 E; 6972489 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (150 mm thick)	Thawed (Active layer)					1276
		SILT (LOESS) - some gravel (WEATHERED BEDROCK), trace clay, occasional granitoid boulders at surface, wet, orange brown, angular granitoid clasts						
	Excavated	GRAVEL (WEATHERED BEDROCK) - silty, trace sand, trace clay, well graded, brown, angular granitoid clasts, mainly pea to pebble sized			04O			
1		- at 1.0 m, bouldery			04R			1275
		- at 1.2 m, bouldery, silty, some sand, some gravel, trace clay - (Gravel - 20%; Sand - 30%, Silt - 44%; Clay - 7%) - at 1.3 m, boulders, sandy	Frozen, Nbn		04	19.5		
		END OF TESTPIT (1.3 metres) Note: Stopped due to refusal on frozen ground and boulders (DIGGABILITY 9-10)						
2								1274
3								1273
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.3 m
Drilling Rig Type: Excavator	Start Date: 2017 October 9
Logged By: SM	Completion Date: 2017 October 9
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-05**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1250 m
Coffee Creek, Yukon	UTM: 580740 E; 6972380 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, and densely packed angular granitoid boulders up to 1m in diameter (200 mm thick)	Thawed (Active layer)					1250
		PEAT - dark brown, (200 mm thick)						
		GRAVEL (WEATHERED BEDROCK) - trace to some silt, trace clay, wet, occasional silt lens, angular pea sized granite gravel			05O			
1		SILT - sandy, gravelly (WEATHERED BEDROCK), some clay - (Gravel - 28%; Sand - 28%, Silt - 34%; Clay - 11%)	Frozen, Vr, Vs ~10-40%, reticulate structure		05	35.4		1249
		END OF TESTPIT (1.0 metre) Note: Stopped due to refusal on frozen ground						
2								1248
3								1247
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1 m
Drilling Rig Type: Excavator	Start Date: 2017 October 9
Logged By: SM	Completion Date: 2017 October 9
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-06**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1237 m
Coffee Creek, Yukon	UTM: 580064 E; 6971889 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (100-500 mm thick)	Thawed (Active layer)					1237
		- at 0.15 m, 150 mm thick peat lens - mesic to humic, dark brown to black, 3 m wide						
		SILT (LOESS) - some sand, trace gravel (WEATHERED BEDROCK), trace clay, occasional granite boulder at surface, moist, brown, (200 mm thick)			06O			
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace clay, moist, brown, cobbles and boulders disseminated throughout, clear and bubble rich ice			06			
			Frozen, Vc, Vx 10-15% beneath peat lens, Vc 5-10% not beneath peat lens, some 5-20 mm thick coatings on gravel					
		GRANITE (BEDROCK) - fractured	Vc <5%					
1					06R			1236
		END OF TESTPIT (1.1 metres)						
2								1235
3								1234
3.5								

Contractor: JDS	Completion Depth: 1.1 m
Drilling Rig Type: Excavator	Start Date: 2017 October 8
Logged By: SM	Completion Date: 2017 October 8
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-07**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1315 m
Coffee Creek, Yukon	UTM: 580093 E; 6972177 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (300 mm thick)	Thawed (Active layer)					1315
		SILT (LOESS) - gravelly (WEATHERED BEDROCK), some sand, trace clay, moist, medium brown, equidimensional to elongated granite, cobbles and boulders disseminated throughout, coarse sand						
		GRAVEL (WEATHERED BEDROCK) - sandy, trace silt, trace clay, weathered bedrock, moist, brown, equidimensional to elongate granite clasts - (Gravel - 71%; Sand - 25%, Silt & Clay - 5%)			07O 07	3.7	●	
1		GRANITE (BEDROCK) - slightly to moderately weathered (W2-W3), fractured	Frozen, Ice infilled fractures, ~10% visible ice		07R			1314
		END OF TESTPIT (1.2 metres)						
2								1313
3								1312
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type: Excavator	Start Date: 2017 October 8
Logged By: SM	Completion Date: 2017 October 8
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-08**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1315 m
Coffee Creek, Yukon	UTM: 580693 E; 6972155 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, 100 mm thick organic silt lenses, (200 mm thick)	Unfrozen					1315
		SILT (LOESS) - trace to some gravel (WEATHERED BEDROCK), mainly pebbles and cobbles, trace clay, moist, brown - at 0.4 m, dark brown grey silty gravel lens - at 0.7 m, gravelly			08O			
1		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace clay, damp, brown, mainly pea sized gravel - at 1.1 m, bouldery, DIGGABILITY 8-9						1314
		GRANITE (BEDROCK) - slightly to completely weathered (W2-W3), orange weathering, fractured			08R			
2								1313
		END OF TESTPIT (2.1 metres) Note: Stopped due to refusal weathered bedrock (DIGGABILITY 10)						
3								1312
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 2.1 m
Drilling Rig Type: Excavator	Start Date: 2017 October 8
Logged By: SM	Completion Date: 2017 October 8
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-09**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1256 m
Coffee Creek, Yukon	UTM: 581285 E; 6972105 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (100 mm thick)	Unfrozen					1256
		SILT (LOESS) - some gravel to gravelly (WEATHERED BEDROCK), trace clay, gap graded, moist, brown, layer of large granite boulders up to 700 mm diameter at and near surface			09O			
1		GRANITE (BEDROCK) - fractured, DIGGABILITY 9			09R			1255
		END OF TESTPIT (1.5 metres)						
2								1254
3								1253
3.5								

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: Excavator	Start Date: 2017 October 8
Logged By: SM	Completion Date: 2017 October 8
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-10**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1293 m
Coffee Creek, Yukon	UTM: 580064 E; 6971889 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1293
	Excavated	MOSS - rootlets, dark brown, occasional granite boulder near surface, (150 mm thick)	Thawed (Active layer)					
		PEAT - mesic, moist, dark brown, discontinuous						
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace clay, moist, brown, pebbles and cobbles disseminated throughout			10O			
1		SILT - sandy, some gravel (WEATHERED BEDROCK), some clay, angular granitoid clasts, brown, bubbly and clear ice lenses, pebble and cobble sizes	Frozen, Vs,Vc 20-40%					1292
			Nbn		10	47.98		
		- (Gravel - 11%; Sand - 26%, Silt - 46%; Clay - 17%)						
		END OF TESTPIT (1.7 metres) Note: Stopped due to refusal on frozen silt						
2								1291
3								1290
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 8
Logged By: SM	Completion Date: 2017 October 8
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-11**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1260 m
Coffee Creek, Yukon	UTM: 580681 E; 6971911 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1260
		MOSS - rootlets, dark brown, (300 mm thick)	Unfrozen					
		SAND AND GRAVEL (WEATHERED BEDROCK) - some silt, trace clay, well graded, moist, brown, angular pea sized granitoid gravel, occasional cobbles and boulders disseminated throughout, coarse sand, DIGGABILITY 1-2, at top: granitoid boulder layer (up to 2 m in diameter), elongate						
					11O			
1								1259
	Excavated	- at 1.2 m, silt lens - sandy, some gravel, moist						
		- at 1.7 m, bouldery						
		GRANITE (BEDROCK) - gravelly, fractured, slightly to completely weathered (W2-W3), light yellow brown, some orange specks, weathers to coarse sand and gravel						
		- sample contains both slightly and completely weathered bedrock			11R			
2								1258
		END OF TESTPIT (2.7 metres)						
		Note: Stopped due to refusal on bedrock						
3								1257
3.5								

Contractor: JDS	Completion Depth: 2.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 10
Logged By: SM	Completion Date: 2017 October 10
Reviewed By: VER	Page 1 of 1

TETRA TECH

Testpit No: **TP17-12**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: HLF	Ground Elev: 1240 m
Coffee Creek, Yukon	UTM: 581289 E; 6971944 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1240
	Excavated	MOSS AND SILT (ORGANIC) - rootlets, granitoid boulders up to 3 m in diameter on and near surface, dark brown moss, brown to black silt, (200 mm thick)	Unfrozen					
		SILT (LOESS) - some gravel (WEATHERED BEDROCK), trace clay, gap graded, moist, brown, DIGGABILITY 1						
		GRAVEL (WEATHERED BEDROCK) - trace silt, moist, brown, granitoid clasts, angular, some elongate clasts, pea sized gravel disseminated throughout, DIGGABILITY 1						
1								1239
					12O			
		GRANITE (BEDROCK) - fractured, DIGGABILITY 9						
					12R			
2								1238
		END OF TESTPIT (2.4 metres)						
3								1237
3.5								

Contractor: JDS	Completion Depth: 2.4 m
Drilling Rig Type: Excavator	Start Date: 2017 October 8
Logged By: SM	Completion Date: 2017 October 8
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-13**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Event Ponds	Ground Elev: 1223 m
Coffee Creek, Yukon	UTM: 581537 E; 6972432 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1223
	Excavated	MOSS - rootlets, dark brown, (100 to 300 mm thick)	Thawed (Active layer)					
		SILT (LOESS) - trace gravel (WEATHERED BEDROCK), trace clay, trace sand, moist, brown, granite boulders near surface						
		GRAVEL (WEATHERED BEDROCK) - sandy, silty, trace clay, moist, brown, some silt lenses, DIGGABILITY 1-2 - (Gravel - 40%; Sand - 28%, Silt - 26%; Clay - 6%)			13	10	●	
1								1222
			Frozen, Vx <5%					
		BOULDERS (WEATHERED BEDROCK) - some gravel, some sand, trace silt (LOESS), moderately to highly weathered granite (W3-W4), DIGGABILITY 9						
		END OF TESTPIT (1.5 metres) Note: Stopped due to refusal on bedrock or large boulder						
2								1221
3								1220
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: Excavator	Start Date: 2017 October 7
Logged By: SM	Completion Date: 2017 October 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-15**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Event Ponds	Ground Elev: 1221 m
Coffee Creek, Yukon	UTM: 581689 E; 6792306 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1221
	Excavated	MOSS - roots, (200 mm thick)	Unfrozen			
		GRAVEL (WEATHERED BEDROCK) - silty, some sand, trace clay, moderately to highly weathered, moist, some siltier lenses, angular granite pebbles and cobbles disseminated throughout - at 0.2 m, bouldery - at 0.3 m, silt (organic) lens				
1						1220
		END OF TESTPIT (1.4 metres) Note: Stopped due to refusal on bedrock or very large boulders				
2						1219
3						1218
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.4 m
Drilling Rig Type: Excavator	Start Date: 2017 October 7
Logged By: SM	Completion Date: 2017 October 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-16**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Event Ponds	Ground Elev: 1213 m
Coffee Creek, Yukon	UTM: 581779 E; 6972462 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1213
	Excavated	MOSS - fine roots, (200 mm thick)	Unfrozen					
		SAND - gravelly (WEATHERED BEDROCK), silty, trace clay, brown, silt (organic) lenses - moist, brownish black, DIGGABILITY 1, (150 mm thick)			16	7.4	●	
		- (Gravel - 31%; Sand - 37%, Silt - 26%; Clay - 6%)						
		GRAVEL (WEATHERED BEDROCK) - some silt, trace sand, trace clay, poorly graded, moist, brown, slightly to highly weathered granite, equidimensional, mainly pea sized gravel, coarse sand lenses, a few boulders at top			16O			
1								1212
		- at 1.2 m, some sand, trace silt, weathered granite boulders, cobbles and pebbles, DIGGABILITY 7						
		- at 1.7 m, 200-300 mm thick sand layer - completely weathered granite, moist, light yellow			16R			
		END OF TESTPIT (1.9 metres)						
2		Note: DIGGABILITY 8-9						1211
3								1210
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.9 m
Drilling Rig Type: Excavator	Start Date: 2017 October 7
Logged By: SM	Completion Date: 2017 October 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-17**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Plant Site	Ground Elev: 1190 m
Coffee Creek, Yukon	UTM: 582115 E; 6972615 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1190
	Excavated	MOSS - roots, dark brown, (150 mm thick)	Unfrozen					
		SILT (LOESS) - trace clay, trace sand, trace gravel (WEATHERED BEDROCK), occasional large granite boulder near surface, brown, DIGGABILITY 1			17O			
1								1189
		GRANITE/SCHIST (BEDROCK) - fractured, slightly weathered (W2) granite on one side of testpit, slightly to highly weathered (W2-W3) schist on the other			17R			
		- water seepage						
		END OF TESTPIT (1.65 metres)						
2								1188
3								1187
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.65 m
Drilling Rig Type: Excavator	Start Date: 2017 October 7
Logged By: SM	Completion Date: 2017 October 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-18**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Plant Site	Ground Elev: 1184 m
Coffee Creek, Yukon	UTM: 582115 E; 6972615 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - fine roots, (150 mm thick)	Unfrozen			1184
		SILT (LOESS) - trace sand, trace gravel (WEATHERED BEDROCK), trace clay, moist, light orange brown, angular schist pebbles, occasional cobbles disseminated throughout, (250 mm thick)				
		GRAVEL (WEATHERED BEDROCK) - some sand, trace silt, trace clay, slightly to moderately weathered schist, moderately well graded, moist, light orange brown, angular pebbles and cobbles disseminated throughout, DIGGABILITY 1, potentially good aggregate source				
1	Excavated					1183
2		- at 2.1 m, cobbles, trace sand, DIGGABILITY 7				1182
3		- at 3.0 m, DIGGABILITY 9				1181
		END OF TESTPIT (3.1 metres)				
3.5						

Contractor: JDS	Completion Depth: 3.1 m
Drilling Rig Type: Excavator	Start Date: 2017 October 7
Logged By: SM	Completion Date: 2017 October 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-18a**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Plant Site	Ground Elev: 1187 m
Coffee Creek, Yukon	UTM: 582243 E; 6972630 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1187
		MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen					
		SILT (LOESS) - sandy, trace gravel (WEATHERED BEDROCK), trace clay, moist, brown, DIGGABILITY 1						
1		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace clay, well graded, moist, brown, occasional sand bed, angular elongated schist cobbles and boulders disseminated throughout, DIGGABILITY 1-2 - (Cobble - 11%; Gravel - 45%; Sand - 27%, Silt & Clay - 18%)			18a	5.6	●	1186
	Excavated	SCHIST (BEDROCK) - slightly to completely weathered (W2-W4), moist, greenish brown, DIGGABILITY 2-3						
2								1185
		END OF TESTPIT (2.9 metres) Note: Refusal on more competent bedrock, (DIGGABILITY 10)						
3								1184
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 2.9 m
Drilling Rig Type: Excavator	Start Date: 2017 October 10
Logged By: SM	Completion Date: 2017 October 10
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-18b**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Plant Site	Ground Elev: 1185 m
Coffee Creek, Yukon	UTM: 582251 E; 6972374 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1185
	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen					
		SILT (LOESS) - some gravel (WEATHERED BEDROCK), trace sand, trace clay, moist, brown, angular schist, occasional cobbles disseminated throughout						
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace clay, weathered gravel, moist, greenish grey, angular schist - slightly to completely weathered (W2-W4), pebbles and cobbles disseminated throughout, some boulders, fine to coarse micaceous sand						
		- at 0.8 m, sand lens - trace gravel, moist, orange brown, fine to coarse sand						
1					18b	5.3	●	1184
		- (Gravel - 65%; Sand - 23%, Silt & Clay - 12%)						
		SCHIST (BEDROCK) - slightly to moderately weathered (W2-W3), fractured, angular boulders, some cobbles, grades upward to overlying gravel			18R			
2								1183
		END OF TESTPIT (2.8 metres)						
3								1182
3.5								

Contractor: JDS	Completion Depth: 2.8 m
Drilling Rig Type: Excavator	Start Date: 2017 October 10
Logged By: SM	Completion Date: 2017 October 10
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-19**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Fuel Tanks	Ground Elev: 1176 m
Coffee Creek, Yukon	UTM: 582341 E; 6972582 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - fine roots, dark brown, (100 mm thick)	Unfrozen			1176
		BOULDERS (WEATHERED BEDROCK) - some gravel, trace sand, trace silt, slightly weathered (W2), dark brown, very angular granite and schist, DIGGABILITY 6				
		- at 0.4 m, 200 to 700 mm thick silt lens - trace clay, trace gravel, light brown to brown, very angular gravel				
		- at 0.8 m, medium brown, DIGGABILITY 9				
1	Excavated					1175
2		END OF TESTPIT (2.0 metres)				1174
3						1173
3.5						

Contractor: JDS	Completion Depth: 2 m
Drilling Rig Type: Excavator	Start Date: 2017 October 6
Logged By: SM	Completion Date: 2017 October 6
Reviewed By: VER	Page 1 of 1

TETRA TECH

Testpit No: **TP17-20**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Plant Site	Ground Elev: 1176 m
Coffee Creek, Yukon	UTM: 582294 E; 6972678 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - fine roots, dark brown, (300 mm thick)	Thawed (Active layer)			1176
		SILT (LOESS) - some sand, some granite and schist gravel (WEATHERED BEDROCK), trace clay, brown, subangular to angular boulder pockets near surface, DIGGABILITY 1				
		- sandier				
1		SAND AND GRAVEL (WEATHERED BEDROCK) - trace silt, trace clay, weathered granite to weathered schist, light brown, beige and white, DIGGABILITY 1	Completely frozen, Nbn			1175
	Excavated	GRAVEL (WEATHERED BEDROCK) - some sand, slightly weathered (W2), angular schist, cobbles and occasional boulders disseminated throughout				
2		WEATHERED BEDROCK - fractured, DIGGABILITY 8-9				1174
		END OF TESTPIT (2.6 metres)				
3						1173
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 2.6 m
Drilling Rig Type: Excavator	Start Date: 2017 October 6
Logged By: SM	Completion Date: 2017 October 6
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-21**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Plant Site	Ground Elev: 1178 m
Coffee Creek, Yukon	UTM: 582448 E; 6972662 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1178
	Excavated	MOSS - roots, dark brown, (200 mm thick)	Unfrozen					
		SILT (LOESS) - micaceous, some sand, trace gravel (WEATHERED BEDROCK), trace clay, moist, light brown, fine sand, schist pebbles, cobbles and boulders disseminated throughout, DIGGABILITY 1			21O			
		SAND (WEATHERED BEDROCK) - silty, some gravel (WEATHERED BEDROCK), trace clay, moderately weathered (W3), friable, moist, very soft, greenish dark grey, schist pebbles and cobbles disseminated throughout, DIGGABILITY 2 - (Gravel - 20%; Sand - 55%, Silt - 22%; Clay - 3%) - at 1.0 m, gravel lenses - sandy, some silt, trace clay			21 21R	15		
1								1177
		BEDROCK - fractured, DIGGABILITY 9						
		END OF TESTPIT (1.7 metres) Note: Stopped due to refusal on more competent bedrock						
2								1176
3								1175
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 6
Logged By: SM	Completion Date: 2017 October 6
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-22**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Plant Site	Ground Elev: 1175 m
Coffee Creek, Yukon	UTM: 582365 E; 6972709 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - roots, dark brown, (150 mm thick)	Unfrozen					1175
		SILT (LOESS) - trace clay, trace gravel (WEATHERED BEDROCK), brown, angular pebbles and cobbles disseminated throughout, occasional boulders up to 500 mm diameter, DIGGABILITY 1 - at 0.15 m, granite boulder pocket - slightly weathered, (W2), orange where weathered, subangular to angular						
		GRAVEL (WEATHERED BEDROCK) - some sand, trace silt, trace clay, moderately to highly weathered schist, crumbly, soft, dark green grey, DIGGABILITY 2 - water seepage			22			
		SCHIST (BEDROCK) - moderately weathered (W3), fractured, DIGGABILITY 9-10						
		END OF TESTPIT (0.9 metres)						
1								1174
2								1173
3								1172
3.5								

Contractor: JDS	Completion Depth: 0.9 m
Drilling Rig Type: Excavator	Start Date: 2017 October 7
Logged By: SM	Completion Date: 2017 October 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-23**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Plant site	Ground Elev: 1171 m
Coffee Creek, Yukon	UTM: 582483 E; 6972750 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1171
	Excavated	MOSS - roots, dark brown, (300 mm thick)	Thawed (Active layer)			
		SILT (LOESS) - some gravel (WEATHERED BEDROCK), moist, light brown, green patches, angular schist pebbles, cobbles and boulders disseminated throughout				
1		GRAVEL (WEATHERED BEDROCK) - trace silt, trace clay, slightly to moderately weathered (W2-W3), moist, loose, light brown, angular schist pebbles, cobbles and boulders disseminated throughout - at 1.1 m, grades to greenish grey				1170
		SCHIST (BEDROCK) - greenish dark grey, orange weathering, DIGGABILITY 8	Ice crystals between fissility planes, ~5% visible ice			
2		END OF TESTPIT (1.7 metres)				1169
3						1168
3.5						

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 6
Logged By: SM	Completion Date: 2017 October 6
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-24**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Crusher Area	Ground Elev: 1122 m
Coffee Creek, Yukon	UTM: 582916 E; 6972826 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1122
	Excavated	MOSS - roots, dark brown, gravel lens with some silt beneath moss, (200 mm thick)	Thawed (Active layer)					
		PEAT - humic, dark brown						
		SAND AND GRAVEL (WEATHERED BEDROCK) - some silt, trace clay, wet, mottled medium dark brown with orange brown specks, angular gneiss, pebbles, cobbles and boulders disseminated throughout, DIGGABILITY 1 - (Gravel - 35%; Sand - 37%, Silt - 20%; Clay - 9%)	Nbn Vx, Vs lenses <1 mm thick		24	20.1		
1								1121
		END OF TESTPIT (1.1 metres) Note: Stopped due to refusal on bedrock (DIGGABILITY 9)						
2								1120
3								1119
3.5								

Contractor: JDS	Completion Depth: 1.1 m
Drilling Rig Type: Excavator	Start Date: 2017 October 6
Logged By: SM	Completion Date: 2017 October 6
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-25**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Run of Mine Stockpile	Ground Elev: 1137 m
Coffee Creek, Yukon	UTM: 582885 E; 6972922 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1137
	Excavated	MOSS - roots, dark brown, (150 mm thick)	Unfrozen					
		PEAT - dark brown, (200 mm thick)						
		GRAVEL (WEATHERED BEDROCK) - silty, sandy, trace clay, slightly to highly weathered (W2-W3), cohesive, moist, loose to compact, brown and grey brown, mottled with orange specks, DIGGABILITY 1 - (Gravel - 48%; Sand - 21%, Silt - 23%; Clay - 9%)			25a 25O	9.8	●	
1		- some silt, moderately to completely weathered (W3-W4), orange brown, subangular to angular gravel - (Gravel - 49%; Sand - 35%, Silt & Clay - 16%)			25b	10.9	●	1136
		SAND (WEATHERED BEDROCK) - mica, completely weathered schist (W5), green, yellow and orange, DIGGABILITY 1			25R			
		END OF TESTPIT (1.65 metres) Note: Stopped due to refusal on bedrock						
2								1135
3								1134
3.5								

Contractor: JDS	Completion Depth: 1.65 m
Drilling Rig Type: Excavator	Start Date: 2017 October 6
Logged By: SM	Completion Date: 2017 October 6
Reviewed By: VER	Page 1 of 1

TETRA TECH

Testpit No: **TP17-26**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Run of Mine Stockpile	Ground Elev: 1128 m
Coffee Creek, Yukon	UTM: 583266 E; 6972926 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1128
	Excavated	MOSS - roots, dark brown with 10 mm grey layer at base, (100 mm thick)	Unfrozen					
		SAND (WEATHERED BEDROCK) - trace gravel, trace silt, dry, loose, orange brown, angular pebbles, cobbles and boulders disseminated throughout, fine to coarse schist and mica sand						
		- (Gravel - 8%; Sand - 86%, Silt & Clay - 5%)			26	8.7	●	
1		- firm, dark grey						1127
		GRAVEL (WEATHERED BEDROCK) - trace sand, angular schist pebbles, cobbles and boulders disseminated throughout						
		END OF TESTPIT (1.4 metres) Note: Stopped due to refusal on competent bedrock						
2								1126
3								1125
3.5								

Contractor: JDS	Completion Depth: 1.4 m
Drilling Rig Type: Excavator	Start Date: 2017 October 5
Logged By: SM	Completion Date: 2017 October 5
Reviewed By: VER	Page 1 of 1

TETRA TECH

Testpit No: **TP17-27**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Frozen Soil Stockpile	Ground Elev: 1159 m
Coffee Creek, Yukon	UTM: 583471 E; 6973567 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - roots, dark brown, (200 mm thick)	Unfrozen					1159
		SILT (LOESS) - sandy, trace gravel (WEATHERED BEDROCK), moist, brown, DIGGABILITY 2						
		- (Gravel - 6%; Sand - 35%, Silt & Clay - 59%)			27	19.7		
		GRAVEL (WEATHERED BEDROCK) - some sand, trace silt, orange brown and grey brown beds, angular schist pebbles and cobbles disseminated throughout, micaceous silt lenses - some sand, trace gravel, moist, grey brown						
1	Excavated							1158
		- trace sand, trace silt, dry, fine to coarse micaceous sand, cobbles and boulders disseminated throughout						
2								1157
		END OF TESTPIT (2.8 metres) Note: Stopped due to refusal on competent bedrock						
3								1156
3.5								

Contractor: JDS	Completion Depth: 2.8 m
Drilling Rig Type: Excavator	Start Date: 2017 October 5
Logged By: SM	Completion Date: 2017 October 5
Reviewed By: VER	Page 1 of 1

TETRA TECH

Testpit No: **TP17-28**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Frozen Soil Stockpile	Ground Elev: 1177 m
Coffee Creek, Yukon	UTM: 583349 E; 6973863 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1177
	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			
		BOULDERS (WEATHERED BEDROCK) - trace silt, trace clay, angular schist slabs to 1.5 metres long, DIGGABILITY 5				
		SILT (LOESS) - sandy, some gravel (WEATHERED BEDROCK), trace clay, moist, brown, angular schist gravel, 500 to 900 mm thick, DIGGABILITY 3				
1						1176
		SCHIST (BEDROCK) - weathered, elongated, DIGGABILITY 5				
		END OF TESTPIT (1.6 metres)				
2						1175
3						1174
3.5						

Contractor: JDS	Completion Depth: 1.6 m
Drilling Rig Type: Excavator	Start Date: 2017 October 10
Logged By: SM	Completion Date: 2017 October 10
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-29**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Frozen Soil Stockpile	Ground Elev: 1189 m
Coffee Creek, Yukon	UTM: 583227 E; 6974142 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1189
	Excavated	PEAT - fibrous, dry, dark brown, charcoal, roots	Unfrozen					
		GRAVEL (WEATHERED BEDROCK) - sandy, silty, trace clay, moist, brown, angular schist pebbles, cobbles and boulders disseminated throughout, fine to coarse sand, DIGGABILITY 2						
					29	8.5	●	
1		- (Gravel - 53%; Sand - 24%, Silt & Clay - 24%)						1188
		- at 1.2 m, trace sand, trace silt, occasional very angular schist pebbles, cobbles and boulders disseminated throughout						
		END OF TESTPIT (1.7 metres) Note: Stopped due to refusal on schist bedrock						
2								1187
3								1186
3.5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 5
Logged By: SM	Completion Date: 2017 October 5
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-30**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Explosives Storage	Ground Elev: 1279 m
Coffee Creek, Yukon	UTM: 585831 E; 6974399 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - roots (150 mm thick)	Unfrozen					1279
		GRAVEL (WEATHERED BEDROCK) - trace to some silt, trace sand, trace clay, dry, loose, brown, angular schist, DIGGABILITY 2-3 - at 0.15 m, bouldery, less silty						
		- (Gravel - 94%; Sand - 2%, Silt & Clay - 3%)			30	2.4		
		- at 0.9 m, boulders, grey						
1	Excavated							1278
		- larger boulders up to 700 mm						
2								1277
3		END OF TESTPIT (3.0 metres) Note: Stopped due to refusal on bedrock						1276
3.5								

Contractor: JDS	Completion Depth: 3 m
Drilling Rig Type: Excavator	Start Date: 2017 October 5
Logged By: SM	Completion Date: 2017 October 5
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-31**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Kona Pit	Ground Elev: 1276 m
Coffee Creek, Yukon	UTM: 579621 E; 6973029 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1276
	Excavated	MOSS - rootlets, dark brown, (300 mm thick)	Thawed (Active layer)					
		GRAVEL (WEATHERED BEDROCK) - trace to some silt, trace clay, moist to wet, brown, some siltier lenses, mainly crumbled granitoid pea sized gravel						
1					310			1275
		- bouldery, DIGGABILITY 9	Frozen, Nbn					
		END OF TESTPIT (1.8 metres) Note: Stopped due to refusal on frozen ground						
2								1274
3								1273
3.5								

Contractor: JDS	Completion Depth: 1.8 m
Drilling Rig Type: Excavator	Start Date: 2017 October 9
Logged By: SM	Completion Date: 2017 October 9
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-32**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Kona Pit	Ground Elev: 1265 m
Coffee Creek, Yukon	UTM: 579723 E; 6973038 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								1265
	Excavated	MOSS - rootlets, dark brown, (200 mm thick)	Unfrozen					
		SILT (COLLUVIUM) - some sand, some gravel, trace clay, moist, brown, 10 mm silt bed at top, 5 mm thick silt lamination at bottom						
		BURIED SOIL - rootlets, peat like, moist						
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace clay, slightly to highly weathered (W2-W3) angular granite, moist, brown, mainly pea sized gravel, DIGGABILITY 2			32O			
1								1264
		GRANITE (BEDROCK) - slightly to completely weathered (W2-W3), light brown, orangey areas, DIGGABILITY 7			32R			
		END OF TESTPIT (1.5 metres) Note: Stopped due to refusal on more competent bedrock						
2								1263
3								1262
3.5								

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: Excavator	Start Date: 2017 October 9
Logged By: SM	Completion Date: 2017 October 9
Reviewed By: VER	Page 1 of 1

TETRA TECH

Testpit No: **TP17-49**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Latte Pit	Ground Elev: 1129 m
Coffee Creek, Yukon	UTM: 583210 E; 6973460 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			1129
		SILT (LOESS) - gravelly (WEATHERED BEDROCK), trace sand, trace clay, moist, reddish brown, angular schist pebbles and cobbles disseminated throughout				
	Excavated	GRAVEL (WEATHERED BEDROCK) - sandy, trace silt, trace clay, moist, reddish brown, some boulders, pebbles and cobbles disseminated throughout, DIGGABILITY 1				
1		SCHIST (BEDROCK) - fractured, slightly to completely weathered (W2-W4), fractured, moist, reddish brown, localized green schist sand, DIGGABILITY 8-9				1128
		- possible ore				
		END OF TESTPIT (1.4 metres) Note: Stopped due to refusal on more competent bedrock				
2						1127
3						1126
3.5						

Contractor: JDS	Completion Depth: 1.4 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-52**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Latte Pit	Ground Elev: 1104 m
Coffee Creek, Yukon	UTM: 583066 E; 6973296 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1104
	Excavated	MOSS - rootlets, dark brown (100 mm thick)	Thawed (Active layer)			
		PEAT - mesic, moist, dark brown, (100 mm thick)				
		SAND (WEATHERED BEDROCK) - some gravel to gravelly, moist, angular elongated schist pebbles and cobbles disseminated throughout				
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace clay, occasional quartz pebbles, angular schist cobbles and small boulders disseminated throughout, silt coatings on clasts, DIGGABILITY 3				
1						1103
		- DIGGABILITY 8-9	Frozen, Vx 10-20%, ice crystals between clasts and in rock fractures			
		END OF TESTPIT (1.8 metres) Note: Stopped due to refusal on frozen ground				
2						1102
3						1101
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.8 m
Drilling Rig Type: Excavator	Start Date: 2017 October 10
Logged By: SM	Completion Date: 2017 October 10
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-53**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Latte Pit	Ground Elev: 1122 m
Coffee Creek, Yukon	UTM: 583358 E; 6973315 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (100 mm thick)	Unfrozen			1122
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace clay, moist, reddish brown, angular pebbles and cobbles disseminated throughout, DIGGABILITY 1				
	Excavated	SCHIST (BEDROCK) - moderately to completely weathered (W3-W4), fractured, orange or green micaceous sand lenses, reddish brown ore, DIGGABILITY 1				
1		- at 1.3 m, DIGGABILITY 8				1121
		END OF TESTPIT (1.6 metres)				
2						1120
3						1119
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.6 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-55a**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Latte Pit	Ground Elev: 1110 m
Coffee Creek, Yukon	UTM: 583060 E; 6973183 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Thawed (Active layer)			1110
		PEAT - woody, fibric to mesic				
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt for 200 mm, trace clay, organics, dark brown				
		- brown				
			Frozen, Vc 20%, coatings up to 2 mm thick			
1		END OF TESTPIT (0.9 metres) Note: Stopped due to refusal on frozen ground				1109
2						1108
3						1107
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 0.9 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-55b**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Latte Pit	Ground Elev: 1110 m
Coffee Creek, Yukon	UTM: 583060 E; 6973183 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1110
	Excavated	MOSS - rootlets, dark brown, (100 mm thick)	Unfrozen			
		GRAVEL (WEATHERED BEDROCK) - silty, some sand, trace clay, moist, brown, DIGGABILITY 1, (300 mm thick)				
		- trace sand, mainly angular pebbles and cobbles, some boulders disseminated throughout				
1						1109
		END OF TESTPIT (1.5 metres) Note: Stopped due to refusal, (DIGGABILITY 10)				
2						1108
3						1107
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-56**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Latte Pit	Ground Elev: 1111 m
Coffee Creek, Yukon	UTM: 583337 E; 6973160 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1111
	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			
		PEAT - fibric to mesic, dark brown, DIGGABILITY 1 (100 to 250 mm thick)				
		SILT (LOESS) - trace gravel (WEATHERED BEDROCK), trace clay, brown, DIGGABILITY 1				
		GRAVEL (WEATHERED BEDROCK) - silty, trace clay, dark brown, orange specks, DIGGABILITY 1				
1		- at 0.9 m, sandy, some silt, brown to orange, pebbles, cobbles and boulders disseminated throughout, DIGGABILITY 7-8 - more orange with depth				1110
		END OF TESTPIT (1.6 metres)				
2						1109
3						1108
3.5						

Contractor: JDS	Completion Depth: 1.6 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-58**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1155 m
Coffee Creek, Yukon	UTM: 584454 E; 6975143 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1155
	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Thawed (Active layer)			
		GRAVEL (COLLUVIUM) - some sand, some silt, well graded, brown, air voids in upper 500 mm, angular schist, pebbles and cobbles disseminated throughout, DIGGABILITY 1-2				
1						1154
		COBBLES AND BOULDERS (WEATHERED BEDROCK) - some silt, coarser, some pebbles disseminated throughout, DIGGABILITY 1-2				
			Frozen, Vs <5%, reticulate structure			
2		END OF TESTPIT (1.9 metres) Note: Stopped due to refusal on frozen ground, (DIGGABILITY 10)				1153
3						1152
3.5						

Contractor: JDS	Completion Depth: 1.9 m
Drilling Rig Type: Excavator	Start Date: 2017 October 11
Logged By: SM	Completion Date: 2017 October 11
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-59**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1249 m
Coffee Creek, Yukon	UTM: 584083 E; 6974824 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1249
	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Thawed (Active layer)			
		SAND AND GRAVEL (COLLUVIUM?) - well graded, moist, brown, angular schist gravel, cobbles and boulders, DIGGABILITY 1				
1						1248
		SILT - some gravel (WEATHERED BEDROCK), trace clay, brown, schist gravel, cobbles and boulders disseminated throughout, DIGGABILITY 8	Vc <5%			
		END OF TESTPIT (1.7 metres)				
2						1247
3						1246
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 11
Logged By: SM	Completion Date: 2017 October 11
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-62**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1249 m
Coffee Creek, Yukon	UTM: 583859 E; 6974691 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - roots, dark brown, (200 mm thick)	Thawed (Active layer)			1249
		PEAT - fibrous, moist, dark brown, (200 mm thick)				
	Excavated	SILT (LOESS) - trace to some gravel, trace clay, angular schist, cobbles and boulders disseminated throughout, DIGGABILITY 9	Frozen, Vs, Vc 5-20%, 1-20 mm coatings, 10-100 mm lenses			
1						1248
		END OF TESTPIT (1.8 metres)				
2						1247
3						1246
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.8 m
Drilling Rig Type: Excavator	Start Date: 2017 October 11
Logged By: SM	Completion Date: 2017 October 11
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-63**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1296 m
Coffee Creek, Yukon	UTM: 584090 E; 6974524 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			1296
		GRAVEL (COLLUVIUM) - trace to some silt, cobbles with void spaces near top, well graded, moist, brown, angular schist				
1		- sandy				1295
		- boulders				
2		SCHIST (BEDROCK) - weathered to sand locally, fractured				1294
3		END OF TESTPIT (2.7 metres)				1293
3.5						

Contractor: JDS	Completion Depth: 2.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 11
Logged By: SM	Completion Date: 2017 October 11
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-64**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1263 m
Coffee Creek, Yukon	UTM: 584396 E; 6974545 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (100 mm thick)	Thawed (Active layer)			1263
		GRAVEL (COLLUVIUM) - trace silt, moist, brown, angular clasts with void spaces near surface, cobbles and boulders disseminated throughout, DIGGABILITY 1-2				
	Excavated	- siltier				
1		SILT - gravelly (WEATHERED BEDROCK), cobbles and boulders disseminated throughout, moist, brown, DIGGABILITY 1-2				1262
		- DIGGABILITY 8 at permafrost table	Frozen, Vc, Vx 5%, 1-3 mm coatings on gravel and cobbles			
		END OF TESTPIT (1.7 metres)				
2						1261
3						1260
3.5						

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 11
Logged By: SM	Completion Date: 2017 October 11
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-65**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1192 m
Coffee Creek, Yukon	UTM: 584915 E; 6974573 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Thawed (Active layer)			1192
		GRAVEL (COLLUVIUM) - sandy, some silt, moist, brown, void spaces, angular schist cobbles, boulders and some pebbles with localized void spaces, elongate, platy, DIGGABILITY 5				
		- wet				
1						1191
		- DIGGABILITY 9 at permafrost table	Frozen, Vc <1 mm thick, 1% ice			
		END OF TESTPIT (1.4 metres) Note: Stopped due to refusal on frozen ground				
2						1190
3						1189
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.4 m
Drilling Rig Type: Excavator	Start Date: 2017 October 12
Logged By: SM	Completion Date: 2017 October 12
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-66**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1274 m
Coffee Creek, Yukon	UTM: 583784 E; 6974249 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			1274
	Excavated	GRAVEL (COLLUVIUM) - sandy, some silt, moist, some void spaces between clasts, mainly elongated schist gravel, cobbles and some boulders disseminated throughout, vague bedding dipping downslope, DIGGABILITY 5				
1						1273
2		END OF TESTPIT (1.9 metres) Note: DIGGABILITY 8-9				1272
3						1271
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.9 m
Drilling Rig Type: Excavator	Start Date: 2017 October 11
Logged By: SM	Completion Date: 2017 October 11
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-67**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1287 m
Coffee Creek, Yukon	UTM: 584058 E; 6974267 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1287
	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			
		GRAVEL (WEATHERED BEDROCK) - trace silt, trace clay, angular schist, pebbles, cobbles and boulders disseminated throughout, well graded, vague beds of poorly graded material, DIGGABILITY 3				
1						1286
		- at 1.3 m, sandy, some silt, DIGGABILITY 7				
2						1285
		END OF TESTPIT (2.5 metres) DIGGABILITY 9				
3						1284
3.5						

Contractor: JDS	Completion Depth: 2.5 m
Drilling Rig Type: Excavator	Start Date: 2017 October 11
Logged By: SM	Completion Date: 2017 October 11
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-68**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1267 m
Coffee Creek, Yukon	UTM: 584389 E; 6974247 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			1267
	Excavated	SILT (LOESS) - very bouldery at top, gravelly (WEATHERED BEDROCK), trace to some sand, trace clay, well graded, moist, brown, angular schist pebbles, cobbles and boulders disseminated throughout, DIGGABILITY 1				
1		- bouldery, DIGGABILITY 8				1266
		- occasional orange weathered schist clast				
2		END OF TESTPIT (1.9 metres) Note: Stopped due to refusal on bedrock				1265
3						1264
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.9 m
Drilling Rig Type: Excavator	Start Date: 2017 October 14
Logged By: SM	Completion Date: 2017 October 14
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-69**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1238 m
Coffee Creek, Yukon	UTM: 584924 E; 6974282 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (200 mm thick)	Unfrozen			1238
		GRAVEL (WEATHERED BEDROCK) - silty, trace clay, well graded, moist, brown, angular schist, pebbles, cobbles and boulders disseminated throughout, elongate, platy, DIGGABILITY 1				
1	Excavated	SCHIST (BEDROCK) - moderately weathered (W3), DIGGABILITY 9				1237
		END OF TESTPIT (1.7 metres) Note: Stopped due to refusal on bedrock (DIGGABILITY 10)				
2						1236
3						1235
3.5						

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: Excavator	Start Date: 2017 October 12
Logged By: SM	Completion Date: 2017 October 12
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-70**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1186 m
Coffee Creek, Yukon	UTM: 584088 E; 6973963 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1186
	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			
		GRAVEL (WEATHERED BEDROCK) - silty, trace sand, trace clay, damp, brown, angular schist pebbles and cobbles disseminated throughout, occasional boulders, DIGGABILITY 1				
1		- at 1.0 m, sandy, trace silt, light brown				1185
		SCHIST (BEDROCK) - trace silt, trace sand, damp, fractured, brown, DIGGABILITY 8-9				
2		END OF TESTPIT (2.0 metres) Note: Stopped due to refusal on bedrock, (DIGGABILITY 10)				1184
3						1183
3.5						

Contractor: JDS	Completion Depth: 2 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-71**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1216 m
Coffee Creek, Yukon	UTM: 584619 E; 6973937 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			1216
		SILT (LOESS) - bouldery (WEATHERED BEDROCK), some clay, gap graded, moist, low plastic, brown, angular clast, DIGGABILITY 1				
		GRAVEL (WEATHERED BEDROCK) - sandy, trace silt, trace clay, moist, light brown, angular schist, pebbles, cobbles and boulders disseminated throughout, micaceous sand, some granitoid clasts (mostly boulders), DIGGABILITY 3				
1	Excavated					1215
2						1214
		SCHIST (BEDROCK) - some sand, trace silt, fractured, moist, light brown, DIGGABILITY 9				
3						1213
		END OF TESTPIT (3.1 metres) Note: Stopped due to refusal on bedrock (DIGGABILITY 10)				
3.5						

Contractor: JDS	Completion Depth: 3.1 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-72**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1241 m
Coffee Creek, Yukon	UTM: 584949 E; 6973970 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0						1241
	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			
		SILT (LOESS) - some cobbles (WEATHERED BEDROCK), trace clay, trace sand, gap graded, moist, brown, some pebbles disseminated throughout, occasional boulder at surface, DIGGABILITY 1				
1						1240
		SCHIST (BEDROCK) - fractured, dark green and grey, very platy boulders, DIGGABILITY 9 - at 1.4 m, sandy, gravelly, micaceous sand, fine gravel				
		END OF TESTPIT (1.6 metres) Note: Stopped due to refusal on bedrock, (DIGGABILITY 10)				
2						1239
3						1238
3.5						

Contractor: JDS	Completion Depth: 1.6 m
Drilling Rig Type: Excavator	Start Date: 2017 October 12
Logged By: SM	Completion Date: 2017 October 12
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-73**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1161 m
Coffee Creek, Yukon	UTM: 584416 E; 6973804 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (200 mm thick)	Thawed (Active layer)			1161
		PEAT - woody, fibrous, moist, dark brown, discontinuous, (200 mm thick), DIGGABILITY 1				
		SILT (LOESS) - some gravel (WEATHERED BEDROCK), trace clay, gap graded, moist, brown, angular pebbles and cobbles disseminated throughout, (200 mm thick), DIGGABILITY 1-2				
		GRAVEL (WEATHERED BEDROCK) - sandy, trace silt, trace clay, well graded, moist, light brown, subangular to angular schist pebbles, cobbles and boulders disseminated throughout, DIGGABILITY 1-2				
			Frozen Vc, Vs 20-40%, 3 mm thick ice coatings, 1 mm thick layers			
1		END OF TESTPIT (0.9 metres) Note: Stopped due to refusal on frozen ground (DIGGABILITY 10)				1160
2						1159
3						1158
3.5						

Contractor: JDS	Completion Depth: 0.9 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-74**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1092 m
Coffee Creek, Yukon	UTM: 584079 E; 6973600 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Thawed (Active layer)			1092
		PEAT - fibric, continuous, moist, dark brown, DIGGABILITY 1, (150 mm thick)				
		SILT (ORGANIC) - peaty, soft, brown, overlies peat locally, DIGGABILITY 1, (200 mm thick)				
		GRAVEL (WEATHERED BEDROCK) - silty, trace sand, trace clay, mainly pebbles and cobbles, some boulders disseminated throughout, DIGGABILITY 2				
			Frozen, Vc, Vs 10%, layers and coatings 1 mm thick			
		END OF TESTPIT (0.8 metres) Note: Stopped due to refusal on frozen material, (DIGGABILITY 10)				
1						1091
2						1090
3						1089
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 0.8 m
Drilling Rig Type: Excavator	Start Date: 2017 October 13
Logged By: SM	Completion Date: 2017 October 13
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-75**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1148 m
Coffee Creek, Yukon	UTM: 584679 E; 6973669 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (150 mm thick)	Unfrozen			1148
		SAND AND GRAVEL (WEATHERED BEDROCK) - moist, well graded, brown, platy boulder layer on top, pebbles, cobbles and boulders disseminated throughout, DIGGABILITY 2				
1		END OF TESTPIT (1.0 metre) Note: Stopped due to refusal on bedrock (DIGGABILITY 10)				1147
2						1146
3						1145
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1 m
Drilling Rig Type: Excavator	Start Date: 2017 October 14
Logged By: SM	Completion Date: 2017 October 14
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-76**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1071 m
Coffee Creek, Yukon	UTM: 584309 E; 6973471 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - woody, rootlets, dark brown, (300 mm thick)	Thawed (Active layer)			1071
		- at 0.25 m, silty SILT (LOESS) - trace gravel (WEATHERED BEDROCK), trace clay, dry, brown, DIGGABILITY 1				
		GRAVEL (WEATHERED BEDROCK) - silty, some sand, trace clay, slightly weathered (W2), moist, brown, mainly angular schist cobbles and pebbles, occasional boulders disseminated throughout, DIGGABILITY 1				
		SAND AND GRAVEL (WEATHERED BEDROCK) - some silt, trace clay, well graded, moist, brown, angular schist pebbles, cobbles and boulders disseminated throughout, DIGGABILITY 1				
1						1070
		- at 1.3 m, light brown, DIGGABILITY 9	Frozen, Vc, Vs 10-20%, layers and coatings 1 mm thick			
		END OF TESTPIT (1.6 metres) Note: Stopped due to refusal on frozen ground, (DIGGABILITY 10)				
2						1069
3						1068
3.5						

Contractor: JDS	Completion Depth: 1.6 m
Drilling Rig Type: Excavator	Start Date: 2017 October 12
Logged By: SM	Completion Date: 2017 October 12
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-77**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1017 m
Coffee Creek, Yukon	UTM: 584091 E; 6973370 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (200 mm thick)	Thawed (Active layer)			1017
		GRAVEL (COLLUVIUM) - angular cobbles and boulders, void spaces, DIGGABILITY 1				
		SAND AND SILT (WEATHERED BEDROCK) - some gravel (WEATHERED BEDROCK), trace clay, slightly to moderately weathered (W2-W3), moist, brown, angular schist pebbles, cobbles and boulders disseminated throughout, DIGGABILITY 1				
1						1016
	Excavated	- at 1.7 m, wet				
2						1015
		- at 2.3 m, clayey				
		GRAVEL (WEATHERED BEDROCK) - sandy, silty (LOESS), wet, brown, subangular to angular, DIGGABILITY 3				
3						1014
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 4 m
Drilling Rig Type: Excavator	Start Date: 2017 October 12
Logged By: SM	Completion Date: 2017 October 12
Reviewed By: VER	Page 1 of 2

Testpit No: **TP17-77**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1017 m
Coffee Creek, Yukon	UTM: 584091 E; 6973370 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
3.5						
	Excavated		300 mm long lens of frozen material with Vc 1%			
4		END OF TESTPIT (4.0 metres) Note: End of excavator reach				1013
5						1012
6						1011
7						1010

TETRA TECH

Contractor: JDS	Completion Depth: 4 m
Drilling Rig Type: Excavator	Start Date: 2017 October 12
Logged By: SM	Completion Date: 2017 October 12
Reviewed By: VER	Page 2 of 2

Testpit No: **TP17-78**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Supremo Pit	Ground Elev: 1082 m
Coffee Creek, Yukon	UTM: 584758 E; 6973337 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, dark brown, (300 mm thick)	Thawed (Active layer)			1082
		GRAVEL AND SAND (WEATHERED BEDROCK) - some silt to silty, trace clay, well graded, moist, brown, angular schist pebbles and cobbles, some boulders disseminated throughout, DIGGABILITY 3				
1		SILT - sandy, some gravel (WEATHERED BEDROCK), trace clay, well graded, brown, angular schist pebbles and cobbles, some boulders disseminated throughout, DIGGABILITY 9	Vc, Vs, Vr 10-20%, layers 1 mm thick			1081
		END OF TESTPIT (1.3 metres) Note: Stopped due to refusal on frozen ground, (DIGGABILITY 10)				
2						1080
3						1079
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.3 m
Drilling Rig Type: Excavator	Start Date: 2017 October 12
Logged By: SM	Completion Date: 2017 October 12
Reviewed By: VER	Page 1 of 1

Testpit No: **TP17-79**

Project: Coffee Fall 2017 Testpitting Program	Project No: ENG.EARC03094-01.004
Location: Double Double Pit	Ground Elev: 1106 m
Coffee Creek, Yukon	UTM: 584997 E; 6973268 N; Z 7

Depth (m)	Method	Soil Description	Thermal Condition and Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - rootlets, dark brown, (200 mm thick)	Unfrozen			1106
		SILT (LOESS) - some gravel (WEATHERED BEDROCK), trace clay, moist, brown, angular schist gravel, (200 mm thick)				
		SAND AND GRAVEL (WEATHERED BEDROCK) - micaceous, completely weathered (W5), moist, fine to coarse sand consisting of completely weathered schist, angular schist cobbles and boulders disseminated throughout, DIGGABILITY 1-3				
1	Excavated					1105
		SCHIST (BEDROCK) - slightly to highly weathered (W2-W4), dark greenish grey, platy fractured schist pieces of variable size, DIGGABILITY 8				
2						1104
		END OF TESTPIT (2.3 metres)				
3						1103
3.5						

TETRA TECH

Contractor: JDS	Completion Depth: 2.3 m
Drilling Rig Type: Excavator	Start Date: 2017 October 12
Logged By: SM	Completion Date: 2017 October 12
Reviewed By: VER	Page 1 of 1

APPENDIX C

GEOTECHNICAL LABORATORY SOIL TEST RESULTS

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	Coffee Mine - Fall 2017 Geotech. Investigation	Sample No.:	See Below
Project Number:	ENG.EARC03094-01 (Task 004)	Date Tested:	October 25, 2017
Client:	JDS Energy & Mining Inc.	Tested By:	AT/SD
Address:	Coffee Creek, YT	Page:	1 of 1

B.H. Number	Depth (m)	Moisture Content (%)	Visual Description of Soil
TP-17-04	1.3 - 1.4	19.5	
TP-17-05	0.9 - 1.0	35.4	
TP-17-07	0.7 - 0.8	3.7	
TP-17-10	1.3 - 1.4	47.9	
TP-17-13	0.8 - 0.9	10.0	
TP-17-16	0.3 - 0.4	7.4	
TP-17-18a	1.2 - 1.3	5.6	
TP-17-18b	1.1 - 1.2	5.3	
TP-17-21	0.9 - 1.0	15.0	
TP-17-24	0.7 - 0.8	20.1	
TP-17-25a	0.4 - 0.5	9.8	
TP-17-25b	1.1 - 1.2	10.9	
TP-17-26	0.8 - 0.9	8.7	
TP-17-27	0.5 - 0.6	19.7	
TP-17-29	0.9 - 1.0	8.5	
TP-17-30	0.7 - 0.8	2.4	

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

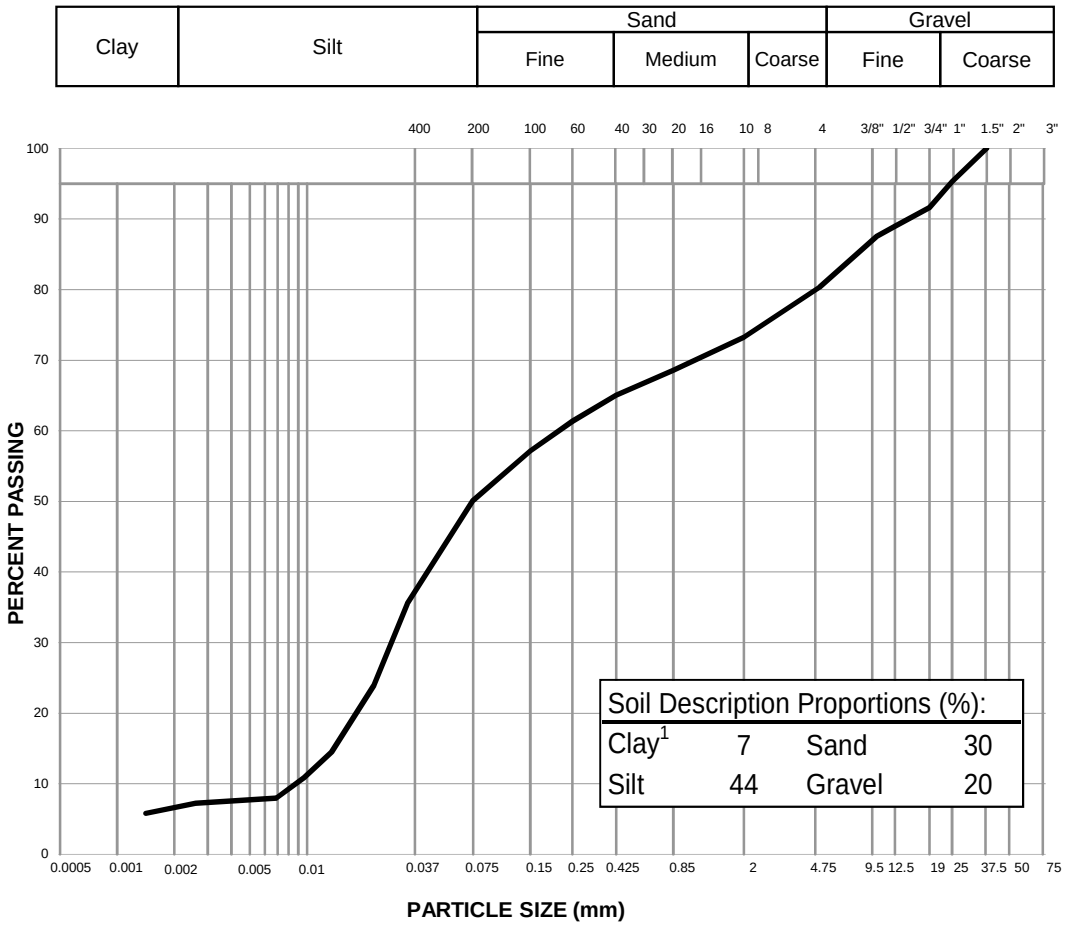
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-04
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.3 - 1.4 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 4, 2017 By: AMT	Date sampled:	-
Soil Description[2]:	SILT - sandy, some gravel, trace clay	Sampled By:	SM
		USC Classification:	Cu: 24.6
Moisture Content:	19.5%		Cc: 0.4

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	95
19	92
12.5	89
10	88
5	80
2	73
0.85	69
0.425	65
0.25	61
0.15	57
0.075	50.1
0.0338	35.5
0.0224	23.9
0.0135	14.5
0.0097	10.9
0.0069	8.0
0.0026	7.3
0.0014	5.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to Tetra Tech description protocols

Specification: _____

Remarks: _____

_____

Reviewed By: _____ C.E.T.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

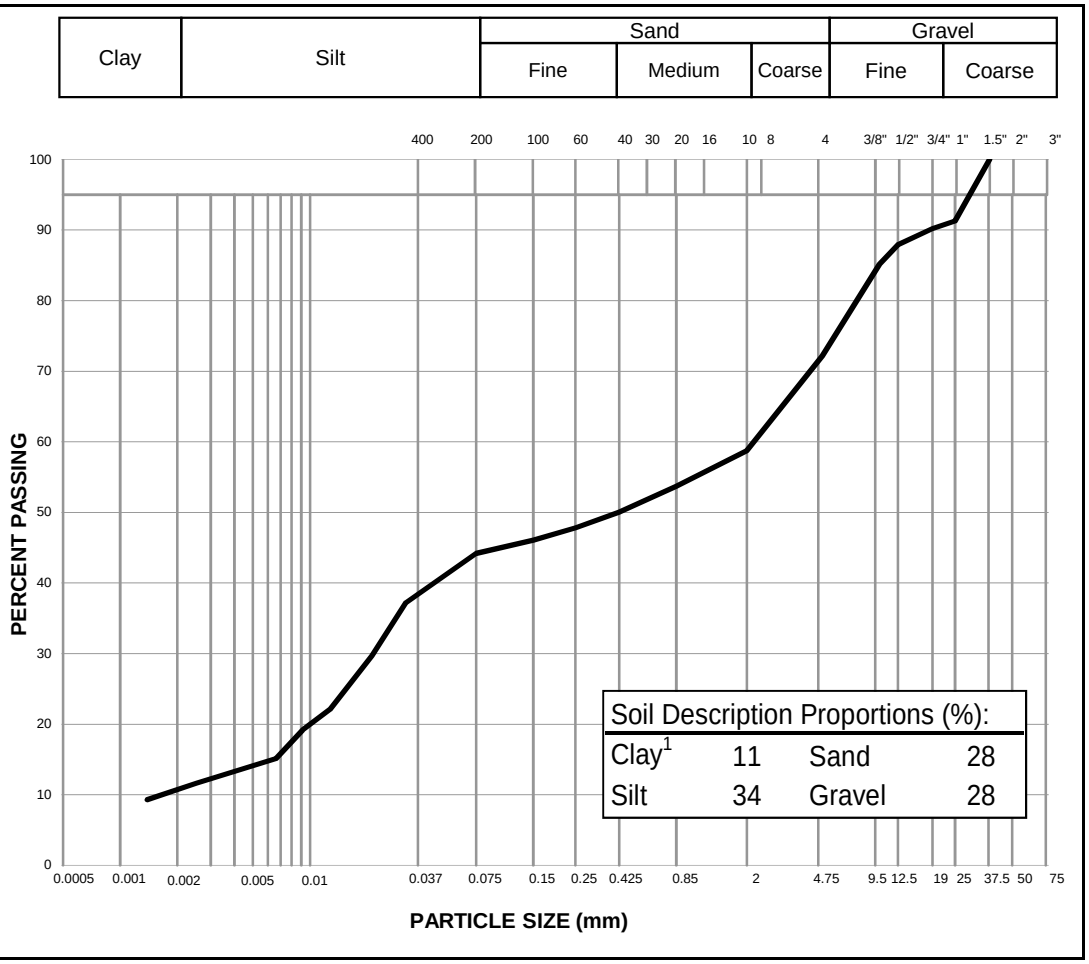
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-05
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.9 - 1.0 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 4, 2017 By: AMT	Date sampled:	-
Soil Description[2]:	SILT - gravelly, sandy, some clay	Sampled By:	SM
		USC Classification:	Cu: 1321.5
Moisture Content:	35.4%		Cc: 0.1

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	91
19	90
12.5	88
10	85
5	72
2	59
0.85	54
0.425	50
0.25	48
0.15	46
0.075	44.2
0.0321	37.2
0.0212	29.7
0.0128	22.1
0.0092	19.2
0.0066	15.1
0.0025	11.6
0.0014	9.3



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to Tetra Tech description protocols

Specification: _____

Remarks: _____

_____

Reviewed By: _____ C.E.T.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

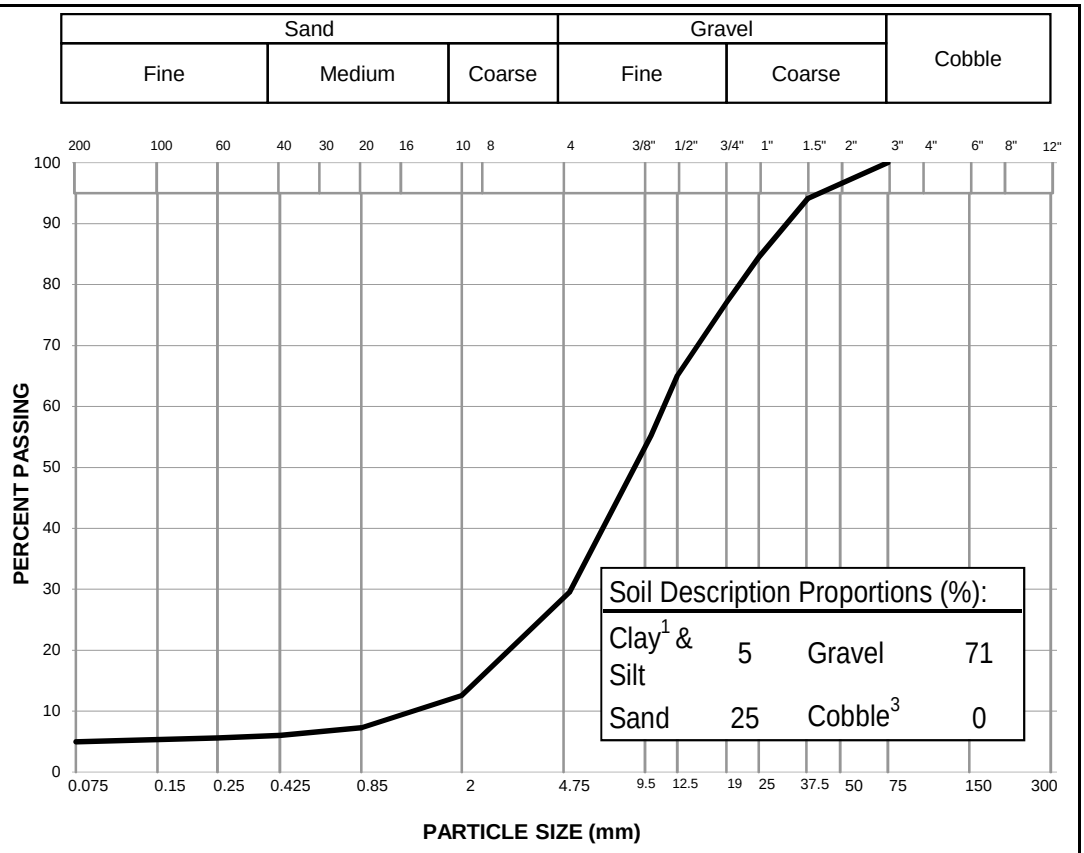
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-07
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.7 - 0.8 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: SD	Date sampled:	-
Soil Description[2]:	GRAVEL - sandy, trace silt	Sampled By:	SM
		USC Classification:	Cu: 7.8
Moisture Content:	3.7%		Cc: 1.6

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	94
25	85
19	77
12.5	65
10	55
5	29
2	13
0.85	7
0.425	6
0.25	6
0.15	5
0.075	5.0



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

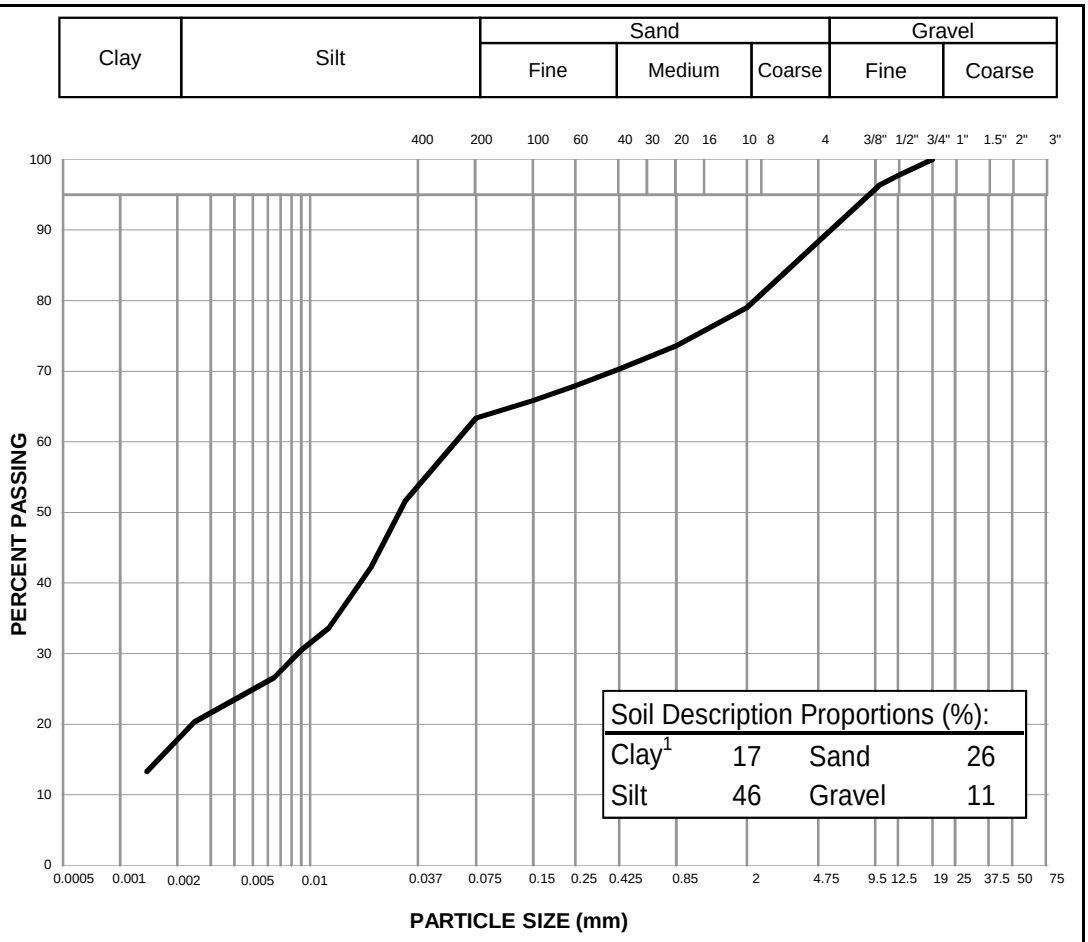
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-10
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.3 - 1.4 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 4, 2017 By: AMT	Date sampled:	-
Soil Description[2]:	SILT - sandy, some clay, some gravel	Sampled By:	SM
		USC Classification:	Cu: #N/A
Moisture Content:	47.9%		Cc: #N/A

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	100
12.5	98
10	96
5	89
2	79
0.85	74
0.425	70
0.25	68
0.15	66
0.075	63.3
0.0318	51.6
0.0210	42.2
0.0126	33.6
0.0090	30.5
0.0065	26.6
0.0025	20.3
0.0014	13.3



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to Tetra Tech description protocols

Specification: _____

Remarks: _____

_____

Reviewed By: _____ C.E.T.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

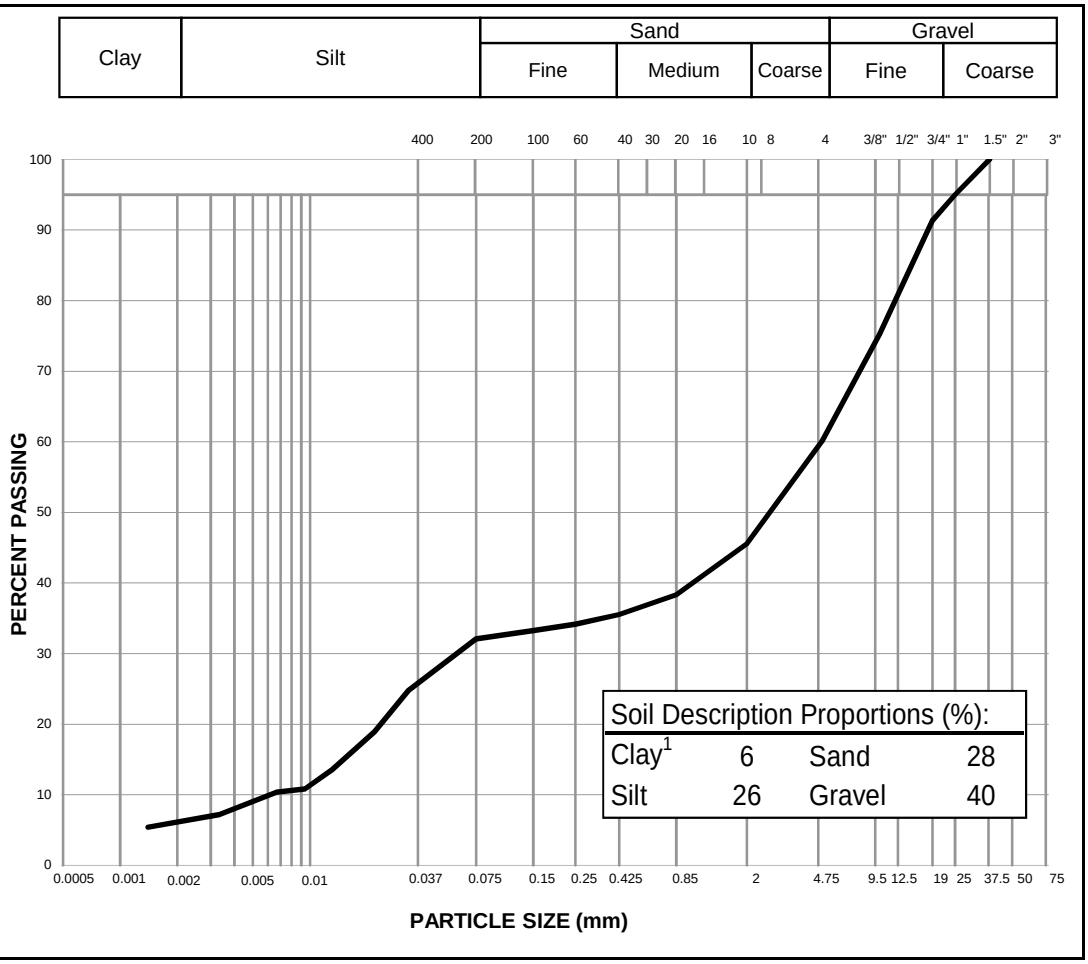
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-13
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.8 - 0.9 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: AMT	Date sampled:	-
Soil Description[2]:	GRAVEL - sandy, silty, trace clay	Sampled By:	SM
		USC Classification:	Cu: 791.2
Moisture Content:	10.0%		Cc: 0.1

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	95
19	91
12.5	81
10	75
5	60
2	46
0.85	38
0.425	36
0.25	34
0.15	33
0.075	32.1
0.0331	24.8
0.0219	18.9
0.0131	13.5
0.0094	10.8
0.0067	10.4
0.0033	7.2
0.0014	5.4



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to Tetra Tech description protocols

Specification: _____

Remarks: _____

_____

Reviewed By: _____ C.E.T.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

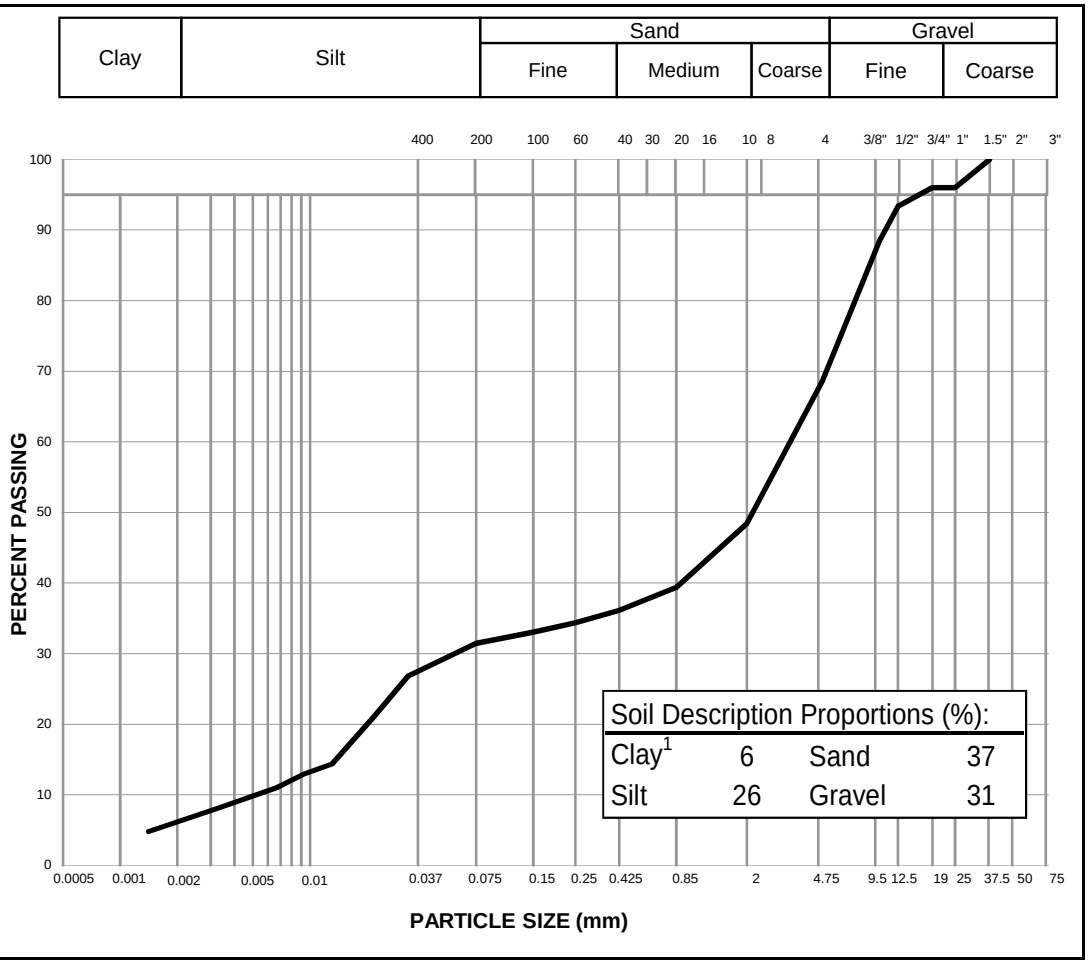
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-16
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.3 - 0.4 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: AMT	Date sampled:	-
Soil Description[2]:	SAND - gravelly, silty, trace clay	Sampled By:	SM
		USC Classification:	Cu: 679.8
Moisture Content:	7.4%		Cc: 0.2

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	96
19	96
12.5	93
10	88
5	69
2	48
0.85	39
0.425	36
0.25	34
0.15	33
0.075	31.5
0.0329	26.8
0.0217	21.1
0.0131	14.4
0.0093	12.9
0.0067	11.0
0.0033	8.1
0.0014	4.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to Tetra Tech description protocols

Specification: _____

Remarks: _____

_____

Reviewed By: _____ C.E.T.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

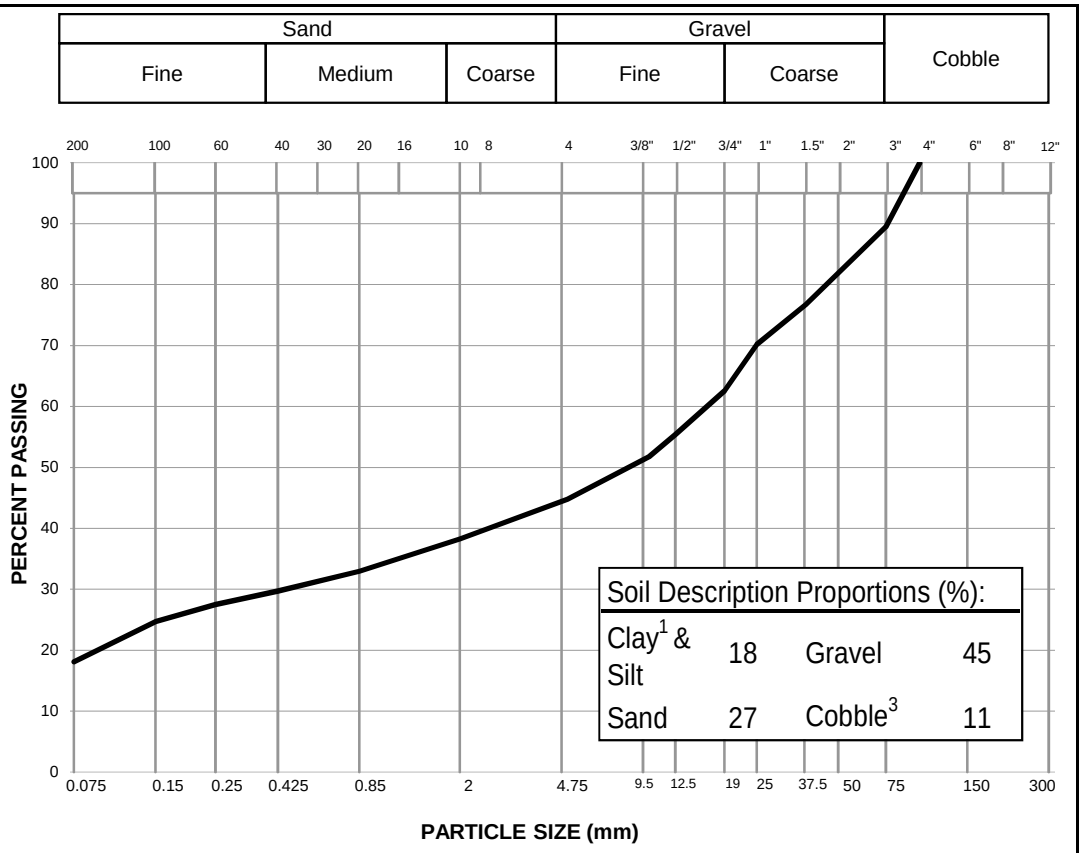
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-18a
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.2 - 1.3 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: SD	Date sampled:	-
Soil Description[2]:	GRAVEL - sandy, some silt, some cobbles	Sampled By:	SM
		USC Classification:	Cu: #N/A
Moisture Content:	5.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	100
75	89
50	
38	77
25	70
19	63
12.5	55
10	52
5	45
2	38
0.85	33
0.425	30
0.25	28
0.15	25
0.075	18.1



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

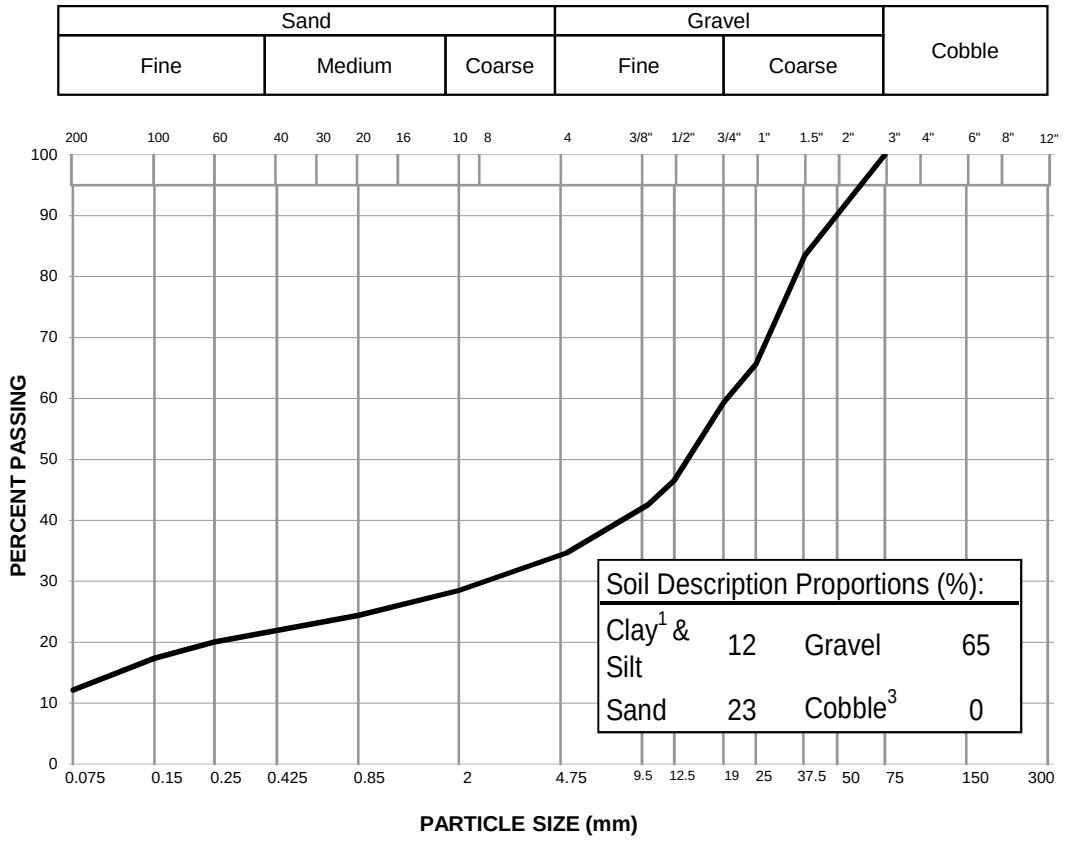
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-18b
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.1 - 1.2 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: SD	Date sampled:	-
Soil Description[2]:	GRAVEL - sandy, some silt	Sampled By:	SM
		USC Classification:	Cu: #N/A
Moisture Content:	5.3%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	83
25	66
19	59
12.5	47
10	43
5	35
2	28
0.85	24
0.425	22
0.25	20
0.15	17
0.075	12.1



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

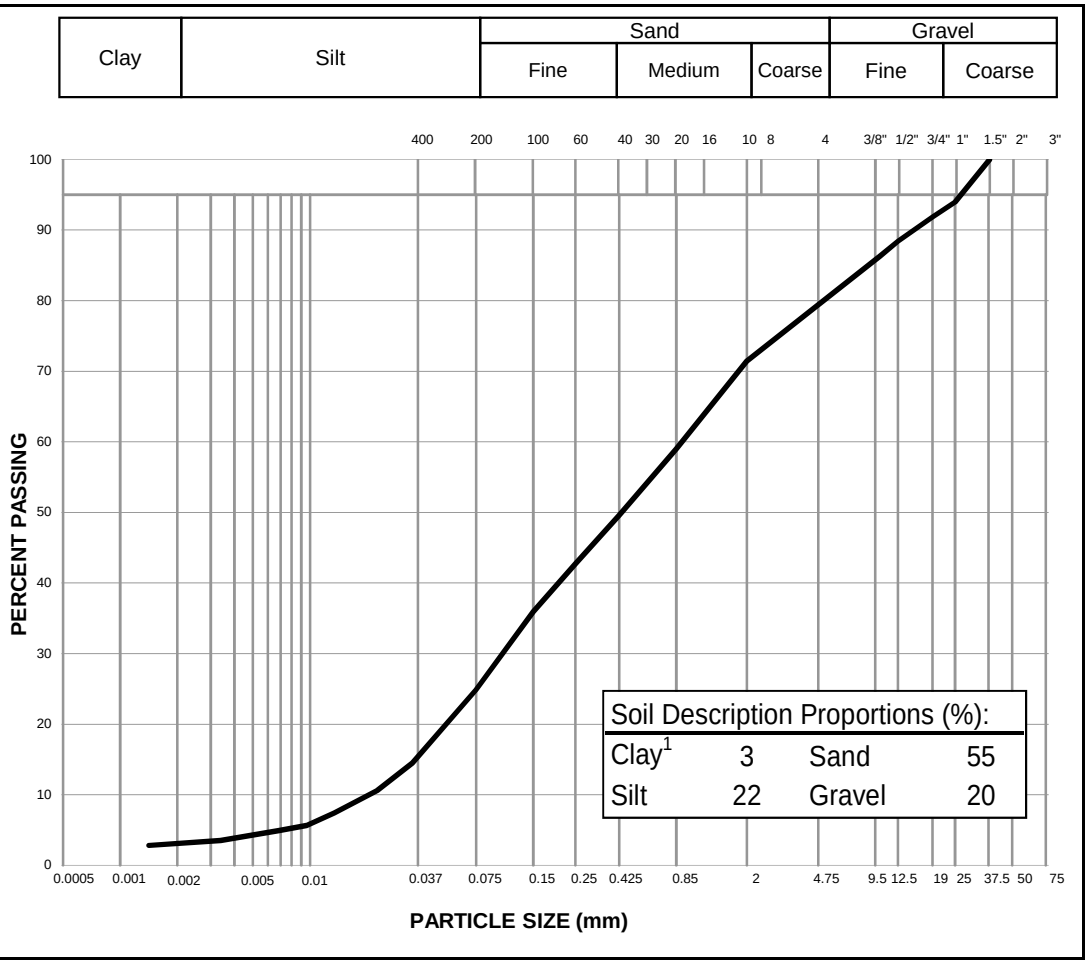
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-21
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.9 - 1.0 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: AMT	Date sampled:	-
Soil Description[2]:	SAND - silty, some gravel, trace clay	Sampled By:	SM
		USC Classification:	Cu: 45.2
Moisture Content:	15.0%		Cc: 0.6

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	94
19	92
12.5	88
10	86
5	80
2	71
0.85	59
0.425	50
0.25	43
0.15	36
0.075	24.9
0.0346	14.5
0.0226	10.6
0.0134	7.4
0.0096	5.7
0.0069	5.0
0.0034	3.5
0.0014	2.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to Tetra Tech description protocols

Specification: _____

Remarks: _____

_____

Reviewed By: _____ C.E.T.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

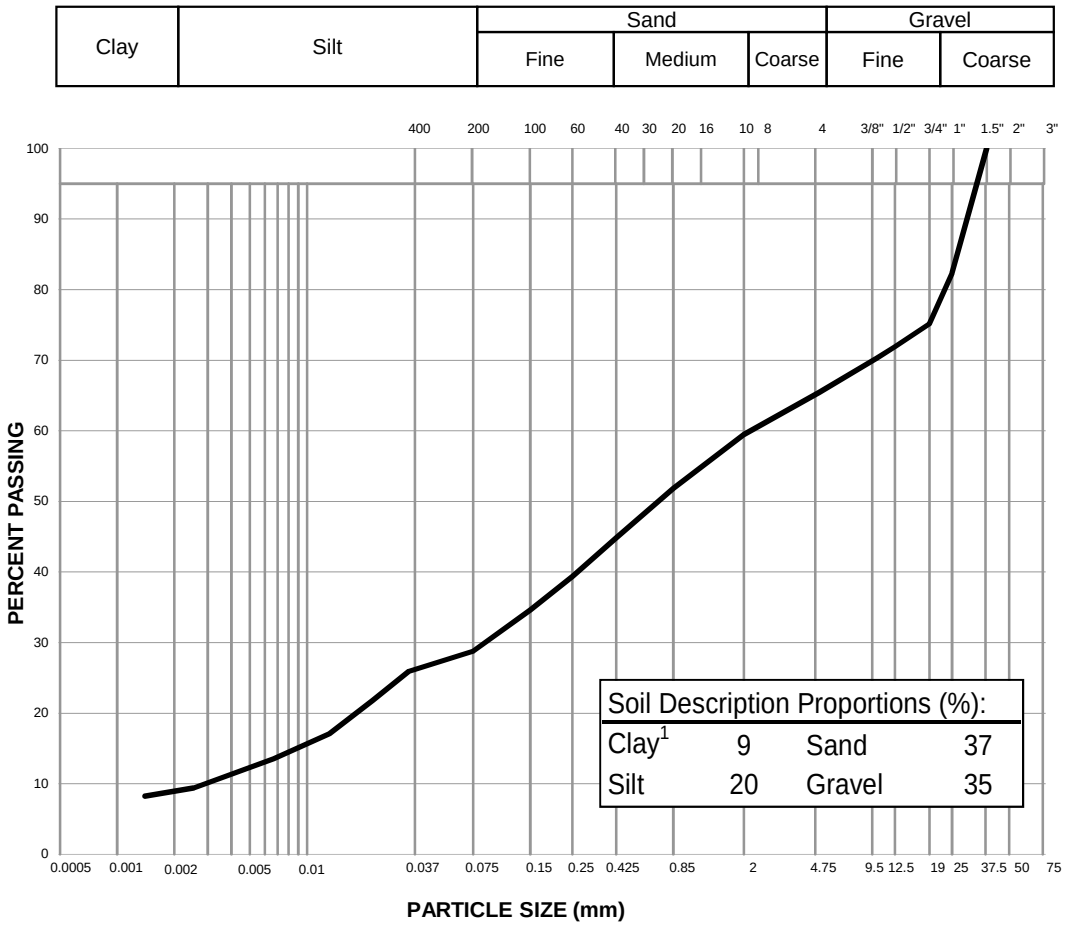
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-24
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.7 - 0.8 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: AMT	Date sampled:	-
Soil Description[2]:	SAND and GRAVEL - some silt, trace clay	Sampled By:	SM
		USC Classification:	Cu: 725.7
Moisture Content:	20.1%		Cc: 1.2

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	82
19	75
12.5	72
10	70
5	65
2	59
0.85	52
0.425	45
0.25	39
0.15	35
0.075	28.8
0.0343	25.9
0.0222	21.8
0.0131	17.1
0.0094	15.3
0.0067	13.5
0.0025	9.4
0.0014	8.2



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to Tetra Tech description protocols

Specification: _____

Remarks: _____

_____

Reviewed By: _____ C.E.T.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

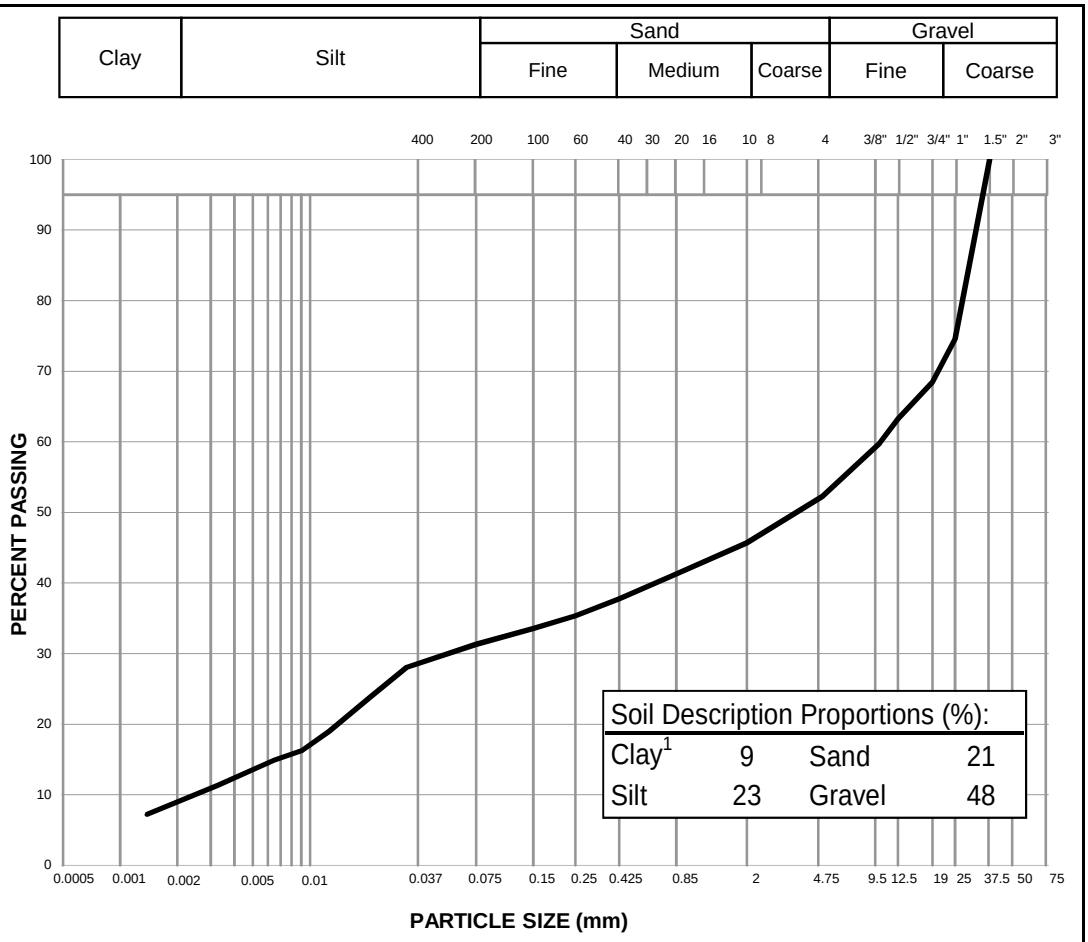
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-25a
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.4 - 0.5 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: AMT	Date sampled:	-
Soil Description[2]:	GRAVEL - silty, sandy, trace clay	Sampled By:	SM
		USC Classification:	Cu: 3826.7
Moisture Content:	9.8%		Cc: 0.1

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	75
19	68
12.5	63
10	60
5	52
2	46
0.85	41
0.425	38
0.25	35
0.15	34
0.075	31.3
0.0322	28.0
0.0210	24.0
0.0126	19.0
0.0091	16.3
0.0065	14.9
0.0032	11.3
0.0014	7.2



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to Tetra Tech description protocols

Specification: _____

Remarks: _____

_____

Reviewed By: _____ C.E.T.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

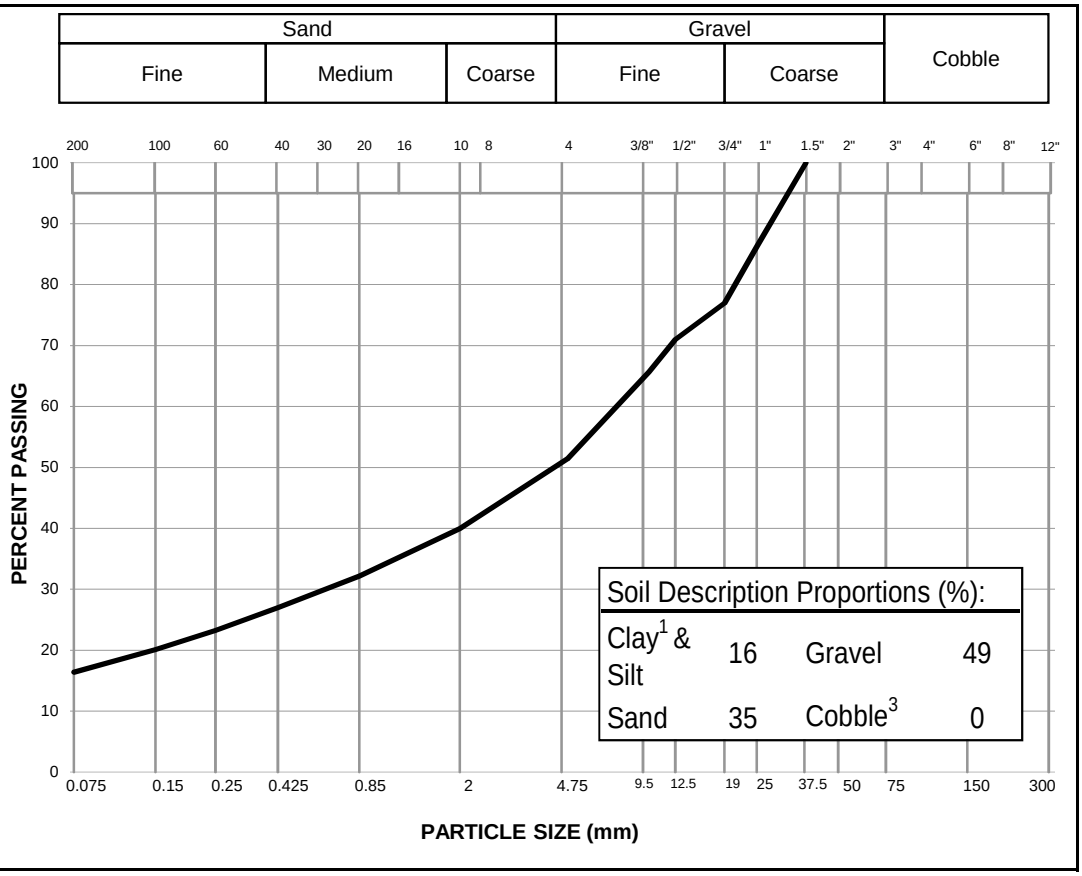
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-25b
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.1 - 1.2 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: SD	Date sampled:	-
Soil Description[2]:	GRAVEL - sandy, some silt	Sampled By:	SM
		USC Classification:	Cu: #N/A
Moisture Content:	10.9%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	86
19	77
12.5	71
10	66
5	51
2	40
0.85	32
0.425	27
0.25	23
0.15	20
0.075	16.4



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

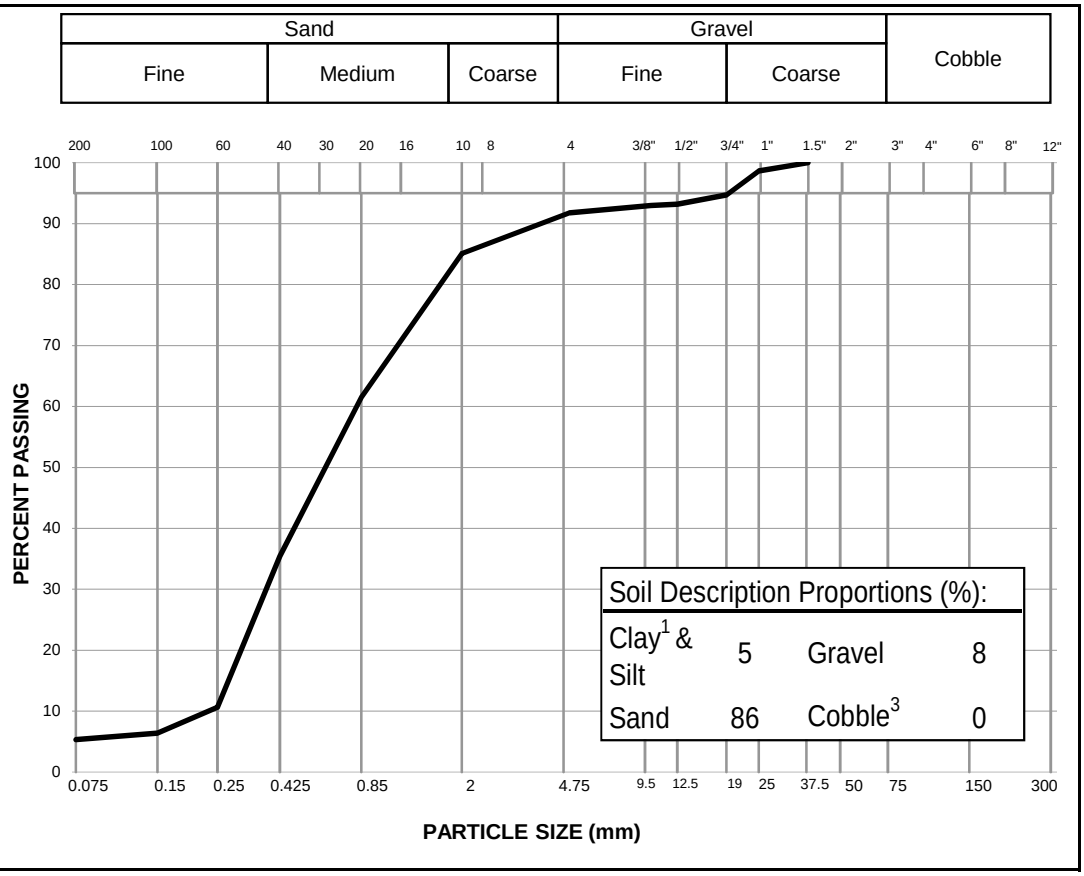
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-26
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.8 - 0.9 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: SD	Date sampled:	-
Soil Description[2]:	SAND - trace gravel, trace silt	Sampled By:	SM
		USC Classification:	Cu: 3.5
Moisture Content:	8.7%		Cc: 0.8

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	99
19	95
12.5	93
10	93
5	92
2	85
0.85	62
0.425	35
0.25	11
0.15	6
0.075	5.3



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

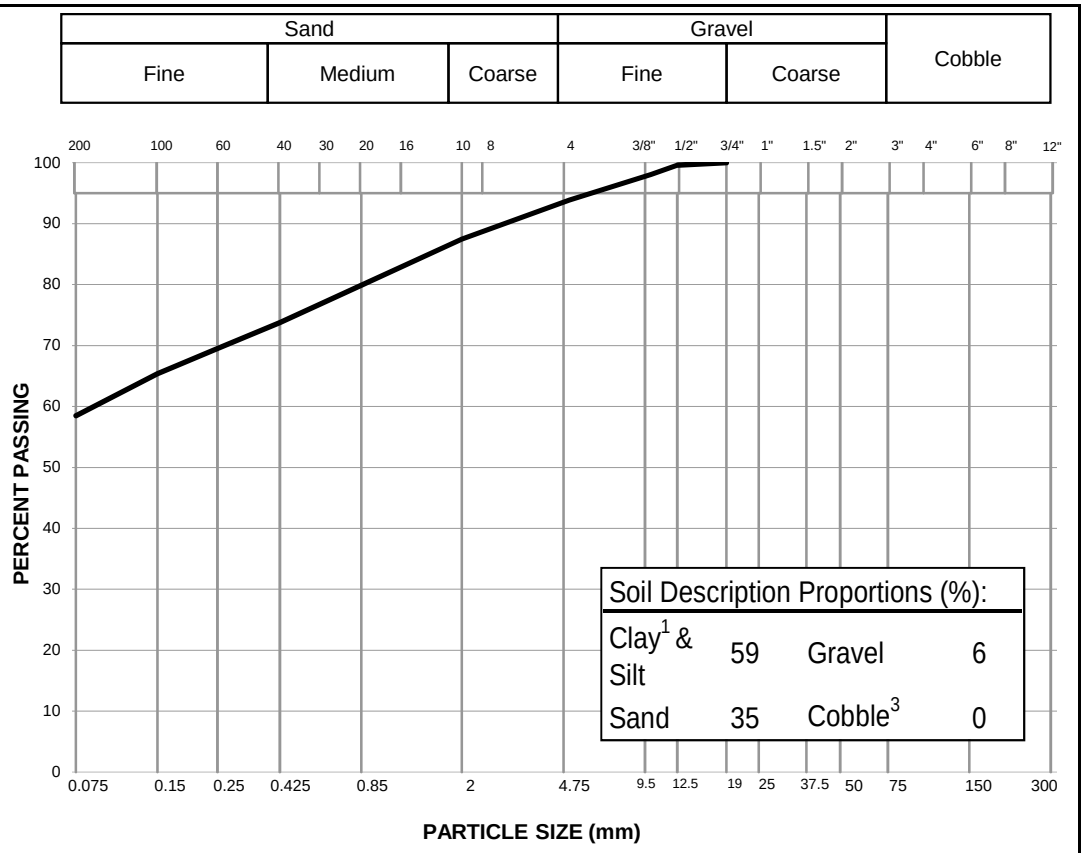
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-27
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.5 - 0.6 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: SD	Date sampled:	-
Soil Description[2]:	SILT - sandy, trace gravel	Sampled By:	SM
		USC Classification:	Cu: #N/A
Moisture Content:	20.3%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	100
12.5	100
10	98
5	94
2	87
0.85	80
0.425	74
0.25	70
0.15	65
0.075	58.5



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

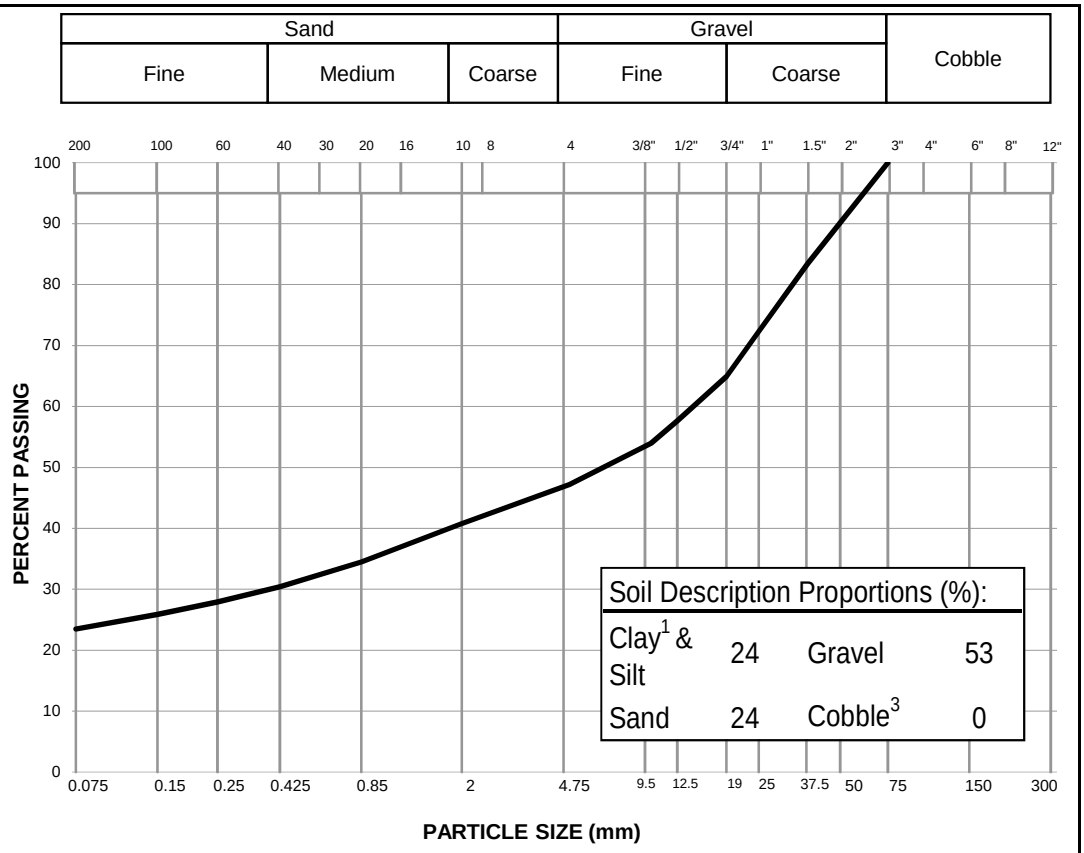
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-29
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.9 - 1.0 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: SD	Date sampled:	-
Soil Description[2]:	GRAVEL - sandy, silty	Sampled By:	SM
		USC Classification:	Cu: #N/A
Moisture Content:	8.5%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	83
25	72
19	65
12.5	58
10	54
5	47
2	41
0.85	34
0.425	30
0.25	28
0.15	26
0.075	23.5



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

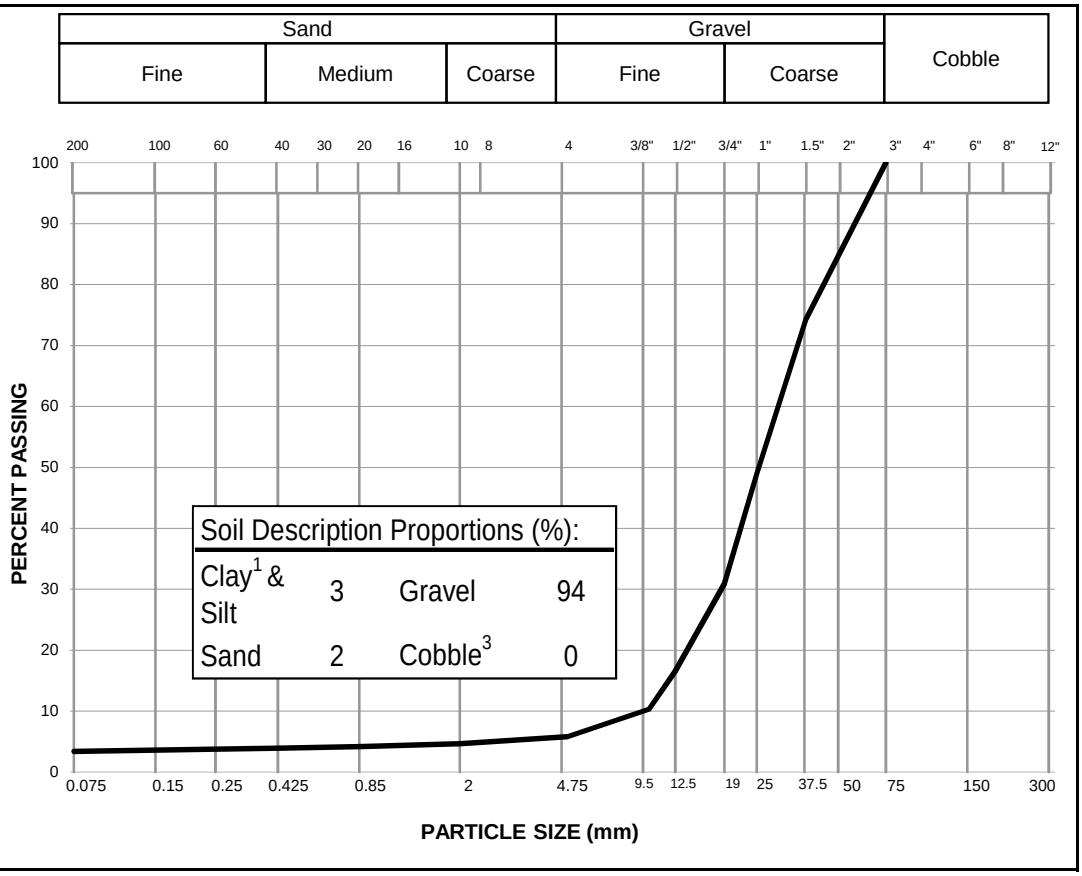
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Fall 2017 Geotech. Investigation	Sample No.:	TP-17-30
Project No.:	ENG.EARC03094-01 (Task 004)	Material Type:	-
Site:	Coffee Mine, YT	Sample Loc.:	-
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.7 - 0.8 m
Client Rep.:	Jasmine Craig	Sampling Method:	Grab
Date Tested:	November 1, 2017 By: SD	Date sampled:	-
Soil Description[2]:	GRAVEL - trace silt, trace sand	Sampled By:	SM
		USC Classification:	Cu: 3.2
Moisture Content:	2.4%		Cc: 1.2

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	74
25	49
19	31
12.5	17
10	10
5	6
2	5
0.85	4
0.425	4
0.25	4
0.15	4
0.075	3.4



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

APPENDIX 2-I

Fall 2018 Testpitting Program Date Report, Coffee Gold Project

Fall 2018 Testpitting Program Data Report
Coffee Gold Project



PRESENTED TO

JDS ENERGY & MINING INC.

JANUARY 9, 2019
ISSUED FOR USE
FILE: ENG.EARC03094-06

Tetra Tech Canada Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

This page intentionally left blank.

EXECUTIVE SUMMARY

Tetra Tech Canada Inc. (Tetra Tech) was retained by JDS Energy & Mining Inc. (JDS) to provide geotechnical consulting services for a testpitting program in the Coffee Gold Project (the Project) area in the fall of 2018. The objective of the testpitting program was to investigate the composition, diggability, and thickness of the overburden materials overlying bedrock throughout the Project area.

The Fall 2018 Testpitting Program was carried out from September 5 to September 26, 2018 and consisted of excavation of testpits, logging, and sampling of the exposed surficial materials at the following proposed mine development and construction sites: Java Airstrip alignment, Supremo, Double Double, and South Latte/Supremo Open Pit areas, the Facility Pond area, the Halfway Diversion, the Latte Diversion Channel (Latte Diversion), and the potential borrow source located at km 0.3 of the existing site access road. The fall 2018 program augments a testpitting program completed by Tetra Tech within proposed infrastructure footprints and in the proposed open pit areas in the fall of 2017.

To achieve the objective of the testpitting program, overburden materials were exposed in 69 testpits by either hand-digging or the use of an excavator. Due to the Halfway Diversion being inaccessible by the excavator, testpits in this area were dug by hand. Unfrozen (or thawed) and frozen overburden soil and bedrock exposed in the completed testpits was logged and sampled.

Representative samples of overburden material, including five samples collected by JDS in the potential borrow sources located between 2-3 km and 6-7 km sections of the existing access road, were tested at Tetra Tech's geotechnical laboratories in Whitehorse and Edmonton. The completed testing included particle size distribution, moisture content analyses, and a limited number of hydrometer, Atterberg limit, excess ice content, and bulk density tests. Bulk samples taken from the testpits excavated along the Java Airstrip alignment were combined for California Bearing Ratio (CBR) testing at Tetra Tech's geotechnical laboratory in Edmonton. The five soil samples collected by JDS in the km 2-3 and km 6-7 Borrow Source areas were tested for moisture-density (Proctor) relationship in Whitehorse.

Various types of overburden surficial materials were identified within the testpits. These include loess, weathered bedrock, bedrock fragments in a soil matrix, colluvium, alluvium, and organic material (peat and moss cover). Descriptions of these surficial materials provided in the report augment Tetra Tech's previous characterization of surficial geology units in the Project area. Permafrost was observed in many of the testpits. Frozen soils with non-visible ice and visible ground ice formations were described in the testpit logs, photographed, and sampled for geotechnical laboratory testing.

The suitability of the materials from potential borrow source areas for construction was assessed. At the proposed Java Airstrip site, the suitability of the cut materials is limited in most construction applications where durable materials are required. The unprocessed material can be used as road or airstrip subgrade fill, or as general fill. However, the high silt content of the overburden materials excavated in cut locations along the airstrip will make them very difficult to compact to suitable levels during the winter but would be suitable for placement in the summer. The processed material can be used as a subgrade fill in the airstrip, apron, and taxiway. There has been mention of significant screening being undertaken to generate a suitably graded material for use as airstrip surfacing material. Tetra Tech believes that although the desired gradation might possibly be able to be produced, there is a high possibility that the produced material will not be suitably durable and will break down generating excessive dust. Other sources of material such as the alluvial gravel at km 0.3 or quarried material from durable bedrock are recommended to produce airstrip surfacing gravel.

The excessive content of fines in the overburden materials in the Supremo and the Double Double Open Pit areas indicate that these overburden materials, including uppermost fractured, fragmented, and highly weathered bedrock easily break down making these materials marginal for use in most construction applications. The unprocessed material could be used as road subgrade and as general fill, if placed during the summer. If the material is processed, either by screening or crushing oversize boulder-sized rock fragments, it may be used for general fill or potentially as an embankment fill for dam construction subject to the design specifications. This processed material would not be suitable as a structural fill required below building foundations or slabs on grade.

Overburden materials encountered in the km 0.3 potential borrow source area consist of well-sorted alluvium (sand and sub-rounded gravel) covered by a veneer of silty material and organics. Although this alluvial material is well suited for use in most construction applications, the lack of particle angularity may require crushing of larger aggregates. The processed material can be used for road and airstrip surfacing and concrete aggregate. To achieve better compaction, a selected proportion of the overlying silt may require blending with the alluvium to increase the fines content.

Overburden materials sampled in the km 2-3 and km 6-7 potential borrow sources consist of coarse rock fragments in a well-graded gravelly and sandy matrix with trace to some silt. The particle size distribution analysis done on this material shows the content of fines ranging from 8% to 18%. The durability of the gravel-sized clasts raises concerns about the potential breakdown of these particles into finer material if exposed to either mechanical loading (vehicle traffic) or freeze thaw cycles. The unprocessed material can be used as a general fill and in road and airstrip subgrades. However, the presence of cobble-sized competent rock fragments indicates that if screened and crushed, the processed material could be used in locations where more specific particle size distributions are required (e.g. sand bedding material).

TABLE OF CONTENTS

EXECUTIVE SUMMARY I

1.0 INTRODUCTION 1

2.0 TESTPITTING GEOTECHNICAL INVESTIGATION 1
2.1 General 1
2.2 Testpit Locations 2
2.3 Testpitting Methodology 7
2.4 Geotechnical Logging 8
2.5 Laboratory Testing 8
2.5.1 General 8
2.5.2 Index Testing 11
2.5.3 California Bearing Ratio 11
2.5.4 Moisture-Density Relationship (Proctor) 11

3.0 SUBSURFACE CONDITIONS 11
3.1 General 11
3.2 Surficial Materials 12
3.2.1 Loess 12
3.2.2 Weathered Bedrock 12
3.2.3 Colluvium 12
3.2.4 Organic Material 12
3.3 Java Airstrip 13
3.3.1 Subsurface Conditions 13
3.3.2 Suitability of Overburden and Upper Bedrock Material for Construction 14
3.4 Supremo Open Pit 14
3.4.1 Subsurface Conditions 14
3.4.2 Suitability of Overburden Material for Construction 16
3.5 Double Double Open Pit 16
3.5.1 Subsurface Conditions 16
3.5.2 Suitability of Overburden Material for Construction 17
3.6 Latte Diversion 18
3.7 South Latte / Supremo Open Pit Area 19
3.8 Facility Pond Area 20
3.9 Halfway Diversion 22
3.10 Km 0.3 Borrow Source 23
3.10.1 Subsurface Conditions 23
3.10.2 Suitability of Overburden Material for Construction 23
3.11 Km 2-3/Km 6-7 Borrow Source Areas 24

4.0 CLOSURE 25

REFERENCES 26

LIST OF TABLES IN TEXT

Table 1: Testpit Information Summary 3
Table 2: Summary of Offsite Geotechnical Laboratory Testing Results 9
Table 3: Summary of California Bearing Ratio Test Results 11
Table 4: Overburden and Bedrock Condition Summary, Java Airstrip 13
Table 5: Overburden and Bedrock Condition Summary, Supremo Open Pit 15
Table 6: Overburden and Bedrock Condition Summary, Double Double Open Pit 17
Table 7: Overburden and Bedrock Condition Summary, Latte Diversion 18
Table 8: Overburden and Bedrock Condition Summary, South Latte / Supremo Open Pit Area 20
Table 9: Overburden and Bedrock Condition Summary, Facility Pond Area 21
Table 10: Overburden and Bedrock Condition Summary, Halfway Diversion 22
Table 11: Overburden and Bedrock Condition Summary, km 0.3 Borrow Source Area 23

APPENDIX SECTIONS

FIGURES

Figure 1 Site Location
Figure 2 As-Built 2018 Testpit Site Location Index Map
Figure 2a As-Built 2018 Testpit Locations, Halfway Diversion and Alpha Pond
Figure 2b As-Built 2018 Testpit Locations, Halfway Diversion
Figure 2c As-Built 2018 Testpit Locations, Supremo Open Pit
Figure 2d As-Built 2018 Testpit Locations, Latte Diversion
Figure 2e As-Built 2018 Testpit Locations, Facility Pond and Latte Diversion
Figure 2f As-Built 2018 Testpit Locations, Supremo and Double Double Open Pits
Figure 2g As-Built 2018 Testpit Locations, Java Airstrip Site
Figure 2h As-Built 2018 Testpit Locations, Km 6-7 Borrow Source Area
Figure 2i As-Built 2018 Testpit Locations, Km 2-3 Borrow Source Area
Figure 2j As-Built 2018 Testpit Locations, Km 0.3 Borrow Source Area

PHOTOGRAPHS

Photos 1-2 TP18-18-01
Photos 3-4 TP18-18-02
Photos 5-6 TP18-18-03
Photos 7-8 TP18-08-03A
Photos 9-10 TP18-18-04
Photos 11-12 TP18-18-04A
Photos 13-14 TP18-18-05
Photos 15-16 TP18-18-06
Photos 17-18 TP18-18-07
Photos 19-20 TP18-18-08
Photos 21-22 TP18-18-09

Photos 23-24	TP18-18-10
Photos 25-26	TP18-18-11
Photos 27-28	TP18-18-12
Photos 29-30	TP18-18-13
Photos 31-32	TP18-18-14
Photos 33-34	TP18-18-15
Photos 35-36	TP18-18-16
Photos 37-38	TP18-18-17
Photos 39-40	TP18-18-18
Photos 41-42	TP18-18-19
Photos 43-44	TP18-18-20
Photos 45-46	TP18-18-21
Photos 47-48	TP18-18-22
Photos 49-50	TP18-18-23
Photos 51-52	TP18-18-24
Photos 53-54	TP18-18-25
Photos 55-56	TP18-18-26
Photos 57-58	TP18-18-27
Photos 59-60	TP18-18-28
Photos 61-62	TP18-18-29
Photos 63-64	TP18-18-30
Photos 65-66	TP18-18-31
Photos 67-68	TP18-18-32
Photos 69-70	TP18-18-33
Photos 71-72	TP18-18-36
Photos 73-74	TP18-18-37
Photos 75-76	TP18-18-38
Photos 77-78	TP18-18-39
Photos 79-80	TP18-18-40
Photos 81-82	TP18-18-41
Photos 83-84	TP18-18-42
Photos 85-86	TP18-18-43
Photos 87-88	TP18-18-44
Photos 89-90	TP18-18-45
Photos 91-92	TP18-18-46
Photos 93-94	TP18-18-47
Photos 95-96	TP18-18-48
Photos 97-98	TP18-18-49
Photos 99-100	TP18-18-50
Photos 101-102	TP18-18-51
Photos 103-104	TP18-18-52
Photos 105-106	TP18-18-53
Photos 107-108	TP18-18-54
Photos 109-110	TP18-18-55
Photos 111-112	TP18-18-56

Photos 113-114	TP18-18-57
Photos 115-116	TP18-18-58
Photo 117	TP18-18-59
Photos 118-119	TP18-18-60
Photos 120-121	TP18-18-61
Photos 122-123	TP18-18-62
Photos 124-125	TP18-18-63
Photos 126-127	TP18-18-64
Photos 128-130	TP18-18-65
Photos 131-132	TP18-18-66
Photos 133-135	TP18-18-67
Photos 136-137	TP18-18-68
Photos 138-139	TP18-18-69
Photo 140	TP72-01
Photo 141	TP74-01

APPENDICES

Appendix A	Tetra Tech’s Limitations on Use of this Document
Appendix B	Testpit Logs
Appendix C	Geotechnical Laboratory Soil Test Results

GLOSSARY

Acronyms/Abbreviations	Definition
Active Layer	The top layer of ground subject to annual thawing and freezing in areas underlain by permafrost.
Aggregate Resource	Sand, gravel, or crushed stone used for construction and other industrial purposes.
Alluvium	Materials transported by fluvial action and deposited in river channels and along the floodplains.
Clast	An individual constituent or fragment of a sediment or rock, produced by the physical disintegration (e.g. freeze-thaw cycles) of a larger rock mass. Synonyms include a rock fragment and a stone.
Colluvium	Materials deposited as a result of downslope movements due to gravity, such as rock fall and debris slides.
Cryostructure	The structural characteristics of frozen earth materials determined by the amount and distribution of ground ice (non-visible pore ice and visible excess ice, i.e. ice lenses, inclusions, coatings etc.). Can be described as massive (Nbn and Nbe), layered (Vs), reticulate (Vr) etc.
Cryoturbation	Heaving, churning, and sorting of soil and surficial materials due to repeated freezing and thawing (frost action); results in the development of convoluted structures in the soil, and patterned ground such as stone stripes and sorted polygons.
Debris Slide	A shallow slide consisting of a mass of soil, vegetation, and surficial material; initial displacement is along one or several surfaces of rupture. Composed of comparatively dry and largely unconsolidated earthy material and results in an irregular, hummocky deposit.
Eolian	Well sorted materials, predominantly silt and fine to medium sand, which have been eroded, transported, and deposited by wind.
Excess Ice	The volume of ice in the ground that exceeds the total pore volume that the ground would have under natural unfrozen conditions.
Fibric	The least decomposed state of organic materials – large amounts of weakly decomposed fibres whose botanical origins are readily identifiable are visible. Fibric material has 40% or more by volume of fibre that retains its character upon rubbing.
Frost Jacking	Cumulative upward displacement of objects embedded in the ground, caused by frost action.
Ground Ice	A general term referring to all types of ice (segregated, intrusive, vein etc.) formed in freezing and frozen ground. Occurs in pores, cavities, voids, cracks, fractures, and other openings in frozen soil or rock.
Humic	The greatest decomposed state of organic materials. It has the lowest amount of fiber, the highest bulk density, and the lowest saturated water-holding capacity of the organic materials. It is physically and chemically stable over time, unless drained. Fibres can be easily destroyed by rubbing.

Acronyms/Abbreviations	Definition
Ice Content	The amount of ice contained in frozen or partially frozen soil or rock. Ice content is normally expressed in one of two ways: ▪ On a dry-weight basis (gravimetric), as the ratio of the mass of the ice in a sample to the mass of the dry sample, expressed as a percentage; or ▪ On a volume basis (volumetric), as the ratio of the volume of ice in a sample to the volume of the whole sample, expressed as a percentage.
Loess	A homogeneous massive deposit formed by wind, consisting mainly of silt.
Mesic	Organic material in a stage of decomposition that is intermediate between fibric and humic. Fibre remaining after rubbing constitutes greater than 10% and less than 40% of the volume of the material.
Peat	Unconsolidated compressible material consisting largely of undecomposed, or slightly decomposed, organic matter accumulated under water-saturated conditions. Peat is commonly formed by the slow decay of successive layers of aquatic and semi-aquatic plants in swampy or water-logged areas, where oxygen is absent.
Permafrost	Ground, soil, or rock that remains at or below 0˚C for at least two consecutive years.
Permafrost, Ice-Rich	Permafrost containing excess ice.
Permafrost Table	The upper boundary of permafrost.
Suprapermafrost Water	Water occurring in the active layer above the permafrost table.
Weathered Bedrock	The chemical and physical decomposition and disintegration of bedrock due to exposure to air, moisture, organic matter, and temperature change.

ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
BGS	Below Ground Surface
4WD	Four Wheel Drive
ALT	Active Layer Thickness
CBR	California Bearing Ratio
JDS	JDS Energy & Mining Inc.
Nbe	Well bonded perennially frozen soil with excess ice
Nbn	Well bonded perennially frozen soil with no excess ice
Nf	Poorly bonded or friable perennially frozen soil, no excess ice
Vc	Perennially frozen soil with excess ice visible as ice coating on particles
Vr	Perennially frozen soil with excess ice visible as random or irregularly oriented ice formations
Vs	Perennially frozen soil with excess ice visible as stratified or distinctly oriented ice formations
Vx	Perennially frozen soil with excess ice visible as individual ice inclusions
WRSA	Waste Rock Storage Area

SITE INVESTIGATION WAIVER STATEMENT

To minimize the risk of damage to underground utilities, locating and marking of all underground services will be completed by an independent utility locator service, along with any information provided by the property owner (or their representative) prior to any intrusive field investigation operations. The property owner (or their representative) is responsible for ensuring that any private utilities, such as storm sewers or buried power and gas lines, are identified and located within the investigation areas before the start of any field investigation program. Because Tetra Tech Canada Inc. (Tetra Tech) cannot verify or rely on the accuracy of this information, Tetra Tech will not accept responsibility for damage, or cause for delay, to any party for private or public utilities not properly identified and or located. Any and all costs resulting from the damaged utility, and/or utilities, as a result of our investigation will be the responsibility of JDS Energy & Mining Inc.

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of JDS Energy & Mining Inc. and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than JDS Energy & Mining Inc., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by JDS Energy & Mining Inc. (JDS) to provide geotechnical consulting services for a testpitting program in the Coffee Gold Project (the Project) area in the fall of 2018. The site location map is shown in Figure 1. The objective of the testpitting program was to investigate the composition, diggability, and thickness of the overburden materials overlying bedrock throughout the Project area.

Several previous geotechnical site investigation programs were completed in the Project area, including the most recent geotechnical investigations carried out by Tetra Tech (2017a, b) and jointly by Tetra Tech and SRK Consulting (2017c). The Fall 2018 Testpitting Program was designed to augment a testpitting program completed by Tetra Tech within proposed infrastructure footprints and in proposed open pit areas in the fall of 2017 (Tetra Tech 2017a).

The Fall 2018 Testpitting Program took place from September 5 to September 26, 2018. It consisted of excavation of testpits, logging, and sampling of the exposed surficial materials along the proposed Java Airstrip alignment, in the Supremo, Double Double, and South Latte/Supremo Open Pit areas, in the Facility Pond area, along the Halfway Diversion, the Latte Diversion Channel (Latte Diversion), and in the potential borrow source located at km 0.3 along the existing site access road. (Figures 2 and 2a to 2j). Representative samples of overburden material, including five samples collected by JDS in the potential borrow sources located between 2-3 km and 6-7 km sections of the existing access road (Figures 2, 2h, and 2i), were shipped to Tetra Tech's geotechnical laboratory in Whitehorse for index testing. Specialized testing, such as California Bearing Ratio (CBR), for the samples collected along the Java Airstrip alignment, was performed at Tetra Tech's geotechnical laboratory in Edmonton.

This report presents the geotechnical and permafrost data collected during the Fall 2018 Testpitting Program, including testpit logs and geotechnical laboratory test results. The uppermost subsurface conditions in the proposed mine development areas and at mine construction sites are summarized from the new data.

The data acquired is intended to assist in determining the composition and distribution of surficial materials across the Project footprint and can aid in the updating of material inventory and plan for storage and management of excavated materials. The data can also be used to manage surficial materials during the pre-stripping program.

This report incorporates and is subject to Tetra Tech's Limitations on Use of this Document which are included in Appendix A.

2.0 TESTPITTING GEOTECHNICAL INVESTIGATION

2.1 General

The Fall 2018 Testpitting Program was managed by Dr. Vladislav Roujanski, P.Geol., a senior geologist-geocryologist based in Tetra Tech's Edmonton office, who also provided technical support for the field program. Testpit logging and overburden surficial material sampling was performed in the field by Ms. Jasmine Lalli, E.I.T., based in Tetra Tech's Edmonton office.

Ms. Leigh Sawchyn was JDS's representative on site coordinating the testpitting program on behalf of JDS. Excellent support staff was provided by JDS to excavate the testpits both by excavator and by hand.

Access to the mine laydown area was provided by 4WD pickup. A side-by-side all-terrain vehicle was used to access the testpit sites from the mine laydown area and to scout out locations of testpits to determine the least

environmentally damaging path to be taken by the excavator to mobilize to the testpit locations. The hand-dug testpits in the Halfway Diversion area were accessed by helicopter. Accommodation for all was provided at Goldcorp's Coffee Camp.

Daily Field Reports were compiled at the end of each field day and sent to all interested parties at JDS and Tetra Tech. Weather, work undertaken, names and numbers of testpits completed and samples taken, preliminary information acquired from the testpits, safety and environmental information, and any delays/breakdowns were described in the reports.

2.2 Testpit Locations

The Project area is located within Zone 7 of the Universal Transverse Mercator (UTM) Grid. The horizontal datum for this project is the North American Datum 1983 (NAD83).

Survey control for the testpitting program was provided by Tetra Tech field personnel using a handheld GPS unit (Garmin GPSMAP 62) to locate, verify, and take as-built coordinates of the testpit locations. The as-built testpit coordinates are presented on testpit logs in Appendix B and are summarized in Table 1. Testpit locations are also shown on Figures 2 and 2a to 2j.

Table 1: Testpit Information Summary

Site Infrastructure	Testpit ID	Coordinates UTM Zone 7		Permafrost Condition	Approximate Depth to Fractured Bedrock (m)	Completion Depth (m)
		Northing (m)	Easting (m)			
Java Airstrip Alignment	TP18-18-01	6973546	589168	Unfrozen	0.50	1.60
	TP18-18-02	6973439	589335	Unfrozen	0.50	1.70
	TP18-18-03	6973451	589666	Unfrozen	0.50	1.00
	TP18-18-03A	6973438	589881	Unfrozen	1.30	2.30
	TP18-18-04	6973305	590324	Unfrozen	0.80	1.50
	TP18-18-04A	6973428	589932	Unfrozen	0.40	1.20
km 0.3 Borrow Site	TP18-18-05	6976533	597818	Permafrost encountered at approx. 3.0 m	-	3.00
	TP18-18-06	6976568	597858	Permafrost encountered at approx. 4.0 m	-	4.00
	TP18-18-07	6976607	597895	Permafrost encountered at approx. 0.75 m on one end of pit; approx. 1.5 m for the rest of pit	-	1.70
	TP18-18-08	6976607	597818	Permafrost encountered at approx. 3.70 m	-	3.70
	TP18-18-09	6976531	597895	Unfrozen	-	4.50

Table 1: Testpit Information Summary

Site Infrastructure	Testpit ID	Coordinates UTM Zone 7		Permafrost Condition	Approximate Depth to Fractured Bedrock (m)	Completion Depth (m)
		Northing (m)	Easting (m)			
Supremo	TP18-18-10	6974290	584314	Unfrozen	Undetermined	1.70
	TP18-18-11	6974362	584279	Unfrozen	0.60	1.50
	TP18-18-12	6974360	584346	Permafrost encountered at approx. 1.2 m	Undetermined	1.20
	TP18-18-13	6974455	584310	Unfrozen	0.30	1.30
	TP18-18-14	6974553	584276	Permafrost encountered at approx. 0.7 m	0.70	1.40
	TP18-18-15	6974554	584338	Unfrozen	0.60	1.60
	TP18-18-16	6974236	584344	Unfrozen	1.00	1.30
	TP18-18-17	6974194	584235	Unfrozen	0.50	1.80
	TP18-18-18	6974109	584214	Unfrozen	1.20	1.60
	TP18-18-19	6974174	584339	Unfrozen	0.70	1.50
	TP18-18-20	6973697	584099	Permafrost encountered at approx. 0.5 m	0.80	1.70
	TP18-18-21	6973775	583939	Unfrozen	2.00	3.50
	TP18-18-22	6973699	583951	Unfrozen	2.50	4.00
	TP18-18-23	6973611	584101	Permafrost encountered at approx. 0.7 m	Undetermined	1.30
	TP18-18-24	6973587	584161	Unfrozen	2.00	4.00
Double Double	TP18-18-25	6973302	584988	Unfrozen	0.50	1.40
	TP18-18-26	6973325	585045	Unfrozen	1.30	1.80
	TP18-18-27	6973357	585390	Unfrozen	1.50	4.00
	TP18-18-28	6973298	585182	Unfrozen	1.20	2.20
	TP18-18-29	6973292	585066	Unfrozen	0.50	1.50
	TP18-18-30	6973289	584899	Unfrozen	0.70	1.70
	TP18-18-31	6973291	584958	Unfrozen	0.90	1.90

Table 1: Testpit Information Summary

Site Infrastructure	Testpit ID	Coordinates UTM Zone 7		Permafrost Condition	Approximate Depth to Fractured Bedrock (m)	Completion Depth (m)
		Northing (m)	Easting (m)			
South Latte/ Supremo	TP18-18-32	6973107	584041	Unfrozen	1.20	4.00
	TP18-18-33	6972989	584017	Unfrozen	1.20	1.70
South Latte	TP18-18-36	6973113	583568	Permafrost encountered at approx. 1.0 m	Undetermined	1.70
	TP18-18-37	6972966	583611	Permafrost encountered at approx. 1.0 m	Undetermined	1.00
	TP18-18-38	6972913	583637	Permafrost encountered at approx. 1.2 m	Undetermined	1.20
	TP18-18-39	6972791	583682	Unfrozen	0.20	1.20
Facility Pond Area	TP18-18-40	6972594	583245	Unfrozen	1.00	3.00
	TP18-18-41	6972622	583212	Unfrozen	0.90	2.30
	TP18-18-42	6972644	583052	Permafrost encountered at approx. 1.9 m	1.00	1.90
	TP18-18-43	6972577	582970	Unfrozen	0.80	2.00
	TP18-18-44	6972544	583067	Unfrozen	1.90	2.80
	TP18-18-45	6972551	583166	Permafrost encountered at approx. 2.0 m	0.80	2.00
	TP18-18-46	6972495	583231	Permafrost encountered at approx. 1.2 m	Undetermined	1.20
	TP18-18-47	6972489	583120	Unfrozen	Undetermined	2.70
	TP18-18-48	6972433	583188	Unfrozen	1.00	2.70
	TP18-18-49	6972687	583267	Unfrozen	1.30	2.10

Table 1: Testpit Information Summary

Site Infrastructure	Testpit ID	Coordinates UTM Zone 7		Permafrost Condition	Approximate Depth to Fractured Bedrock (m)	Completion Depth (m)
		Northing (m)	Easting (m)			
Latte Diversion Channel	TP18-18-50	6972839	583451	Permafrost encountered at approx. 0.5 m in one corner of pit	Undetermined	1.30
	TP18-18-51	6972771	583345	Permafrost encountered at approx. 0.5 m	Undetermined	2.10
	TP18-18-52	6972692	583224	Unfrozen	1.00	2.30
	TP18-18-53	6972625	583078	Unfrozen	1.25	2.60
	TP18-18-54	6972572	582907	Unfrozen	2.00	2.50
	TP18-18-55	6972511	582748	Unfrozen	1.50	2.50
	TP18-18-56	6972461	582591	Unfrozen	0.70	1.70
	TP18-18-57	6972442	582419	Unfrozen	1.20	2.30
	TP18-18-58	6972397	582285	Permafrost encountered at approx. 1.3 m	Undetermined	1.30
	TP18-18-59	6972345	582121	Unfrozen	Undetermined	2.30
	TP18-18-60	6972288	581947	Unfrozen	Undetermined	2.30
	TP18-18-61	6972218	581847	Unfrozen	Undetermined	1.90
	TP18-18-62	6972146	581774	Unfrozen	Undetermined	1.50
	TP18-18-63	6972067	581710	Unfrozen	Undetermined	2.10
Halfway Diversion	TP18-18-64	6973550	581378	Permafrost encountered at approx. 0.25 m	Undetermined	1.00
	TP18-18-65	6973822	581437	Unfrozen	Undetermined	1.4
	TP18-18-66	6974230	581753	Permafrost encountered at approx. 0.7m	Undetermined	1.1
	TP18-18-67	6974466	581601	Unfrozen	0.80	1.4
	TP18-18-68	6975993	582938	Unfrozen	Undetermined	1.2
	TP18-18-69	6976175	583579	Permafrost encountered at approx. 0.45 m	Undetermined	1.2

Table 1: Testpit Information Summary

Site Infrastructure	Testpit ID	Coordinates UTM Zone 7		Permafrost Condition	Approximate Depth to Fractured Bedrock (m)	Completion Depth (m)
		Northing (m)	Easting (m)			
km 2-3/km 6-7 Borrow Sources	TP18-18-70	6975525	597078	-	-	-
	TP18-18-71	6975460	597121	-	-	-
	TP18-18-72	6974037	595106	-	-	-
	TP18-18-73	6974049	594987	-	-	-
	TP18-18-74	6974021	594701	-	-	-

2.3 Testpitting Methodology

To achieve the objective of the testpitting program, overburden materials were exposed in 69 testpits by either hand-digging or the use of an excavator. As per their availability, a CAT 320C, CAT 349F, CAT 312C, or, most often, CAT 336E excavator was used. Due to Halfway Diversion being inaccessible by the excavator, testpits in this area were dug by hand.

Unfrozen (or thawed) and frozen overburden soil and bedrock exposed in the completed testpits was logged and sampled immediately following the testpit excavation to ensure that there was minimal thermal disturbance to permafrost exposed in the testpit walls. Representative disturbed soil samples were placed in plastic bags for moisture preservation and transported in plastic pails (unfrozen samples) or in coolers (frozen samples) to the offsite geotechnical laboratory.

Proposed TP18-18-34 and TP18-18-35 locations were found to be originally selected on a very steep slope that was inaccessible to the excavator and, therefore, these two proposed testpits were cancelled. Two additional testpits (TP18-18-03A and TP18-18-04A) were excavated along the proposed Java Airstrip alignment.

Five additional testpits (TP18-18-70 through TP18-18-74) were dug by JDS in the potential borrow sources located between 2-3 km and 6-7 km sections of the existing access road after Tetra Tech personnel left the Project site. No testpit logs are available for these testpits. One sample was collected from each of the five testpits (sample numbers TP70-01 through TP74-01). All five samples were tested at Tetra Tech's geotechnical laboratory in Whitehorse and the test results are included in this report.

All testpits were infilled immediately following logging and sampling. Organic cover was removed first and set aside; it was replaced last to help insulate the disturbed overburden material and prevent permafrost thaw. Photos were taken of the soils and bedrock encountered, as well as of the infilled excavations to record the reclamation efforts. Selected photographs of the overburden and fragmented bedrock, as well as some photos of the testpit sites before and after excavation, are presented in the "Photographs" section of this report.

2.4 Geotechnical Logging

Overburden soils were logged according to the Modified Unified Soil Classification System guidelines (Appendix B), ASTM and Tetra Tech's methodology for logging frozen and unfrozen overburden, which includes soil composition, particle shape, moisture, colour, and consistency of soil (ASTM D2488 and Tetra Tech's WM4400), and frozen soil classification based on whether ice is visible or not (ASTM D4083 and Tetra Tech's WM4102).

Information recorded in the testpit logs included types of surficial materials, depth to bedrock (where applicable), presence of peat/organic soil, grain size and composition of deposits, frozen/unfrozen state, diggability, active layer thickness (ALT), and amount and type of ground ice, if present. The field testpit logs are provided in Appendix B.

2.5 Laboratory Testing

2.5.1 General

Laboratory testing of a select number of representative samples of various overburden surficial material types were taken for analysis to Tetra Tech's geotechnical laboratory in Whitehorse. Testing performed included particle size distribution and moisture content analyses, and a limited number of hydrometer, Atterberg limit, excess ice content, and bulk density tests. Bulk samples taken from the testpits excavated along the Java Airstrip alignment (Figures 2 and 2g) were combined for California Bearing Ratio (CBR) testing at Tetra Tech's geotechnical laboratory in Edmonton. The five soil samples collected by JDS in the km 2-3 and km 6-7 Borrow Source areas (Figures 2, 2h, and 2i) were tested for moisture-density (Proctor) relationship.

The geotechnical laboratory soil testing results are summarized in Tables 2 and 3, are shown on the testpit logs in Appendix B, and are presented fully in Appendix C.

Table 2: Summary of Offsite Geotechnical Laboratory Testing Results

Site Infrastructure	Sample Number	Depth		Moisture Content (%)	Fines (%)		Sand (%)	Gravel (%)	Cobble (%)	Atterberg Limits			Excess Ice Content (% by volume)	Bulk Density (kg/m^3)	Proctor Result	
		From (m)	To (m)		Clay (%)	Silt (%)				LL	PL	PI			Maximum Dry Density (kg/m^3)	Optimum Moisture Content (%)
Java Airstrip Alignment	TP01-01	0.30	0.50	11.9	34		32	34	0	17	14	3	-	-	2,040	10.9
	TP02-01	0.20	0.40	13.9									-	-		
	TP03-01	0.20	0.30	29.2									-	-		
	TP03A-01	0.70	1.30	9.5									-	-		
	TP04-01	0.35	0.80	-									-	-		
	TP04A-01	0.10	0.40	16.4									-	-		
km 0.3 Borrow Site	TP05-02	0.70	1.40	2.1	2		68	30	0	-	-	-	-	-	-	-
	TP06-01	0.15	1.00	8.4	36		44	20	0	-	-	-	-	-	-	-
	TP06-02	1.00	1.50	1.4	-		95	5	0	-	-	-	-	-	-	-
	TP06-03	4.00	4.00	6.1	13		72	15	0	-	-	-	-	-	-	-
	TP07-02	1.40	1.60	3.4	2		92	6	0	-	-	-	-	-	-	-
	TP08-02	0.65	1.10	1.7	3		55	42	0	-	-	-	-	-	-	-
	TP08-03	1.10	1.60	2.1	1		98	1	0	-	-	-	-	-	-	-
	TP09-02	1.20	1.50	1.6	1		88	11	0	-	-	-	-	-	-	-
Supremo	TP12-01	0.40	1.20	22.8	55		17	28	0	-	-	-	-	-	-	-
	TP14-01	0.30	0.70	24.1	59		14	27	0	-	-	-	-	-	-	-
	TP17-01	0.00	1.80	11.8	27		26	47	0	-	-	-	-	-	-	-
	TP21-01	0.30	3.50	9.7	17		34	49	0	-	-	-	-	-	-	-
	TP24-01	0.40	1.00	11.5	25		39	36	0	-	-	-	-	-	-	-
Double Double	TP25-01	0.20	1.40	11.0	21		36	43	0	-	-	-	-	-	-	-
	TP27-01	0.30	4.00	10.1	11		49	40	0	-	-	-	-	-	-	-
	TP28-01	0.20	2.20	10.7	25		37	38	0	-	-	-	-	-	-	-
	TP30-01	0.30	1.70	12.2	25		37	38	0	-	-	-	-	-	-	-
South Latte/ Supremo	TP32-01	0.15	0.70	11.1	13		38	49	0	-	-	-	-	-	-	-
	TP32-02	0.70	1.20	17.0	13	19	36	32	-	-	-	-	-	-	-	-
	TP33-01	0.20	0.90	26.4	19		33	48	0	-	-	-	-	-	-	-
South Latte	TP36-01	0.50	1.00	40.4	25		32	43	0	-	-	-	-	-	-	-
	TP36-02	1.00	1.70	17.4	7	9	47	37	-	32	0	0	-	-	-	-
	TP38-01	0.40	1.00	-	52		20	28	0	-	-	-	-	-	-	-

Table 2: Summary of Offsite Geotechnical Laboratory Testing Results

Site Infrastructure	Sample Number	Depth		Moisture Content (%)	Fines (%)		Sand (%)	Gravel (%)	Cobble (%)	Atterberg Limits			Excess Ice Content (% by volume)	Bulk Density (kg/m^3)	Proctor Result	
		From (m)	To (m)		Clay (%)	Silt (%)				LL	PL	PI			Maximum Dry Density (kg/m^3)	Optimum Moisture Content (%)
Facility Pond Area	TP40-01	0.30	1.00	8.9	9		42	49	0	-	-	-	-	-	-	-
	TP42-01	0.40	1.00	19.3	19		50	31	0	-	-	-	-	-	-	-
	TP43-01	0.20	0.80	12.5	23		34	43	0	-	-	-	-	-	-	-
	TP48-01	0.30	1.00	15.1	18		38	44	0	-	-	-	-	-	-	-
	TP49-01	0.40	1.00	11.6	8	15	55	22	-	27	0	0	-	-	-	-
Latte Diversion Channel	TP51-01	0.50	1.00	17.8	26		51	23	0	-	-	-	-	-	-	-
	TP52-01	0.45	1.00	14.4	21		46	33	0	-	-	-	-	-	-	-
	TP58-01	0.60	1.30	25.2	43		36	21	0	-	-	-	-	-	-	-
	TP59-01	0.35	1.30	11.4	8	25	34	33	-	25	0	0	-	-	-	-
	TP59-02	1.30	2.30	8.1	22		40	38	0	-	-	-	-	-	-	-
	TP62-01	0.45	1.30	11.7	27		32	41	0	-	-	-	-	-	-	-
Halfway Diversion	TP64-01	0.25	0.50	194.7	57		43	0	0	-	-	-	-	-	-	-
	TP65-01	0.20	0.50	35.1	22		35	43	0	-	-	-	-	-	-	-
	TP66-01	0.50	0.70	19.0	11	36	38	15	-	0	0	0	0.0	2,116	-	-
	TP66-02	0.70	1.10	41.9	27		27	46	0	-	-	-	29.9	-	-	-
	TP67-02	0.50	0.80	28.6	62		28	10	0	-	-	-	-	-	-	-
	TP68-02	0.45	0.90	9.5	22		33	38	7	-	-	-	-	-	-	-
	TP68-03	0.90	1.20	10.3	7	15	38	40	-	0	0	0	-	-	-	-
	TP69-01	0.90	0.95	529.0	-		-	-	-	-	-	-	41.7	1,001	-	-
	TP69-02	0.40	0.70	277.2	-		-	-	-	-	-	-	34.9	-	-	-
	TP69-03	0.80	1.20	313.7	-		-	-	-	-	-	-	34.4	-	-	-
km 2-3/km 6-7 Borrow Sources	TP70-01	1.50	1.50	5.0	8		38	41	13	-	-	-	-	-	2,150	7.0
	TP71-01	1.50	1.50	7.1	12		57	31	0	-	-	-	-	-	2,170	7.5
	TP72-01	1.50	1.50	12.6	18		26	49	7	-	-	-	-	-	2,060	8.0
	TP73-01	1.50	1.50	4.8	9		19	65	7	-	-	-	-	-	2,140	7.0
	TP74-01	1.50	1.50	9.9	10		32	54	4	-	-	-	-	-	2,160	7.5

2.5.2 Index Testing

Index testing was conducted to characterize and determine physical-mechanical characteristics of the various overburden materials. The testing included particle size distribution and moisture content analysis on most of the samples. Atterberg limit tests were performed, as requested by SRK, on a select number of samples from the Facility Pond Area, Halfway Diversion, Latte Diversion, and South Latte areas. Samples that were able to remain frozen received excess ice content determination and bulk density testing.

2.5.3 California Bearing Ratio

CBR testing was conducted to evaluate the mechanical strength of the overburden material along the proposed Java Airstrip alignment. It was performed on a combined sample of all material collected from the Java Airstrip alignment to aid in the airstrip design. The results of the CBR testing are summarized in Table 3 and shown fully in Appendix C.

Table 3: Summary of California Bearing Ratio Test Results

	Before Soaking			After Soaking		
	10 Blows	**25 Blows**	**56 Blows**	**10 Blows**	**25 Blows**	**56 Blows**
Bearing Ratio (0.1")	25.6%	43.0%	51.4%	19.4%	30.0%	34.1%
Bearing Ratio (0.2")	34.8%	59.9%	61.9%	25.0%	46.6%	48.8%
Moisture Content	11.0%	11.0%	11.0%	12.8%	11.2%	11.1%
Moisture Content at Top 1"	-	-	-	13.4%	12.4%	11.4%

2.5.4 Moisture-Density Relationship (Proctor)

The Proctor compaction test was conducted on the samples obtained from the potential borrow sources located between 2-3 km and 6-7 km sections of the existing access road to determine the optimal moisture content at which the borrow material will reach its maximum dry density. The moisture-density relationship was determined using the Modified Proctor method as per ASTM D1557. The moisture-density relationship was also determined for the samples obtained from the Java Airstrip alignment as part of the CBR testing. These Proctor test results are summarized in Table 2 and shown fully in Appendix C.

3.0 SUBSURFACE CONDITIONS

3.1 General

Sixty-nine testpits were excavated during the Fall 2018 Testpitting Program along the proposed Java Airstrip alignment, in the Supremo, Double Double, and South Latte/Supremo Open Pit areas, in the Facility Pond area, along the Halfway Diversion, the Latte Diversion, and in the km 0.3 potential borrow source area. The testpit locations are shown in Figures 2 and 2a to 2j. Testpit logs containing sample locations and geotechnical laboratory test results are provided in Appendix B.

The overburden materials and subsurface conditions, observed in all 69 testpits are summarized for each of the proposed mine development and construction sites in the following sections. The summary includes ground diggability assessment to describe the influence of ground conditions on excavating equipment performance. The

diggability range of 1 to 10, with 10 being the most difficult to dig and 1 being the easiest, established by Tetra Tech to compare testpit materials in the Project area (Tetra Tech 2017a) was used in this report.

Permafrost was observed in many of the testpits. Frozen soils with non-visible ice and visible ground ice formations were described in the testpit logs (Appendix B), photographed and sampled for geotechnical laboratory testing.

Selected photographs of the overburden and bedrock exposed in the completed testpits are presented in the "Photographs" section of this report.

3.2 Surficial Materials

Various types of overburden surficial materials were identified within the testpits. These include loess, weathered bedrock, bedrock fragments in a soil matrix, colluvium, alluvium, and organic material (peat and moss cover). These surficial materials are briefly described below to augment Tetra Tech's previous characterization of surficial geology units (Tetra Tech 2017a).

3.2.1 Loess

Loess in the Project area is of wind-blown (eolian) origin (Bond and Lipovsky 2011). As opposed to a generally uniform homogeneous silty soil mass found in other regions, the loess in the Project area tends to become mixed with weathered bedrock or infill voids in fragmented bedrock.

Loess mixed with varying amounts of coarser overburden material particles was generally observed in the uppermost portion of the excavated testpits. It commonly forms a matrix for varying amounts of rock fragments of a wide range of sizes – from gravel to boulders.

3.2.2 Weathered Bedrock

The proposed open pit areas (Supremo, Double Double, Latte) are often covered with weathered bedrock ranging from slightly to completely weathered into residual soil varieties. The residual soil consists of rock material converted into soil. The original rock mass structure and material fabric are completely destroyed; however, the resultant soil has not been significantly transported.

The residual soil forms a soft mica sand in schist areas (TP18-18-24) and an easily crumbled sand to pea-sized gravel in granitic areas (TP18-18-59). Testpitting with an excavator commonly had refusal on competent fractured bedrock, whereas fragmented, frost-shattered bedrock was still diggable.

3.2.3 Colluvium

Colluvium was identified in several testpits on slopes (Photo 7 and Photo 135). A textural indicator used to confirm this type of surficial material was the presence of void spaces between angular cobble-sized and boulder-sized rock fragments and a lack of finer material.

3.2.4 Organic Material

Organic material described in the testpit logs includes moss and an underlying peat layer of varying thickness, but generally not exceeding 0.7 m (TP18-18-37).

3.3 Java Airstrip

3.3.1 Subsurface Conditions

Six testpits (TP18-18-01 to TP18-18-04A) were excavated along the proposed Java Airstrip alignment (Figures 2 and 2g). The subsurface conditions of the site are discussed below and are summarized in Table 4.

Table 4: Overburden and Bedrock Condition Summary, Java Airstrip

Testpit ID	Organic Layer Thickness (m)	Approx. Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-01	0.20	0.50	Rock fragments in a gravel, silty, sandy, trace to some clay matrix	N/A	Unfrozen	-	1.60
TP18-18-02	0.20	0.50	Rock fragments in a gravel, silty, sandy, trace to some clay matrix	N/A	Unfrozen	-	1.70
TP18-18-03	0.20	0.50	Rock fragments in a gravel, silty, sandy, trace to some clay matrix	N/A	Unfrozen	-	1.00
TP18-18-03A	0.10	1.30	Rock fragments in a gravel, silty, sandy, trace to some clay matrix	N/A	Unfrozen	1 (0-1.3 m) 3 (1.3-2.3 m) 10 at 2.3 m	2.30
TP18-18-04	0.35	0.80	Rock fragments in a gravel, silty, sandy, trace to some clay matrix	N/A	Unfrozen	-	1.50
TP18-18-04A	0.10	0.40	Rock fragments in a gravel, silty, sandy, trace to some clay matrix	N/A	Unfrozen	1 (0-0.4 m) 3 (0.4-1.2 m) 10 at 1.2 m	1.20

The organic material layer along the proposed airstrip alignment consists of moss, lichen and peat (fibric to mesic), and rootlets up to 0.35 m thick, dry to damp, light to dark brown.

Cobble-sized and boulder-sized rock fragments approximately 10% to 40% by volume in a gravel, silty, sandy trace to some clay matrix make up the bulk of the residual soil (weathered bedrock) overburden unit. In TP18-18-03A, a layer of cobbly colluvium approximately 0.7 m thick was observed on gentle slope (Photo 7). Thickness of the overburden layer along the airstrip alignment ranged from 0.4 m in TP18-18-04A to 1.3 m in TP18-18-03A.

Permafrost was not encountered in any of the six testpits.

3.3.2 Suitability of Overburden and Upper Bedrock Material for Construction

The proposed Java Airstrip has been designed using a cut and fill approach (Tetra Tech 2018), the suitability of the cut materials for use in the fill sections is discussed here.

Overburden materials along the proposed airstrip alignment (under the thin organic veneer) consist of coarse schist rock fragments (up to 40% by volume) in a well-graded silty, gravelly, sandy matrix. The overburden material has an excessive fines content of up to 34% and is predominantly silt. Furthermore, the likelihood that the uppermost fractured, fragmented, and highly weathered bedrock may easily break down limits the use of this material in most construction applications where durable materials are required.

The unprocessed material can be used as road or airstrip subgrade fill, or as general fill; however, the high silt content will make it difficult to attain suitable compaction during winter construction. It is most suitable for placement during summer months, when it can be placed in an unfrozen condition. Winter placement of the overburden material may cause potential settlement of the runway surface during the following thaw season. If settlement is tolerable in the first summer, then the materials could be considered for use in the airstrip subgrade.

Materials excavated along the airstrip alignment can be improved using appropriate treatment to meet the recommended material specifications and allow for placement with sufficient densification during the winter. The excessive silt in the overburden material requires removal through sieving or blending (McGregor et al. 2010). The presence of boulder-sized rock fragments will need screening and possibly crushing of the oversized fraction. The processed material can be used as a subgrade fill in the airstrip, apron, and taxiway.

In an attempt to achieve suitably graded material for use as airstrip surfacing material, significant screening of the material excavated from the airstrip would have to be undertaken. Tetra Tech believes that although the desired gradation might be produced, there is a high possibility that the produced material will not be suitably durable and will break down generating excessive dust. Other sources of material such as the alluvial gravel material at km 0.3 or quarried material from durable bedrock are recommended to produce airstrip surfacing gravel.

The difficulty of testpit diggability increased with depth ranging from 1 to 3 in the upper soil units to 10 at the bottom of the excavation at depths ranging between 1.2 m to 2.3 m. Testpit excavation refusal occurred on fractured bedrock.

3.4 Supremo Open Pit

3.4.1 Subsurface Conditions

Fifteen testpits (TP18-18-10 to TP18-18-24) were excavated in the Supremo Open Pit area (Figures 2 and 2c). The subsurface conditions of the site are discussed below and are summarized in Table 5.

Table 5: Overburden and Bedrock Condition Summary, Supremo Open Pit

Testpit ID	Organic Layer Thickness (m)	Approximate Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-10	0.30	Undetermined	Rock fragments, gravel, sand	N/A	Unfrozen	8-9	1.70
TP18-18-11	0.30	0.60	Silt, rock fragments, sand, gravel	N/A	Unfrozen	6-8	1.50
TP18-18-12	0.20	Undetermined	Silt, gravel	1.2	Nbe	-	1.20
TP18-18-13	0.10	0.30	Silt, rock fragments, sand	N/A	Unfrozen	5; 10 at 1.3 m	1.30
TP18-18-14	0.25	0.70	Silt, gravel, rock fragments	0.70	Vs, Vc, Vx, 10-15%	1-2 (0-0.7 m) 9-10 at 1.4 m	1.40
TP18-18-15	0.30	0.60	Silt, rock fragments, gravel	N/A	Unfrozen	-	1.60
TP18-18-16	0.30	1.00	Rock fragments, silt, gravel	N/A	Unfrozen	1-2; 10 at 1.3 m	1.30
TP18-18-17	-	0.50	Rock fragments, gravel, sand, silt	N/A	Unfrozen	1; 10 at 1.8 m	1.80
TP18-18-18	-	1.20	Sand, gravel, cobbles	N/A	Unfrozen	1; 10 at 1.6 m	1.60
TP18-18-19	0.30	0.70	Cobbles, silt, gravel, sand	N/A	Unfrozen	1-2; 10 at 1.5 m	1.50
TP18-18-20	0.30	0.80	Gravel, rock fragments	0.5	Vx, 30% Nbe underneath	1-2; 9-10 at 1.7 m	1.70
TP18-18-21	0.30	2.00	Rock fragments, gravel, sand	N/A	Unfrozen	1-2 (0-2 m) 6-7 at 3.5 m	3.50
TP18-18-22	0.30	2.50	Sand and gravel	N/A	Unfrozen	1-2; 10 at 4.0 m	4.00
TP18-18-23	0.40	Undetermined	Silt, gravel, rock fragments	0.7	Vx, (% unknown) Nbe underneath	1-2; 10 at 1.3 m	1.30
TP18-18-24	0.40	2.00	Sand and gravel, silt, sand	N/A	Unfrozen	1-2 (0-2 m) 5-6 to 4.0 m	4.00

The organic material layer within the Supremo Pit footprint consists of moss and peat (fibric to mesic) up to 0.4 m thick, and rootlets, damp to moist, light to dark brown. The organic material is underlain by rock fragments in a finer soil matrix, weathered bedrock (residual soil) or silt (loess).

Silt (loess) in the testpits is mixed with varying amounts of coarser particles. It is also present in the underlying surficial materials, forming a matrix to coarser soil particles. Silt was also observed in the fragmented bedrock. Thickness of the loess layer varies from 0.2 m in TP18-18-13 to more than 0.8 m in TP18-18-12.

Rock fragment units consist of cobble-sized and boulder-sized angular to sub-angular clasts in a finer soil matrix.

Permafrost conditions with both non-visible ice (Nbe) and visible ice (Vx, Vc, Vs) were observed in four testpits (TP18-18-12, -14, -20, and -23; Photos 32, 44, and 50). The volumetric ice content was estimated to be as high as 30% (TP18-18-20). The ALT ranged from 0.5 m (TP18-18-20) to 1.2 m (TP18-18-12).

3.4.2 Suitability of Overburden Material for Construction

Overburden materials encountered below a veneer of organics in the Supremo Open Pit area consists of coarse schist and granite rock fragments of up to 70% by volume. Overburden materials range from a poorly-graded silt (loess) to well-graded silty, gravelly, sandy matrix. The fines content in the overburden material is up to 59% and is predominantly silt. The likelihood that the uppermost fractured, fragmented, and highly weathered bedrock may easily break down, makes this material marginal for use in most construction applications. The unprocessed material could be used as road subgrade and as a general fill if placed during the summer.

Marginal materials can be improved using appropriate treatment to meet the recommended material specifications. Excessive content of silt in the material requires its removal through sieving or blending (McGregor et al. 2010). The presence of boulder-sized rock fragments will need screening and possibly crushing of the oversized fraction. The processed material can be used as a general fill across the site and potentially as an embankment fill for dam construction subject to the design specifications. This processed material would not be suitable as a structural fill required below building foundations or slabs on grade.

Shallow ice-rich permafrost (up to 30% by volume) encountered in some locations will require additional special measures, such as drainage control and air drying of the excavated stockpiled material.

Refusal in the testpits occurred either on frozen ground or fractured bedrock. Diggability ranged from 1 to 2 in the upper soil units and 9 to 10 in the lower units.

3.5 Double Double Open Pit

3.5.1 Subsurface Conditions

Seven testpits (TP18-18-25 to TP18-18-31) were excavated in the Double Double Pit area (Figures 2 and 2f). The subsurface conditions of the site are discussed below and are summarized in Table 6.

Table 6: Overburden and Bedrock Condition Summary, Double Double Open Pit

Testpit ID	Organic Layer Thickness (m)	Approximate Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-25	0.20	0.50	Gravel and sand	N/A	Unfrozen	1-4; 10 at 1.4 m	1.40
TP18-18-26	0.20	1.30	Silt, rock fragments, gravel	N/A	Unfrozen	1-2 (0-0.5 m); 7 (0.5-1.8 m); 9 at 1.8 m	1.80
TP18-18-27	0.30	1.50	Sand and gravel	N/A	Unfrozen	1-2; 8 at 4 m	4.00
TP18-18-28	0.20	1.20	Gravel and sand	N/A	Unfrozen	1-2; 8-9 at 2.2 m	2.20
TP18-18-29	0.20	0.50	Silt, rock fragments	N/A	Unfrozen	1-2; 10 at 1.5 m	1.50
TP18-18-30	0.30	0.70	Gravel and sand, rock fragments, silt	N/A	Unfrozen	1-2; 8-9 at 1.7 m	1.70
TP18-18-31	0.30	0.90	Silt, rock fragments	N/A	Unfrozen	1-2; 9 at 1.9 m	1.90

The organic material layer within the Double Double Pit footprint consists of moss and peat (fibric to mesic) up to 0.3 m thick, and rootlets, damp to moist, light to dark brown. The organic material was found to be underlain by weathered bedrock (residual soil) in TP18-18-25, - 27, -28, and -30 and silt (loess) in TP18-18-26, -29, and -31.

Well graded gravel and sand with varying amounts of silt, clay and cobbles in the testpits make up the bulk of the residual soil (weathered bedrock) overburden unit.

Silt (loess) was found to be mixed with gravel in TP18-18-26 and TP18-18-31, and gravel and cobbles in TP18-18-29. Thickness of the loess layer varies from 0.3 m in TP18-18-26 and TP18-18-29 to 0.6 m in TT18-18-31.

Rock fragment units consist of cobble and boulder-sized angular to sub-angular clasts in a finer soil matrix.

Permafrost was not encountered in any of the seven testpits.

3.5.2 Suitability of Overburden Material for Construction

Overburden materials encountered below a veneer of organics in the Double Double Open Pit area consists of coarse schist rock fragments of up to 80% by volume, in a poorly-graded (silt, loess) to well-graded silty, gravelly, sandy matrix. The fines content in the overburden material is up to 25%, and the fines are predominantly made up of silt. The likelihood that the uppermost fractured, fragmented, and highly weathered bedrock may easily break down make this material marginal for use in most construction applications. The unprocessed material can potentially be used as road subgrade and as a general fill, if placed during the summer.

Marginal materials can be improved using appropriate treatment to meet the recommended material specifications. Excessive content of silt in the material requires its removal through sieving or blending (McGregor et al. 2010).

The presence of boulder-sized rock fragments will need screening and possibly crushing of the oversized fraction. The processed material can be used as a general fill across the site and potentially, as an embankment fill for dam construction subject to the design specifications. This processed material would not be suitable as a structural fill such as might be required below building foundations or slabs on grade.

Refusal in the testpits occurred on fractured bedrock. Diggability ranged from 1 to 2 in the upper soil units to 9 to 10 in the deeper overburden.

3.6 Latte Diversion

Fourteen testpits (TP18-18-50 to TP18-18-63) were excavated along the proposed Latte Diversion (Figures 2, 2d, and 2e). The subsurface conditions of the site are discussed below and are summarized in Table 7.

Table 7: Overburden and Bedrock Condition Summary, Latte Diversion

Testpit ID	Organic Layer Thickness (m)	Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-50	0.50	Undetermined	Rock fragments, silt	N/A	Vx, 10-15%	1-2 (0-1.3 m); 10 at 1.3 m	1.30
TP18-18-51	0.50	Undetermined	Sand, silt, rock fragments	0.5	Vx, 5-10%	1 (0-2.1 m); 10 at 2.1 m	2.10
TP18-18-52	0.50	1.00 (?)	Sand, gravel	N/A	Unfrozen	10 at 2.3 m	2.30
TP18-18-53	0.35	1.25	Silt, sand, gravel, cobbles	N/A	Unfrozen	1-2 (0-2.6 m); 10 at 2.6 m	2.60
TP18-18-54	0.30	2.00	Silt, sand, gravel, rock fragments	N/A	Unfrozen	1-2 (0-2.5 m); 10 at 2.5 m	2.50
TP18-18-55	0.30	1.50	Silt, sand, rock fragments	N/A	Unfrozen	1-2 (0-2.5 m); 10 at 2.5 m	2.50
TP18-18-56	0.30	0.70 (?)	Silt, sand, rock fragments	N/A	Unfrozen	1-2 (0-1.7 m); 10 at 1.7 m	1.70
TP18-18-57	0.30	1.20 (?)	Silt, sand, rock fragments	N/A	Unfrozen	1-2 (0-1.2 m); 7 (1.2-2.3 m) 10 at 2.3 m	2.30
TP18-18-58	0.40	Undetermined	Silt, sand, cobbles, boulders	1.3	Vx, Vs, 20%	1-2 (0-1.3 m); 10 at 1.3 m	1.30
TP18-18-59	0.35	Undetermined	Sand, gravel, boulders	N/A	Unfrozen	10 at 2.3 m	2.30
TP18-18-60	0.20	Undetermined	Silt, sand, gravel, boulders	N/A	Unfrozen	3-4 (0-2.3 m); 10 at 2.3 m	2.30

Table 7: Overburden and Bedrock Condition Summary, Latte Diversion

Testpit ID	Organic Layer Thickness (m)	Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-61	0.40	Undetermined	Silt, boulders	N/A	Unfrozen	8-9	1.90
TP18-18-62	0.45	Undetermined	Gravel, sand, rock fragments	N/A	Unfrozen	5-6 (0-1.5 m); 10 at 1.5 m	1.50
TP18-18-63	0.25	Undetermined	Silt, rock fragments	N/A	Unfrozen	6 (0-2.1 m); 9 at 2.1 m	2.10

The organic material layer along the proposed Latte Diversion channel consists of moss and peat (fibric to humic) up to 0.5 m thick, and rootlets, damp to wet, medium to dark brown. The organic material was found to be underlain by rock fragments in a finer soil matrix, weathered bedrock (residual soil) or silt (loess).

Silt (loess) in the testpits is mixed with varying amounts of coarser particles – cobble and boulder-sized rock fragments, gravel and sand. It is also present in the underlying surficial materials, often forming a matrix to coarser soil particles, and in the fragmented bedrock. Thickness of the loess layer varies from 0.4 m in TP18-18-56 to 1.7 m in TP18-18-54.

Rock fragment units consist of cobble-sized and boulder-sized angular to sub-angular clasts in a finer soil matrix, including loess.

Permafrost conditions with visible ice (Vx, Vs) were observed in three testpits (TP18-18-50, -51, and; -58; Photos 100, 102, and 116). The volumetric ice content was estimated to be as high as 20% (TP18-18-58). The ALT ranged from 0.5 m (TP18-18-51) to 1.3 m (TP18-18-58).

Refusal in the testpits occurred either on frozen ground or fractured bedrock. Diggability ranged from 1 to 2 in the upper soil units and 9 to 10 in the lower units.

3.7 South Latte / Supremo Open Pit Area

Six testpits (TP18-18-32, TP18-18-33, and TP18-18-36 to TP18-18-39) were excavated in the South Latte/Supremo area (Figures 2 and 2e). The subsurface conditions of the site are discussed below and summarized in Table 8.

Table 8: Overburden and Bedrock Condition Summary, South Latte / Supremo Open Pit Area

Testpit ID	Organic Layer Thickness (m)	Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-32	0.15	1.20	Gravel and sand	N/A	Unfrozen	1	4.00
TP18-18-33	0.20	1.20	Gravel, sand	N/A	Unfrozen	1 (0-1.2 m); 3 (1.2-1.7 m); 10 at 1.7 m	1.70
TP18-18-36	0.50	Undetermined	Gravel, rock fragments, sand	1.0	Vx, 5-10%	1-2 (0-1 m); 10 at 1.7 m	1.70
TP18-18-37	0.70	Undetermined	Silt, gravel, cobbles	1.0	Vx, Vc, 15-20%	1-2 (0-1 m); 10 at 1.0 m	1.00
TP18-18-38	0.40	Undetermined	Silt, gravel, rock fragments	1.2	Vx, Vc, 25-30%	1 (0-1.2 m); 10 at 1.2 m	1.20
TP18-18-39	0.20	0.20 (?)	Rock fragments, silt	N/A	Unfrozen	10 at 1.2 m	1.20

The organic material layer consists of moss and peat (fibric to mesic) up to 0.7 m thick (TP18-18-37), damp to wet, medium to dark brown. The organic material was found to be underlain either by rock fragments in a finer soil matrix, mostly weathered bedrock (residual soil) or silt (loess) in TP18-18-38.

The units of rock fragments consist of cobble-sized angular to sub-angular clasts in a finer soil matrix.

Permafrost conditions with visible ice (Vx, Vc,) were observed in three testpits (TP18-18-36, -37, and -38; Photos 72, 74, and 76). The volumetric ice content was estimated to be as high as 30% (TP18-18-38). The ALT ranged from 1.0 m to 1.2 m.

Refusal in the testpits occurred either on frozen ground or fractured bedrock. Diggability ranged from 1 to 2 throughout the testpits (3 in the middle of TP18-18-33), until refusal, where diggability was rated 10.

3.8 Facility Pond Area

Ten testpits (TP18-18-40 to TP18-18-49) were excavated in the Facility Pond area (Figures 2 and 2e). The subsurface conditions of the site are discussed below and are summarized in Table 9.

Table 9: Overburden and Bedrock Condition Summary, Facility Pond Area

Testpit ID	Organic Layer Thickness (m)	Approximate Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-40	0.30	1.00	Gravel and sand	N/A	Unfrozen	1 (0-3 m); 10 at 3 m	3.00
TP18-18-41	0.45	0.90	Gravel and sand	N/A	Unfrozen	1-2 (0-2.3 m); 10 at 2.3 m	2.30
TP18-18-42	0.40	1.00	Sand, gravel, rock fragments	1.90	Vx, 5-10%	1-2 (0-2.5 m); 10 at 2.5 m	1.90
TP18-18-43	0.20	0.80	Gravel, sand	N/A	Unfrozen	1-2 (0-2 m); 10 at 2 m	2.00
TP18-18-44	0.30	1.90	Silt, sand, rock fragments	N/A	Unfrozen	1-2 (0-2 m); 5 (2-2.8 m) 10 at 2.8 m	2.80
TP18-18-45	0.40	0.80	Silt, rock fragments	2.0	Vx, 20%	1-2 (0-2 m); 10 at 2 m	2.00
TP18-18-46	0.40	Undetermined	Silt, cobbles	1.2	Vx, 10-15%	1 (0-1.2 m); 10 at 1.2 m	1.20
TP18-18-47	0.30	Undetermined	Silt, rock fragments	N/A	Unfrozen	1-2 (0-2 m); 3-4 (2-2.7 m); 10 at 2.7 m	2.70
TP18-18-48	0.30	1.00	Gravel and sand	N/A	Unfrozen	1-2 (0-2.7 m); 10 at 2.7 m	2.70
TP18-18-49	0.40	1.30	Sand, cobbles	N/A	Unfrozen	1-2 (0-2.1 m); 10 at 2.1 m	2.10

The organic material layer within the Facility Pond Area consists of moss and peat (fibric to humic) up to 0.4 m thick, and rootlets, damp to wet, medium to dark brown. The organic material was found to be underlain mainly by rock fragments in a finer soil matrix, weathered bedrock (residual soil) or silt (loess).

Silt (loess) in the testpits is mixed with varying amounts of coarser particles – cobble and boulder-sized rock fragments, gravel and sand. It is also present in the underlying surficial materials, often forming a matrix to coarser soil particles, and in the fragmented bedrock. Thickness of the loess layer varies from 0.4 m in TP18-18-45 to 1.7 m in TP18-18-47.

Permafrost conditions with visible ice (Vx) were observed in three testpits (TP18-18-42, -45, and -46; Photos 84, 90, and 92). The volumetric ice content was estimated to be as high as 20% (TP18-18-45). The ALT ranged from 1.2 m (TP18-18-46) to 2.0 m (TP18-18-45).

Refusal in the testpits occurred either on frozen ground or fractured bedrock. Diggability ranged from 1 to 2 throughout most of the testpits, 3 to 5 in some of the intermediate units, and 10 in the lower units.

3.9 Halfway Diversion

Six testpits (TP18-18-64 to TP18-18-69) were excavated along the proposed Halfway Diversion alignment (Figures 2, 2a, and 2b). The subsurface conditions of the site are discussed below and summarized in Table 10.

Table 10: Overburden and Bedrock Condition Summary, Halfway Diversion

Testpit ID	Organic Layer Thickness (m)	Approximate Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-64	0.30	Undetermined	Silt and sand	0.3	Vc, Vx, Vs, 15-35%	10	1.00
TP18-18-65	0.20	Undetermined	Gravel and sand	N/A	Unfrozen	-	1.40
TP18-18-66	0.50	Undetermined	Silt and sand, gravel, rock fragments	0.70	Vx, Vs, 30%	10 at 1.1 m	1.10
TP18-18-67	0.30	0.80	Gravel and cobbles, silt, sand	N/A	Unfrozen	-	1.40
TP18-18-68	0.10	Undetermined	Cobbles and gravel, gravel and sand	N/A	Unfrozen	-	1.20
TP18-18-69	0.40	Undetermined	Silt	0.4	Vx, Vc, Vs, 30-45%	-	1.20

The organic material layer along the proposed Halfway Diversion consists of moss and peat (fibric to humic) up to 0.5 m thick, and rootlets, damp to wet, medium to dark brown. The organic material was found to be underlain by silt (loess) in TP18-18-64, -66, and -69, weathered bedrock (residual soil) in TP18-18-65 and gravel- and cobble-sized colluvium in TP18-18-67 and TP18-18-68.

Silt (loess) in the testpits is mixed with varying amounts of coarser particles as well as trace amounts of clay. Silt (loess) is also present in the underlying surficial materials, forming a matrix to coarser soil particles, and in the fragmented bedrock. Thickness of the loess layer along the proposed Halfway Diversion alignment varies between 0.2 m in TP18-18-66 and 0.8 m in TP18-18-69.

Well graded gravel and sand with varying amounts of silt, clay, and cobbles make up the bulk of the residual soil (weathered bedrock) overburden unit.

The units of rock fragments consist of cobble-sized and boulder-sized angular to sub-angular clasts in a finer soil matrix, including loess.

Refusal in the testpits occurred either on frozen ground or fractured bedrock.

Permafrost conditions with visible ice (Vx, Vs, Vc) were observed in three testpits (TP18-18-64, -66, and -69; Photos 127, 132, and 139). The volumetric ice content was estimated to be as high as 45% (TP18-18-69). An excess ice content (Beaker) test performed on a frozen soil sample collected at a depth of 0.9 m in TP18-18-69 showed volumetric ice content of 42%. The ALT ranged from 0.3 m in TP18-18-64 to 0.7 m in TP18-18-66.

3.10 Km 0.3 Borrow Source

3.10.1 Subsurface Conditions

Five testpits (TP18-18-05 to TP18-18-09) were excavated in the potential borrow source located at km 0.3 of the existing site access road (Figures 2 and 2j). The subsurface conditions of the site are discussed below and are summarized in Table 11.

Table 11: Overburden and Bedrock Condition Summary, km 0.3 Borrow Source Area

Testpit ID	Organic Layer Thickness (m)	Approximate Overburden Thickness (m)	Major Overburden Soil Types	Approximate Active Layer Thickness (m)	Permafrost Condition	Diggability (1-10)	Completion Depth (m)
TP18-18-05	0.15	-	Silt and sand, sand	3.0	Vx, 15-20%	1; 10 at 3.0	3.00
TP18-18-06	0.15	-	Sand and silt, sand	4.0	Vx, 10-15%	1; 10 at 4.0	4.00
TP18-18-07	0.15	-	Silt, sand	0.8 m one one end of pit; 1.5 m for the rest of pit	Nbn; Vx, 15-20%	1; 10 at 1.7 m	1.70
TP18-18-08	0.15	-	Silt, sand and gravel, sand	3.7	Vx, 25-30% Nbe underneath	1; 10 at 3.7 m	3.70
TP18-18-09	0.10	-	Sand	N/A	Unfrozen	1	4.50

The organic material layer within the km 0.3 Borrow Source area consists of moss and peat (fibric to mesic) up to 0.15 m thick, damp, medium to dark brown. The organic material was found to be underlain by alluvium (silt, sand, and gravel).

Silt in the testpits was found almost entirely in the uppermost layers only (ranging from 0.5 m to 1.25 m), with little to no silt found in the layers below. Clean sand with varying amounts of gravel ranging from 1% to 42%, was generally found in the lower layers until refusal on permafrost was reached. The only exception to this was in TP18-18-06, where some silt was found below 1.5 m depth; however, no silt was found in an intermediate layer from 1.0 m to 1.5 m.

Permafrost conditions with both non-visible ice (Nbe, Nbn) and visible ice (Vx) were observed in four testpits (TP18-18-05 to TP18-18-08). The volumetric ice content was estimated to be as high as 30% (TP18-18-08). The ALT in these pits ranged from 0.75 m in TP18-18-07 to 4.0 m in TP18-18-06. No permafrost was encountered in TP18-18-09.

3.10.2 Suitability of Overburden Material for Construction

Overburden materials encountered in the km 0.3 Borrow Source area consist of well-sorted alluvium (sand and sub-rounded gravel) covered by a veneer of silty material and organics. Although this material is well suited for use in most construction applications, the lack of particle angularity may require crushing of larger aggregates found at

this location. The processed material can be used for road and airstrip surfacing, or even as concrete aggregate. To achieve better compaction, alluvium material may require blending and mixing in with the overlying silt.

Ice-rich permafrost (up to 30% by volume) encountered in some locations within the km 0.3 Borrow Source area will require additional special measures, such as drainage control and air drying of the excavated stockpiled material.

Diggability was consistently at a rating of 1 throughout all the testpits in the km 0.3 Borrow Area until refusal. Refusal in all testpits, except for TP18-18-09, occurred on frozen ground. No frozen ground was encountered in TP18-18-09 to a depth of 4.5 m, at which the testpit excavation was terminated.

3.11 Km 2-3/Km 6-7 Borrow Source Areas

Five samples collected from five additional testpits excavated by JDS in the potential borrow sources located between 2-3 km and 6-7 km sections of the existing access road were examined and tested at Tetra Tech's geotechnical laboratories. The test results are summarized in Table 2 and included in Appendix C.

Overburden materials sampled in these potential borrow areas consist of coarse rock fragments in a well-graded gravelly and sandy, trace to some silt matrix (Photos 140 and 141). The gravelly matrix breaks down primarily into sand, as the particle size distribution analysis done on this material shows the content of fines ranging from 8% to 18% (Table 2). The durability of the gravel-sized clasts raises concerns about the potential breakdown of these particles into finer material, if exposed to either mechanical loading (vehicle traffic) or freeze thaw cycles.

The unprocessed material can be used as a general fill and in road and airstrip subgrades. However, the presence of cobble-sized competent rock fragments (Photos 140 and 141) indicates that if screened and crushed, the processed material could be potentially used in locations requiring more stringent particle size distributions (e.g. bedding material).

4.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

Prepared by:
Jasmine Lalli, E.I.T.
Geotechnical Engineer-in-Training, Arctic Region
Direct Line: 587.460.3472
Jasmine.Lalli@tetratech.com

Prepared by:
Vladislav Roujanski. Ph.D., P.Geol. (AB, NT/NU)
Senior Geologist-Geocryologist, Arctic Region
Direct Line: 587.460.3610
Vladislav.Roujanski@tetratech.com

PROFESSIONAL ENGINEER
YUKON
DEREK C. CATHRO
TERRITORY
2019/01/09

Reviewed by:
Kevin W. Jones, P.Eng. (YT/NT/NU/AB/BC)
Vice President, Arctic Development
Direct Line: 587.460.3533
Kevin.Jones@tetratech.com

Reviewed by:
Derek C. Cathro, M.Eng., P.Eng. (YT/NT/NU/AB)
Senior Vice President
Direct Line: 587.460.3477
Derek.Cathro@tetratech.com

/jf

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date January 9/19
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

REFERENCES

ASTM International. 2018. ASTM D4083: Standard Practice for Description of Frozen Soils (Visual-Manual Procedure). 2018 Annual Book of ASTM Standards, American Society for Testing and Materials, Vol. 04.08, Philadelphia.

ASTM International. 2018. ASTM D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). 2018 Annual Book of ASTM Standards, American Society for Testing and Materials, Vol. 04.08, Philadelphia.

Bond, J.D. and Lipovsky, P.S., 2011. Surficial geology, soils and permafrost of the northern Dawson Range. In: Yukon Exploration and Geology 2010, K.E. MacFarlane, L.H. Weston, and C. Relf (eds.), Yukon Geological Survey, p. 19-32.

McGregor, R., Doré, G., Hayley, D.W., Wilkins, G., Hoeve, E., Grozic, E., Roujanski, V., and Jansen, A. 2010. Guidelines for Development and Management of Transportation Infrastructure in Permafrost Regions. Transportation Association of Canada, Ottawa, p.177.

Tetra Tech Canada Inc. (Tetra Tech). 2018. Coffee Gold Mine Project, Airstrip Design. Drawings. Presented to JDS Energy & Mining Inc., dated July 30, 2018, p.25.

Tetra Tech. 2017a. Fall 2017 Testpitting Program Report (Issued for Use), Coffee Mine Site, Phase 1: Proposed Infrastructure Footprints; Phase 2: Proposed Open Pit Areas. Presented to JDS Energy & Mining Inc., dated December 18, 2017, p.11.

Tetra Tech 2017b. Summer 2017 Geotechnical Investigation Data Report (Issued for Use), Coffee Mine Site, Coffee Gold Project. Presented to JDS Energy & Mining Inc., dated November 30, 2017, p.59.

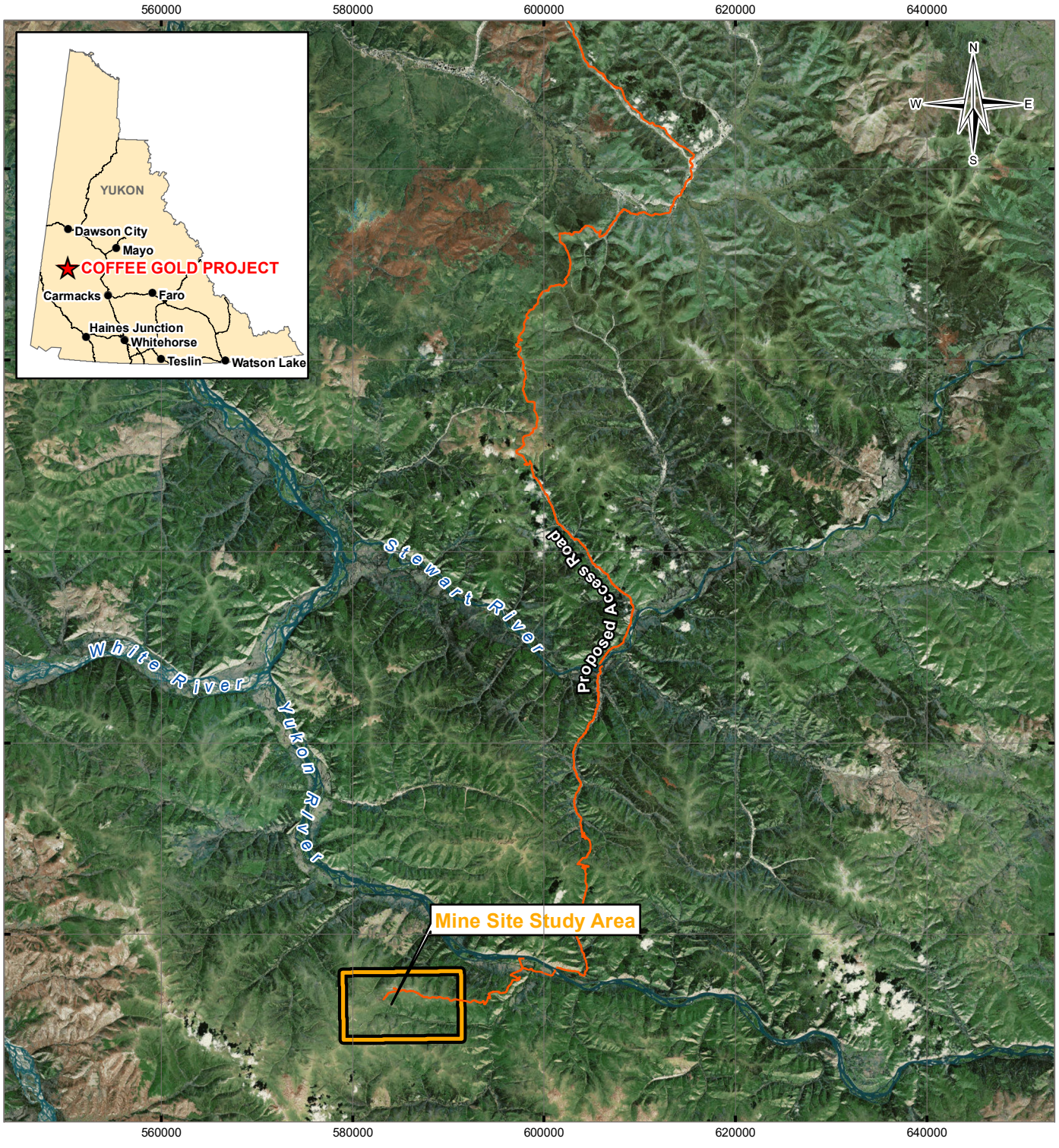
Tetra Tech and SRK Consulting. 2017c. Fall 2016 Geotechnical Investigation Data Report (Issued for Use), Coffee Mine Site, Coffee Gold Project. Presented to Goldcorp Inc., dated March 20, 2017, p.50.

WM4102 Logging of Perennially Frozen Soils and Ground Ice for Engineering Purposes. Tetra Tech Canada Inc.'s work method, p.37.

WM4400 Geotechnical Soil Classification. EBA, A Tetra Tech Company's Work Method, p.16.

FIGURES

Figure 1 Site Location
Figure 2 As-Built 2018 Testpit Site Location Index Map
Figure 2a As-Built 2018 Testpit Locations, Halfway Diversion and Alpha Pond
Figure 2b As-Built 2018 Testpit Locations, Halfway Diversion
Figure 2c As-Built 2018 Testpit Locations, Supremo Open Pit
Figure 2d As-Built 2018 Testpit Locations, Latte Diversion
Figure 2e As-Built 2018 Testpit Locations, Facility Pond and Latte Diversion
Figure 2f As-Built 2018 Testpit Locations, Supremo and Double Double Open Pits
Figure 2g As-Built 2018 Testpit Locations, Java Airstrip Site
Figure 2h As-Built 2018 Testpit Locations, Km 6-7 Borrow Source Area
Figure 2i As-Built 2018 Testpit Locations, Km 2-3 Borrow Source Area
Figure 2j As-Built 2018 Testpit Locations, Km 0.3 Borrow Source Area



LEGEND

- Mine Site Study Area
- Proposed Access Road

NOTES
Base data source:
Imagery from ESRI;
Earthstar Geographics (1999)
Road data from Kaminak (February 2016)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

Site Location

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	JDS Energy & Mining Inc.

Scale: 1:600,000
10 5 0 10
Kilometres

TETRA TECH

FILE NO. EARC03094-06_Figure1.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03094-06	MEZ	SL	VER	0

OFFICE	DATE
Tt-VANC	January 8, 2019

Figure 1

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure1.mxd modified 1/8/2019 by megan.verburg

582000 584000 586000 588000 590000 592000 594000 596000 598000

6980000 6978000 6976000 6974000 6972000 6970000 6968000

Dan Man Creek
Toulsany Creek
Yukon River
Halfway Creek

2a 2b 2c 2d 2e 2f 2g 2h 2i 2j

N W E S

LEGEND

- Testpit As-Built (Fall 2018)
- Watercourse

NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

As-Built 2018 Testpit Site Location Index Map

PROJECTION UTM Zone 7	**DATUM** NAD83	**CLIENT**
Scale: 1:57,500 (1 0.5 0 1 Kilometres)		
FILE NO. EARC03094-06_Figure2.mxd		TETRA TECH
OFFICE Tt-VANC	**DWN** MRV / **CKD** SL / **APVD** VER / **REV** 0	Figure 2
DATE January 8, 2019	**PROJECT NO.** ENG.EARC03094-06	

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2.mxd modified 1/8/2019 by megan.verburg

582500 582750 583000 583250 583500 583750

6976250 6976000 6975750 6975500 6975250

TP18-68

TP18-69

HALFWAY DIVERSION CHANNEL

ALPHA POND

Halfway Creek

N S E W

LEGEND

- Testpit As-Built (Fall 2018)
- Contour (10 m)
- Diversion Channel Alignment
- Pond Boundary

OVERVIEW

a b c d e f g h i j

NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS
ISSUED FOR USE

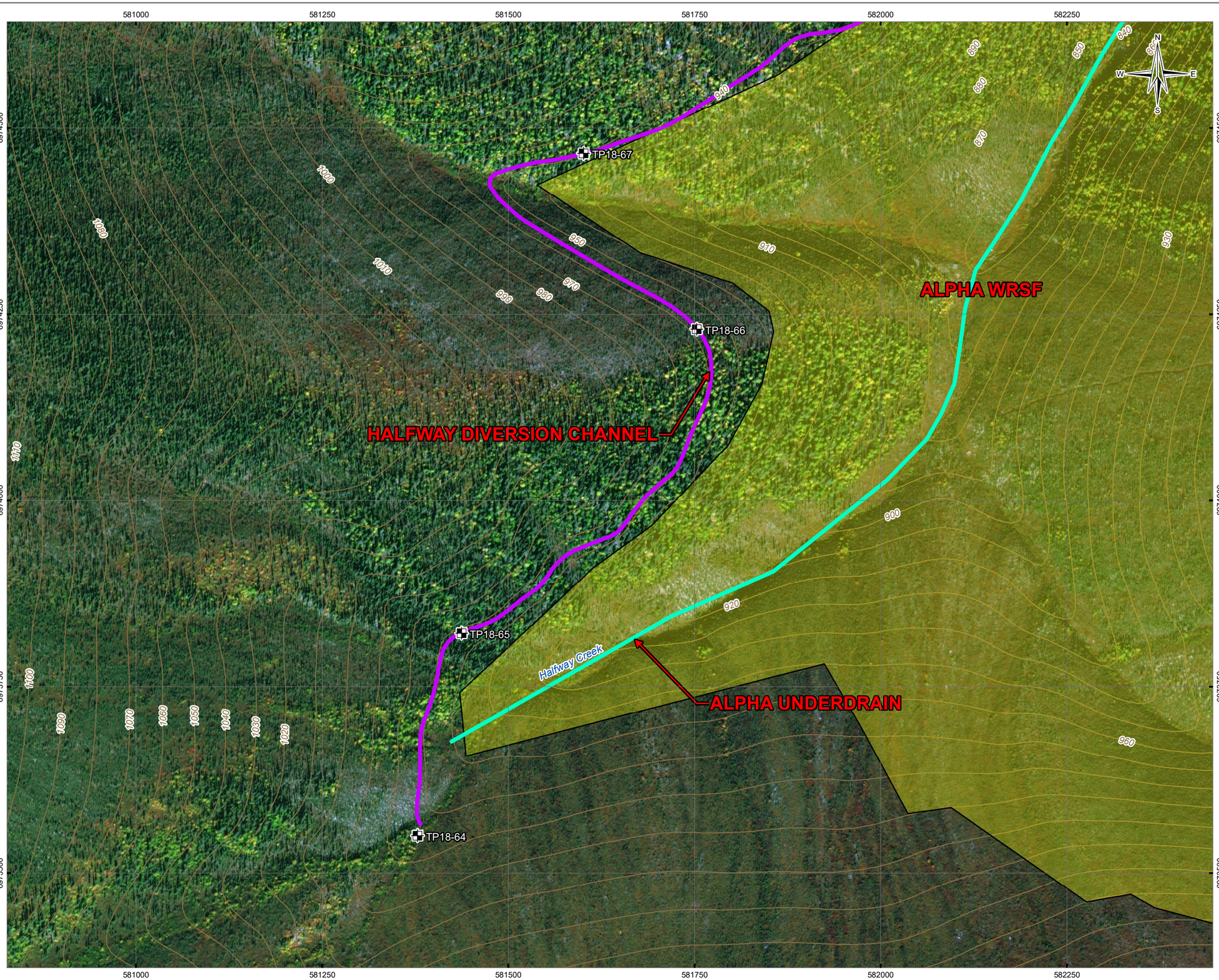
COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

As-Built 2018 Testpit Locations
Halfway Diversion and Alpha Pond

PROJECTION: UTM Zone 7	DATUM: NAD83	CLIENT			
Scale: 1:5,000 (100 50 0 100 Metres)					
FILE NO.: EARC03094-06_Figure2aj.mxd					
OFFICE: Tt-VANC	DWN: MRV	CKD: SL	APVD: VER	REV: 0	Figure 2a
DATE: January 8, 2019	PROJECT NO.: ENG.EARC03094-06				

TETRA TECH

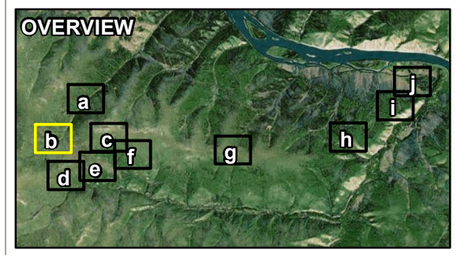
Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg



Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg

LEGEND

- Testpit As-Built (Fall 2018)
- Contour (10 m)
- Waste Rock Storage Facility (WRSF)
- Diversion Channel Alignment
- Underdrain Alignment



NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS

ISSUED FOR USE

COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

As-Built 2018 Testpit Locations Halfway Diversion

PROJECTION UTM Zone 7			**DATUM** NAD83		**CLIENT**
Scale: 1:5,000 100 50 0 100 Metres					TETRA TECH
FILE NO. EARC03094-06_Figure2aj.mxd					
OFFICE Tt-VANC	**DWN** MRV	**CKD** SL	**APVD** VER	**REV** 0	**Figure 2b**
DATE January 8, 2019	**PROJECT NO.** ENG.EARC03094-06				

583500 583750 584000 584250 584500 584750

6974500 6974250 6974000 6973750 6973500

TP18-14 TP18-15 TP18-13 TP18-11 TP18-12 TP18-10 TP18-16 TP18-17 TP18-19 TP18-18 TP18-21 TP18-22 TP18-20 TP18-23 TP18-24

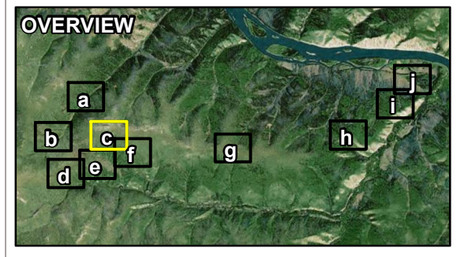
SUPREMO PIT

1250 1250 1300 1290 1280 1270 1240 1230 1200 1190 1170 1180 1220 1210 1140 1150 1120 1160 1110 1130 1090 1030 1070 1100 1020 1040 1050 1060

N W E S

LEGEND

- Testpit As-Built (Fall 2018)
- Contour (10 m)
- Frozen Soil Stockpile
- Pit
- Haul Road Alignment
- Diversion Channel Alignment
- Site Road



NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT FALL 2018 TESTPITTING PROGRAM

As-Built 2018 Testpit Locations Supremo Open Pit

PROJECTION UTM Zone 7		**DATUM** NAD83			**CLIENT**
Scale: 1:5,000 — 100 50 0 100 Metres					
FILE NO. EARC03094-06_Figure2aj.mxd					TETRA TECH
OFFICE Tt-VANC	**DWN** MRV	**CKD** SL	**APVD** VER	**REV** 0	**Figure 2c**
DATE January 8, 2019	**PROJECT NO.** ENG.EARC03094-06				

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg

581500 581750 582000 582250 582500 582750 583000

6972750 6972500 6972250 6972000 6971750

EVENTS POND

LATTE DIVERSION CHANNEL

TP18-43 TP18-54 TP18-55 TP18-56 TP18-57 TP18-58 TP18-59 TP18-60 TP18-61 TP18-62 TP18-63

1150 1160 1170 1180 1190 1200 1210 1220 1230 1240 1250 1260 1090 1070 1050 1010 1000 990 980 970 960 940 930 1120 1140 1030 1070 1040 1110 1100 1130 1020 950 910 900 890 920 880 870 860 850

N W E S

LEGEND

- Testpit As-Built (Fall
- Contour (10 m)
- ROM Stockpile
- Haul Road Alignment
- Diversion Channel
- Pond Boundary
- Site Road

OVERVIEW

a b c d e f g h i j

NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

As-Built 2018 Testpit Locations
Latte Diversion

PROJECTION: UTM Zone 7		DATUM: NAD83		CLIENT	
Scale: 1:5,000 (100 50 0 100 Metres)					
FILE NO.: EARC03094-06_Figure2aj.mxd					
OFFICE: Tt-VANC	DWN: MRV	CKD: SL	APVD: VER	REV: 0	Figure 2d
DATE: January 8, 2019	PROJECT NO.: ENG.EARC03094-06				

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg

583000 583250 583500 583750 584000 584250

6973250 6973000 6972750 6972500 6972250

SUPREMO PIT

LATTE PIT

LATTE DIVERSION CHANNEL

FACILITY POND

TP18-36 TP18-32 TP18-33 TP18-37 TP18-38 TP18-39 TP18-50 TP18-51 TP18-52 TP18-49 TP18-42 TP18-53 TP18-41 TP18-43 TP18-54 TP18-40 TP18-44 TP18-45 TP18-47 TP18-46 TP18-48

1120 1090 1040 1030 950 1080 1090 1050 1010 980 970 920 1060 1110 1100 1070 1050 1020 1000 990 950 900 890 880 870 860 840 650 630 910

N S E W

LEGEND

- Testpit As-Built (Fall
- Contour (10 m)
- Pit
- ROM Stockpile
- Haul Road Alignment
- Diversion Channel
- Pond Boundary
- Site Road

OVERVIEW

a b c d e f g h i j

NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

As-Built 2018 Testpit Locations
Facility Pond and Latte Diversion

PROJECTION: UTM Zone 7	DATUM: NAD83				CLIENT
Scale: 1:5,000 (100 50 0 100 Metres)					
FILE NO.: EARC03094-06_Figure2aj.mxd					TETRA TECH
OFFICE: Tt-VANC	DWN: MRV	CKD: SL	APVD: VER	REV: 0	Figure 2e
DATE: January 8, 2019	PROJECT NO.: ENG.EARC03094-06				

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg

584500 584750 585000 585250 585500 585750 586000

6973750 6973500 6973250 6973000 6972750

SUPREMO PIT

DOUBLE DOUBLE PIT

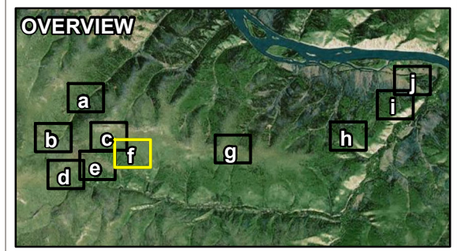
TP18-26 TP18-27 TP18-25 TP18-28 TP18-29 TP18-30 TP18-31

1210 1220 1200 1190 1160 1170 1140 1150 1120 1130 1160 1110 1030 1070 1100 1020 1050 1030 1010 1040 1030 990 1000 960 970 940 950 910 920 930 900 880 890 860 870 840 850

N S E W

LEGEND

- Testpit As-Built (Fall
- Contour (10 m)
- Pit
- Haul Road Alignment
- Diversion Channel



NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

As-Built 2018 Testpit Locations
Supremo and Double Double Open Pits

PROJECTION UTM Zone 7	**DATUM** NAD83	**CLIENT**	
Scale: 1:5,000 100 50 0 100 Metres			
FILE NO. EARC03094-06_Figure2aj.mxd			
OFFICE Tt-VANC	**DWN** MRV / **CKD** SL / **APVD** VER / **REV** 0		**Figure 2f**
DATE January 8, 2019	**PROJECT NO.** ENG.EARC03094-06		

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg

589000 589250 589500 589750 590000 590250 590500

6974000 6973750 6973500 6973250 6973000

TP18-01
TP18-02
TP18-03
TP18-03A
TP18-04A
TP18-04

LEGEND

- Testpit As-Built (Fall
- Contour (10 m)
- Approximate Limit of Site Grading for Cut and
- Apron Centreline
- Runway Centreline
- Site Road

OVERVIEW

a b c d e f g h i j

NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

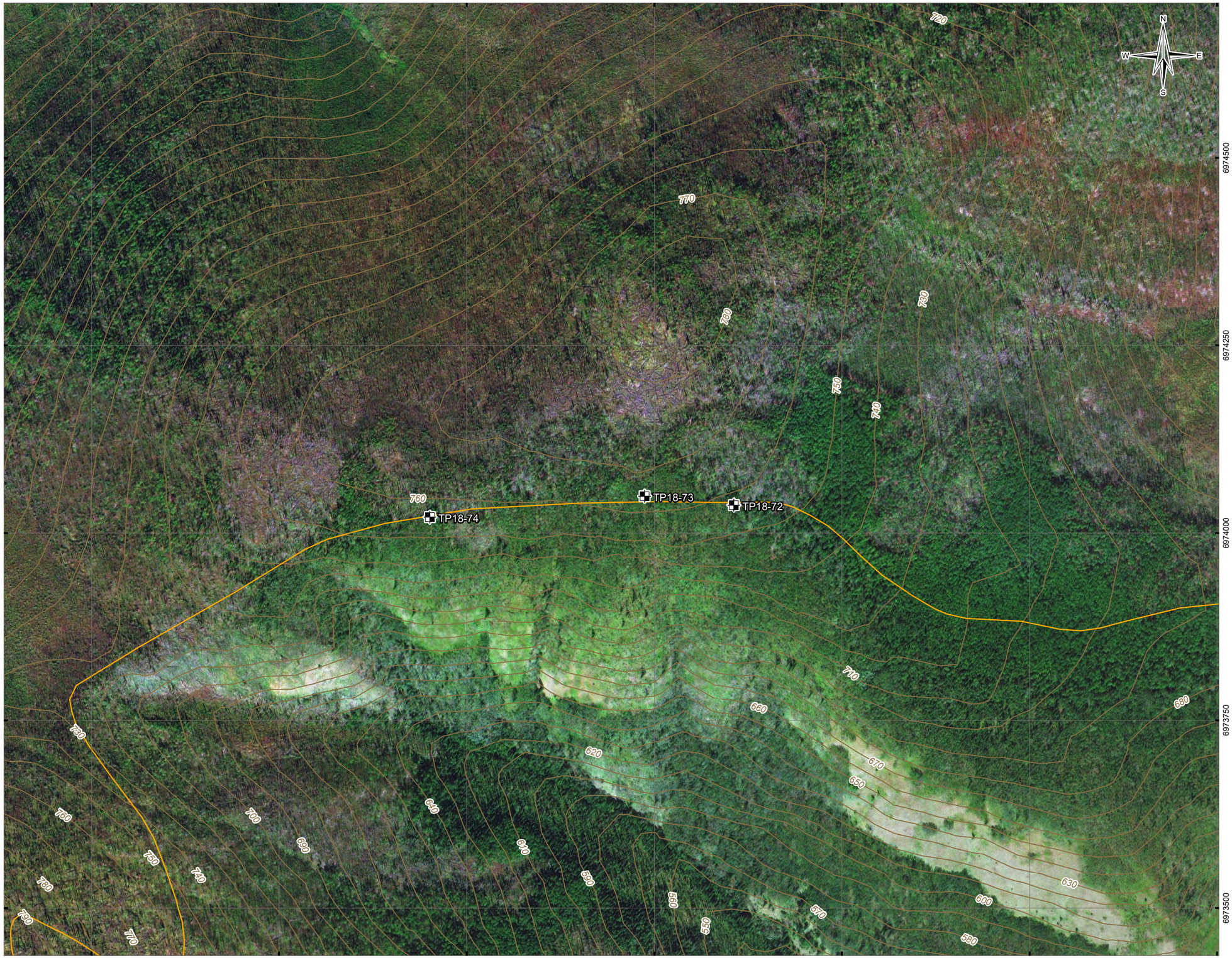
STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

As-Built 2018 Testpit Locations
Java Airstrip Site

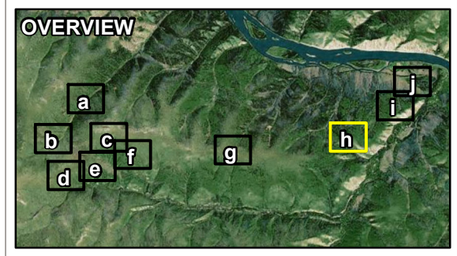
PROJECTION: UTM Zone 7	DATUM: NAD83			CLIENT
Scale: 1:5,000 (100 50 0 100 Metres)				
FILE NO.: EARC03094-06_Figure2aj.mxd				TETRA TECH
OFFICE: Tt-VANC	DWN: MRV	CKD: SL	APVD: VER	REV: 0
DATE: January 8, 2019	PROJECT NO.: ENG.EARC03094-06			Figure 2g

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg



LEGEND

- Testpit As-Built (Fall
- Contour (10 m)
- Site Road



NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

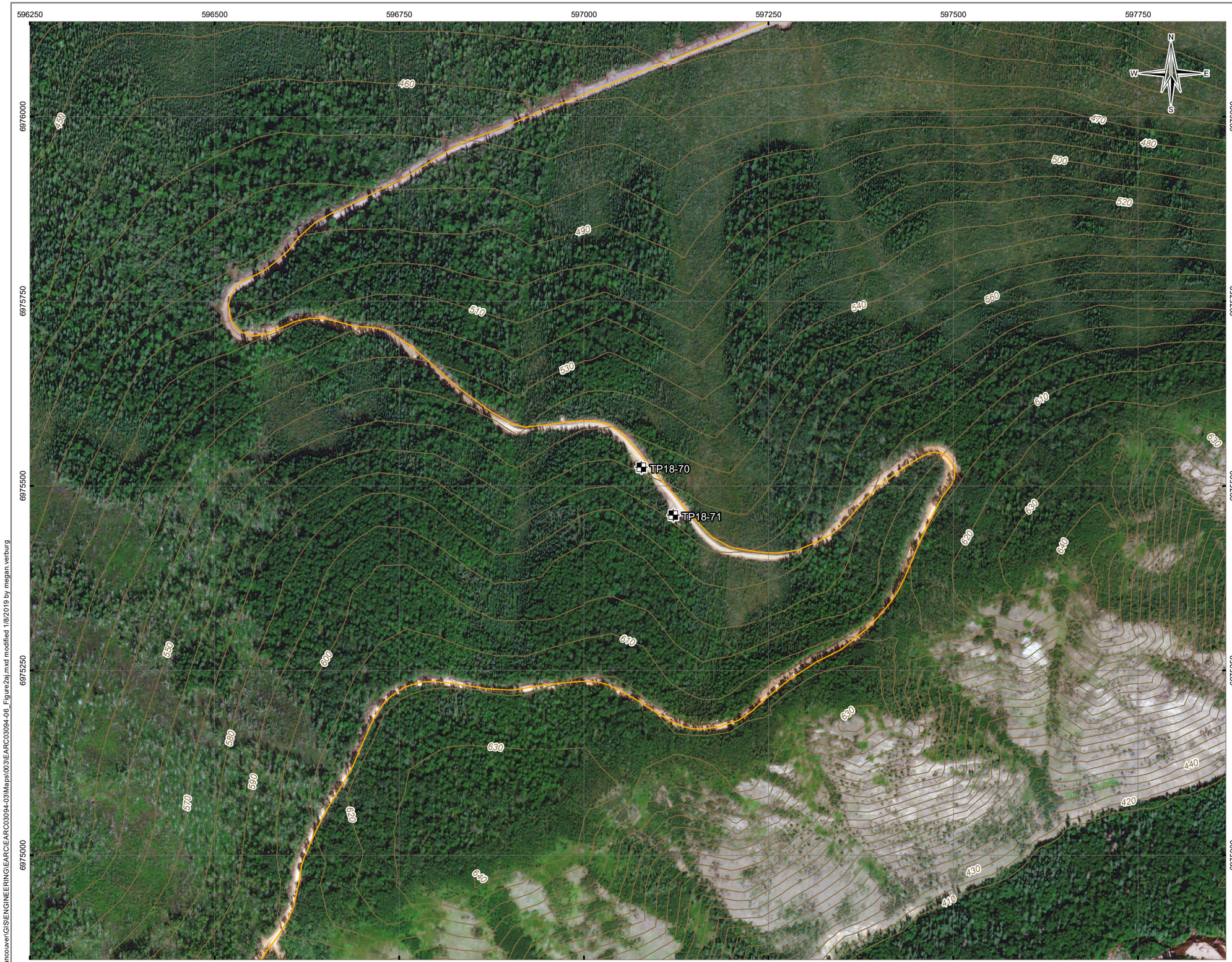
STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT FALL 2018 TESTPITTING PROGRAM

As-Built 2018 Testpit Locations Km 6-7 Borrow Source Area

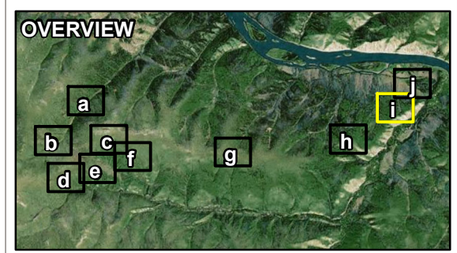
PROJECTION UTM Zone 7	**DATUM** NAD83	**CLIENT**	
Scale: 1:5,000 — 100 50 0 100 — Metres			
FILE NO. EARC03094-06_Figure2aj.mxd		TETRA TECH	
OFFICE Tt-VANC	**DWN** MRV / **CKD** SL / **APVD** VER / **REV** 0		Figure 2h
DATE January 8, 2019	**PROJECT NO.** ENG.EARC03094-06		

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg



LEGEND

- Testpit As-Built (Fall
- Contour (10 m)
- Site Road



NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT FALL 2018 TESTPITTING PROGRAM

As-Built 2018 Testpit Locations Km 2-3 Borrow Source Area

PROJECTION UTM Zone 7		**DATUM** NAD83			**CLIENT**
Scale: 1:5,000					
100 50 0 100 Metres					TETRA TECH
FILE NO. EARC03094-06_Figure2aj.mxd					
OFFICE Tt-VANC	**DWN** MRV	**CKD** SL	**APVD** VER	**REV** 0	**Figure 2i**
DATE January 8, 2019	**PROJECT NO.** ENG.EARC03094-06				

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg

597250 597500 597750 598000 598250 598500

6977000 6976750 6976500 6976250 6976000

390 400 410 420 430 460 470 450 440 480 490

TP18-08 TP18-07 TP18-06 TP18-05 TP18-09

N W E S

LEGEND

- Testpit As-Built (Fall
- Contour (10 m)
- Concrete Aggregate Borrow Prospect
- Access Road
- Site Road

OVERVIEW

a b c d e f g h i j

NOTES

Base Imagery Source: DigitalGlobe, 2009-2015 (varies)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
FALL 2018
TESTPITTING PROGRAM

As-Built 2018 Testpit Locations
Km 0.3 Borrow Source Area

PROJECTION UTM Zone 7		**DATUM** NAD83			**CLIENT**
Scale: 1:5,000 100 50 0 100 Metres					
FILE NO. EARC03094-06_Figure2aj.mxd					TETRA TECH
OFFICE Tt-VANC	**DWN** MRV	**CKD** SL	**APVD** VER	**REV** 0	**Figure 2j**
DATE January 8, 2019	**PROJECT NO.** ENG.EARC03094-06				

Q:\Vancouver\GIS\ENGINEERING\EARC\EARC03094-03\Maps\003\EARC03094-06_Figure2aj.mxd modified 1/8/2019 by megan.verburg

PHOTOGRAPHS

Photos 1-2	TP18-18-01
Photos 3-4	TP18-18-02
Photos 5-6	TP18-18-03
Photos 7-8	TP18-08-03A
Photos 9-10	TP18-18-04
Photos 11-12	TP18-18-04A
Photos 13-14	TP18-18-05
Photos 15-16	TP18-18-06
Photos 17-18	TP18-18-07
Photos 19-20	TP18-18-08
Photos 21-22	TP18-18-09
Photos 23-24	TP18-18-10
Photos 25-26	TP18-18-11
Photos 27-28	TP18-18-12
Photos 29-30	TP18-18-13
Photos 31-32	TP18-18-14
Photos 33-34	TP18-18-15
Photos 35-36	TP18-18-16
Photos 37-38	TP18-18-17
Photos 39-40	TP18-18-18
Photos 41-42	TP18-18-19
Photos 43-44	TP18-18-20
Photos 45-46	TP18-18-21
Photos 47-48	TP18-18-22
Photos 49-50	TP18-18-23
Photos 51-52	TP18-18-24
Photos 53-54	TP18-18-25
Photos 55-56	TP18-18-26
Photos 57-58	TP18-18-27
Photos 59-60	TP18-18-28
Photos 61-62	TP18-18-29
Photos 63-64	TP18-18-30
Photos 65-66	TP18-18-31
Photos 67-68	TP18-18-32

Photos 69-70	TP18-18-33
Photos 71-72	TP18-18-36
Photos 73-74	TP18-18-37
Photos 75-76	TP18-18-38
Photos 77-78	TP18-18-39
Photos 79-80	TP18-18-40
Photos 81-82	TP18-18-41
Photos 83-84	TP18-18-42
Photos 85-86	TP18-18-43
Photos 87-88	TP18-18-44
Photos 89-90	TP18-18-45
Photos 91-92	TP18-18-46
Photos 93-94	TP18-18-47
Photos 95-96	TP18-18-48
Photos 97-98	TP18-18-49
Photos 99-100	TP18-18-50
Photos 101-102	TP18-18-51
Photos 103-104	TP18-18-52
Photos 105-106	TP18-18-53
Photos 107-108	TP18-18-54
Photos 109-110	TP18-18-55
Photos 111-112	TP18-18-56
Photos 113-114	TP18-18-57
Photos 115-116	TP18-18-58
Photo 117	TP18-18-59
Photos 118-119	TP18-18-60
Photos 120-121	TP18-18-61
Photos 122-123	TP18-18-62
Photos 124-125	TP18-18-63
Photos 126-127	TP18-18-64
Photos 128-130	TP18-18-65
Photos 131-132	TP18-18-66
Photos 133-135	TP18-18-67
Photos 136-137	TP18-18-68
Photos 138-139	TP18-18-69

Photo 140 TP72-01
Photo 141 TP74-01



Photo 1: Beginning excavation at TP18-18-01.



Photo 2: Completed excavation at TP18-18-01.



Photo 3: Typical subsurface conditions along Java Airstrip alignment at TP18-18-02. Tape measure is open to 1.7 m.



Photo 4: Close-up of material found at TP18-18-02.



Photo 5: Typical subsurface conditions along Java Airstrip alignment at TP18-18-03. Tape measure is open to 1.0 m.



Photo 6: Completed excavation at TP18-18-03.



Photo 7: Over 0.5 m of colluvium found at TP18-18-03A. Tape measure is open to 1.0 m.



Photo 8: Completed excavation at TP18-18-03A.



Photo 9: Excavation in progress at TP18-18-04.

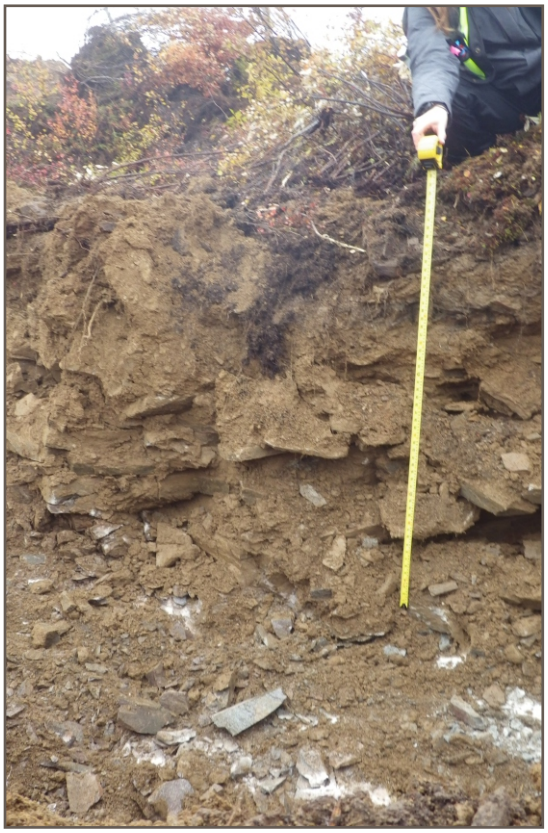


Photo 10: Typical subsurface conditions along Java Airstrip alignment at TP18-18-04. Tape measure is open to 1.4 m.



Photo 11: Typical subsurface conditions along Java Airstrip alignment at TP18-18-04A. Black mark on tape measure is 1.0 m.



Photo 12: Completed excavation at TP18-18-04A.



Photo 13: Silt, underlain by sand and gravel (alluvium) exposed in TP18-18-05, the km 0.3 Borrow Source area at TP18-18-05.



Photo 14: Refusal on permafrost at approximately 3.0 m depth TP18-18-05.



Photo 15: Typical sand, and gravel alluvium covered by silt found in the km 0.3 Borrow Source area at TP18-18-06.



Photo 16: Close-up of alluvium at TP18-18-06.



Photo 17: Over 1.0 m thick silt deposit underlain by uniformly graded sand found at TP18-18-07. Tape measure is open to 1.0 m.

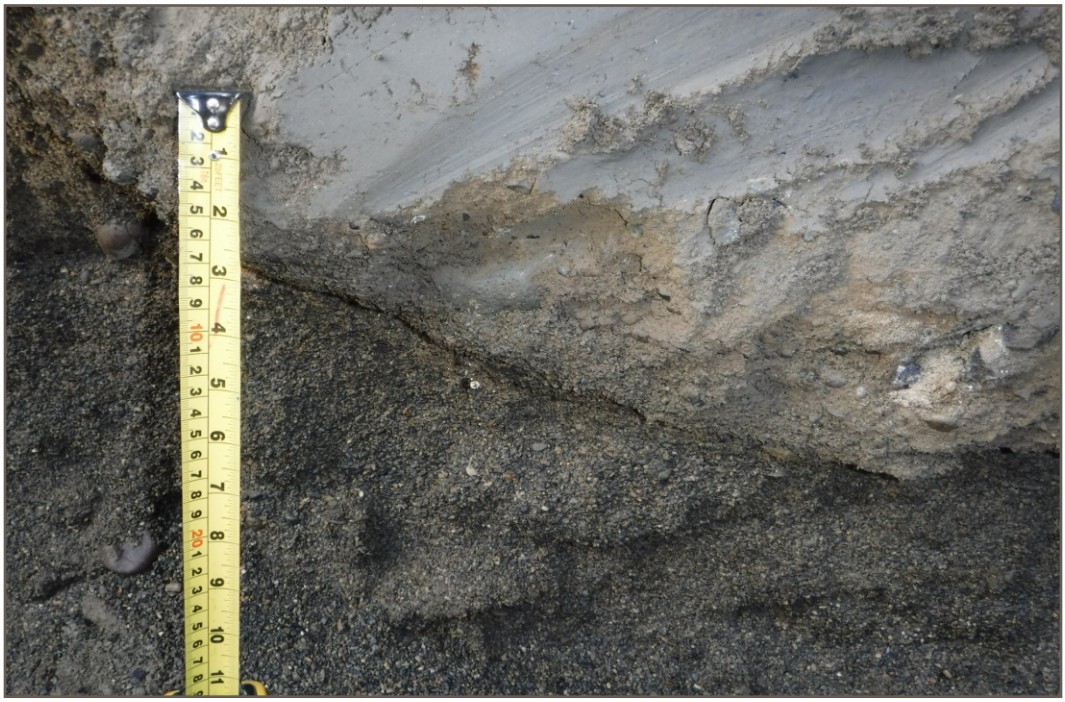


Photo 18: Close-up of transition from silt layer to sand layer at TP18-18-07.



Photo 19: TP18-18-08 after backfilling.



Photo 20: Wavy stratification in sanoly and gravelly alluvium found at TP18-18-08.



Photo 21: Alluvium deposit at TP18-18-09.



Photo 22: Clean sand deposit found in km 0.3 Borrow Source area at TP18-18-09.



Photo 23: Cobble-sized and boulder-sized angular rock fragments at TP18-18-10.



Photo 24: Completed excavation at TP18-18-10.



Photo 25: Excavating at TP18-18-11.



Photo 26: Many cobble-sized angular clasts at TP18-18-11.



Photo 27: Beginning excavation at TP18-18-12.



Photo 28: Silt (loess) deposit at TP18-18-12.



Photo 29: Silt (loess) deposit with rock fragments (weathered bedrock) at TP18-18-13.



Photo 30: Completed excavation at TP18-18-13.



Photo 31: Silt (loess) deposit with rock fragments (weathered bedrock) at TP18-18-14.



Photo 32: Ice inclusions at TP18-18-14.



Photo 33: Silt (loess) deposit with rock fragments (weathered granite) at TP18-18-15.



Photo 34: Cobble-sized angular rock fragments in a silty, sandy matrix at TP18-18-15.



Photo 35: Cobble-sized and boulder-sized rock fragments in a mainly silt (loess) matrix at TP18-18-16.



Photo 36: Approximately 50%-60% oversized material at TP18-18-16.



Photo 37: Beginning excavation at TP18-18-17.



Photo 38: Cobble-sized and boulder-sized rock fragments in a gravelly, silty, sandy matrix at TP18-18-17.



Photo 39: Beginning excavation at TP18-18-18.



Photo 40: Bedrock weathered completely down to sand at TP18-18-18.



Photo 41: Cobbles in a mainly silty matrix at TP18-18-19.



Photo 42: Refusal on fragmented bedrock at TP18-18-19.



Photo 43: Silty gravel with some sand at TP18-18-20.

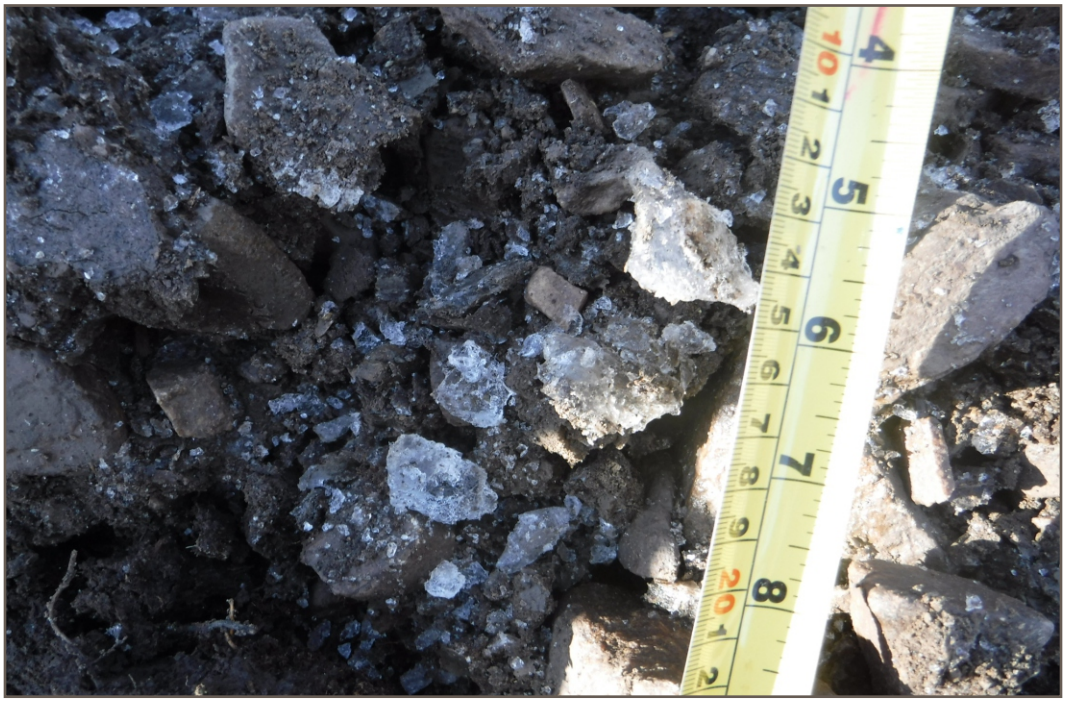


Photo 44: Ice inclusions at TP18-18-20.



Photo 45: Many cobble-sized and boulder sized angular clasts at TP18-18-21.



Photo 46: Completed excavation at TP18-18-21.



Photo 47: Sand and gravel at TP18-18-22.



Photo 48: Fractured and weathered schist at TP18-18-22.



Photo 49: Gravelly silt (loess) deposit at TP18-18-23.

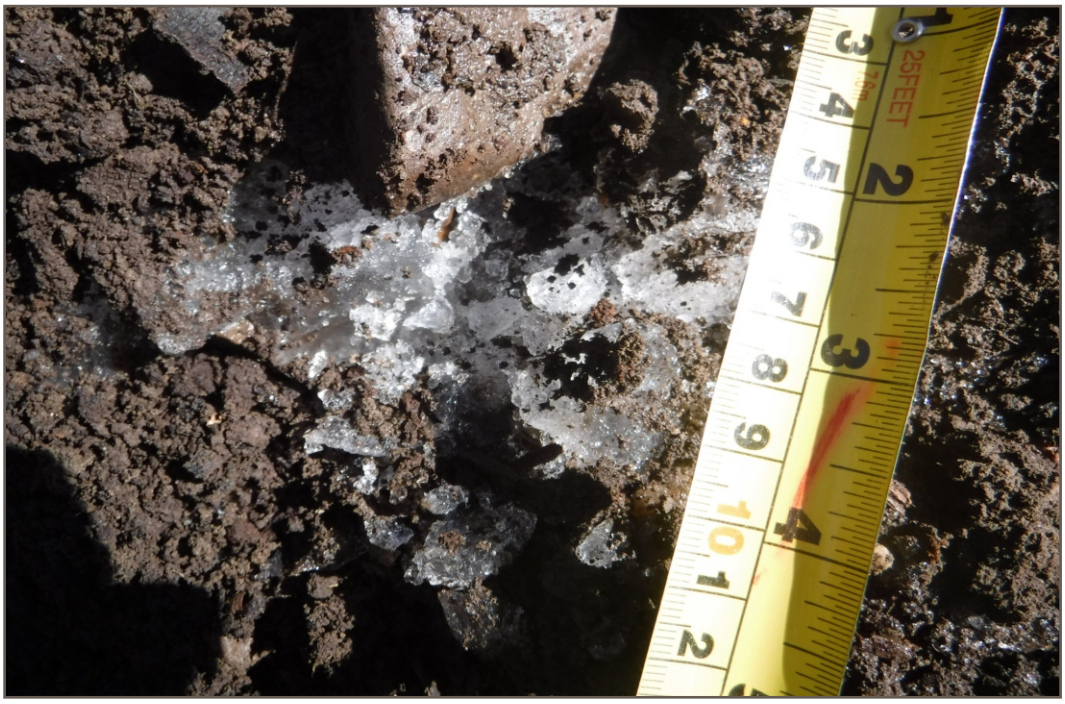


Photo 50: Ice inclusions at TP18-18-23.



Photo 51: Completed excavation at TP18-18-24. Tape measure is open to 1.0 m.

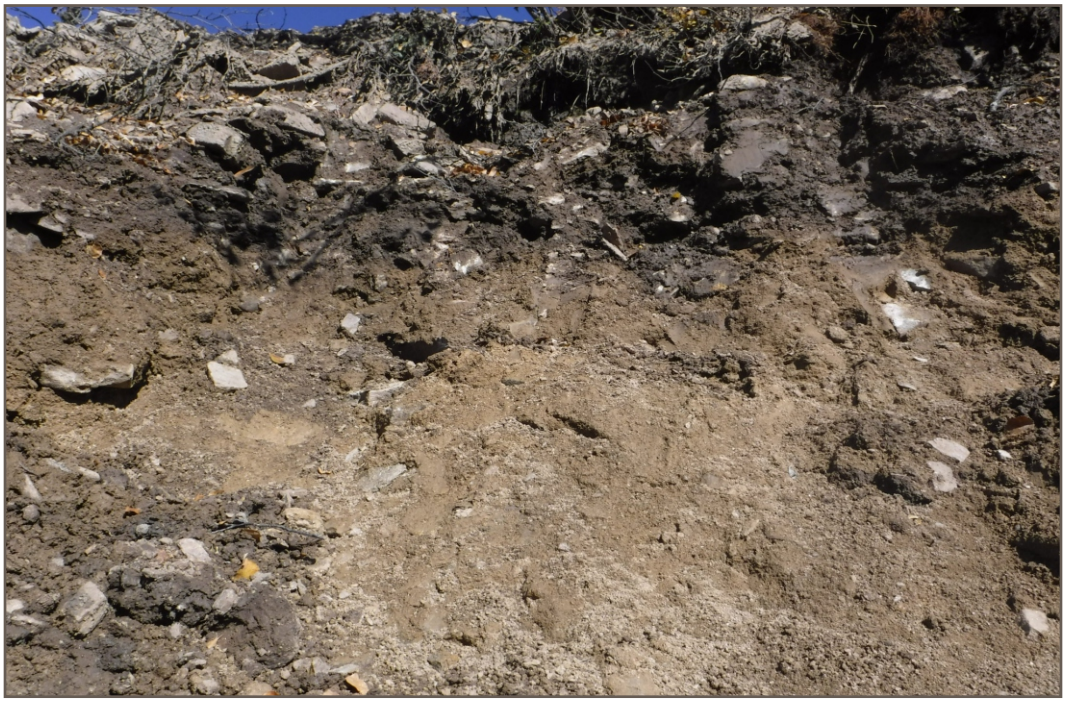


Photo 52: Sand, gravel, and silt mixture at TP18-18-24.



Photo 53: Completed excavation at TP18-18-25. Tape measure is open to 1.0 m.



Photo 54: Fragmented and weathered schist (bedrock) at TP18-18-25.



Photo 55: Silt (loess) and weathered bedrock at TP18-18-26.



Photo 56: Fragmented and weathered schist (bedrock) at TP18-18-26. Tape measure is open to 30 cm.



Photo 57: Completed excavation at TP18-18-27.



Photo 58: Fragmented and weathered schist clasts in a mainly sandy, gravelly matrix at TP18-18-27.



Photo 59: Bedrock weathered down to mostly gravel, sand and silt at TP18-18-28.



Photo 60: Fractured schist bedrock breaking along foliation planes at TP18-18-28.



Photo 61: Weathered schist at TP18-18-29.



Photo 62: Fractured and fragmented bedrock at TP18-18-29.



Photo 63: Completed excavation at TP18-18-30.



Photo 64: Fragmented and weathered bedrock at TP18-18-30.



Photo 65: Completed excavation at TP18-18-31.



Photo 66: Fragmented schist bedrock at TP18-18-31.



Photo 67: Completed excavation at TP18-18-32. Tape measure is open to 1.0 m.



Photo 68: Bedrock weathered down to mainly gravel, sand, and silt at TP18-18-32.



Photo 69: Bedrock weathered down to a mix of gravel, sand, and silt at TP18-18-33. Tape measure is open to 1.0 m.



Photo 70: Completed excavation at TP18-18-33.



Photo 71: Completed excavation at TP18-18-36. Tape measure is open to 30 cm.



Photo 72: Ice inclusion at TP18-18-36.



Photo 73: More than 0.5 m thick layer of peat was measured at TP18-18-37.

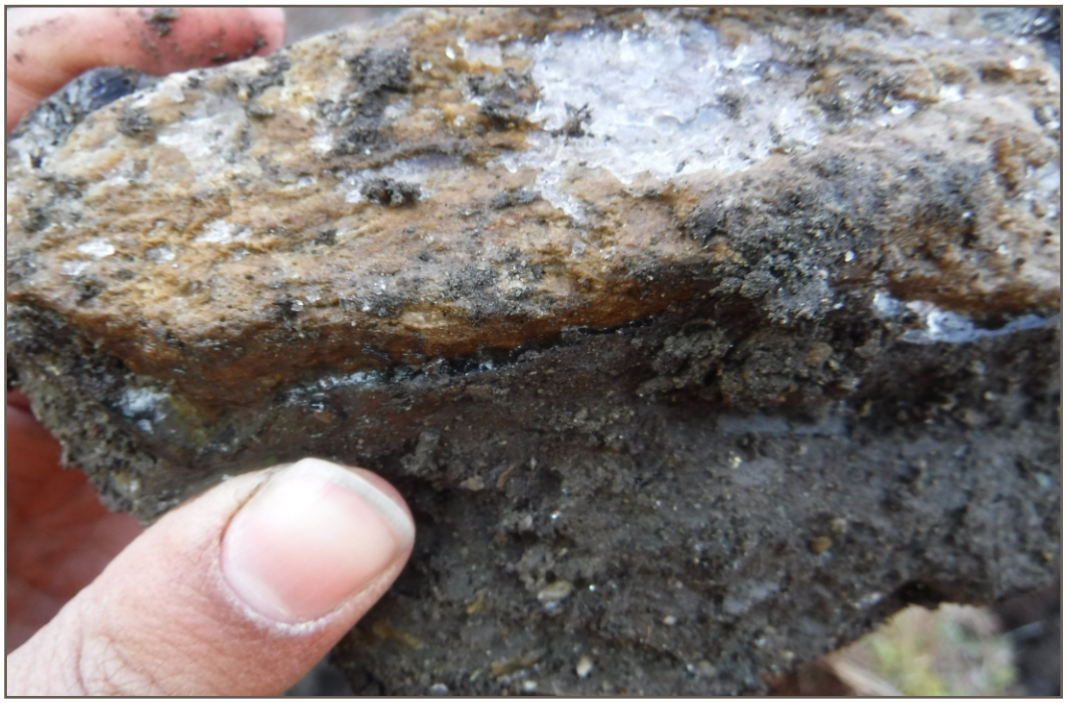


Photo 74: Ice coating around cobble at TP 18-18-37.



Photo 75: Silt (loess) deposit at TP18-18-38. Tape measure is open to 30 cm.

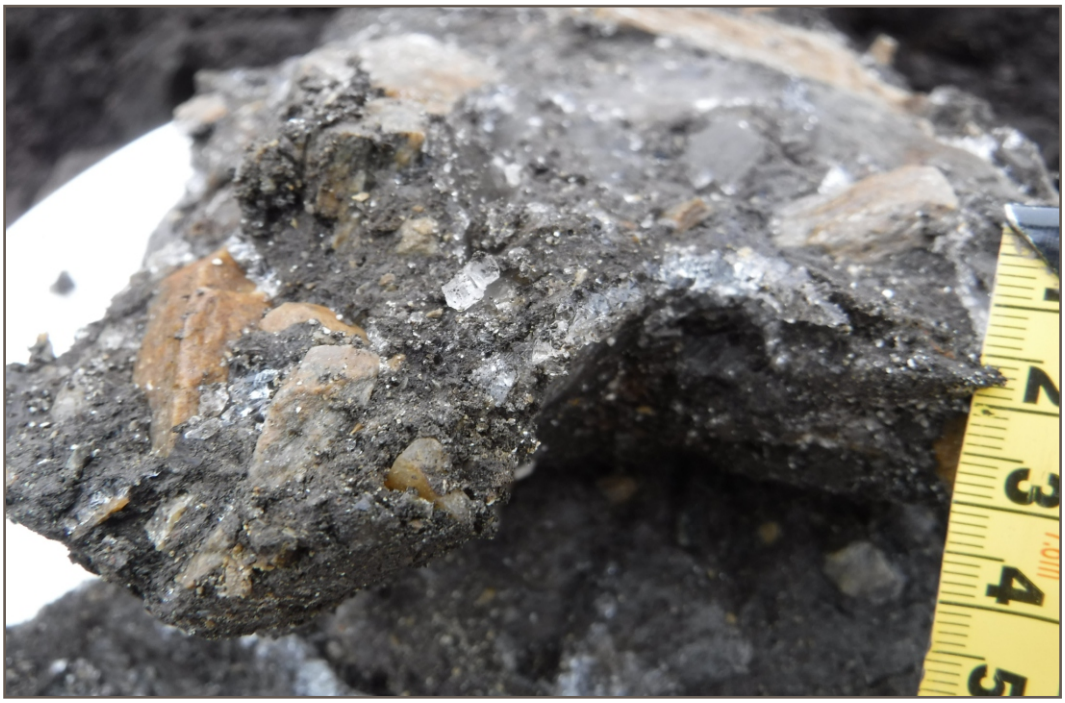


Photo 76: Ice inclusions and coatings at TP18-18-38.



Photo 77: Fractured and fragmented bedrock in a mainly silty, sandy matrix at TP18-18-39.



Photo 78: Completed excavation at TP18-18-39.



Photo 79: Bedrock weathered down to mostly gravel and sand at TP18-18-40.



Photo 80: Fragmented bedrock at TP18-18-40.



Photo 81: Approximately 0.5 m thick layer of peat at TP18-18-41.



Photo 82: Completed excavation at TP18-18-41.



Photo 83: Angular schist fragments in a mainly sandy, gravelly matrix at TP18-18-42.



Photo 84: Ice inclusions at TP18-18-42.



Photo 85: Cobble-sized and boulder-sized clasts in a weathered bedrock matrix at TP18-18-43. Tape measure is open to 1.0 m.



Photo 86: Fractured, fragmented schist bedrock at TP18-18-43. Tape measure is open to 30 cm.



Photo 87: Completed excavation at TP18-18-44.



Photo 88: Fractured, fragmented schist bedrock at TP18-18-44.



Photo 89: Wall face of TP18-18-45.



Photo 90: Ice lens and inclusions at TP18-18-45.



Photo 91: Cobble-sized and boulder-sized clasts in a mainly silty matrix at TP18-18-46.



Photo 92: Ice inclusions at TP18-18-46.

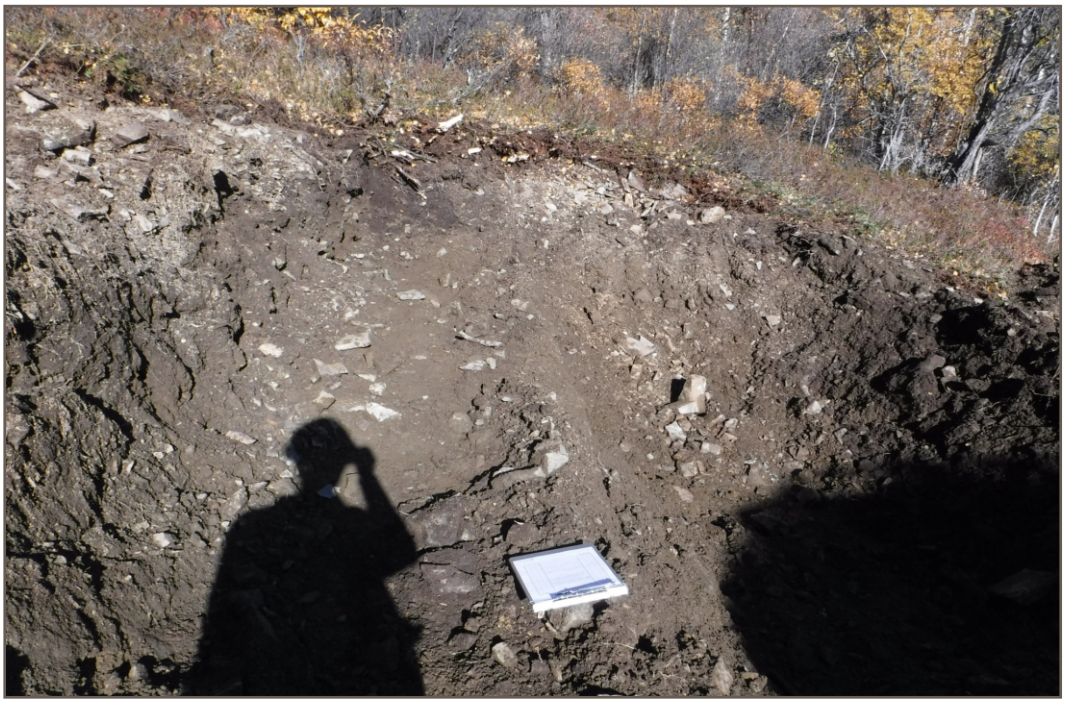


Photo 93: Completed excavation at TP18-18-47.



Photo 94: Cobble-sized and boulder-sized clasts in a mainly silty matrix at TP18-18-47.



Photo 95: Cobble-sized angular clasts in a gravel and sand matrix. TP18-18-48.



Photo 96: Fractured, fragmented schist bedrock breaking along multiple planes at TP18-18-48.



Photo 97: Completed excavation at TP18-18-49. Tape measure is open to 1.0 m.



Photo 98: Bedrock weathered down to mainly sand at TP18-18-49.



Photo 99: Completed excavation at TP18-18-50. Tape measure is open to 30 cm.

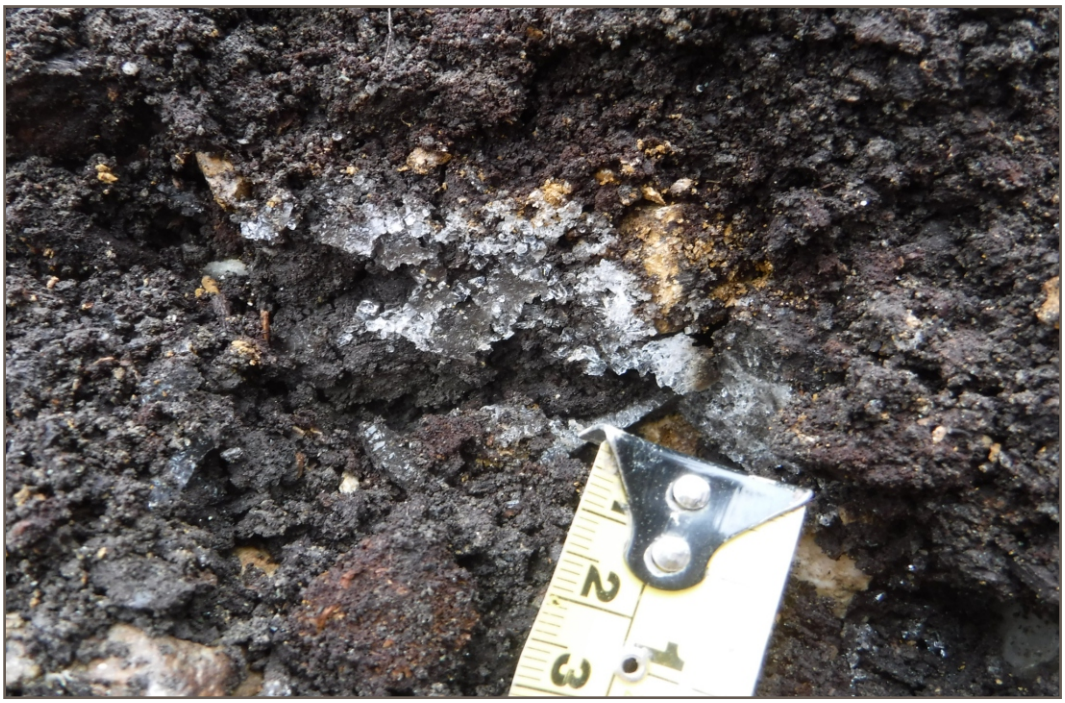


Photo 100: Ice inclusions at TP18-18-50.



Photo 101: Completed excavation at TP18-18-51. Tape measure is open to 1.0 m.



Photo 102: Ice inclusions at TP18-18-51.



Photo 103: Sub-angular cobble-sized clasts in a sandy, silty, gravelly matrix at TP18-18-52. Tape measure is open to 1.0 m.



Photo 104: Wall face at TP18-18-52.



Photo 105: Wall face at TP18-18- 53.



Photo 106: Completed excavation at TP18-18-53.



Photo 107: Completed excavation at TP18-18-54. Tape measure is open to 1.0 m.

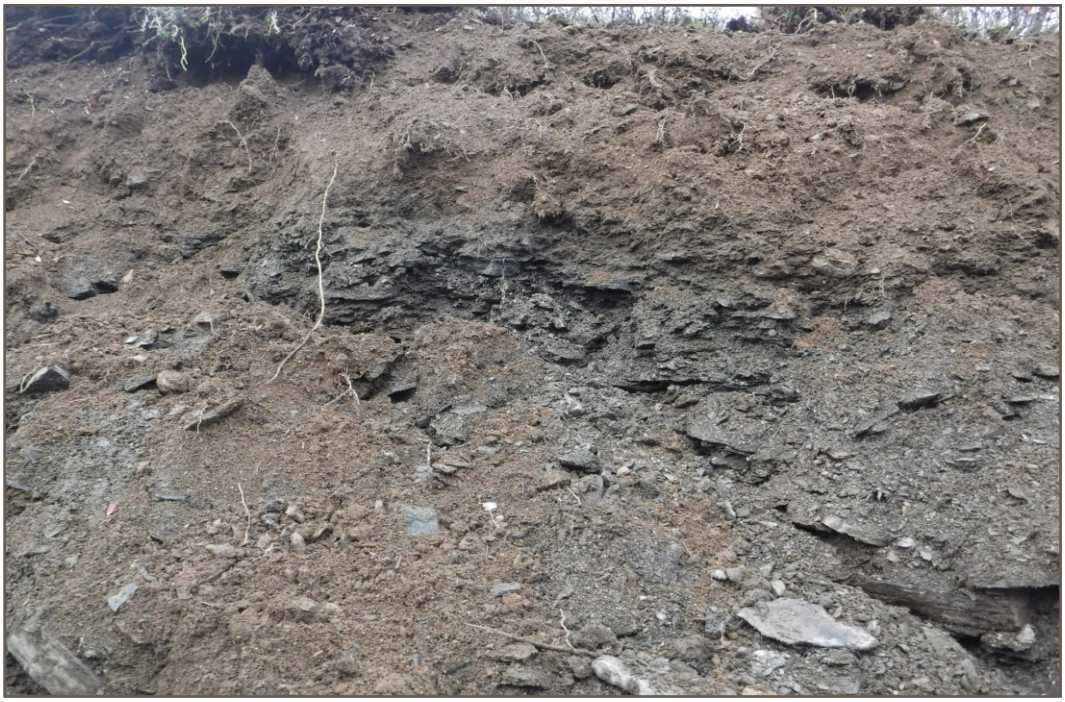


Photo 108: Weathered bedrock at TP18-18-54.



Photo 109: Wall face at TP18-18-55.



Photo 110: Weathered bedrock at TP18-18-55.



Photo 111: Cobble-sized and boulder-sized clasts in a mainly silty, sandy matrix at TP18-18-56.



Photo 112: Fractured, fragmented schist bedrock at TP18-18-56.



Photo 113: Completed excavation at TP18-18-57.



Photo 114: Wall face at TP18-18-57. Black mark on tape measure is 1.0 m.



Photo 115: Cobble-sized and boulder-sized clasts disseminated throughout a mainly silt and sand matrix.



Photo 116: Ice lenses at TP18-18-58.



Photo 117: Bedrock weathered down to mainly sand, gravel, and silt at TP18-18-59.



Photo 118: Completed excavation at TP18-18-60.



Photo 119: TP18-18-60 was in a large boulder field.



Photo 120: Completed excavation at TP18-18-61.



Photo 121: Silt deposit with many large boulders disseminated throughout at TP18-18-61.



Photo 122: Water accumulating at bottom of TP18-18-62.



Photo 123: Large boulders disseminated throughout TP18-18-62.



Photo 124: Sandy, silt (loess) deposit at TP18-18-63.



Photo 125: Completed excavation at TP18-18-63.



Photo 126: Frozen silt and sand at TP18-18-64. Tape measure is open to 1.0 m.



Photo 127: Ice lenses at TP18-18-64.



Photo 128: Water accumulation at bottom of TP18-18-65.



Photo 129: Wall face at TP18-18-65. Tape measure is open to 1.5 m.



Photo 130: TP18-18-65 after backfilling.



Photo 131: Wall face at TP18-18-66.



Photo 132: Ice lenses at TP18-18-66.



Photo 133: TP18-18-67 after backfilling.



Photo 134: Original ground site conditions at TP18-18-67.



Photo 135: Colluvium overlying a sandy, silt layer and fractured, fragmented bedrock. Black mark on tape measure is 1.0 m.



Photo 136: Wall face at TP18-18-68. Black mark on tape measure is 1.0 m.



Photo 137: Mostly gravel and sand at TP18-18-68.



Photo 138: Densely treed site at TP18-18-69.



Photo 139: Frozen silt at TP18-18-69.



Photo 140: Soil sample TP72-01, km 6-7 Borrow Source area.



Photo 141: Soil sample TP74-01, km 6-7 Borrow Source area.

APPENDIX A

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

1.17 SAMPLES

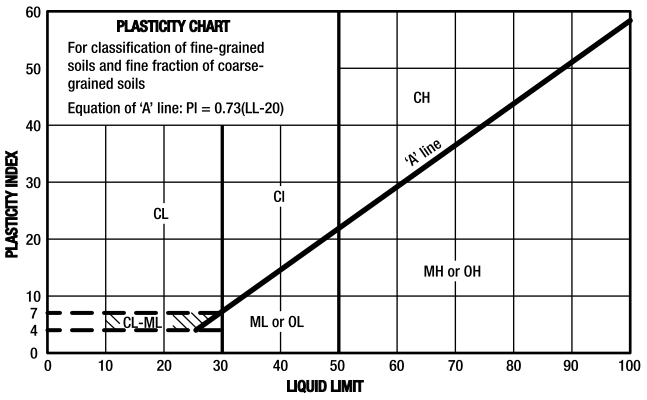
TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

APPENDIX B

TESTPIT LOGS

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols $C_U = D_{60} / D_{10}$ Greater than 4 $C_C = \frac{(D_{30})2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits plot above "A" line or plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	Less than 5% Pass 75 µm sieve More than 12% Pass 75 µm sieve 5% to 12% Pass 75 µm sieve $C_U = D_{60}/D_{10}$ Greater than 6 $C_C = \frac{(D_{30})2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above "A" line or plasticity index greater than 7	
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS Liquid limit <50		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity		
	SILTS Liquid limit >50		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit <30		CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit 30-50		CI	Inorganic clays of medium plasticity, silty clays		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit >50		CH	Inorganic clays of high plasticity, fat clays		
	ORGANIC SILTS AND CLAYS Liquid limit <50		OL	Organic silts and organic silty clays of low plasticity		
	ORGANIC SILTS AND CLAYS Liquid limit >50		OH	Organic clays of medium to high plasticity		
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils		



* Based on the material passing the 75 mm sieve

† ASTM Designation D 2487, for identification procedure see D 2488 USC as modified by PFRA

SOIL COMPONENTS

FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS	
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR
GRAVEL coarse fine	75 mm 19 mm	19 mm 4.75 mm	>35 % 21 to 35 % 11 to 20 % >0 to 10 %	"and" "y-adjective" "some" "trace"
SAND coarse medium fine	4.75 mm 2.00 mm 425 µm	2.00 mm 425 µm 75 µm		
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior	

OVERSIZE MATERIAL

Rounded or subrounded

COBBLES	75 mm to 300 mm
BOULDERS	> 300 mm

Not rounded

ROCK FRAGMENTS	>75 mm
ROCKS	> 0.76 cubic metre in volume

TETRA TECH

GROUND ICE DESCRIPTION

VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
V	Vx	Individual ice crystals or inclusions		
	Vc	Ice coatings on particles		
	Vr	Random or irregularly oriented ice formations		
	Vs	Stratified or distinctly oriented ice formations		
	Vu	Ice formations uniformly distributed throughout frozen soil		

ICE NOT VISIBLE

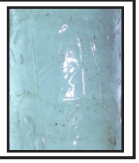
GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
N	Nf	Poorly-bonded or friable		
	Nbn	No excess ice, well-bonded		
	Nbe	Excess ice, well-bonded		

LEGEND: Soil ☐ Ice ■

NOTES:

1. Dual symbols are used to indicate borderline or mixed ice classifications.
2. Visual estimates of ice contents indicated on borehole logs ± 5%
3. This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes.

VISIBLE ICE GREATER THAN 50% BY VOLUME

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
ICE	ICE + Soil Type	Ice with soil inclusions (greater than 25 mm thick)		
	ICE	Ice without soil inclusions (greater than 25 mm thick)		

TETRA TECH

Testpit No: **TP18-18-01**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Java Airstrip	Ground Elev: 1180.94 m
Coffee Creek, Yukon	UTM: 589168 E; 6973546 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Bulk Density (kg/m^3) 1400 1600 1800 2000 / Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	Elevation (m)
0								
	Excavated	ORGANICS AND PEAT - dry to damp, light to medium brown, (200 mm thick)	Unfrozen					
		GRAVEL (WEATHERED BEDROCK) - silty, sandy, trace to some clay matrix, cobble and boulder sized rock fragments approximately 20-30% by volume disseminated throughout, rootlets, dry, light brown - (Gravel - 34%, Sand - 32%, Silt & Clay - 34%) - CBR test was performed			01-01	11.9		
1		BEDROCK - fractured, fragmented						1180
		END OF TESTPIT (1.60 metres) Note: Stopped due to refusal on bedrock						
2								1179
3								1178
4								1177
5								1176

TETRA TECH

Contractor: JDS	Completion Depth: 1.6 m
Drilling Rig Type: CAT 320C	Start Date: 2018 September 7
Logged By: JL	Completion Date: 2018 September 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-02**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Java Airstrip	Ground Elev: 1180.03 m
Coffee Creek, Yukon	UTM: 589335 E; 6973439 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Bulk Density (kg/m^3) 1400 1600 1800 2000 / Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	Elevation (m)
0	Excavated	ORGANICS AND PEAT - roots, dry to damp, light to medium brown, (200 mm thick)	Unfrozen					1180
		GRAVEL (WEATHERED BEDROCK) - silty, sandy, trace to some clay matrix, cobble and boulder sized angular rock fragments approximately 10-15% by volume disseminated throughout, rootlets, dry, light brown - (Gravel - 34%, Sand - 32%, Silt & Clay - 34%) - CBR test was performed			02-01	13.9		
1		BEDROCK - fractured, fragmented						1179
		END OF TESTPIT (1.70 metres)						
2								1178
3								1177
4								1176
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: CAT 320C	Start Date: 2018 September 7
Logged By: JL	Completion Date: 2018 September 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-03**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Java Airstrip	Ground Elev: 1186.75 m
Coffee Creek, Yukon	UTM: 589666 E; 6973451 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Bulk Density (kg/m^3) 1400 1600 1800 2000 / Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	Elevation (m)
0	Excavated	ORGANICS AND PEAT - roots, dry to damp, light to medium brown, (200 mm thick)	Unfrozen					
		GRAVEL (WEATHERED BEDROCK) - silty, sandy, trace to some clay matrix, cobble and boulder sized angular rock fragments approximately 30-40% by volume disseminated throughout, rootlets, dry, light brown - (Gravel - 34%, Sand - 32%, Silt & Clay - 34%) - CBR test was performed			03-01	29.2		1186
1		BEDROCK - fractured, fragmented END OF TESTPIT (1.00 metre)						
2								1185
3								1184
4								1183
5								1182

Contractor: JDS	Completion Depth: 1 m
Drilling Rig Type: CAT 320C	Start Date: 2018 September 7
Logged By: JL	Completion Date: 2018 September 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-03A**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Java Airstrip	Ground Elev: 1174.24 m
Coffee Creek, Yukon	UTM: 589881 E; 6973438 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Bulk Density (kg/m^3) 1400 1600 1800 2000 / Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	Elevation (m)
0		MOSS AND PEAT - fibric, damp, medium to dark brown, (100 mm thick)	Unfrozen					
		COBBLES (COLLUVIUM) - gravelly, trace sand, angular micaceous schist clasts to 30 mm diameter, Diggability=1						1174
1	Excavated	GRAVEL (WEATHERED BEDROCK) - silty, sandy, trace to some clay matrix, damp, some cohesion, light to medium brown, cobble and boulder sized angular micaceous schist rock fragments to 40 mm thick approximately 20-30% by volume disseminated throughout, some thin platy clasts, Diggability=1 - (Gravel - 34%, Sand - 32%, Silt & Clay - 34%) - CBR test was performed			03A-01	9.5		1173
2		SCHIST (BEDROCK) - fractured, fragmented, elongated clasts to 30-40 mm thick, some thin, platy clasts; rock fragments in a sandy some silt, some gravel matrix, lenses of estimated thickness 10-15 mm of completely weathered bedrock , Diggability=3 - Diggability=10						1172
		END OF TESTPIT (2.30 metres) Notes: Stopped due to refusal on bedrock Gently sloping (approximately 4°) plateau toward north Overall slope of ares ~ 15° toward north Well drained (no evidence of water ponding) Sparse willow and dwarf birch, evidence of past black spruce (burned in forest fire), blueberries, moss and lichen covering ground						
3								1171
4								1170
5								

TETRA TECH

Contractor: JDS	Completion Depth: 2.3 m
Drilling Rig Type: CAT 312C	Start Date: 2018 September 25
Logged By: JL	Completion Date: 2018 September 25
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-04**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Java Airstrip	Ground Elev: 1160.24 m
Coffee Creek, Yukon	UTM: 590324 E; 6973305 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Bulk Density (kg/m^3) 1400 1600 1800 2000	Elevation (m)
0	Excavated	ORGANICS AND PEAT - roots, damp, light to medium brown	Unfrozen				1160
		- (Gravel - 34%, Sand - 34%, Silt & Clay - 34%) - CBR test was performed					
		GRAVEL (WEATHERED BEDROCK) - silty, sandy, trace to some clay matrix, cobble and boulder sized angular rock fragments approximately 20-30% by volume disseminated throughout, rootlets, dry to damp, light brown			04-01	■	
1		BEDROCK - fractured, fragmented					1159
		END OF TESTPIT (1.50 metres) Note: Stopped due to refusal on bedrock					
2							1158
3							1157
4							1156
5							

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: CAT 320C	Start Date: 2018 September 7
Logged By: JL	Completion Date: 2018 September 7
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-04A**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Java Airstrip	Ground Elev: 1172.68 m
Coffee Creek, Yukon	UTM: 589932 E; 6973428 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Bulk Density (kg/m^3) 1400 1600 1800 2000 / Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	Elevation (m)
0	Excavated	MOSS AND PEAT - fibric, damp, medium to dark brown, (100 mm thick)	Unfrozen					
		GRAVEL (COLLUVIUM) - silty, sandy, trace to some clay matrix, rootlets, damp, cohesive, light to medium brown, cobble and boulder sized angular and subangular rock fragments to 10-100 mm thick approximately 20-30% by volume disseminated throughout, some thin, flat, elongated, platy micaceous schist clasts, Diggability=1-2 - (Gravel - 34%, Sand - 32%, Silt & Clay - 34%) - CBR test was performed			04A-01	16.4		
1		SCHIST (BEDROCK) - fractured, fragmented, fracturing along multiple planes, angular clasts to 100 mm thick in a SAND some silt matrix, damp, 10-15 mm thick laminations, Diggability=3-4						1172
		END OF TESTPIT (1.20 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Very gently sloping ground approximately 20 m downslope from crest of a hill Well drained (no evidence of ponding water) Vegetation is relatively thick with abundant dwarf birch, some shrubby willow and abundant blueberry, moss and lichen covering ground Light frost on ground						1171
2								1170
3								1169
4								1168
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type: CAT 312C	Start Date: 2018 September 25
Logged By: JL	Completion Date: 2018 September 25
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-05**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: 0.3 km Borrow Source	Ground Elev: 397.998 m
Coffee Creek, Yukon	UTM: 597818 E; 6976533 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								
	Excavated	MOSS AND PEAT - fibric-mesic, damp, medium to dark brown, woody odour, (150 mm thick)	Seasonally thawed layer (Active layer)					
		SILT AND SAND (ALLUVIUM) - some gravel, trace clay, damp, cohesive, medium brown, occasional lenses of rusty coloured material			05-01			
		SAND (ALLUVIUM) - gravelly, trace to some silt, damp, medium grey brown - (Gravel - 30%, Sand - 68%, Silt & Clay - 2%)						
1		- trace gravel, medium to dark grey, white to brown to black, Diggability=1			05-02	2.1		397
2								396
3		- Diggability=10						395
		END OF TESTPIT (3.00 metres) Notes: Stopped due to refusal on permafrost Flat ground, densely vegetated with tall spruce and birch trees, moss covering ground	Permafrost, Vx estimate 15-20%, ~1-2 mm thick ice inclusions					
4								394
5								393

TETRA TECH

Contractor: JDS	Completion Depth: 3 m
Drilling Rig Type: CAT 349F	Start Date: 2018 September 24
Logged By: JL	Completion Date: 2018 September 24
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-06**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: 0.3 km Borrow Source	Ground Elev: 398 m
Coffee Creek, Yukon	UTM: 597858 E; 6976568 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								398
	Excavated	MOSS AND PEAT - fibric, damp, medium to dark brown, woody odour, (150 mm thick)	Seasonally thawed layer (Active layer)					
		SAND AND SILT (ALLUVIUM) - some gravel, trace clay, trace cobbles, damp, cohesive, medium brown - (Gravel - 20%, Sand - 44%, Silt & Clay - 36%)			06-01	8.4		
1		SAND (ALLUVIUM) - trace gravel, white to brown to black, angular to subangular clasts to 20 mm thick - (Gravel - 5%, Sand - 95%)			06-02	1.4		397
		- some gravel, some silt						
2								396
3								395
		- (Gravel - 15%, Sand - 72%, Silt & Clay - 13%)			06-03	6.1		
4		END OF TESTPIT (4.00 metres) Notes: Stopped due to refusal on permafrost Diggability = 1 Flat ground, densely vegetated with tall spruce and birch trees, moss covering ground	Permafrost, Vx estimate 10-15%, ~ 1-2 mm thick					394
5								393

TETRA TECH

Contractor: JDS	Completion Depth: 4 m
Drilling Rig Type: CAT 349F	Start Date: 2018 September 23
Logged By: JL	Completion Date: 2018 September 23
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-07**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: 0.3 km Borrow Source	Ground Elev: 397.973 m
Coffee Creek, Yukon	UTM: 597895 E; 6976607 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								
	Excavated	MOSS AND PEAT - fibric, damp, medium to dark brown, woody odour, (150 mm thick)	Seasonally thawed layer (Active layer)					
		SILT - some sand, some gravel, trace clay, damp, cohesive, medium brown, Diggability=1						
1			Permafrost table on east end of testpit, Nbn, Diggability=10		07-01			397
		SAND (ALLUVIUM) - trace gravel, trace silt, trace cobbles, moist to wet, white to brown to black, Diggability=1 - (Gravel - 6%, Sand - 92%, Silt & Clay - 2%) - Diggability=10			07-02	3.4	●	
			Permafrost, Vx estimate 15-20%, ~1-2 mm diameter ice inclusions					
2		END OF TESTPIT (1.70 metres) Notes: Stopped due to refusal on permafrost Flat ground, densely vegetated with tall spruce and birch trees, moss covering ground						396
3								395
4								394
5								393

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: CAT 349F	Start Date: 2018 September 23
Logged By: JL	Completion Date: 2018 September 23
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-08**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: 0.3 km Borrow Source	Ground Elev: 397.261 m
Coffee Creek, Yukon	UTM: 597818 E; 6976607 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - fibric-mesic, damp, medium to dark brown, woody odour, (150 mm thick)	Seasonally thawed layer (Active layer)					397
		SILT - sandy, some gravel, rootlets, damp, some cohesion, light to medium brown			08-01			
		SAND AND GRAVEL (ALLUVIUM) - trace silt, trace cobbles, damp, medium grey brown, wavy stratification, Diggability=1 - (Gravel - 42%, Sand - 55%, Silt & Clay - 3%)			08-02	1.7	●	
1		SAND (ALLUVIUM) - trace gravel, trace cobbles, trace silt, damp, dark grey brown - (Gravel - 1%, Sand - 98%, Silt & Clay - 1%)			08-03	2.1	●	396
2								395
3								394
		- Diggability=10						
		END OF TESTPIT (3.70 metres) Notes: Stopped due to refusal on permafrost Flat ground densely vegetated with tall spruce and birch, moss covering ground	Permafrost, Vx estimate 25-30%, ~1-2 mm diameter ice inclusions, appears to be Nbe underneath					
4								393
5								

TETRA TECH

Contractor: JDS	Completion Depth: 3.7 m
Drilling Rig Type: CAT 349F	Start Date: 2018 September 24
Logged By: JL	Completion Date: 2018 September 24
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-09**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: 0.3 km Borrow Source	Ground Elev: 398 m
Coffee Creek, Yukon	UTM: 597895 E; 6976531 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0								398
	Excavated	MOSS AND PEAT - fibric-mesic, damp, medium to dark brown, woody odour, (100 mm thick)	Unfrozen					
		SAND (ALLUVIUM) - gravelly, some silt, trace cobbles, damp, medium reddish brown, gravel varies from white to brown to black, Diggability=1						
		- medium to greyish brown			09-01			
1								397
		- occasional lenses of rusty coloured material - trace to some gravel, trace silt, dark grey, coarser sand - (Gravel - 11%, Sand - 88%, Silt & Clay - 1%)			09-02	1.6	●	
2								396
3								395
4								394
		END OF TESTPIT (4.50 metres) Note: Flat ground, densely vegetated with tall spruce and birch, moss covering ground						
5								393

TETRA TECH

Contractor: JDS	Completion Depth: 4.5 m
Drilling Rig Type: CAT 349F	Start Date: 2018 September 23
Logged By: JL	Completion Date: 2018 September 23
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-10**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1262.95 m
Coffee Creek, Yukon	UTM: 584314 E; 6974290 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0						
	Excavated	MOSS AND PEAT - rootlets, fibric, damp, dark brown, (300 mm thick)	Unfrozen			
		ROCK FRAGMENTS (COLLUVIUM) - cobble and boulder sized angular clasts approximately 50-60% by volume in a sandy, some gravel, some silt, trace clay matrix, rootlets, damp, light to medium grey brown, Diggability=8-9			10-01	
1						1262
		END OF TESTPIT (1.70 metres) Note: Stopped due to refusal on bedrock				
2						1261
3						1260
4						1259
5						1258

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 14
Logged By: JL	Completion Date: 2018 September 14
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-11**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1277.03 m
Coffee Creek, Yukon	UTM: 584279 E; 6974362 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0						1277
	Excavated	PEAT - many large rock fragments throughout, rootlets, mesic, damp, dark brown, (300 mm thick)	Unfrozen			
		SILT (LOESS) - some gravel, trace sand, trace clay matrix, large rock fragments (weathered bedrock) disseminated throughout, rootlets, damp, medium grey brown			11-01	
1		ROCK (SCHIST) FRAGMENTS (WEATHERED BEDROCK) - cobble and boulder sized angular clasts in a sandy, gravelly, some silt, trace clay matrix, damp, medium brown, some grey lenses, Diggability=6-8			11-02	1276
		END OF TESTPIT (1.50 metres) Notes: Stopped due to refusal on bedrock ~ 0.9 metre tall shrubs, moss and many large rocks and rock fragments present on surface				
2						1275
3						1274
4						1273
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 14
Logged By: JL	Completion Date: 2018 September 14
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-12**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1267.15 m
Coffee Creek, Yukon	UTM: 584346 E; 6974360 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - rootlets, fibrous, moist, light green, white and light brown, (200 mm thick)	Seasonally thawed layer (Active layer)					1267
		PEAT - rootlets, mesic, moist, dark brown, (200 mm thick)						
		SILT (LOESS) - gravelly, some sand, trace clay, rootlets, wet, medium grey brown, some orange, some dark grey spots throughout						
1		- (Gravel - 28%, Sand - 17%, Silt & Clay - 55%)			12-01	22.8		1266
		END OF TESTPIT (1.20 metres) Note: Stopped due to refusal on permafrost	Permafrost, Nbe					
2								1265
3								1264
4								1263
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 14
Logged By: JL	Completion Date: 2018 September 14
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-13**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1266.82 m
Coffee Creek, Yukon	UTM: 584310 E; 6974455 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	PEAT AND VEGETATION - fibrous, dry to damp, light brown, (100 mm thick)	Unfrozen			1266
		SILT (LOESS) - some peat and organics, rootlets, trace gravel, trace sand, damp, light to medium brown, (200 mm thick)				
		ROCK FRAGMENTS (WEATHERED BEDROCK) - cobble and boulder sized angular rock fragments approximately 30-40% by volume, in a SILT (LOESS), some sand, trace gravel, trace clay matrix, medium grey brown, occasional dark grey lenses				
1		- damp, Diggability=5 - cobble and boulder sized angular rock fragments approximately 75-80% by volume			13-01	
		- Diggability=10				
		END OF TESTPIT (1.30 metres) Note: Stopped due to refusal on bedrock				1265
2						
3						1264
4						1263
5						1262

TETRA TECH

Contractor: JDS	Completion Depth: 1.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 14
Logged By: JL	Completion Date: 2018 September 14
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-14**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1272.64 m
Coffee Creek, Yukon	UTM: 584276 E; 6974553 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - fibrous, moist, medium reddish brown, (250 mm thick)	Seasonally thawed layer (Active layer)					1272
		PEAT - rootlets, fibric-mesic, moist, dark brown, (50 mm thick)						
		SILT (LOESS) - gravelly, some sand, trace clay, trace peat and organics,, rootlets, wet, medium to dark brown grey, Diggability=1-2 - (Gravel - 27%, Sand - 14%, Silt & Clay - 59%)			14-01	24.1	●	
1		ROCK FRAGMENTS (WEATHERED BEDROCK) - medium grey to light brown, cobble and boulder sized angular rock fragments approximately 30-40% by volume, in a silt, some gravel, some sand, trace clay matrix, Diggability=9-10	Permafrost, Vs, Vc 1-5mm thick ice lenses, Vx 10-15%		14.02			
		END OF TESTPIT (1.40 metres) Note: Stopped due to refusal on frozen fragmented bedrock						1271
2								1270
3								1269
4								1268
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.4 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 14
Logged By: JL	Completion Date: 2018 September 14
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-15**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1263.45 m
Coffee Creek, Yukon	UTM: 584338 E; 6974554 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	VEGETATION AND MOSS - damp, light green and brown, (300 mm thick)	Unfrozen			1263
		PEAT - fibric, damp, medium to dark brown				
		SILT (LOESS) - trace to some gravel, trace clay, rootlets, medium brown, occasional dark grey lenses to 10 mm thick, orange lenses, cobble sized angular rock fragments to 50 mm thick approximately 10-15% by volume				
		ROCK (GRANITE) FRAGMENTS (WEATHERED BEDROCK) - cobble and boulder sized angular rock fragments in a SILT (LOESS), gravelly, trace sand, trace clay matrix, rootlets, medium brown				
1		- gravel and cobble sized angular rock fragments approximately 80-90% by volume in a sandy matrix, grey brown with orange, Diggability=10			15-01	1262
		END OF TESTPIT (1.60 metres)				
2						1261
3						1260
4						1259
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.6 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 14
Logged By: JL	Completion Date: 2018 September 14
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-16**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1251.59 m
Coffee Creek, Yukon	UTM: 584344 E; 6974236 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS AND PEAT - mesic, fibrous, moist, dark brown, woody odour, (300 mm thick)	Unfrozen			1251
		ROCK FRAGMENTS (WEATHERED BEDROCK) - cobble and boulder sized platy, flat, elongated clasts, angular micaceous schist rock fragments approximately 60-70% by volume in a SILT (LOESS) some gravel, trace sand matrix, moist, cohesive, medium brown, Diggability=1-2 - Approximately 50% oversized material			16-01	
1		SCHIST (BEDROCK) - fragmented, weathered, breaking along foliation planes, 5-10 mm thick layers of silt between micaceous schist fragments, Diggability=10				
		END OF TESTPIT (1.30 metres) Notes: Approximately 20° slope, down toward southeast Dwarf birch, dwarf shrubby willows, sparsely treed with short spruce (to approximately 4 m), blueberries, moss covered ground				1250
2						
						1249
3						
						1248
4						
						1247
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 15
Logged By: JL	Completion Date: 2018 September 15
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-17**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1255.62 m
Coffee Creek, Yukon	UTM: 584235 E; 6974194 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	ROCK FRAGMENTS (WEATHERED BEDROCK) - cobble and boulder sized angular, flat, elongated micaceous schist clasts, platy, up to 600 mm diameter approximately 20-25% by volume in a gravel, silty sandy matrix, moist, cohesive, medium brown - (Gravel - 47%, Sand - 26%, Silt & Clay - 27%)	Unfrozen		17-01	11.8		1255
1		SCHIST (BEDROCK) - fragmented, weathered, grey, white, Diggability=1						1254
2		END OF TESTPIT (1.80 metres) Notes: Stopped due to refusal on Bedrock On drill pad, mostly fill material on top. Dug back wall face slightly to get a better face. Approximately 1.5 metres of fill material on top of natural ground, so was able to examine natural ground.						1253
3								1252
4								1251
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.8 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 15
Logged By: JL	Completion Date: 2018 September 15
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-18**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1235.92 m
Coffee Creek, Yukon	UTM: 584214 E; 6974109 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	SAND (WEATHERED BEDROCK) - some gravel, trace silt, moist, medium grey brown, cobble sized angular and subangular micaceous schist clasts approximately 10-15% by volume disseminated throughout	Unfrozen		18-01	1235
1		SCHIST (BEDROCK) - fragmented, weathered, sandy, silty layers between platy micaceous schist clasts, Diggability=1 - 200 mm thick dark grey layer				
2		END OF TESTPIT (1.60 metres) Notes: Stopped due to refusal on bedrock On bench road to drill pad, some dwarf birch and shrubby willow, more tall spruce				1234
3						1233
4						1232
5						1231

Contractor: JDS	Completion Depth: 1.6 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 15
Logged By: JL	Completion Date: 2018 September 15
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-19**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1251.59 m
Coffee Creek, Yukon	UTM: 584339 E; 6974174 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS AND PEAT - roots, rootlets, fibrous, fibric, moist, dark brown, woody odour, (300 mm thick)	Unfrozen			1251
		COBBLES (WEATHERED BEDROCK) - silty, some gravel some sand, moist, cohesive, light to medium brown, angular elongated micaceous schist clasts to 500 mm diameter, platy, flat, elongated clasts - cobble and boulder sized rock fragments approximately 30% by volume in a silty matrix, Diggability=1-2				
1		SCHIST (BEDROCK) - fragmented, angular, platy with silt, some sand, some gravel in between rock fragments, moist, cohesive, light to medium grey brown			19-01	
2		END OF TESTPIT (1.50 metres) Notes: Stopped due to refusal on bedrock Approximately 20° slope, down toward south Dwarf shrubby willows, dwarf birch, labrador tea, blueberries, some tall, full spruce, some shorter spruce, sparse, thick green and white moss covering ground				1250
3						1249
4						1248
5						1247

TETRA TECH

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 15
Logged By: JL	Completion Date: 2018 September 15
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-20**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1114.21 m
Coffee Creek, Yukon	UTM: 584099 E; 6973697 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0						1114
	Excavated	MOSS AND PEAT - some rootlets, mesic, moist, dark brown, woody odour, (300 mm thick)	Seasonally thawed layer (Active layer)			
		GRAVEL (WEATHERED BEDROCK) - silty, some sand, moist, medium brown grey, some red orange stains, angular, flat, elongated, platy, light grey brown to dark grey, micaceous schist clasts to 70 mm diameter	Permafrost, Vx to 30 mm, estimate 30%			
1		SCHIST (BEDROCK) - fragmented, layered, lenses of silt, sandy, some gravel in between clasts, medium grey brown, Diggability=1-2			20-01	1113
		- Diggability=9-10	Nbe			
2		END OR TESTPIT (1.70 metres) Notes: Stopped due to refusal on bedrock Approximate 20° slope, down to south Tall spruce and birch abundant, dwarf shrubby willow, fireweed, moss covering ground				1112
3						1111
4						1110
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 16
Logged By: JL	Completion Date: 2018 September 16
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-21**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1138.54 m
Coffee Creek, Yukon	UTM: 583939 E; 6973775 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - mesic, fibrous, moist, dark brown, woody odour, (300 mm thick)	Unfrozen					1138
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace cobbles, moist, slightly cohesive, light brown, cobble and boulder sized angular and subangular micaceous schist clasts approximately 30-40% by volume, 200-500 mm diameter, flat, elongated, platy, Diggability=1-2 - (Gravel - 49%, Sand - 34%, Silt & Clay - 17%)						
1								1137
					21-01	9.7	●	
2		SCHIST (BEDROCK) - fragmented						1136
3								
		END OF TESTPIT (3.50 metres) Notes: Diggability=6-7 Approximately 20° slope, down toward south Tall spruce, tall birch trees abundant, dwarf birch, dwarf shrubby willows, blueberries, labrador tea, green and white moss covering ground						1135
4								
								1134
5								

TETRA TECH

Contractor: JDS	Completion Depth: 3.5 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 15
Logged By: JL	Completion Date: 2018 September 15
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-22**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1114.42 m
Coffee Creek, Yukon	UTM: 583951 E; 6973699 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0		MOSS AND PEAT - fibric, damp, medium to dark brown, woody odour, (300 mm thick)	Unfrozen			
	Excavated	SAND AND GRAVEL (COLLUVIUM) - trace silt, moist, slightly cohesive, light brown, cobble sized angular and subangular micaceous schist clasts to 300 mm diameter, approximately 20-30% by volume				1114
1						
						1113
2					22-01	
						1112
		SCHIST (BEDROCK) - fractured, weathered, with sand, gravelly, some silt between layers of micaceous schist in fractures along foliation planes, moist, light brown grey, muscovite present, Diggability=1-2				
3						
						1111
4		END OF TESTPIT (4.00 metres) Notes: Stopped due to refusal on fractured bedrock Diggability=5-6 Approximately 20° slope, down toward south Abundance of tall spruce and tall birch, shrubby willow, blueberries, labrador tea, dwarf birch, moss covering ground				1110
5						

TETRA TECH

Contractor: JDS	Completion Depth: 4 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 15
Logged By: JL	Completion Date: 2018 September 5
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-23**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1065.51 m
Coffee Creek, Yukon	UTM: 584101 E; 6973611 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS AND PEAT - some rootlets, humic, damp to moist, medium to dark brown, woody odour	Seasonally thawed layer (Active layer)			1065
		SILT (LOESS) - gravelly, some cobbles, trace sand, moist, cohesive, medium brown, light grey cobbles with some orange, platy, flat, elongated to 200 mm diameter				
1		ROCK FRAGMENTS - cobble and boulder sized angular micaceous schist clasts approximately 50-60% by volume, in a silty, gravelly, trace to some sand matrix, Diggability 1-2	Permafrost, Vx to 60 mm thick, estimate 300x300 mm area in between fractured bedrock clasts		23-01	
		END OF TESTPIT (1.30 metres) Notes: Stopped due to refusal on permafrost Diggability=10 Approximately 25° slope, down toward south Tall spruce and birch abundant, fireweed, dwarf shrubby willows, moss covering ground	Nbe			1064
2						1063
3						1062
4						1061
5						

Contractor: JDS	Completion Depth: 1.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 16
Logged By: JL	Completion Date: 2018 September 16
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-24**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Supremo	Ground Elev: 1071.57 m
Coffee Creek, Yukon	UTM: 584161 E; 6973587 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - rootlets, mesic, moist, dark brown, woody odour	Unfrozen					
		SAND AND GRAVEL - silty, trace cobbles, trace clay, wet, cohesive, dark grey brown - (Gravel - 36%, Sand - 39%, Silt & Clay - 25%)			24-01	11.5	●	1071
1		SAND (WEATHERED BEDROCK) - some gravel, trace cobbles, trace rock fragments, moist, light brown, angular to subangular clasts to 400 mm diameter, Diggability=1-2						1070
2		SCHIST (BEDROCK) - fragmented, platy, flat, elongated, micaceous schist rock fragments to 700 mm diameter, dark grey, some orange, cobble and boulder sized clasts approximately 50-60% by volume in a sandy, gravelly matrix, moist, light brown, Diggability=5-6			24-02			1069
3								1068
4		END OF TESTPIT (4.00 metres) Notes: Stopped due to refusal on bedrock Approximately 30° slope, down toward south Tall spruce and birch abundant, dwarf shrubby willow, fireweed, moss covering ground						1067
5								

TETRA TECH

Contractor: JDS	Completion Depth: 4 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 16
Logged By: JL	Completion Date: 2018 September 16
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-25**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Double Double	Ground Elev: 1102.02 m
Coffee Creek, Yukon	UTM: 584988 E; 6973302 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - fibric to mesic, medium to dark brown, slight woody odour, (200 mm thick)	Unfrozen					1102
		GRAVEL AND SAND (WEATHERED BEDROCK) - silty, trace cobbles, damp, some cohesion, light grey brown, angular clasts of micaceous schist to 250 mm diameter, some flat and elongated, Diggability=1-2 - (Gravel - 43%, Sand - 36%, Silt & Clay - 21%)				11	●	
1		SCHIST (BEDROCK) - fragmented; clasts to 600 mm diameter approximately 70-80% by volume, in a gravelly, sandy, silty, some gravel matrix, damp light grey brown and orange, Diggability=2-4			25-01			1101
		END OF TESTPIT (1.40 metres) Notes: Stopped due to refusal on fractured bedrock Diggability=8-9 Approximately 20° down toward south Tall spruce and birch abundant, dwarf shrubby willow, dwarf birch, some fireweed, abundance of tall grass, some moss covering ground						
2								1100
3								1099
4								1098
5								

Contractor: JDS	Completion Depth: 1.4 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 16
Logged By: JL	Completion Date: 2018 September 16
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-26**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Double Double	Ground Elev: 1106.57 m
Coffee Creek, Yukon	UTM: 585045 E; 6973325 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	PEAT - rootlets, fibric, damp, (200 mm thick)	Unfrozen			1106
		SILT (LOESS) - some gravel, trace sand, moist, cohesive, medium brown, Diggability=1-2				
		SCHIST (BEDROCK) - fragmented, cobble and boulder sized angular, platy, elongated clasts approximately 40-50% by volume, in a silty, gravelly, trace sand matrix, light to medium brown grey, Diggability=7			26-01	
1		- weathered, fractured, fragmented, 5mm thick silt and sand layers and lenses in fractures and voids, light to medium brown grey and orange, Diggability=9				1105
		END OF TESTPIT (1.80 metres) Notes: Stopped due to refusal on bedrock Approximately 15° slope, down toward south Some tall spruce, some short and tall birch, dwarf birch, dwarf shrubby willow, fireweed, grass, labrador tea				
2						1104
3						1103
4						1102
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.8 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 16
Logged By: JL	Completion Date: 2018 September 16
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-27**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Double Double	Ground Elev: 1063.65 m
Coffee Creek, Yukon	UTM: 585390 E; 6973357 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS AND PEAT - mesic, damp, medium to dark brown, slight woody odour, (300 mm thick)	Unfrozen					
		SAND AND GRAVEL (WEATHERED BEDROCK) - trace to some silt, trace cobbles, damp, slight cohesion, light to medium brown, angular and subangular micaceous schist cobbles to 100-200 mm diameter - (Gravel - 40%, Sand - 49%, Silt & Clay - 11%)				10.1		
1								1063
	Excavated	SCHIST (BEDROCK) - fragmented, fractured, rock fragments, flat, elongated, platy clasts, some subangular clasts to 400-500 mm diameter, in a sandy, gravelly, trace silt matrix, damp, light to medium grey brown, orangey, Diggability=1-2			27-01			1062
2								
								1061
3								
								1060
4		END OF TESTPIT (4.00 metres) Notes: Diggability=8 Approximately 35° slope, down toward southeast Tall spruce and birch in abundance, dwarf shrubby willow, tall grass, some dwarf birch Testpit moved approximately 35 metres west of given location due to wet, soft, steep slope being too dangerous for excavator						
								1059
5								

Contractor: JDS	Completion Depth: 4 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 17
Logged By: JL	Completion Date: 2018 September 17
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-28**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Double Double	Ground Elev: 1085.31 m
Coffee Creek, Yukon	UTM: 585182 E; 6973298 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - fibric, damp, medium to dark brown, slight woody odour, (200 mm thick)	Unfrozen					1085
		GRAVEL AND SAND (WEATHERED BEDROCK) - silty, trace cobbles, flat, elongated, platy clasts, damp, slight cohesion, light to medium brown, angular and subangular cobbles, approximately 30 mm thick to 200 mm long approximately 10-20% by volume						
1		- (Gravel - 38%, Sand - 37%, Silt & Clay - 25%)				10.7	●	
		SCHIST (BEDROCK) - fractured, dark grey and light to medium brown with some orange colouration, 20-200 mm thick, breaking along foliation planes, 1-2 mm thick lenses of sand - some silt in fractures, Diggability=1-2			28-01			1084
2								
		END OF TESTPIT (2.20 metres) Notes: Stopped due to refusal on bedrock Diggability=8-9 Approximately 20° slope, down toward south Many tall spruce and birch, dwarf birch, dwarf shrubby willow, blueberries, cranberries, labrador tea, some grass, moss covering ground						1083
3								1082
4								1081
5								

TETRA TECH

Contractor: JDS	Completion Depth: 2.2 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 17
Logged By: JL	Completion Date: 2018 September 17
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-29**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Double Double	Ground Elev: 1093.9 m
Coffee Creek, Yukon	UTM: 585066 E; 6973292 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0						
	Excavated	PEAT - rootlets, fibric, damp, medium to dark brown, slight woody odour, (200 mm thick)	Unfrozen			
		SILT (LOESS) - some gravel, some sand, trace cobbles damp, light to medium brown, angular and subangular, flat, elongated clasts				
		SCHIST (BEDROCK) - fractured, fragmented, damp, light grey brown, platy, flat, elongated clasts, lenses and layers of silt, trace gravel, trace sand to 5 mm thick in fractures and between rock fragments, Diggability=1-2			29-01	
1						1093
		END OF TESTPIT (1.50 metres) Notes: Stopped due to refusal on fractured bedrock Approximately 15° slope, down toward south Some tall spruce, some short and tall birch, dwarf birch, dwarf shrubby willow, fireweed, grass, labrador tea				
2						1092
3						1091
4						1090
5						1089

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 16
Logged By: JL	Completion Date: 2018 September 16
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-30**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Double Double	Ground Elev: 1077.46 m
Coffee Creek, Yukon	UTM: 584899 E; 6973289 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - mesic, damp, dark brown, slight woody odour, (300 mm thick)	Unfrozen					1077
		GRAVEL AND SAND (WEATHERED BEDROCK) - silty, trace cobbles, damp, light grey brown, completely weathered (residual soil) micaceous schist, angular and subangular clasts to 100 mm thick and 250 mm long approximately 10% by volume - (Gravel - 38%, Sand - 37%, Silt & Clay - 25%)						
1		ROCK (SCHIST) FRAGMENTS - cobble and boulder sized, flat, elongated, platy, angular clasts to 10-30 mm thick in a silty, sandy, some gravel matrix, light grey brown to orangey, Diggability=1-2			30-01	12.2		1076
2		END OF TESTPIT (1.70 metres) Notes: Diggability=8-9 Approximately 20° slope, down toward south Tall spruce and birch abundant, dwarf birch, dwarf shrubby willow, blueberries, cranberries, labrador tea, some grass, moss covering ground						1075
3								1074
4								1073
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 17
Logged By: JL	Completion Date: 2018 September 17
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-31**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Double Double	Ground Elev: 1088.06 m
Coffee Creek, Yukon	UTM: 584958 E; 6973291 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0						1088
	Excavated	MOSS AND PEAT - mesic, fibrous, moist, medium to dark brown, slight woody odour, (300 mm thick)	Unfrozen			
		SILT (LOESS) - sandy, some gravel, moist, cohesive, trace angular rock fragments to 300-500 mm diameter, some flat and platy				
1		SCHIST (BEDROCK) - fragmented, angular clasts to 500-600 mm diameter approximately 70-80% by volume in a silt, sandy, some gravel matrix, light to dark grey, orangey, Diggability=1-2			31-01	1087
2		END OF TESTPIT (1.90 metres) Notes: Stopped due to refusal on fragmented bedrock Diggability=9 Approximately 20° slope, down toward southwest Tall spruce and birch abundant, dwarf shrubby willow, swarf birch, blueberries, labrador tea, moss covering ground Light frost on ground in the morning				1086
3						1085
4						1084
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.9 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 17
Logged By: JL	Completion Date: 2018 September 17
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-32**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: South Supremo	Ground Elev: 945.718 m
Coffee Creek, Yukon	UTM: 584041 E; 6973107 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - fibric, damp, medium to dark brown, slight woody odour, (150 mm thick)	Unfrozen					
		GRAVEL AND SAND (WEATHERED BEDROCK) - some silt matrix with angular to subangular micaceous schist fragments to 30 mm thick approximately 20-30% by volume disseminated throughout, damp, medium brown, orangey tone, some thin platy clasts - (Gravel - 49%, Sand - 38%, Silt & Clay - 13%)			32-01	11.1	●	
		SAND (WEATHERED BEDROCK) - gravelly, some silt, some clay, trace cobbles, damp, light brown and light bluish white, greasy, Diggability=1 - (Gravel - 32%, Sand - 36%, Silt - 19%, Clay - 13%)			32-02	17	●	945
1		SCHIST (BEDROCK) - fractured, thin, platy, layered, angular, gravelly sand approximately 5-10 mm thick in fractures, Diggability=1						
2								944
3								943
4		END OF TESTPIT (4.00 metres) Notes: Approximately 25° slop, down toward east Densely vegetated with tall birch and spruce, skinny trunks, some dwarf shrubby willow, cranberries, moss covering ground						942
5								941

TETRA TECH

Contractor: JDS	Completion Depth: 4 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 23
Logged By: JL	Completion Date: 2018 September 23
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-33**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: South Supremo	Ground Elev: 938.623 m
Coffee Creek, Yukon	UTM: 584017 E; 6972989 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - mesic, gravelly, some cobbles, trace quartz disseminated throughout, damp, medium to dark brown, moss is mostly white, angular to subangular schist clasts to 20-30 mm diameter, (200 mm thick)	Unfrozen					938
		GRAVEL (WEATHERED BEDROCK) - sandy, some silt, trace cobbles, trace peat, cobble sized angular to subangular schist clasts to 20 mm thick approximately 10-20% by volume disseminated throughout, damp, dark grey brown with rusty orange tones						
		- (Gravel - 48%, Sand - 33%, Silt & Clay - 19%)			33-01	26.4	●	
1		- some cobbles, trace silt, damp, medium to dark grey, cobble sized angular to subangular micaceous schist clasts approximately 20-40 mm thick, platy						
		- Diggability=1						
		SCHIST (BEDROCK) - fractured, angular layered clasts to 100 mm thick, sand lenses approximately 10 mm thick in fractures, Diggability=3						937
		END OF TESTPIT (1.70 metres) Notes: Stopped due to refusal on bedrock Diggability-10 Approximately 30° slope, down toward east (location moved approximately 10 m north due to steep slope Some shorter spruce trees, very skinny and mostly all dead, some dwarf willow, white and green moss covering ground						
2								936
3								935
4								934
5								

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 23
Logged By: JL	Completion Date: 2018 September 23
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-36**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: South Latte	Ground Elev: 991.215 m
Coffee Creek, Yukon	UTM: 583568 E; 6973113 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - gravel disseminated throughout, fibric to mesic, damp, medium to dark brown, slight woody odour	Seasonally thawed layer (Active layer)					991
		GRAVEL (WEATHERED BEDROCK) - sandy, silty, some organics, trace clay, moist, dark grey brown, cobbles sized angular and subangular clasts approximately to 20 mm thick, some flat, platy clasts with orangey tones, Diggability=1-2 - (Gravel - 43%, Sand - 32%, Silt & Clay - 25%)			36-01	40.4	●	
1		SCHIST (BEDROCK) - fragmented, weathered, cobbles sized rock fragments approximate 30% by volume to 20 mm thick in a SAND AND GRAVEL (WEATHERED BEDROCK), some silt matrix, light grey brown - (Gravel - 37%, Sand - 47%, Silt - 9%, Clay - 7%)	Permafrost, Vx 5-10%, ~1-2 mm diameter ice inclusions		36-02	17.4	●	990
		END OF TESTPIT (1.70 metres) Notes: Stopped due to refusal on permafrost Diggability=10 Approximately 15° slop, down toward east Skinny, scraggly spruce, some dwarf shrubby willow, grass						
2								989
3								988
4								987
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-37**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: South Latte	Ground Elev: 1060.31 m
Coffee Creek, Yukon	UTM: 583611 E; 6972966 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	PEAT - mesic, wet, medium to dark brown	Seasonally thawed layer (Active layer)			1060
		SILT - gravelly, some sand, some cobbles, with organics, wet, dark grey, cobble sized angular and subangular quartz and schist clasts approximately 25-30% by volume approximately 20-40 mm thick, orangey tones, Diggability=1-2			37-01	
1		END OF TESTPIT (1.00 metre) Notes: Stopped due to refusal on permafrost Diggability=10 Approximately 20° slope, down toward east Thin, scraggly spruce, some dwarf shrubby willow, grass, moss on ground Moved approximately 60 m south - given location was too slippery and steep for excavator to access	Permafrost, Vx estimate 15-20%, to 3 mm thick ice inclusions, Vc~2 mm thick ice coatings			1059
2						1058
3						1057
4						1056
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-38**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: South Latte	Ground Elev: 1060.31 m
Coffee Creek, Yukon	UTM: 583637 E; 6972913 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	PEAT - mesic, wet, medium to dark brown, slight sulphur-like odour	Seasonally thawed layer (Active layer)			1060
		SILT (LOESS) - gravelly, some organics, some sand, wet, dark brown - (Gravel - 28%, Sand - 20%, Silt & Clay - 52%)			38-01	
1		SCHIST (BEDROCK) - fragmented, gravel and cobbles, silty, trace sand, trace organics, some flat platy clasts to 300 mm long and 30-50 mm thick, Diggability=1			38-02	
		END OF TESTPIT (1.20 metres) Notes: Stopped due to refusal on permafrost Diggability=10 Approximately 15° slope, down toward east Thin scraggly spruce, some dwarf shrubby willow, moss covering ground	Permafrost, Vx, Vc estimate 25-30% to 20 mm thick ice lenses, Vc to 5 mm thick ice coatings			1059
2						1058
3						1057
4						1056
5						

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-39**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: South Latte	Ground Elev: 1058.86 m
Coffee Creek, Yukon	UTM: 583682 E; 6972791 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0						
	Excavated	MOSS AND PEAT - fibric, damp, medium to dark brown, damp, strong woody odour, (200 mm thick)	Unfrozen			
		SCHIST (BEDROCK) - fractured, fragmented, cobble sized angular and subangular clasts approximately 60-70% by volume in a silty, sandy, some gravel matrix, damp, medium brown, dark grey brown, angular and subangular quartz clasts to 200 mm diameter			39-01	
1						1058
		END OF TESTPIT (1.20 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Approximately 10° slope, down toward southeast Skinny, scraggly spruce, some dwarf shrubby willow, grass, moss covering ground				
2						1057
3						1056
4						1055
5						1054

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-40**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1016.33 m
Coffee Creek, Yukon	UTM: 583245 E; 6972594 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	PEAT - mesic, damp, dark brown, (300 mm thick)	Unfrozen					1016
		GRAVEL AND SAND (WEATHERED BEDROCK) - trace silt, damp, medium grey brown, flat, platy, layered, angular clasts to 40-50 mm thick and 200 mm long - (Gravel - 49%, Sand - 42%, Clay & Silt - 9%)			40-01	8.9	●	
1		SCHIST (BEDROCK) - fragmented, fractured, thin, platy angular clasts, easily breakable, Diggability=1						1015
2								1014
3		END OF TESTPIT (3.00 metres) Notes: Stopped due to refusal on fractured bedrock Approximately 30° slope down toward southeast Densely vegetated with tall spruce and birch, dwarf birch, dwarf shrubby willow, blueberries, moss covering ground						1013
4								1012
5								

Contractor: JDS	Completion Depth: 3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 21
Logged By: JL	Completion Date: 2018 September 21
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-41**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1037.02 m
Coffee Creek, Yukon	UTM: 583212 E; 6972622 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	PEAT - mesic to humic, damp, medium to dark brown	Unfrozen			1037
		GRAVEL AND SAND (WEATHERED BEDROCK) - some silt matrix, damp, slightly cohesive, medium grey brown; cobble sized angular and subangular clasts approximately 10-15% by volume approximately 100 mm long and 50 mm thick disseminated throughout, Diggability=1			41-01	
1		SCHIST (BEDROCK) - fractured, flat, platy clasts, medium to dark greyish brown with orange tones, sandy interlayers 5-10 mm thick in fractures, Diggability=1-2				1036
2						1035
		END OF TESTPIT (2.30 metres) Notes: Stopped due to refusal on bedrock Diggability-10 Approximately 25° slope, down toward southeast Densely vegetated with spruce, dwarf shrubby willow, blueberries, cranberries, labrador tea, thick spongy moss covering ground Location moved approximately 15 m north due to steep slope being too dangerous for excavator				
3						1034
4						1033
5						

TETRA TECH

Contractor: JDS	Completion Depth: 2.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-42**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1062.75 m
Coffee Creek, Yukon	UTM: 583052 E; 6972644 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Seasonally thawed layer (Active layer)					
		PEAT - fibric, many roots and rootlets, damp, medium to dark brown, (300 mm thick)						
		SAND (WEATHERED BEDROCK) - gravelly, some silt, some organics, trace cobbles matrix, completely weathered micaceous schist, damp, cohesive, medium to dark brown, trace quartz, fragmented, flat, elongated, platy clasts disseminated throughout, angular and subangular clasts 10-15% by volume approximately 10-20 mm thick, Diggability=1-2 - (Gravel - 31%, Sand - 50%, Silt & Clay - 19%)			42-01	19.3		1062
1		ROCK (SCHIST) FRAGMENTS - angular clasts in a silty, sandy, gravelly matrix, medium to dark grey and and light orangey brown						
2			Permafrost, Vx 5-10%, ~1-2 mm thick ice inclusions		42-02			1061
		END OF TESTPIT (2.50 metres) Notes: Stopped due to refusal on permafrost Diggability=10 Approximately 25° slope, down toward east Densely vegetated with tall spruce trees and some birch, dwarf shrubby willow, dwarf birch, labrador tea, blueberries, moss covering ground						1060
3								
								1059
4								
								1058
5								

TETRA TECH

Contractor: JDS	Completion Depth: 2.5 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 20
Logged By: JL	Completion Date: 2018 September 20
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-43**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1070.15 m
Coffee Creek, Yukon	UTM: 582970 E; 6972577 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - boulders and cobbles disseminated throughout, mesic, damp, medium to dark brown, woody odour, (200 mm thick)	Unfrozen					1070
		GRAVEL (WEATHERED BEDROCK) - silty matrix, damp, cohesive, medium brown, dark grey, some reddish and orangey tones, cobble and boulder sized angular and subangular clasts approximately 10-20% by volume disseminated throughout			43-01	12.5	●	
		- (Gravel - 43%, Sand - 34%, Clay & Silt - 23%)						
1		SCHIST (BEDROCK) - fractured, fragmented, light and dark grey with orangey and red tones, silt and sand layers around clasts and in fractures, damp, medium brown, Diggability=1-2						1069
2		END OF TESTPIT (2.00 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Approximately 25° slope, down toward east Sparsely treed with shorter spruce, dwarf shrubby birch and willow, blueberries, labrador tea, moss covering ground						1068
3								1067
4								1066
5								

Contractor: JDS	Completion Depth: 2 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 19
Logged By: JL	Completion Date: 2018 September 19
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-44**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1049.9 m
Coffee Creek, Yukon	UTM: 583067 E; 6972544 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS AND PEAT - cobbles and boulders disseminated throughout, moist, mesic, medium to dark brown, flat, elongated, angular clasts to 200 mm thick and 500-600 mm long, (300 mm thick)	Unfrozen			1049
		SILT (LOESS) - some sand, trace gravel, trace cobbles matrix, moist, cohesive, medium brown, flat, platy, elongated clasts to 120 mm diameter and approximately 300 mm long disseminated throughout			44-01	
1		SAND (WEATHERED BEDROCK) - silty, some gravel, some cobbles matrix, damp, cohesive, medium brown grey, cobble and boulder sized angular and subangular clasts, some platy, to 100 mm thick disseminated throughout, Diggability=1-2				
2		SCHIST (BEDROCK) - fractured, fragmented, dark grey, some orange, boulder sized clasts approximately 80-90% by volume to 200 mm thick, in a sand, some silt, some gravel, some cobbles matrix, damp, slightly cohesive, medium brown grey, Diggability=5			44-02	1048
3		END OF TESTPIT (2.80 metres) Notes: Stopped due to refusal on fractured bedrock Diggability=10 Approximately 25° slope, down toward east Densely vegetated with tall spruce trees and some birch, dwarf shrubby willow, dwarf birch, labrador tea, blueberries, moss covering ground Light frost cover ground in the morning Large boulders observed on and just below surface				1047
4						1046
5						1045

TETRA TECH

Contractor: JDS	Completion Depth: 2.8 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 20
Logged By: JL	Completion Date: 2018 September 20
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-45**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1031.09 m
Coffee Creek, Yukon	UTM: 583166 E; 6972551 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0						1031
	Excavated	PEAT - mesic, damp, medium to dark brown	Seasonally thawed layer (Active layer)			
		SILT (LOESS) - some sand, some gravel, trace cobbles matrix, damp, medium grey brown, angular and subangular clasts approximately 10-15% by volume to 30 mm thick and 300 mm long, Diggability=1			45-01	
1		ROCK (SCHIST) FRAGMENTS - weathered, flat, platy, angular clasts to 20 mm thick in a silty, some sand matrix, Diggability=1-2			45-02	1030
2		- water trickling in from upslope, appears to be suprapermafrost water	Permafrost, Vx ~20% to 3 mm thick ice inclusions, one lens approximately 5 mm thick bonding silt to a rock fragment			1029
		END OF TESTPIT (2.00 metres) Notes: Stopped due to refusal on frozen fragmented bedrock Diggability=10 Approximately 25° slope down toward southeast Densely vegetated with tall spruce and birch, dwarf birch, dwarf shrubby willow, blueberries, moss covering ground				
3						1028
4						1027
5						

Contractor: JDS	Completion Depth: 2 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 21
Logged By: JL	Completion Date: 2018 September 21
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-46**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 998.587 m
Coffee Creek, Yukon	UTM: 583231 E; 6972495 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS AND PEAT - mesic, moist, medium to dark brown	Seasonally thawed layer (Active layer)			998
		SILT (LOESS) - cobbly, some sand, some gravel matrix, wet, cohesive, medium brown, cobble and boulder sized angular and subangular micaceous schist clasts approximately 20-25% by volume approximately 10-20 mm thick, flat, elongated, platy, Diggability=1			46-01	
1		END OF TESTPIT (1.20 metres) Notes: Stopped due to refusal on permafrost Approximately 30° slope, down toward east/southeast Densely vegetated with tall spruce trees and some birch, dwarf shrubby willow, dwarf birch, labrador tea, blueberries, moss covering ground	Permafrost, Vx 10-15%, 1-3 mm thick ice inclusions			997
2						996
3						995
4						994
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 20
Logged By: JL	Completion Date: 2018 September 20
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-47**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1016.93 m
Coffee Creek, Yukon	UTM: 583120 E; 6972489 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS AND PEAT - mesic, moist to wet, medium to dark brown, platy, angular and subangular micaceous schist clasts disseminated throughout, (300 mm thick)	Unfrozen			1016
1		SILT (LOESS) - some sand, some gravel, trace clay matrix, moist, cohesive, medium brown, cobble and boulder sized angular and subangular, flat, platy, micaceous schist and quartz clasts approximately 20-30% by volume to approximately 20-30 mm thick, Diggability=1-2			47-01	
2		ROCK (SCHIST) FRAGMENTS - cobble and boulder sized clasts approximately 30-40% by volume in a silty, sandy, some gravel matrix, Diggability=3-4				1015
3		END OF TESTPIT (2.70 metres) Notes: Stopped due to refusal on fragmented bedrock Diggability=10 Approximately 25° slope, down toward east Densely vegetated with tall spruce trees and some birch, dwarf shrubby willow, dwarf birch, labrador tea, blueberries, moss covering ground Light frost cover ground in the morning Large boulders observed on surface				1014
4						1013
5						1012

TETRA TECH

Contractor: JDS	Completion Depth: 2.7 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 20
Logged By: JL	Completion Date: 2018 September 20
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-48**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1002.75 m
Coffee Creek, Yukon	UTM: 583188 E; 6972433 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - mesic, damp, medium to dark brown, slight woody odour (300 mm thick)	Unfrozen					1002
		GRAVEL AND SAND (WEATHERED BEDROCK) - some silt, trace clay matrix, damp, slightly cohesive, medium brown, cobble sized angular and subangular, flat, platy, micaceous schist clasts approximately 15-20% by volume, 2-20 mm thick disseminated throughout, dark grey, some orangey tones - (Gravel - 44%, Sand - 38%, Silt & Clay - 18%)			48-01	15.1	●	
1		SCHIST (BEDROCK) - fractured, dark grey and light grey with reddish orange tones, sand, some silt, some gravel in fractures, breaking vertically in some areas, along foliation in other areas, Diggability=1-2						1001
2								
3		END OF TESTPIT (2.70 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Approximately 25° slope, down toward east Densely vegetated with tall spruce trees and some birch, dwarf shrubby willow, dwarf birch, labrador tea, blueberries, moss covering ground						1000
4								999
5								998

TETRA TECH

Contractor: JDS	Completion Depth: 2.7 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 20
Logged By: JL	Completion Date: 2018 September 20
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-49**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Facility Pond Area	Ground Elev: 1059.26 m
Coffee Creek, Yukon	UTM: 583267 E; 6972687 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS AND PEAT - mesic, damp, medium to dark brown	Unfrozen					1059
		SAND (WEATHERED BEDROCK) - silty, gravelly, damp, slightly cohesive, medium grey brown, angular and subangular clasts approximately 20% by volume to approximately 40 mm thick and up to 300 mm long disseminated throughout, Diggability=1-2						
1		- (Gravel - 22%, Sand - 55%, Silt - 15%, Clay - 8%)			49-01	11.6		1058
		ROCK FRAGMENTS - cobble and boulder sized angular clasts in a sandy, some silt matrix, Diggability=1-2						
2								
		END OF TESTPIT (2.10 metres) Note: Stopped due to refusal on bedrock Diggability=10 Approximately 20° slope, down toward southeast Densely vegetated with spruce, dwarf shrubby willow, blueberries, cranberries, labrador tea, thick spongy moss covering ground						1057
3								1056
4								1055
5								

Contractor: JDS	Completion Depth: 2.1 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-50**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1087.16 m
Coffee Creek, Yukon	UTM: 583451 E; 6972839 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS (SPHAGNUM) - (150 mm thick) PEAT - mesic-humic, moist to wet, dark brown	Seasonally thawed layer (Active layer)			1087
1		ROCK (SCHIST) FRAGMENTS - cobble and boulder sized angular to subangular clasts to 40 mm thick in a SILT (LOESS), some sand, some gravel, trace clay matrix, moist, medium grey brown, finer soil lenses 20-30 mm thick in between clasts, Diggability=1-2	Permafrost in northeast corner of pit, Vx~10-15%, 1-2 mm diameter ice inclusions, Vs~1-2 mm thick ice lenses, Diggability=7-8		50-01 50-02	1086
2		END OF TESTPIT (1.30 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Approximately 10° slope, down toward southeast Densely vegetated with spruce, dwarf shrubby willow, blueberries, cranberries, labrador tea, thick spongy moss covering ground				1085
3						1084
4						1083
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-51**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1078.09 m
Coffee Creek, Yukon	UTM: 583345 E; 6972771 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS (SPHAGNUM) - (150 mm thick) PEAT - humic, moist, dark brown	Seasonally thawed layer (Active layer)					1078
1		SAND (WEATHERED BEDROCK) - silty, gravelly, trace cobbles matrix, damp, some cohesion, medium greyish brown, some thin, flat, platy, angular micaceous schist clasts 40 mm thick disseminated throughout, Diggability=1 - (Gravel - 23%, Sand - 51%, Silt & Clay - 26%) ROCK (SCHIST) FRAGMENTS - cobble and boulder sized platy schist and quartz feldspar clasts in a silty, sandy, trace gravel matrix, Diggability=1	Permafrost in half of pit. Vx 5-10%, ~1-5 mm thick ice inclusions found at bottom of peat layer, Diggability=10		51-01	17.8		1077
2								1076
3		END OF TESTPIT (2.10 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Approximately 20° slope, down toward southeast Densely vegetated with spruce, dwarf shrubby willow, blueberries, cranberries, labrador tea, whick spongy moss covering ground						1075
4								1074
5								

Contractor: JDS	Completion Depth: 2.1 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-52**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1059.26 m
Coffee Creek, Yukon	UTM: 583224 E; 6972692 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS (SPHAGNUM) - (200 mm thick)	Unfrozen					1059
		PEAT - mesic-humic, damp, medium to dark brown, slight woody odour, (300 mm thick)						
1		SAND (WEATHERED BEDROCK) - gravelly, silty, with organics matrix, damp, medium grey brown, cobble sized flat, elongated, subangular schist or quartz feldspar clasts to approximately 10-40 mm thick approximately 30-40% by volume - 20-30 mm thick dark brown organic lens - (Gravel - 33%, Sand - 46%, Silt & Clay - 21%)			52-01	14.4	●	1058
2		SCHIST (BEDROCK) - fractured, fragmented, weathered, silty sand, laminations approximately 10-15 mm thick in between rock fragments						1057
3		END OF TESTPIT (2.30 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Approximately 20° slope, down toward southeast Densely vegetated with spruce, dwarf shrubby willow, blueberries, cranberries, labrador tea, whick spongy moss covering ground						1056
4								1055
5								

TETRA TECH

Contractor: JDS	Completion Depth: 2.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 22
Logged By: JL	Completion Date: 2018 September 22
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-53**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1062.75 m
Coffee Creek, Yukon	UTM: 583078 E; 6972625 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Unfrozen		53-01	1062
		PEAT - some rootlets, humic, damp, medium to dark brown, (250 mm thick)				
1		SILT (LOESS) - sandy, gravelly, trace cobbles, trace organics matrix, damp, cohesive, medium to dark grey brown, some dark lenses, some orangey traces, angular and subangular micaceous schist clasts to 200-250 mm diameter to 100 mm thick disseminated throughout				
2		SCHIST (BEDROCK) - fragmented, cobble sized angular rock clasts in a silty, some sand, trace gravel matrix, damp, cohesive, light to medium grey brown and orange, Diggability=1-2				1061
3		END OF TESTPIT (2.60 metres) Notes: Stopped due to refusal on fractured bedrock Diggability=10 Approximately 25° slope, down toward east Densely vegetated with tall spruce trees and some birch, dwarf shrubby willow, dwarf birch, labrador tea, blueberries, moss covering ground				1060
4						1059
5						1058

Contractor: JDS	Completion Depth: 2.6 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 20
Logged By: JL	Completion Date: 2018 September 20
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-54**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1089.83 m
Coffee Creek, Yukon	UTM: 582907 E; 6972572 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Unfrozen		54-01	1089
		PEAT - mesic, damp, medium to dark brown, woody odour, (200 mm thick)				
1		SILT (LOESS) - sandy, gravelly matrix, damp, medium brown to dark grey, cobble and boulder sized platy, flat, elongated highly weathered clasts to 20 mm thick approximately 50% by volume, breaks very easily				1088
2		SCHIST (BEDROCK) - fractured, slightly weathered to fresh, medium to dark grey brown, reddish orange, clasts to 300 mm thick, breaking along foliation, 10 mm thick silty sand layers in fractures, damp, medium to dark grey brown and reddish, Diggability=1-2				
3		END OF TESTPIT (2.50 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Approximately 20° slope, down toward east Sparsely treed in shorter spruce, dwarf shrubby birch and willow, blueberries, labrador tea, moss covering ground				1087
4						1086
5						1085

Contractor: JDS	Completion Depth: 2.5 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 19
Logged By: JL	Completion Date: 2018 September 19
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-55**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1107.78 m
Coffee Creek, Yukon	UTM: 582748 E; 6972511 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Unfrozen			
		PEAT - boulders disseminated throughout, mesic, damp, medium to dark brown, (200 mm thick)				
		SILT (LOESS) - sandy, gravelly, trace cobbles matrix, damp, medium brown, angular and subangular schist clasts approximately 30% by volume to 400-600 mm long disseminated throughout, light and dark grey, reddish orange, Diggability=1-2				1107
1						
		SCHIST (BEDROCK) - fractured, weathered, angular and subangular fragments to 100 mm thick and 300-400 mm long, sandy silt, some gravel around and in between fractures, damp, light to medium orangey brown, Diggability=1-2			55-01	1106
2						
		END OF TESTPIT (2.50 metres) Notes: Stopped due to refusal on hard fractured bedrock Diggability=10 Approximately 20° slope, down toward southeast Sparsely treed with spruce, dwarf shrubby birch, dwarf shrubby willow, blueberries, cranberries, grass, moss covering ground, large boulders on and just under surface				1105
3						
						1104
4						
						1103
5						

Contractor: JDS	Completion Depth: 2.5 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 19
Logged By: JL	Completion Date: 2018 September 19
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-56**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1129.36 m
Coffee Creek, Yukon	UTM: 582591 E; 6972461 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Unfrozen			1129
		PEAT - granite boulders disseminated throughout, mesic, damp, medium to dark brown, (200 mm thick)				
		SILT (LOESS) - sandy, gravelly, trace cobbles matrix, damp, cohesive, medium brown, boulder sized flat, elongated, platy, angular and subangular clasts approximately 400 mm diameter approximately 30-40% by volume disseminated throughout				
1		SCHIST (BEDROCK) - fractured, fragmented, dark and light grey, orangey, flat, elongated, platy, clasts to 500 mm long in a silt, some sand, some gravel matrix, Diggability=1-2			56-01	1128
2		END OF TESTPIT (1.70 metres) Notes: Stopped due to refusal on bedrock Diggability=10 Approximately 25° slope, down toward southeast Densely vegetated with tall birch and some tall spruce dwarf shrubby willow, blueberries, moss covering ground, many large boulders noticed at and just below surface				1127
3						1126
4						1125
5						

Contractor: JDS	Completion Depth: 1.7 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 19
Logged By: JL	Completion Date: 2018 September 19
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-57**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1143.94 m
Coffee Creek, Yukon	UTM: 582419 E; 6972442 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Unfrozen			
		PEAT - boulders disseminated throughout, fibric, damp, medium to dark brown, slight woody odour, (200 mm thick)				
		SILT (LOESS) - sandy, gravelly, trace cobbles, trace boulders matrix, damp, cohesive, medium brown, angular and subangular clasts approximately 500 mm diameter approximately 40-50% by volume disseminated throughout, Diggability=1-2				
1						1143
		SCHIST (BEDROCK) - fragmented, flat, elongated, platy, dark grey and orange, angular clasts in a silty, some sand, some gravel, some cobbles, trace clay matrix, Diggability=7			57-01	
2						1142
		END OF TESTPIT (2.30 metres) Note: Stopped due to refusal on bedrock Diggability=10 Approximately 10° slope, down toward southeast Some tall spruce and birch, dwarf shrubby birch and willow abundant, labrador tea, blueberries, cranberries, moss covering ground, many large boulders observed on and just under surface				
3						1141
4						1140
5						1139

TETRA TECH

Contractor: JDS	Completion Depth: 2.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 19
Logged By: JL	Completion Date: 2018 September 19
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-58**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1144.57 m
Coffee Creek, Yukon	UTM: 582285 E; 6972397 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - (150 mm thick) PEAT - fibric to mesic, moist, medium to dark brown, (250 mm thick) SILT (LOESS) AND SAND - gravelly, organics, trace clay, rootlets, wet, dark brown and medium grey brown, boulder sized angular rock fragments disseminated throughout - gravelly, cobbly, some sand, wet, water trickling in appears to be suprapermafrost water, Diggability=1-2 - (Gravel - 21%, Sand - 36%, Silt & Clay - 43%)	Seasonally thawed layer (Active layer)		58-01	25.2		1144
1								
2		END OF TESTPIT (1.30 metres) Notes: Stopped due to refusal on permafrost Diggability=10 Approximately 10° slope, down toward southeast Some tall spruce, dwarf shrubby birch and willow in abundance, labrador tea, blueberries, cranberries, moss covering ground, many large boulders on and just under surface	Permafrost, Vx, Vs estimate 20%, 1 mm thick ice inclusions, Vs 1mm thick lenticular ice lenses					1143
3								1142
4								1141
5								1140

TETRA TECH

Contractor: JDS	Completion Depth: 1.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 19
Logged By: JL	Completion Date: 2018 September 19
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-59**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1149.63 m
Coffee Creek, Yukon	UTM: 582121 E; 6972345 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		MOSS - (100 mm thick)	Unfrozen					
		PEAT - fibric, damp, medium to dark brown, slight woody odour, (250 mm thick)						
	Excavated	SAND (WEATHERED BEDROCK) - gravelly, silty, trace cobbles, trace clay, damp, cohesive, light to medium brown, angular to subangular dark grey and orange, boulder sized granite clasts approximately 300 mm long approximately 10% by volume, disseminated throughout						1149
1		- (Gravel - 33%, Sand - 34%, Silt - 25%, Clay - 8%)			59-01	11.4		
		SAND AND GRAVEL (WEATHERED BEDROCK) - silty, some cobbles, some boulders, damp, medium brown, some orange, angular and subangular, light to dark grey, orange clasts approximately 15-20% by volume to 400 mm long						1148
		- highly weathered rock fragments, (transition zone)						
2		- (Gravel - 38%, Sand - 40%, Silt & Clay - 22%)			59-02	8.1		
		END OF TESTPIT (2.30 metres)						1147
		Notes: Stopped due to refusal on bedrock or permafrost Diggability=10 Water seeping in, appears to be suprapermafrost water Approximately 10° slope, down toward southeast Tall spruce, abundant dwarf birch and willow, blueberries, cranberries, moss covering ground, many boulders on and just below surface						
3								1146
4								1145
5								

Contractor: JDS	Completion Depth: 2.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 19
Logged By: JL	Completion Date: 2018 September 19
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-60**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1171.61 m
Coffee Creek, Yukon	UTM: 581947 E; 6972288 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Unfrozen			
		PEAT - granite boulders disseminated throughout, fibric, moist, medium to dark brown, woody odour, (100 mm thick)				
		SILT (LOESS) - sandy, gravelly, trace cobbles, rootlets, boulders disseminated throughout, damp, medium brown			60-01	1171
1		SAND - gravelly, bouldery, some silt, trace cobbles, damp, slightly cohesive, medium brown, granite boulders and cobbles, light to dark grey, orange, Diggability=3-4			60-02	1170
2						
		END OF TESTPIT (2.30 metres) Notes: Stopped due to refusal on boulders Diggability=10 Water seeping through Approximately 20-25° slope, down toward southeast Tall spruce and birch trees around area, dwarf birch and willow shrubs, blueberries, labrador tea, moss covering ground Testpit location is in a large boulder field, exact given location was directly on a large rock so testpit was moved approximately 10 m northeast				1169
3						
						1168
4						
						1167
5						

TETRA TECH

Contractor: JDS	Completion Depth: 2.3 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 18
Logged By: JL	Completion Date: 2018 September 18
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-61**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1189.34 m
Coffee Creek, Yukon	UTM: 581847 E; 6972218 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Unfrozen			1189
		PEAT- bouldery, fibric, moist to wet, medium to dark brown, (300 mm thick)				
		SILT (LOESS) - bouldery, some sand, some gravel, trace cobbles, wet, medium brown, angular to subangular granite clasts to 1 m long, water trickling in steadily			61-02	
1					61-01	1188
2		END OF TESTPIT (1.90 metres) Notes: Stopped due to refusal on large boulders Diggability=8-9 Approximately 20° slope, down toward southeast Some tall spruce, sparsely treed, dwarf shrubby birch, dwarf shrubby willow, blueberries, cranberries, labrador tea green and white moss covering ground, large boulders on and just below ground surface				1187
3						1186
4						1185
5						

TETRA TECH

Contractor: JDS	Completion Depth: 1.9 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 18
Logged By: JL	Completion Date: 2018 September 18
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-62**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1198.59 m
Coffee Creek, Yukon	UTM: 581774 E; 6972146 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Excavated	MOSS - moist, light to medium brown, (300 mm thick)	Unfrozen					1198
		PEAT - mesic to humic, moist, dark brown, subangular to rounded boulders to 1 m diameter disseminated throughout, slight woody odour, (150 mm thick)						
1		GRAVEL (WEATHERED BEDROCK) - sandy, silty, trace clay, wet, medium grey brown, angular to subangular rock fragments disseminated throughout, water trickling into testpit, appears to be suprapermafrost water, Diggability=5-6			62-01	11.7	●	
		- (Gravel - 41%, Sand - 32%, Silt & Clay - 27%)						
		END OF TESTPIT (1.50 metres) Notes: Stopped due to refusal on boulders Diggability=10 Approximately 15° slope, down toward east Some shorter spruce, treed sparsely, dwarf birch, dwarf shrubby willow, blueberries, labrador tea, green and white moss covering ground, many large boulders noticed on and just below ground surface around entire area						1197
2								1196
3								1195
4								1194
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.5 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 18
Logged By: JL	Completion Date: 2018 September 18
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-63**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Latte Diversion	Ground Elev: 1192.26 m
Coffee Creek, Yukon	UTM: 581710 E; 6972067 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Elevation (m)
0	Excavated	MOSS - (100 mm thick)	Unfrozen		63-01	1192
		PEAT - some boulders, fibric to mesic, damp, medium to dark brown, woody odour, (150 mm thick)				
		SILT (LOESS) - sandy, some gravel, trace clay, boulders disseminated throughout, wet, medium grey brown, angular and subangular, light to dark grey and orange, granite and schist clasts to 300 mm thick and 800 mm long, Diggability=6				
1		- some sand, angular and subangular, dark grey and reddish orange schist clasts to 400 mm thick and 800 mm long				1191
2		- water accumulation at the bottom of the testpit				1190
		END OF TESTPIT (2.10 metres) Notes: Stopped due to refusal on boulders Diggability=9 Approximately 15° slope, down toward east Some shorter spruce, treed sparsely, dwarf birch, dwarf shrubby willow, blueberries, labrador tea, green and white moss covering ground, many large boulders noticed on and just below surface around entire area				
3						1189
4						1188
5						

TETRA TECH

Contractor: JDS	Completion Depth: 2.1 m
Drilling Rig Type: CAT 336E	Start Date: 2018 September 18
Logged By: JL	Completion Date: 2018 September 18
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-64**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Halfway Diversion	Ground Elev: 982.441 m
Coffee Creek, Yukon	UTM: 581378 E; 6973550 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Jack hammer Hand dug	MOSS - (100 mm thick) PEAT - rootlets, dark brown, (200 mm thick) - Diggability=10 SILT (LOESS) AND SAND - trace clay, dark brown grey, with organics - (Sand - 43%, Silt & Clay - 57%) - bouldery, sandy	Seasonally thawed layer (Active layer) Permafrost Vc, Vx, Vs 15-25%, 20-30 mm thick ice formations		64-01	194.7		982
			Vc, Vs estimated 25-35%, 20-30 mm thick ice lenses		64-02			
1		END OF TESTPIT (1.00 metre) Notes: Stopped due to refusal on permafrost Diggability=10 Northeast facing slope						981
2								980
3								979
4								978
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1 m
Drilling Rig Type:	Start Date: 2018 September 8
Logged By: JL	Completion Date: 2018 September 8
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-65**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Halfway Diversion	Ground Elev: 971.559 m
Coffee Creek, Yukon	UTM: 581437 E; 6973822 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Hand dug	MOSS - damp, (100 mm thick)	Unfrozen					971
		PEAT - many rootlets, thick roots to 5 mm thick, fibric, damp, dark brown, (100 mm thick)						
		GRAVEL AND SAND (WEATHERED BEDROCK) - silty, moist, medium to dark brown			65-01	35.1		
		- (Gravel - 43%, Sand - 35%, Silt & Clay - 22%)						
		- some gravel			65-02			
1		- gravelly, some cobbles, dark grey						970
		END OF TESTPIT (1.40 metres)						
		Notes: Southeast facing slope						
		Dense mixed forest						
		Water accumulation at the bottom of testpit						
2								969
3								968
4								967
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.4 m
Drilling Rig Type:	Start Date: 2018 September 9
Logged By: JL	Completion Date: 2018 September 9
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-66**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Halfway Diversion	Ground Elev: 953.508 m
Coffee Creek, Yukon	UTM: 581753 E; 6974230 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Excess Ice Content (% by volume) 20 40 60 80 / Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	Elevation (m)
0	Hand dug	MOSS - thick roots, moist, light to medium brown, (300 mm thick)	Seasonally thawed layer (Active layer)					953
		PEAT - rootlets, fibric to mesic, wet, dark brown, (200 mm thick)						
		SILT (LOESS) AND SAND - some gravel, rootlets, wet, dark brown, angular rock fragments to 550 mm x 420 mm disseminated throughout, Diggability=5-6 - (Gravel - 15%, Sand - 38%, Silt - 36%, Clay - 11%)			66-01	19	▲ ●	
1		GRAVEL (WEATHERED BEDROCK) - sandy, silty, trace clay, very dark brown grey, angular granite clasts in a sandy matrix - (Gravel - 46%, Sand - 27%, Silt & Clay - 27%)	Permafrost, Vx, Vs 30% (Beaker test) Vx, Vs, Vc estimated 30%		66-02	41.9	▲ ●	
		ROCK FRAGMENTS - angular clasts in a sandy, silty, some gravel, trace sand matrix						
		END OF TESTPIT (1.10 metres) Notes: Stopped due to refusal on permafrost Diggability=10 Northeast facing slope Boulders observed around site, thick moss cover						952
2								
								951
3								
								950
4								
								949
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.1 m
Drilling Rig Type:	Start Date: 2018 September 10
Logged By: JL	Completion Date: 2018 September 10
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-67**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Halfway Diversion	Ground Elev: 951.097 m
Coffee Creek, Yukon	UTM: 581601 E; 6974466 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Hand dug	MOSS - damp, light to medium brown, (200 mm thick)	Unfrozen					951
		PEAT - (100 mm thick)						
		GRAVEL AND COBBLES (COLLUVIUM) - some silt, rootlets, loose, light grey brown, some orange, flat, elongated, angular clasts approximately to 20-50 mm thick			67-01			
		SILT (LOESS) - sandy, trace gravel, trace clay matrix, rootlets, damp, medium brown, angular clasts disseminated throughout - (Gravel - 10%, Sand - 28% Silt & Clay - 62%) - black charcoal lenses			67-02	28.6		
1		SCHIST (BEDROCK) - fragmented, fractured, angular schist clasts in a sandy, gravelly, silty, trace clay matrix, damp, light to medium brown - angular and subangular rock fragments to 60 mm thick			67-03			950
		END OF TESTPIT (1.40 metres) Notes: Stopped due to refusal on fractured bedrock South facing slope Tall large trees around						
2								949
3								948
4								947
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.4 m
Drilling Rig Type:	Start Date: 2018 September 11
Logged By: JL	Completion Date: 2018 September 11
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-68**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Halfway Diversion	Ground Elev: 856.102 m
Coffee Creek, Yukon	UTM: 582938 E; 6975993 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0	Hand dug	PEAT MOSS (SPHAGNUM) - fibric, wet, dark brown, (100 mm thick)	Unfrozen					856
		COBBLES AND GRAVEL - sandy, trace silt, trace clay, rootlets, damp, medium brown, angular and subangular clast to 300 mm diameter			68-01			
		GRAVEL (COLLUVIUM) - sandy, some silt, trace clay, rootlets, light brown to reddish brown, cobbles disseminated throughout - (Cobbles - 7%, Gravel - 38%, Sand - 33%, Silt & Clay - 22%)			68-02	9.5		
1		GRAVEL AND SAND (COLLUVIUM) - silty, moist, medium grey brown, subangular reddish and greyish gravel - (Gravel - 40%, Sand - 38%, Silt - 15%, Clay - 7%)			68-03	10.3		855
		END OF TESTPIT (1.20 metres) Notes: South facing slope Dense trees around, many angular and subangular light reddish brown rocks noticed						
2								854
3								853
4								852
5								

TETRA TECH

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type:	Start Date: 2018 September 12
Logged By: JL	Completion Date: 2018 September 12
Reviewed By: VER	Page 1 of 1

Testpit No: **TP18-18-69**

Project: Coffee Fall 2018 Testpitting Program	Project No: ENG.EARC03094-06
Location: Halfway Diversion	Ground Elev: 727.901 m
Coffee Creek, Yukon	UTM: 583579 E; 6976175 N; Z 7

Depth (m)	Method	Lithological Description	Thermal Condition and Ground Ice Description	Sample Type	Sample/Run Number	Moisture Content (%)	Excess Ice Content (% by volume) 20 40 60 80 / Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	Elevation (m)
0	Hand dug	MOSS - damp, light to medium brown, (200 mm thick)	Seasonally thawed layer (Active layer)					
		PEAT - rootlets, mesic to humic, wet, dark brown, (200 mm thick)						
	Jack hammer	SILT (LOESS) - organics, trace clay, dark brown	Permafrost, Vx, Vc, Vs 35%, 1 mm thick ice lenses and inclusions		69-02	529	▲	
		- some clay	Some ice inclusions to 20 mm thick					
1		- timber piece, light red brown	Excess Ice 42%		69-01 69-03	313.7 2772	●	727
		END OF TESTPIT (1.20 metres) Notes: Stopped due to refusal on permafrost South to southwest facing slope Testpit location given was directly in creek channel, moved approximately 10 m northwest to avoid water						
2								726
3								725
4								724
5								723

TETRA TECH

Contractor: JDS	Completion Depth: 1.2 m
Drilling Rig Type:	Start Date: 2018 September 13
Logged By: JL	Completion Date: 2018 September 13
Reviewed By: VER	Page 1 of 1

APPENDIX C

GEOTECHNICAL LABORATORY SOIL TEST RESULTS

CALIFORNIA BEARING RATIO (CBR) TEST REPORT

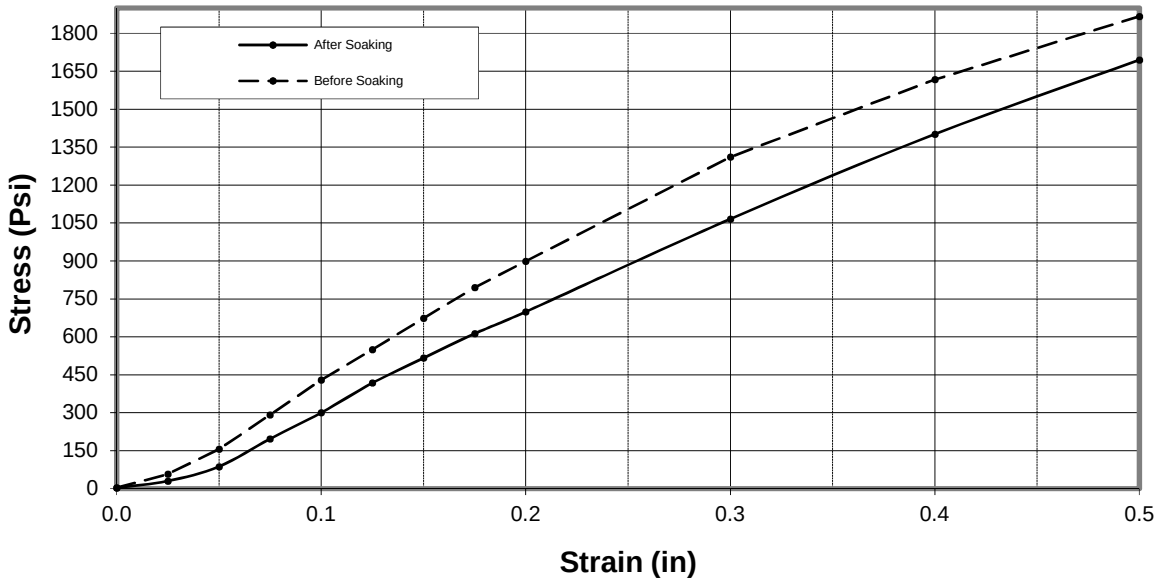
ASTM D1883

Project:	Fall 2018 Testpitting Program	Sample No.:	TP01-01 to TP-04A-01 Combined
Client:	JDS Energy & Mining	CBR Specimen Density:	2003 kg/m³
Project No.:	ENG.EARC03094-06.003	CBR Specimen Compaction	98.2 %
Test Date:	October 12, 2018	Total Swell:	0.30 %
Soaking:	96.0 Hours	Surcharge Mass:	4.54 kg
Description:	GRAVEL, silty, sandy, brown.	Optimum Moisture Content:	10.9 %
Material Retained 19-mm:	16.0%	Max. Dry Density:	2040 kg/m³
		by (ASTM D698) Standard Proctor	

	Before Soaking	After Soaking	Corrected for Zero *
Bearing Ratio (0.1") =	**43.0 %**	**30.0 %**	Yes
Bearing Ratio (0.2") =	**59.9 %**	**46.6 %**	
Moisture Content =	**11.0 %**	**11.2 %**	
Moisture Content @ top 1" =	**-**	**12.4 %**	

* CBR corrected for zero point adjustment as per ASTM D1883, Fig. 2

Load-Penetration



Remarks: 25 Blows

Laboratory: Edmonton **Reviewed By:** _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

CALIFORNIA BEARING RATIO (CBR) TEST REPORT

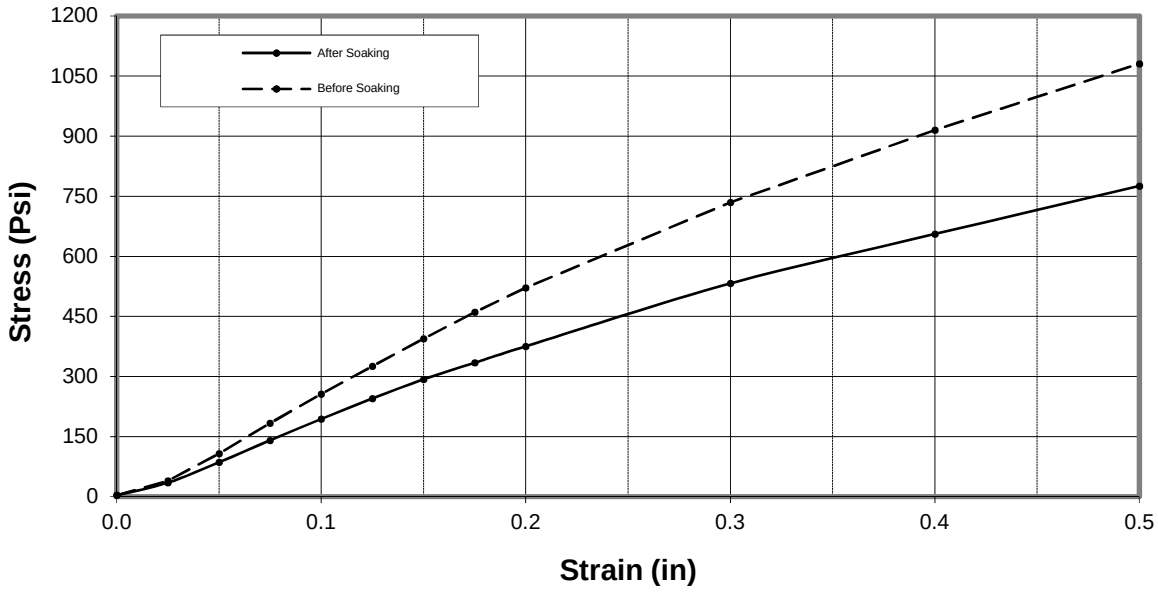
ASTM D1883

Project:	Fall 2018 Testpitting Program	Sample No.:	TP01-01 to TP04A-01 Combined
Client:	JDS Energy & Mining	CBR Specimen Density:	1908 kg/m³
Project No.:	ENG.EARC03094-06.003	CBR Specimen Compaction	93.5 %
Test Date:	October 12, 2018	Total Swell:	0.24 %
Soaking:	96.0 Hours	Surcharge Mass:	4.54 kg
Description:	GRAVEL, silty, sandy, brown.	Optimum Moisture Content:	10.9 %
Material Retained 19-mm:	16.0%	Max. Dry Density:	2040 kg/m³
		by (ASTM D698) Standard Proctor	

	Before Soaking	After Soaking	Corrected for Zero *
Bearing Ratio (0.1") =	**25.6 %**	**19.4 %**	Yes
Bearing Ratio (0.2") =	**34.8 %**	**25.0 %**	
Moisture Content =	**11.0 %**	**12.8 %**	
Moisture Content @ top 1" =	**-**	**13.4 %**	

* CBR corrected for zero point adjustment as per ASTM D1883, Fig. 2

Load-Penetration



Remarks: 10 Blows

Laboratory: Edmonton **Reviewed By:** _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

CALIFORNIA BEARING RATIO (CBR) TEST REPORT

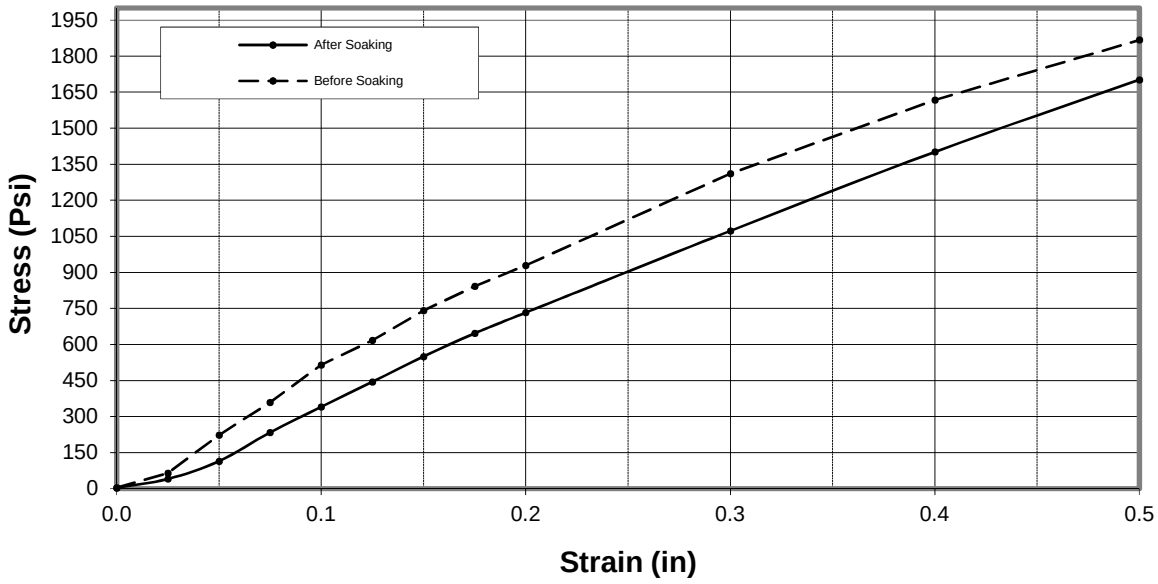
ASTM D1883

Project:	Fall 2018 Testpitting Program	Sample No.:	TP01-01 to TP04A-01 Combined
Client:	JDS Energy & Mining	CBR Specimen Density:	2050 kg/m³
Project No.:	ENG.EARC03094-06.003	CBR Specimen Compaction	100.5 %
Test Date:	October 12, 2018	Total Swell:	0.38 %
Soaking:	96.0 Hours	Surcharge Mass:	4.54 kg
Description:	GRAVEL, silty, sandy, brown.	Optimum Moisture Content:	10.9 %
Material Retained 19-mm:	16.0%	Max. Dry Density:	2040 kg/m³
		by (ASTM D698) Standard Proctor	

	Before Soaking	After Soaking	Corrected for Zero *
Bearing Ratio (0.1") =	**51.4 %**	**34.1 %**	Yes
Bearing Ratio (0.2") =	**61.9 %**	**48.8 %**	
Moisture Content =	**11.0 %**	**11.1 %**	
Moisture Content @ top 1" =	**-**	**11.4 %**	

* CBR corrected for zero point adjustment as per ASTM D1883, Fig. 2

Load-Penetration



Remarks: 56 Blows

Laboratory: Edmonton **Reviewed By:** IDR P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

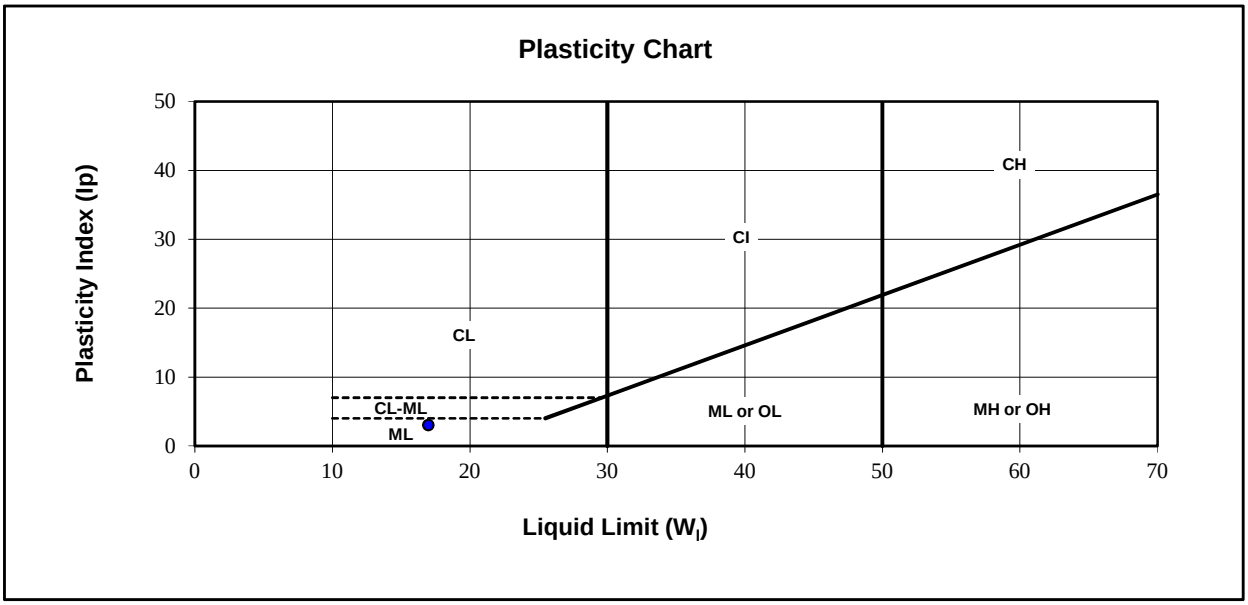
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Fall 2018 Testpitting Program	Sample Number:	TP01-01 to TP04A-01 Combined
		Testpit Number:	TP18-18-01 to TP18-1804A
Project No:	ENG.EARC03094-06.003	Source:	
Client:	JDS Energy & Mining Inc.	Sampled By:	JL Tested By: LL
Attention:	Leigh Sawchyn	Date Sampled:	Sept. 7, and Sept. 25, 2018
Email:	leighs@jdsmining.ca	Date Tested:	November 2, 2018

Sample Description: SILT, sandy.



Liquid Limit ($W_{1)}$) :	17	Natural Moisture (%)	-
Plastic Limit :	14	Soil Plasticity:	Low
Plasticity Index (Ip) :	**3**	Mod.USCS Symbol:	ML

Remarks: *The description is based on the passing 425 um material.

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

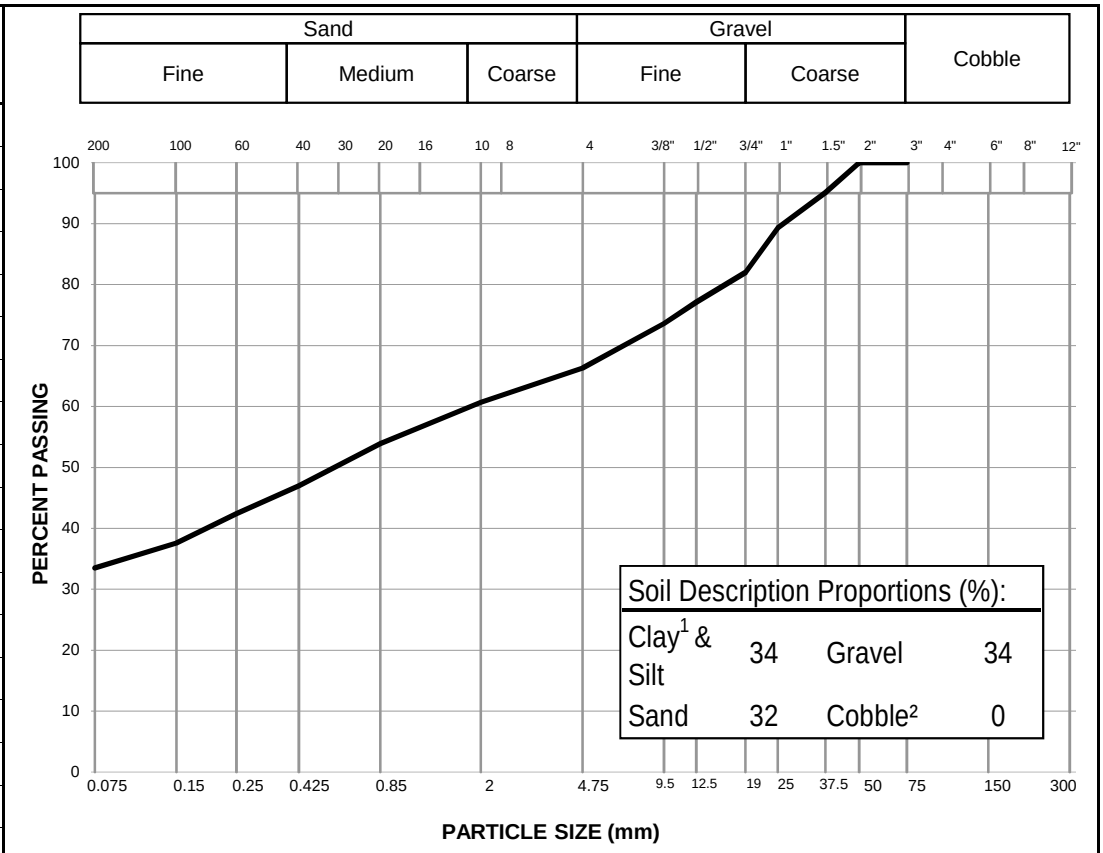
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.	TP01-01 to TP04A-01 Combined
Project No.:	ENG.EARC03094-06.003	Material Type:	
Site:	Coffee Gold Mine, YT	Sample Loc.:	Airstrip Alignment
Client:	JDS Energy & Mining Inc.	Sample Depth:	Varies (0.1 m to 1.3 m)
Client Rep.:	Leigh Sawchyn	Sampling Method:	
Date Tested:	October 23, 2018 By: LL	Date Sampled:	Sept. 7 and Sept. 25, 2018
Soil Description:	GRAVEL, silty, sandy, trace clay. Brown.	Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	N/A		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	100
37.5	95
25	89
19	82
12.5	77
9.5	74
4.75	66
2	61
0.85	54
0.425	47
0.25	42
0.15	38
0.075	33.5



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

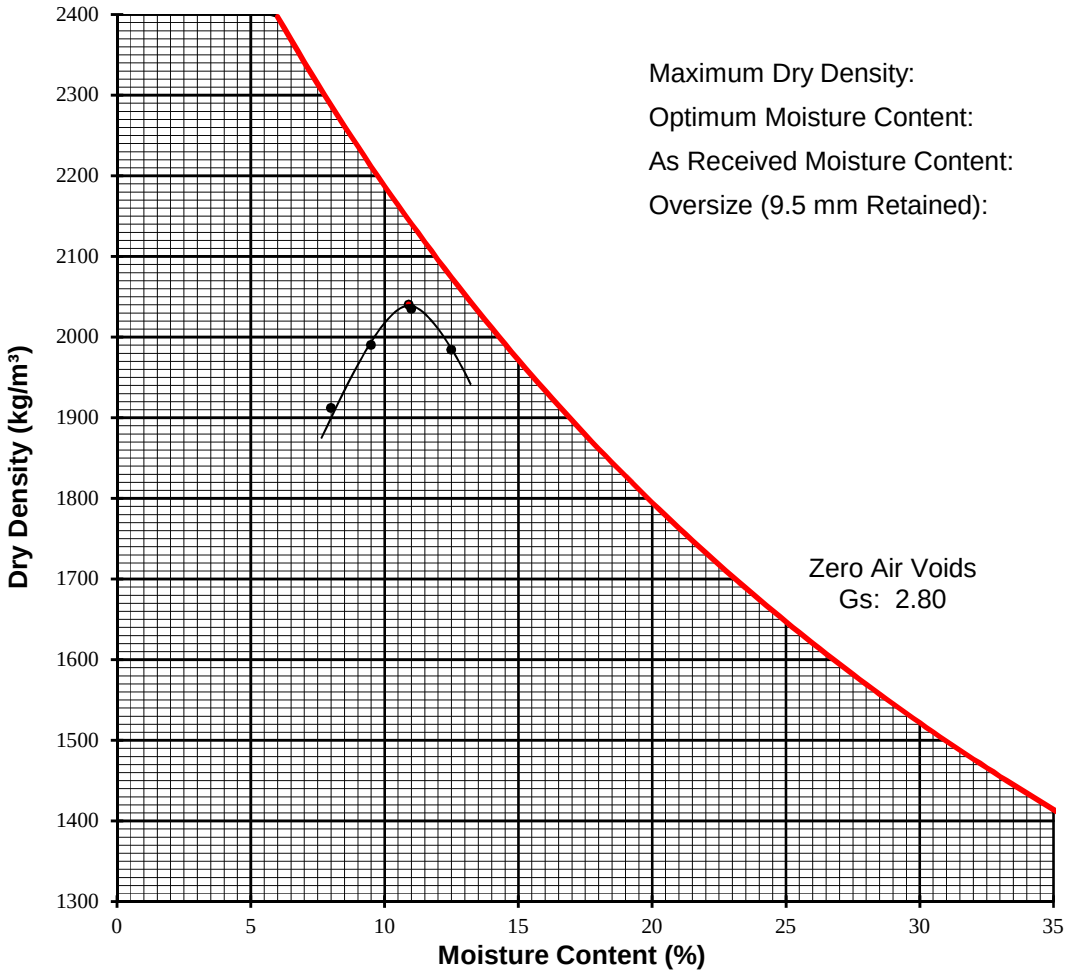
MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D698 (Standard Proctor)

Project:	Fall 2018 Testpitting Program	Sample No.:	2764
Project No.:	ENG.EARC03094-06.003	Sampled By:	JL
Client:	JDS Mining & Energy	Date Sampled:	Sept. 7 and 25, 2018
Attention:	Leigh Sawchyn	Test Date:	October 23, 2018
E-mail:	leighs@jdsmining.com	Test By:	MA
Source:	TP 18-18-01 and TP-18-18-04A Combined Sample	Test Method:	B (Manual)

Sample Location: Java Airstrip

Sample Description: GRAVEL, silty, sandy, brown.



Maximum Dry Density:	**2040**	kg/m³
Optimum Moisture Content:	**10.9**	%
As Received Moisture Content:	14.7	%
Oversize (9.5 mm Retained):	16	%

Remarks:

Reviewed By: JPR P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

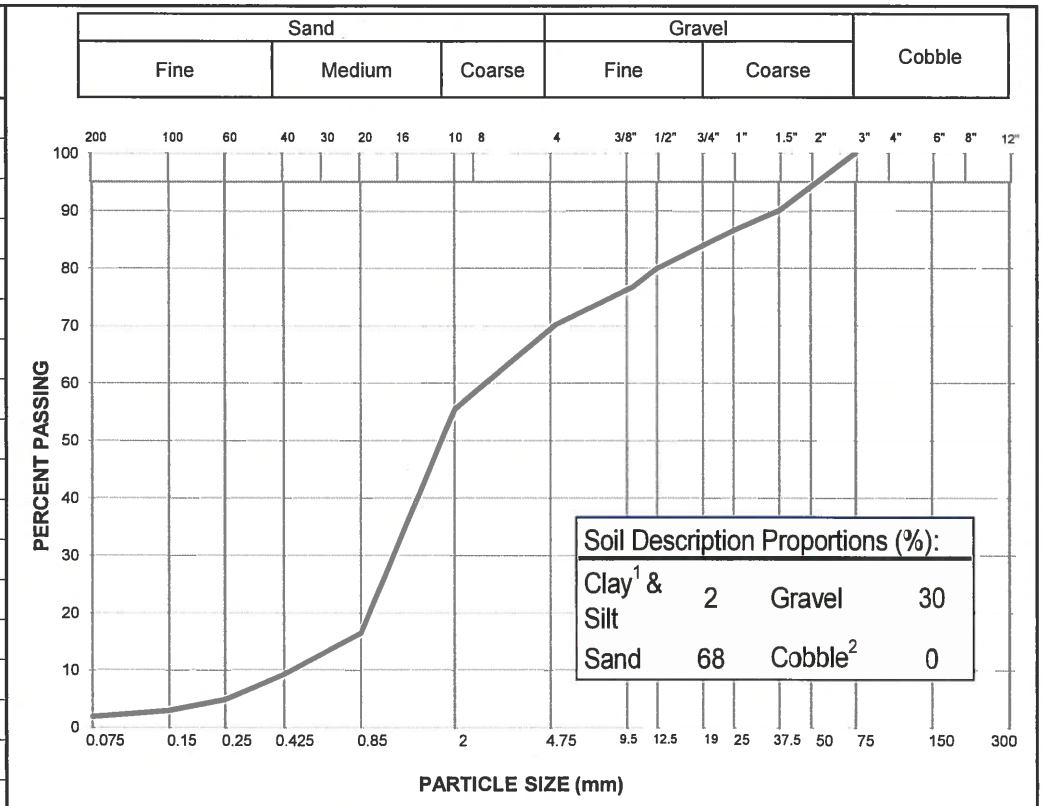
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP05-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	0.3km Borrow Source
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.7 - 1.4 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 14, 2018 By: GK	Date Sampled:	September 24, 2018
		Sampled By:	JL
		USC Classification:	Cu: 6.3
Moisture Content:	2.1%		Cc: 1.1

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	90
25	87
19	84
12.5	80
10	77
5	70
2	55
0.85	17
0.425	9
0.25	5
0.15	3
0.075	2.0



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

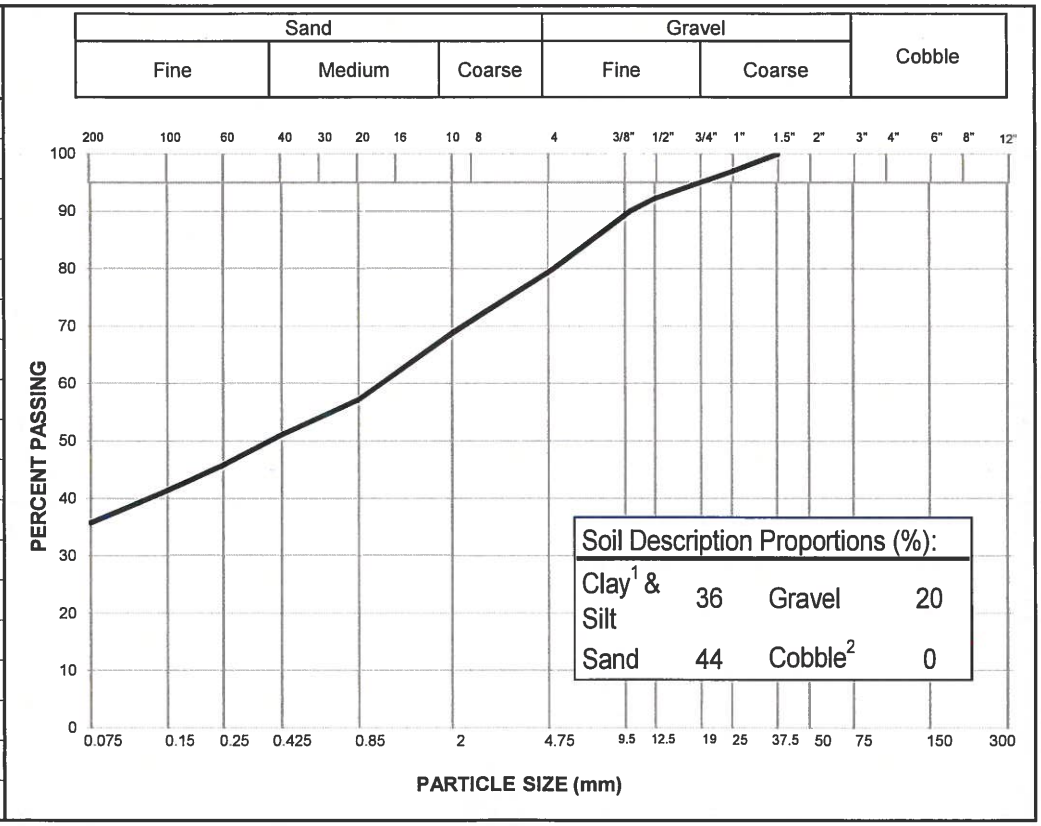
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP06-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	0.3km Borrow Source
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.15 - 1.00 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 14, 2018 By: GK	Date Sampled:	September 23, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	8.4%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	97
19	
12.5	92
10	90
5	80
2	69
0.85	57
0.425	51
0.25	46
0.15	41
0.075	35.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

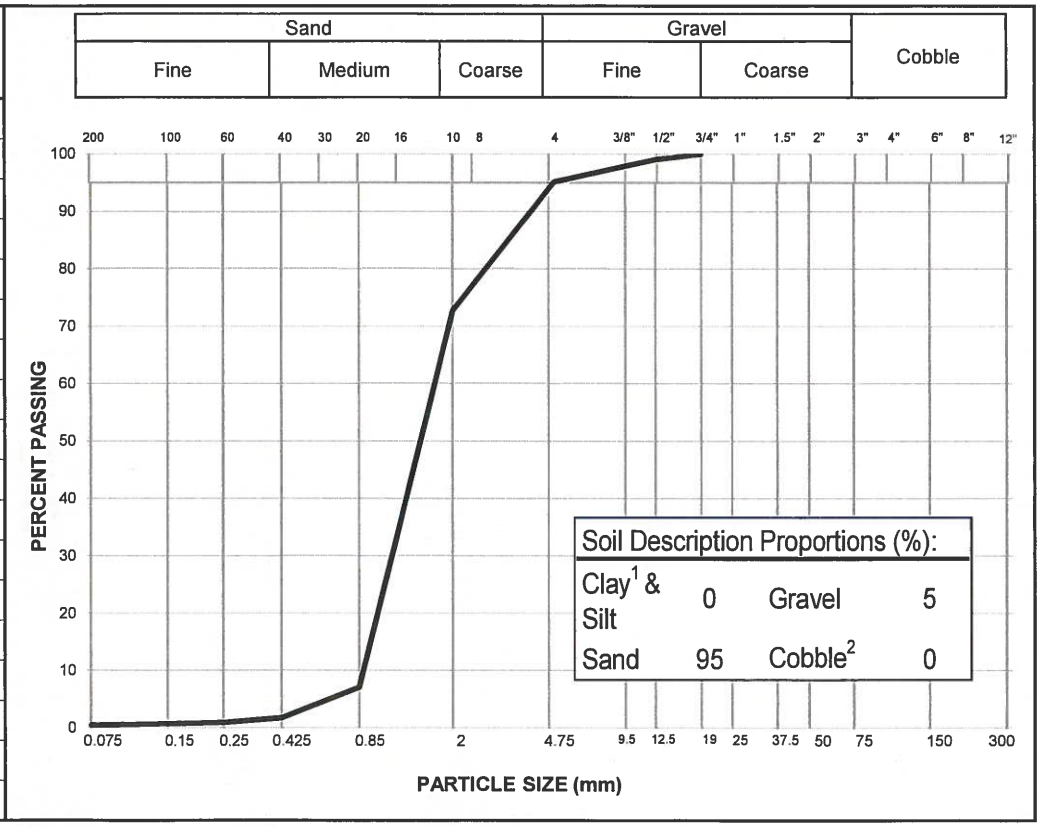
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP06-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	0.3km Borrow Source
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.0 - 1.5 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 14, 2018 By: GK	Date Sampled:	September 23, 2018
		Sampled By:	JL
		USC Classification:	Cu: 2.0
Moisture Content:	1.4%		Cc: 1.0

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	100
12.5	99
10	98
5	95
2	73
0.85	7
0.425	2
0.25	1
0.15	1
0.075	0.4



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

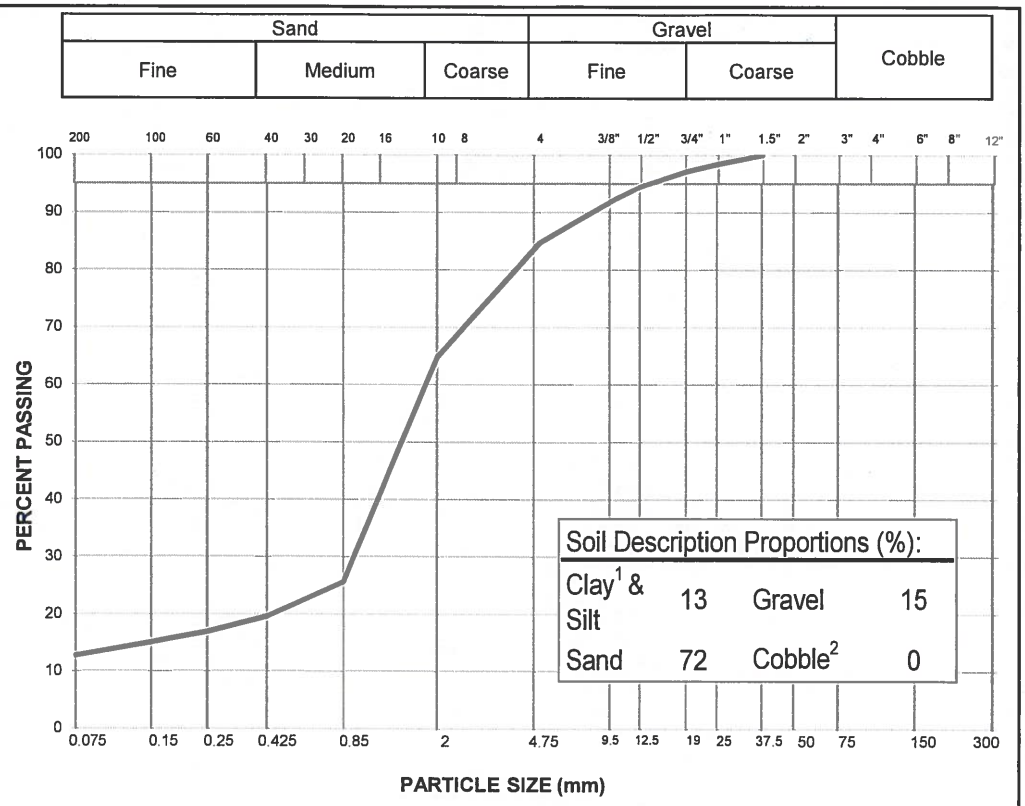
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP06-03
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	0.3km Borrow Source
Client:	JDS Energy & Mining Inc.	Sample Depth:	4.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 15, 2018 By: GK	Date Sampled:	September 23, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	6.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	98
19	97
12.5	94
10	92
5	85
2	65
0.85	26
0.425	20
0.25	17
0.15	15
0.075	12.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

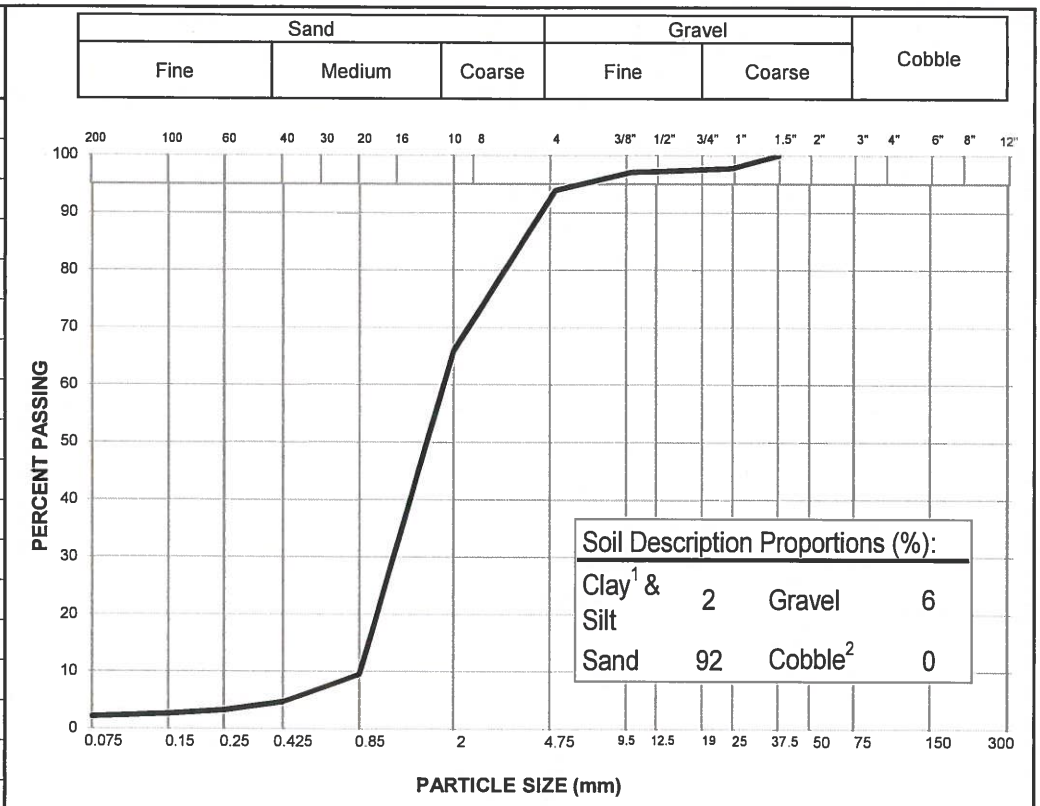
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP07-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	0.3km Borrow Source
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.4 - 1.6 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 14, 2018 By: GK	Date Sampled:	September 23, 2018
		Sampled By:	JL
		USC Classification:	Cu: 2.2
Moisture Content:	3.4%		Cc: 1.0

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	98
19	
12.5	97
10	97
5	94
2	66
0.85	10
0.425	5
0.25	3
0.15	3
0.075	2.1



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

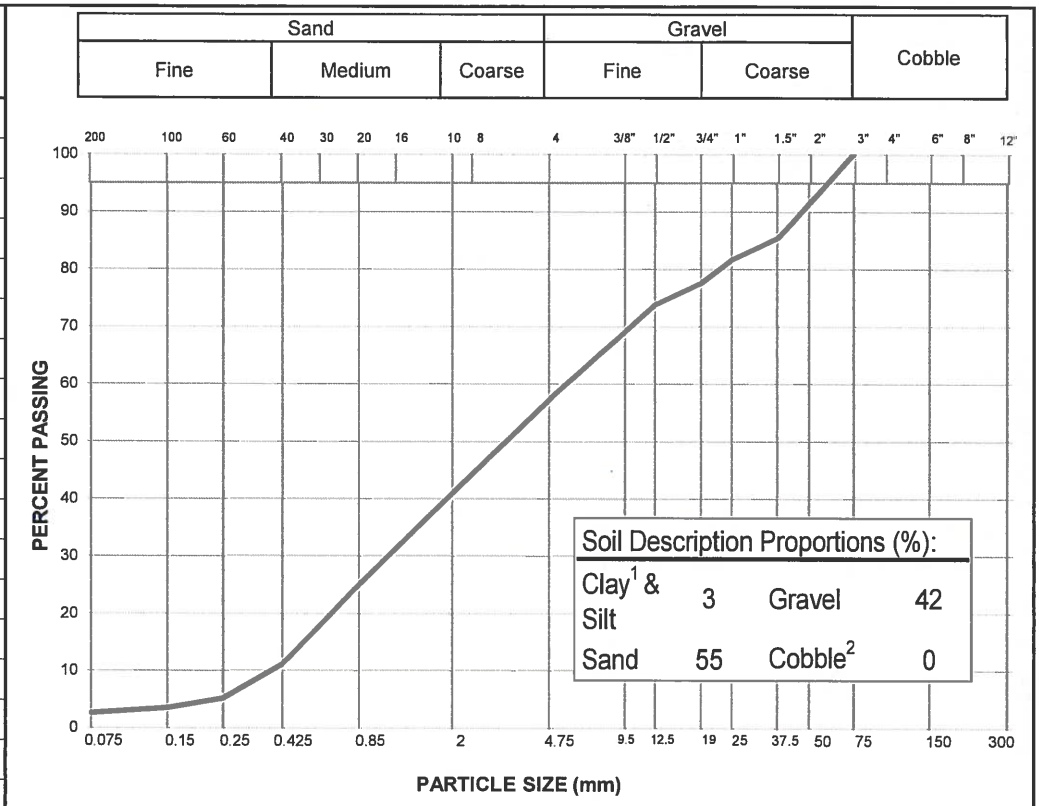
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP08-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	0.3km Borrow Source
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.65 - 1.10 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 14, 2018 By: GK	Date Sampled:	September 24, 2018
		Sampled By:	JL
		USC Classification:	Cu: 14.8
Moisture Content:	1.7%		Cc: 0.6

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	85
25	82
19	78
12.5	74
10	70
5	58
2	41
0.85	25
0.425	11
0.25	5
0.15	4
0.075	2.6



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

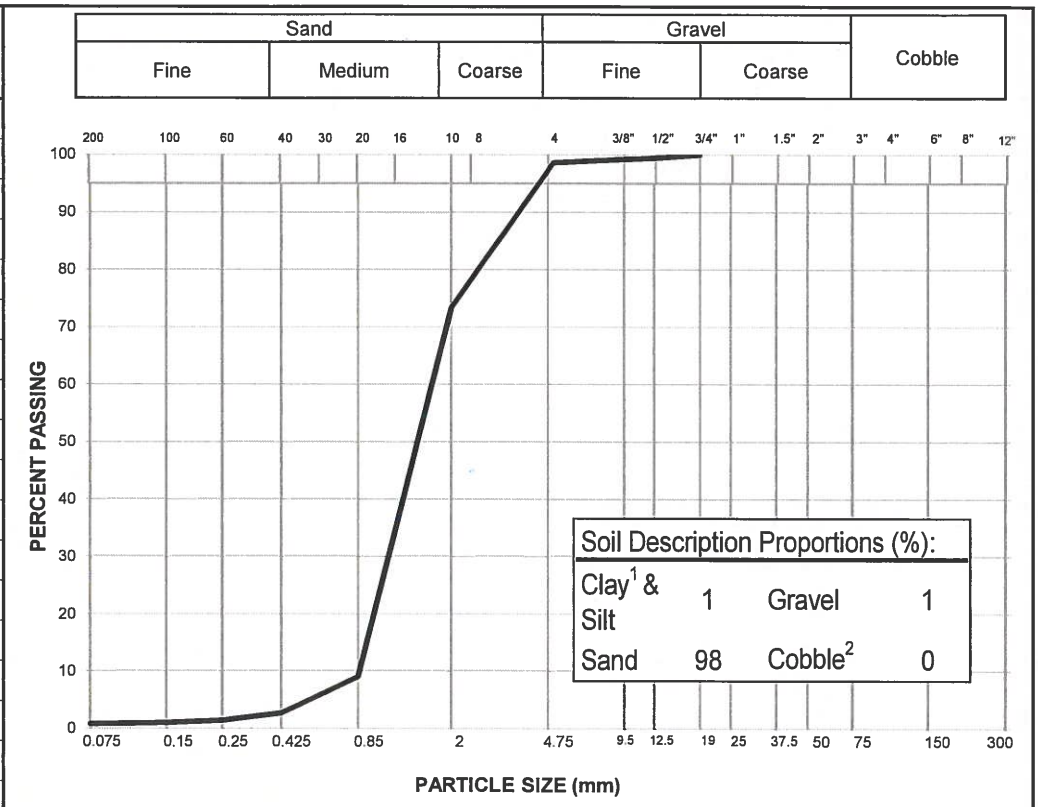
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP08-03
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	0.3km Borrow Source
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.1 - 1.6 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 14, 2018 By: GK	Date Sampled:	September 24, 2018
		Sampled By:	JL
		USC Classification:	Cu: 2.0
Moisture Content:	2.1%		Cc: 1.0

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	100
12.5	99
10	99
5	99
2	73
0.85	9
0.425	3
0.25	1
0.15	1
0.075	0.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

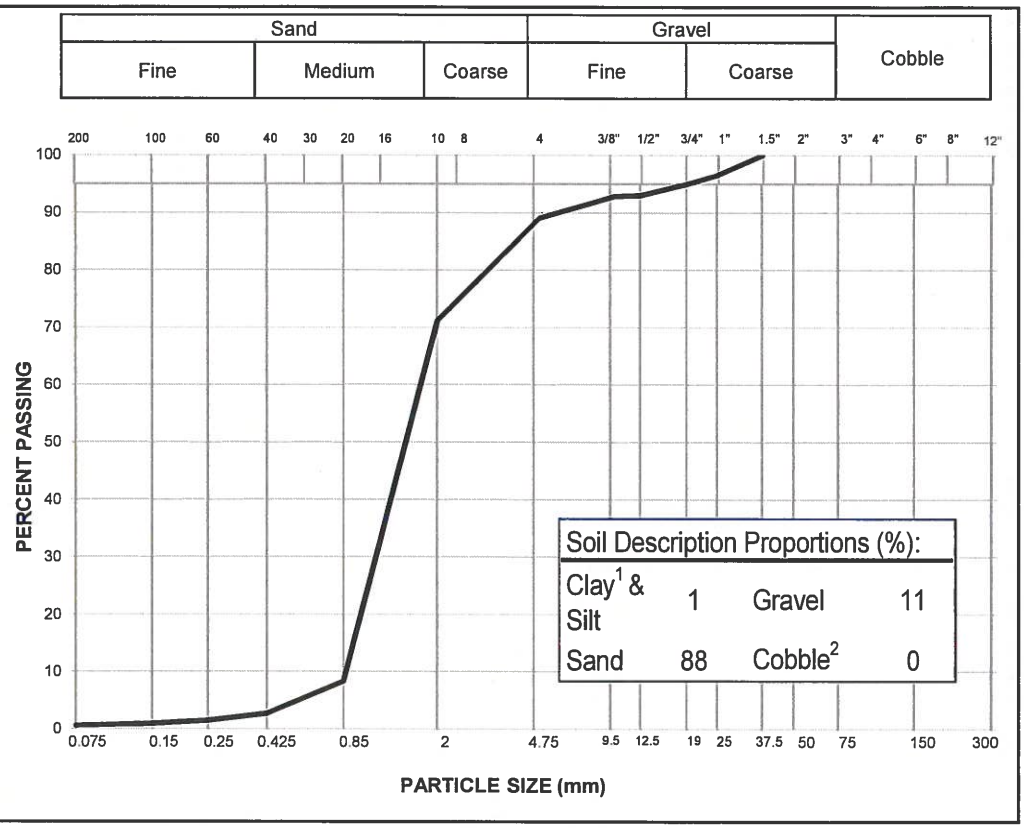
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP09-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	0.3km Borrow Source
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.2 - 1.5 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 14, 2018 By: GK	Date Sampled:	September 23, 2018
		Sampled By:	JL
		USC Classification:	Cu: 2.0
Moisture Content:	1.6%		Cc: 1.0

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	97
19	95
12.5	93
10	93
5	89
2	71
0.85	8
0.425	3
0.25	1
0.15	1
0.075	0.6



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

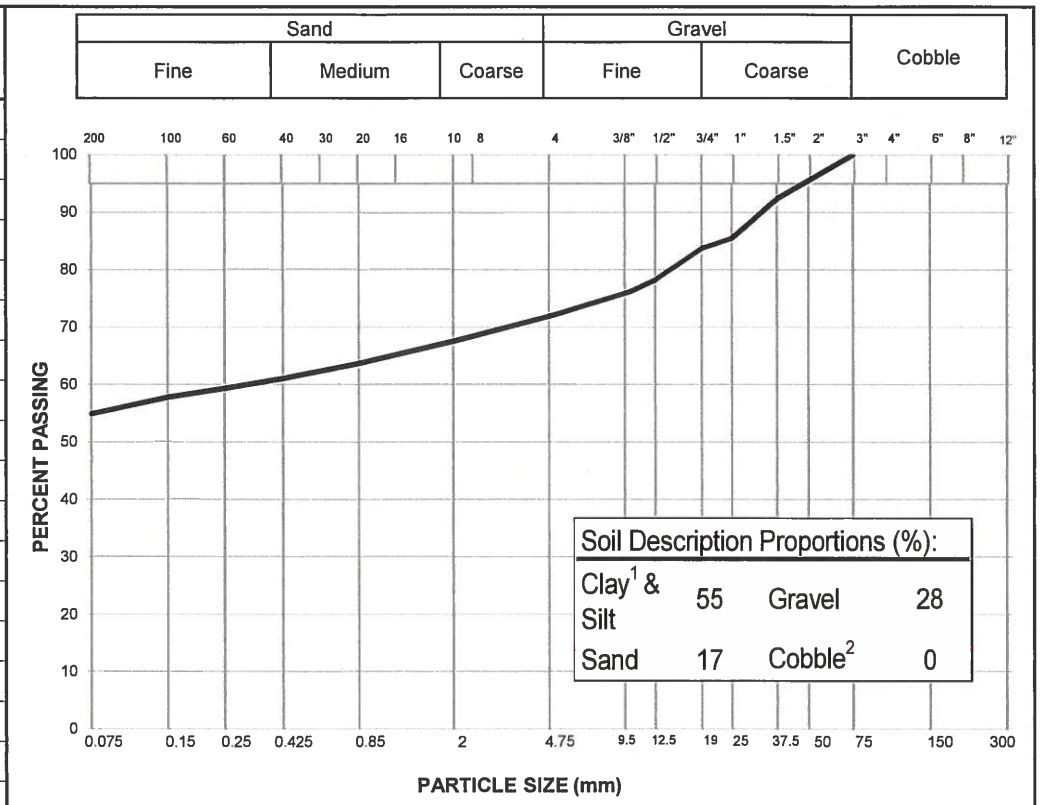
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP12-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.4 - 1.2 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 14, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	21.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	92
25	85
19	84
12.5	78
10	76
5	72
2	68
0.85	64
0.425	61
0.25	59
0.15	58
0.075	54.9



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

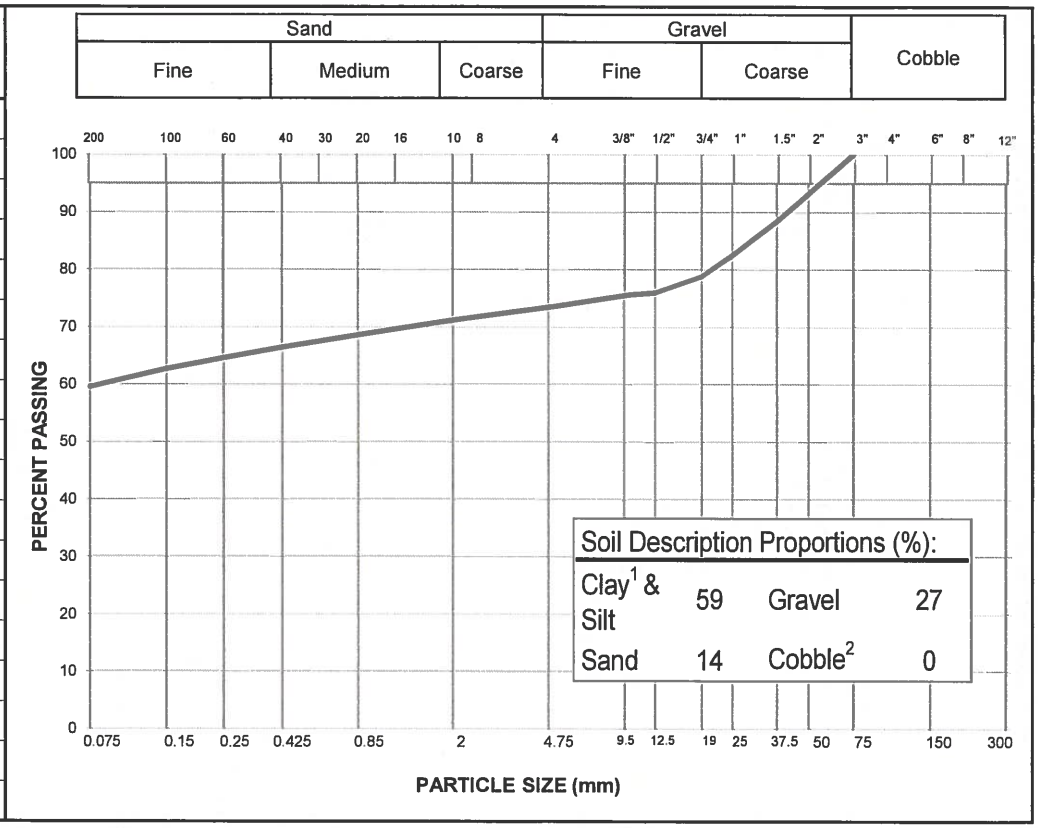
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP14-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.3 - 0.7 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 14, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	24.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	89
25	82
19	79
12.5	76
10	76
5	74
2	71
0.85	69
0.425	66
0.25	65
0.15	63
0.075	59.5



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

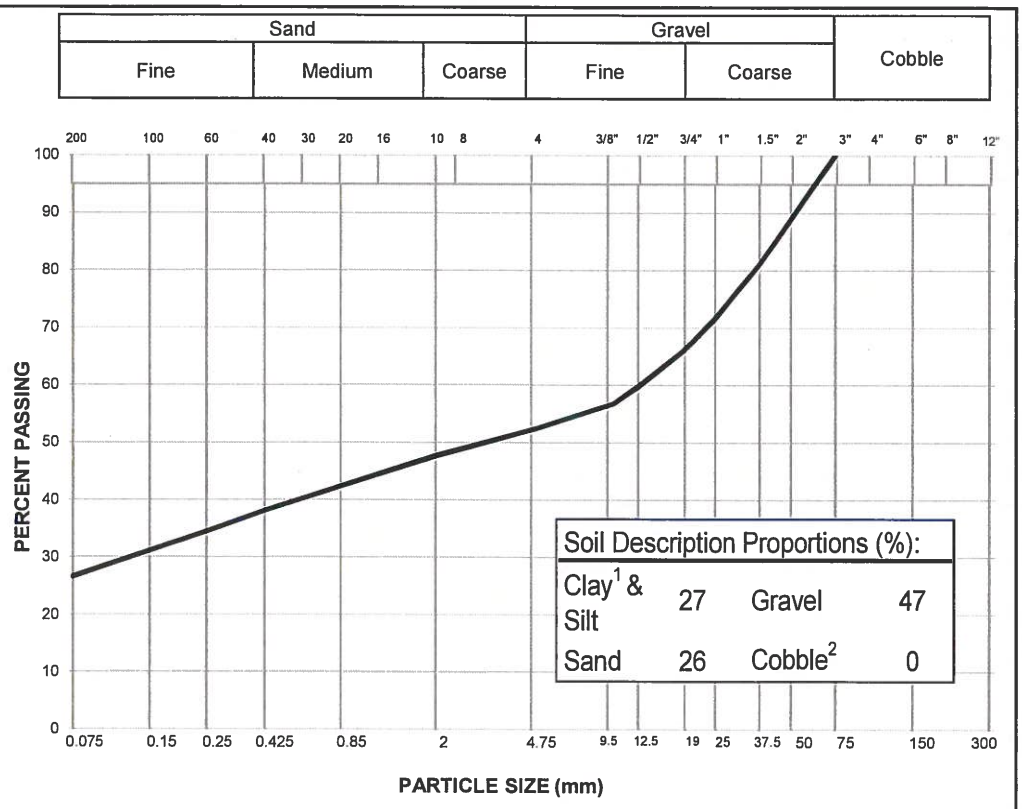
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP17-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.0 - 1.8 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 23, 2018 By: GK	Date Sampled:	September 15, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	11.8%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	81
25	72
19	66
12.5	60
10	57
5	52
2	48
0.85	42
0.425	38
0.25	34
0.15	31
0.075	26.6



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

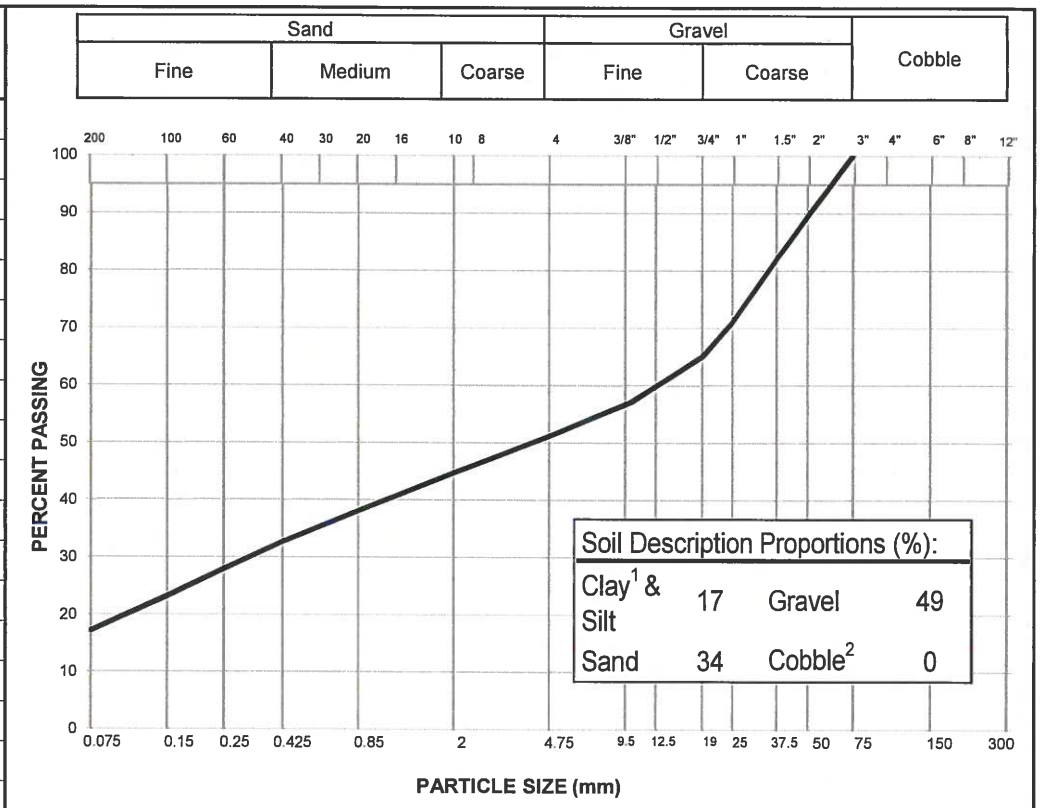
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP21-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.3 - 3.5 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 16, 2018 By: GK	Date Sampled:	September 15, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	9.7%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	82
25	71
19	65
12.5	60
10	57
5	52
2	45
0.85	38
0.425	33
0.25	28
0.15	23
0.075	17.1



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

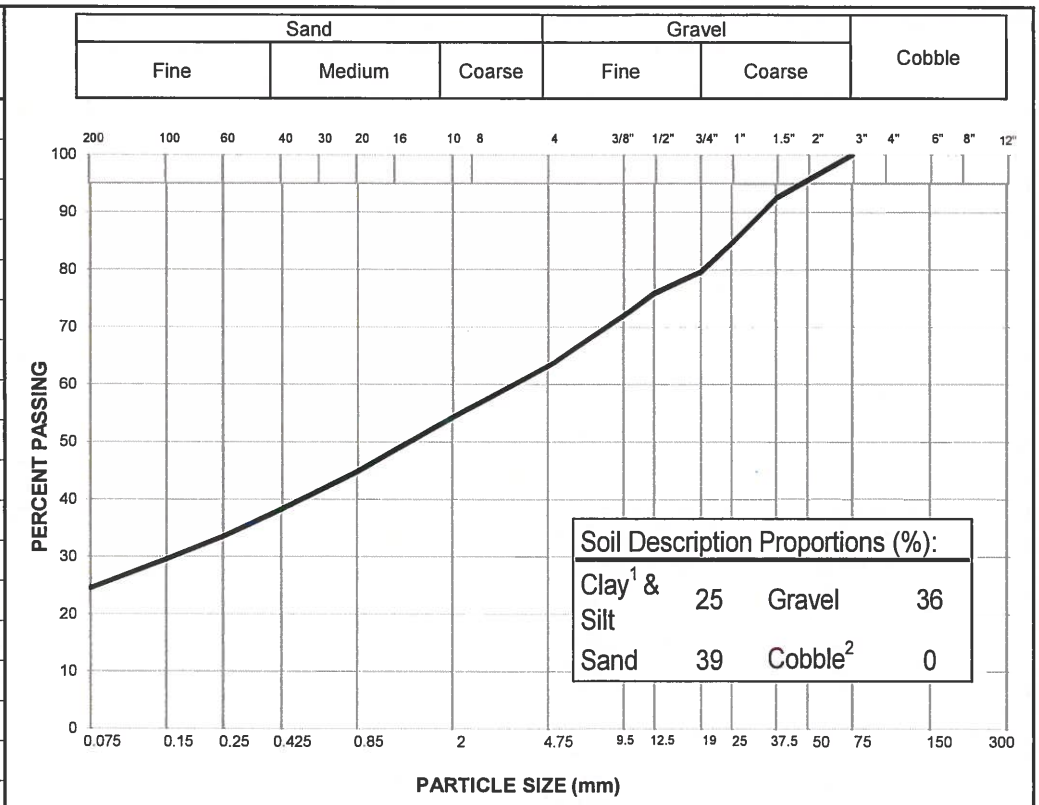
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP24-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.4 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 16, 2018 By: GK	Date Sampled:	September 16, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	11.5%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	93
25	85
19	80
12.5	76
10	73
5	64
2	54
0.85	45
0.425	38
0.25	34
0.15	30
0.075	24.5



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

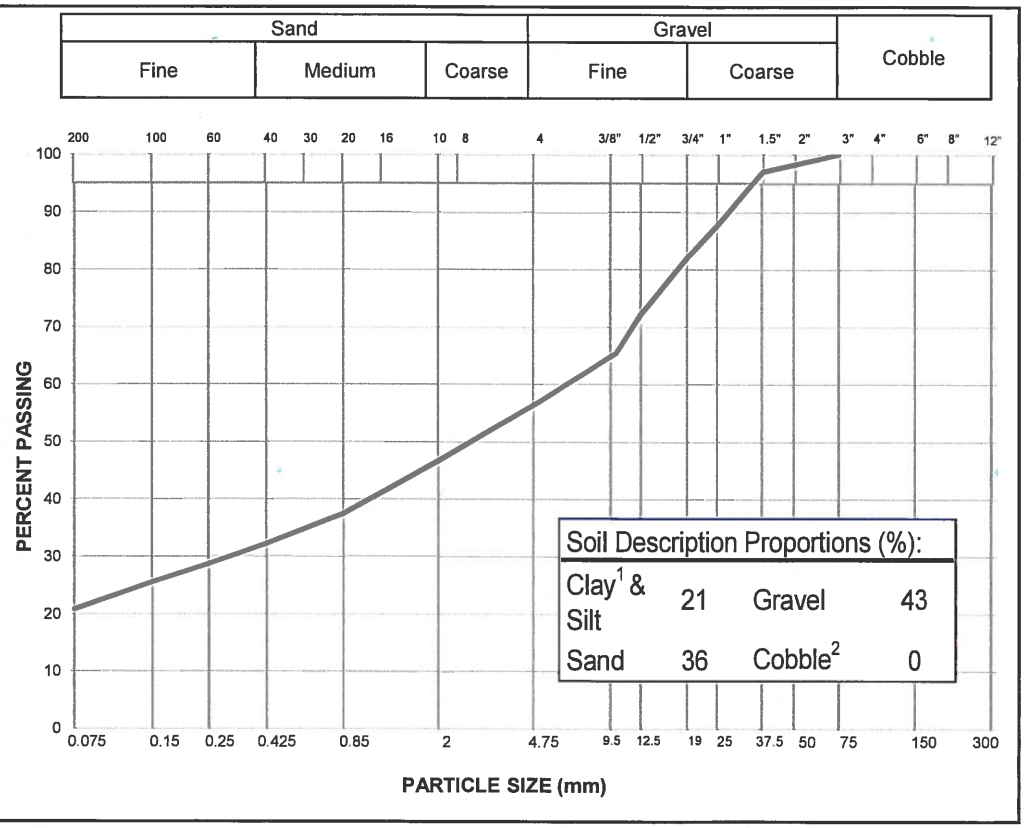
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP25-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Double Double
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.2 - 1.4 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 16, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	11.0%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	97
25	88
19	82
12.5	72
10	65
5	57
2	47
0.85	37
0.425	32
0.25	29
0.15	26
0.075	20.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

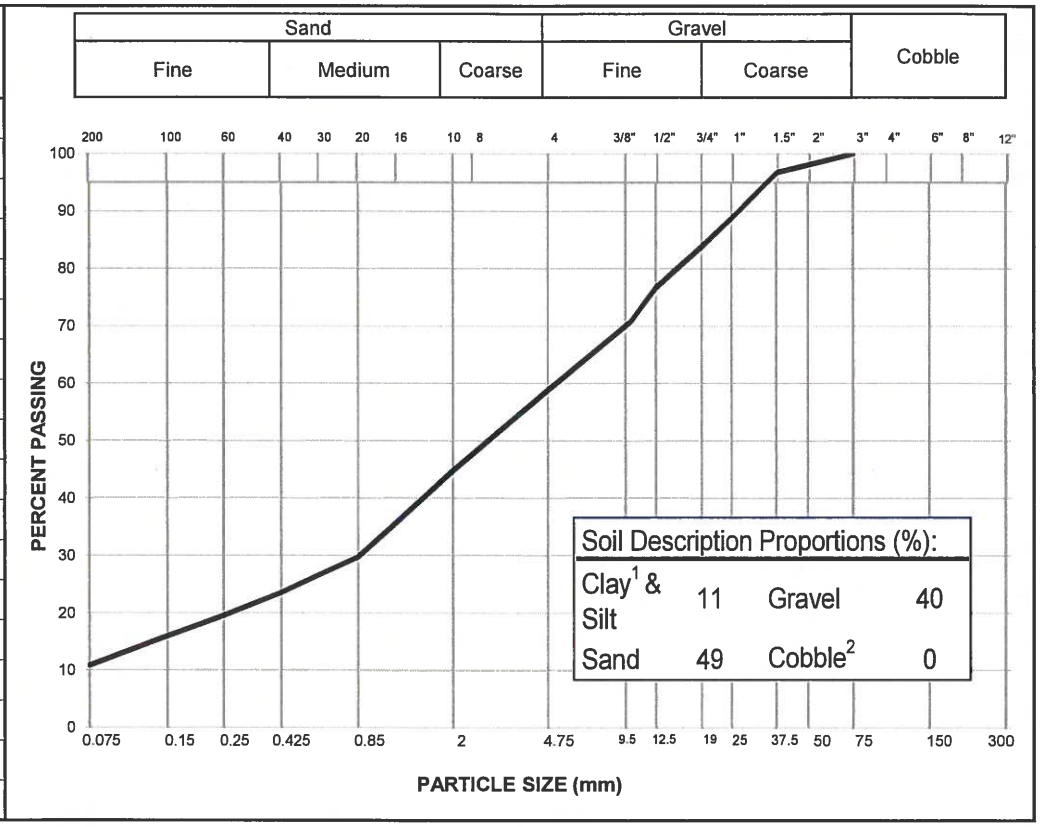
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP27-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Double Double
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.3 - 4.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 19, 2018 By: GK	Date Sampled:	September 17, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	10.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	97
25	89
19	84
12.5	77
10	71
5	60
2	45
0.85	30
0.425	24
0.25	20
0.15	16
0.075	10.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

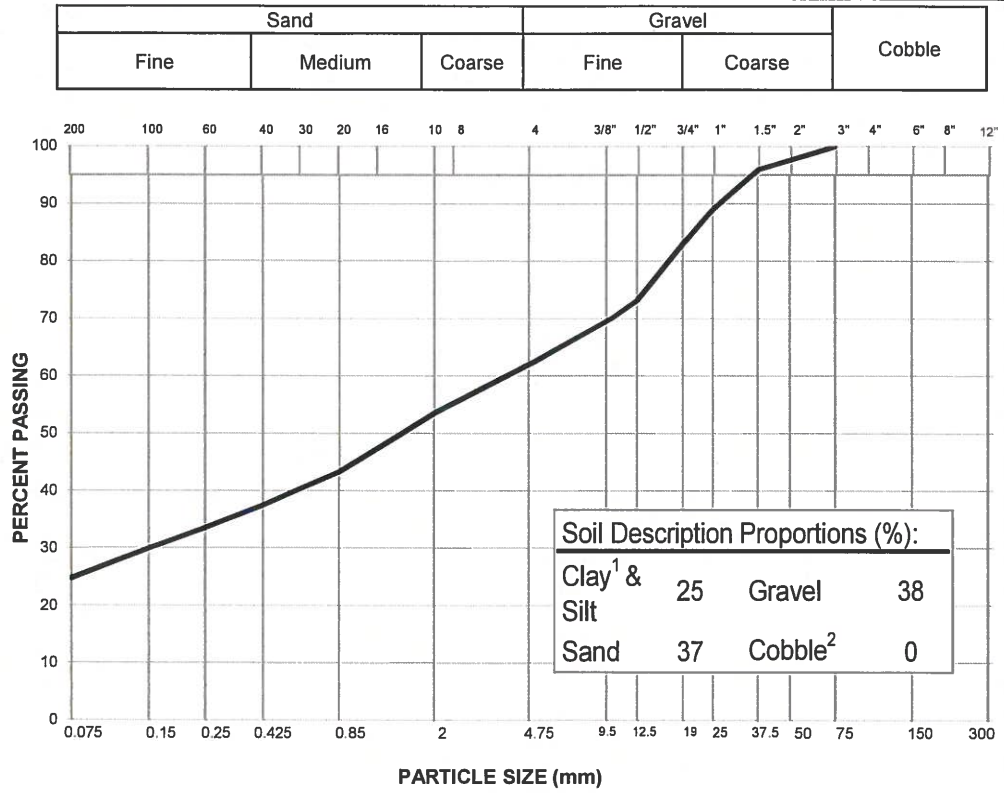
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP28-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Double Double
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.2 - 2.2 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 17, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	10.7%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	96
25	89
19	83
12.5	73
10	70
5	63
2	54
0.85	43
0.425	37
0.25	34
0.15	30
0.075	24.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

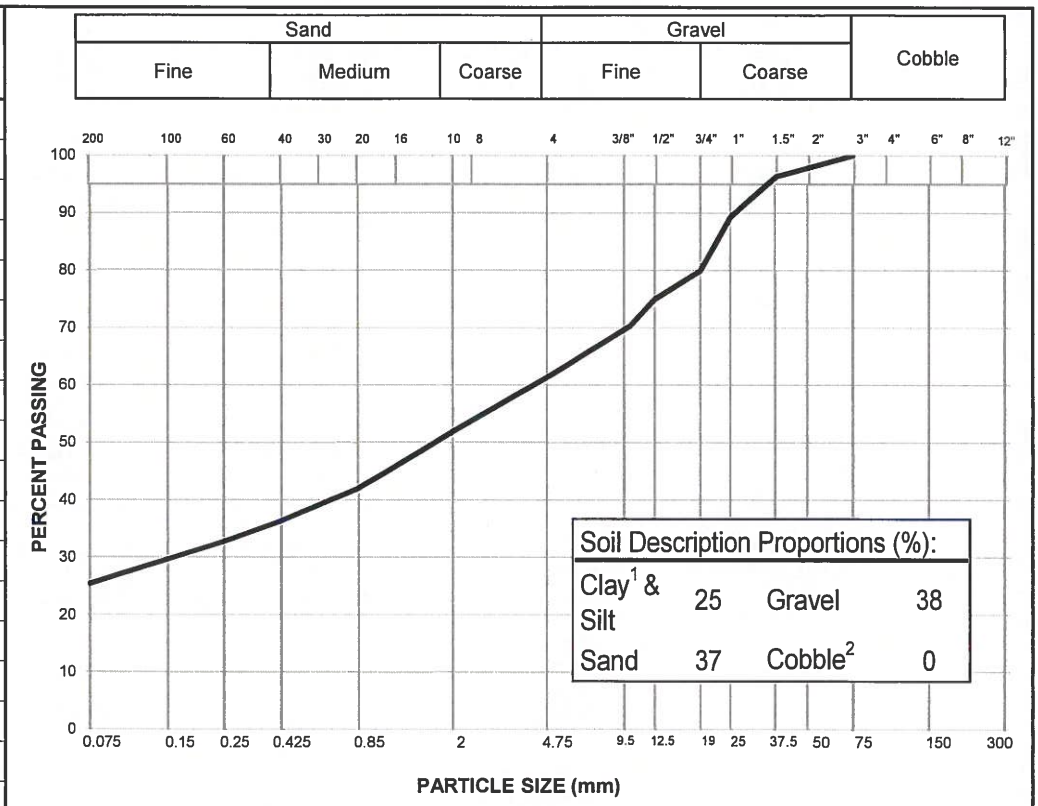
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP30-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Double Double
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.3 - 1.7 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 20, 2018 By: GK	Date Sampled:	September 17, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	12.2%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	96
25	89
19	80
12.5	75
10	70
5	62
2	52
0.85	42
0.425	36
0.25	33
0.15	30
0.075	25.4



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

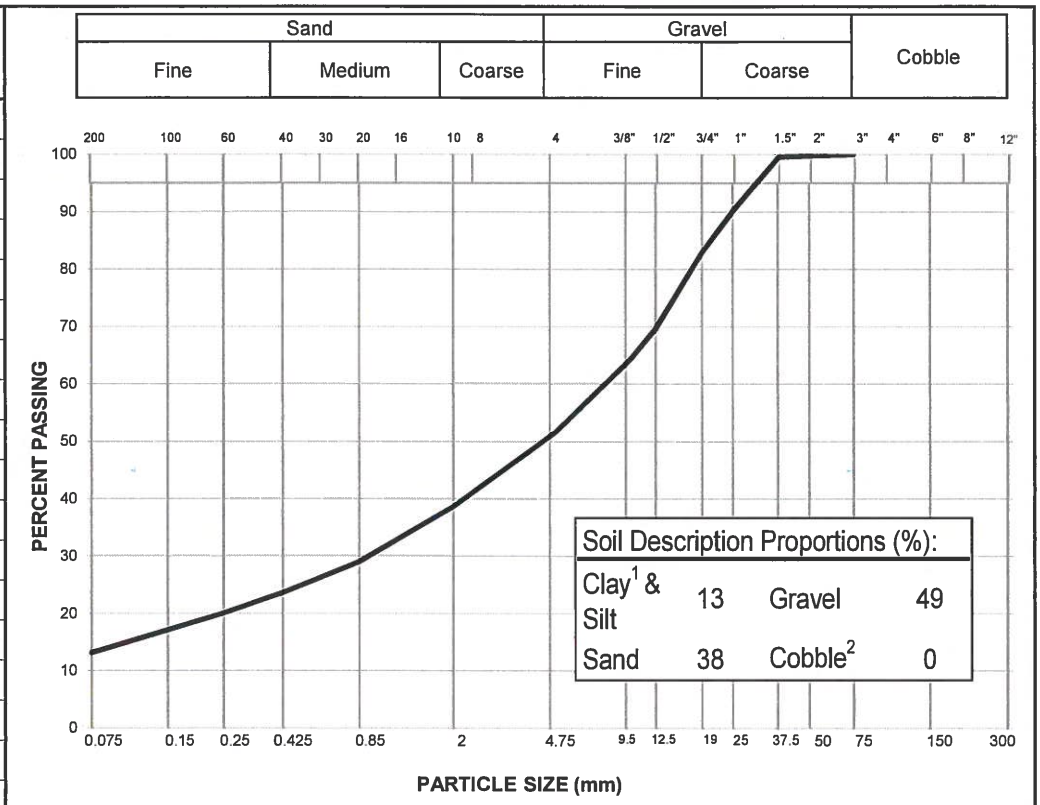
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP32-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	South Latte/Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.15 - 0.70 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 20, 2018 By: GK	Date Sampled:	September 23, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	11.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	100
25	90
19	83
12.5	70
10	64
5	52
2	39
0.85	29
0.425	24
0.25	20
0.15	17
0.075	13.2



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

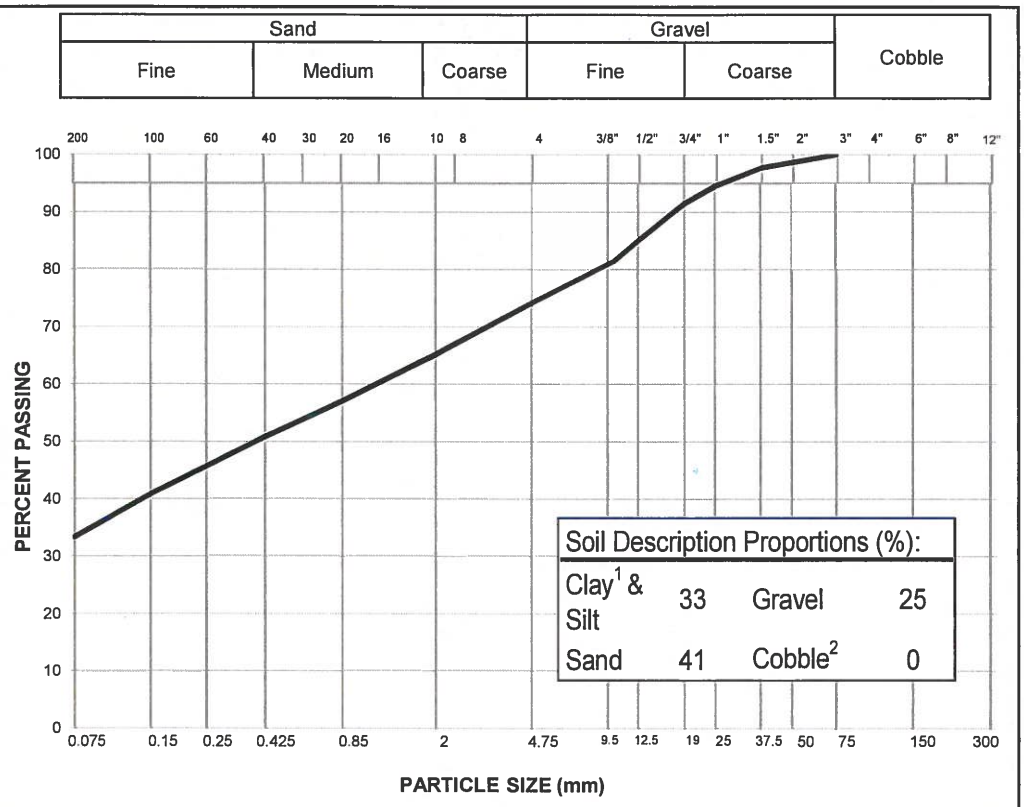
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP32-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	South Latte/Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.7 - 1.2 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 19, 2018 By: GK	Date Sampled:	September 23, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	17.0%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	98
25	95
19	91
12.5	85
10	81
5	75
2	65
0.85	57
0.425	51
0.25	46
0.15	41
0.075	33.3



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

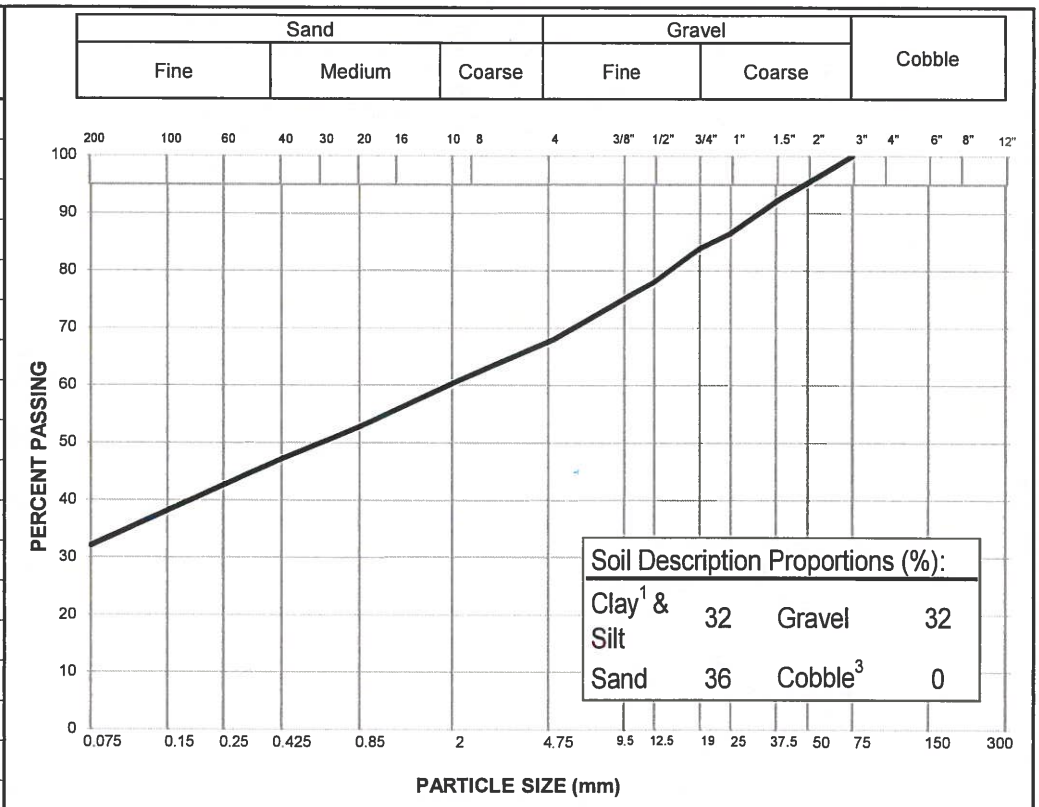
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP32-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	South Latte/Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.7 - 1.2 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 22, 2018 By: AT/GK	Date Sampled:	September 23, 2018
Soil Description[2]:		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	17.0%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	92
25	87
19	84
12.5	78
10	76
5	68
2	60
0.85	53
0.425	47
0.25	43
0.15	38
0.075	32.1



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

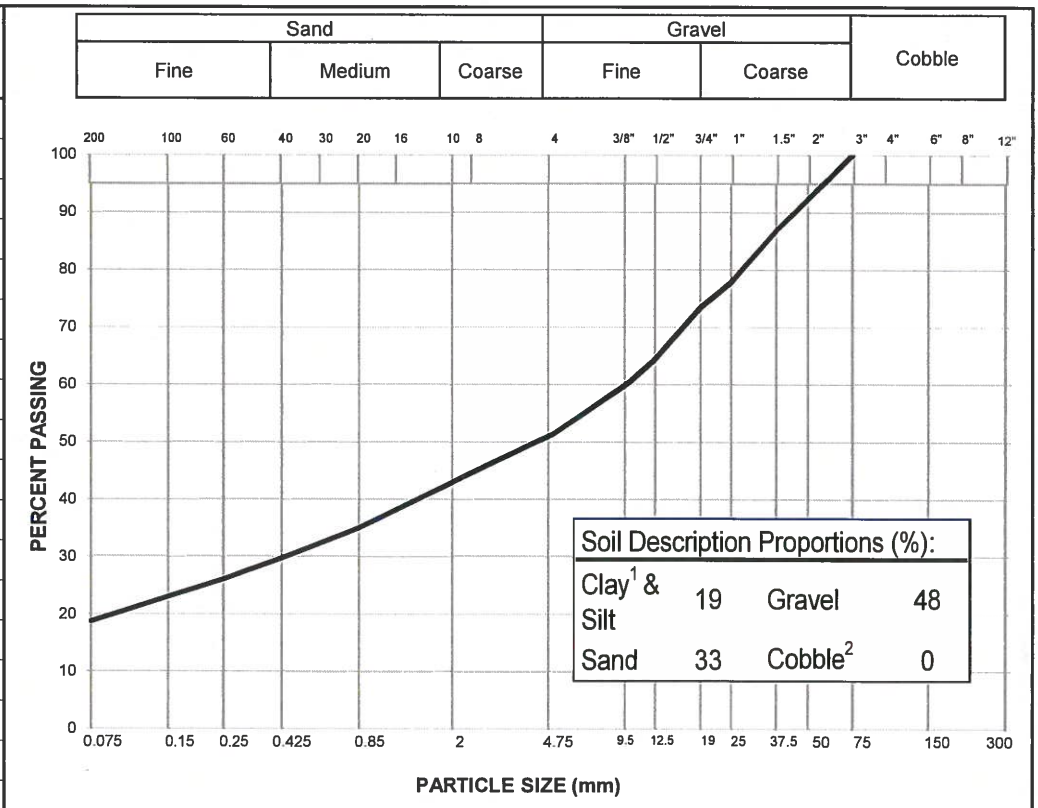
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP33-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	South Latte/Supremo
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.2 - 0.9 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 16, 2018 By: GK	Date Sampled:	September 23, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	26.4%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	87
25	78
19	73
12.5	64
10	61
5	51
2	43
0.85	35
0.425	30
0.25	26
0.15	23
0.075	18.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

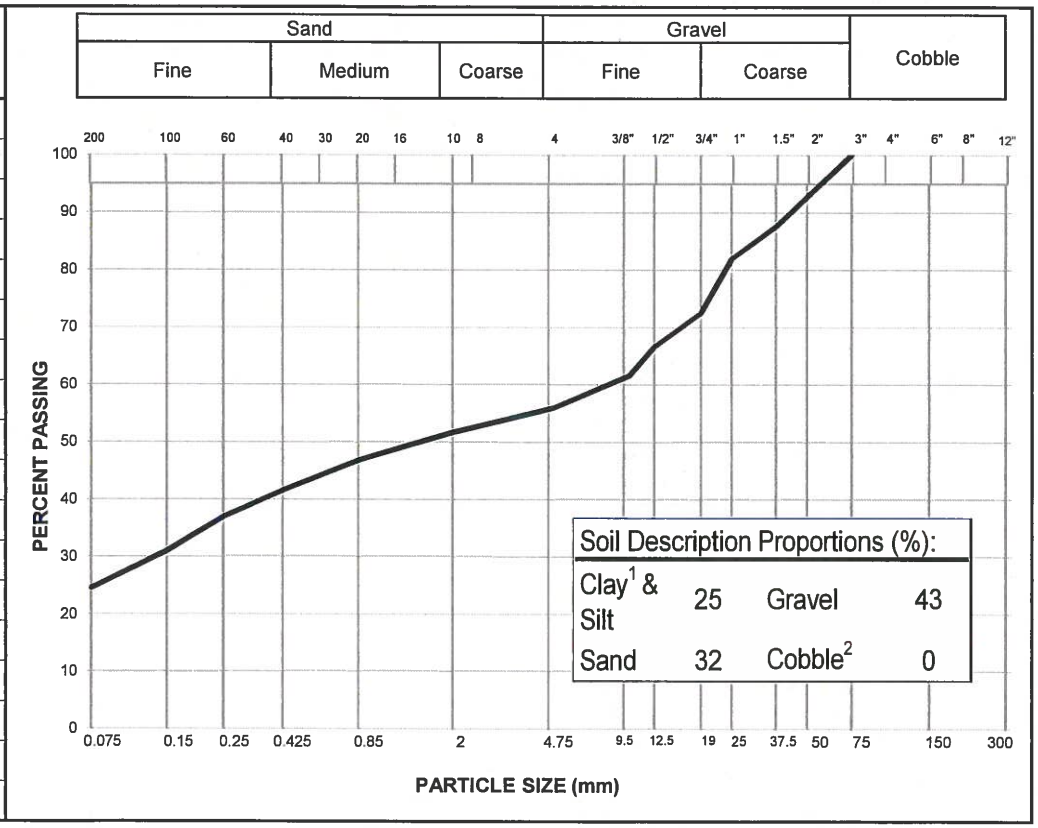
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP36-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	South Latte
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.5 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 22, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	40.4%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	88
25	82
19	73
12.5	67
10	62
5	56
2	52
0.85	47
0.425	42
0.25	37
0.15	31
0.075	24.5



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

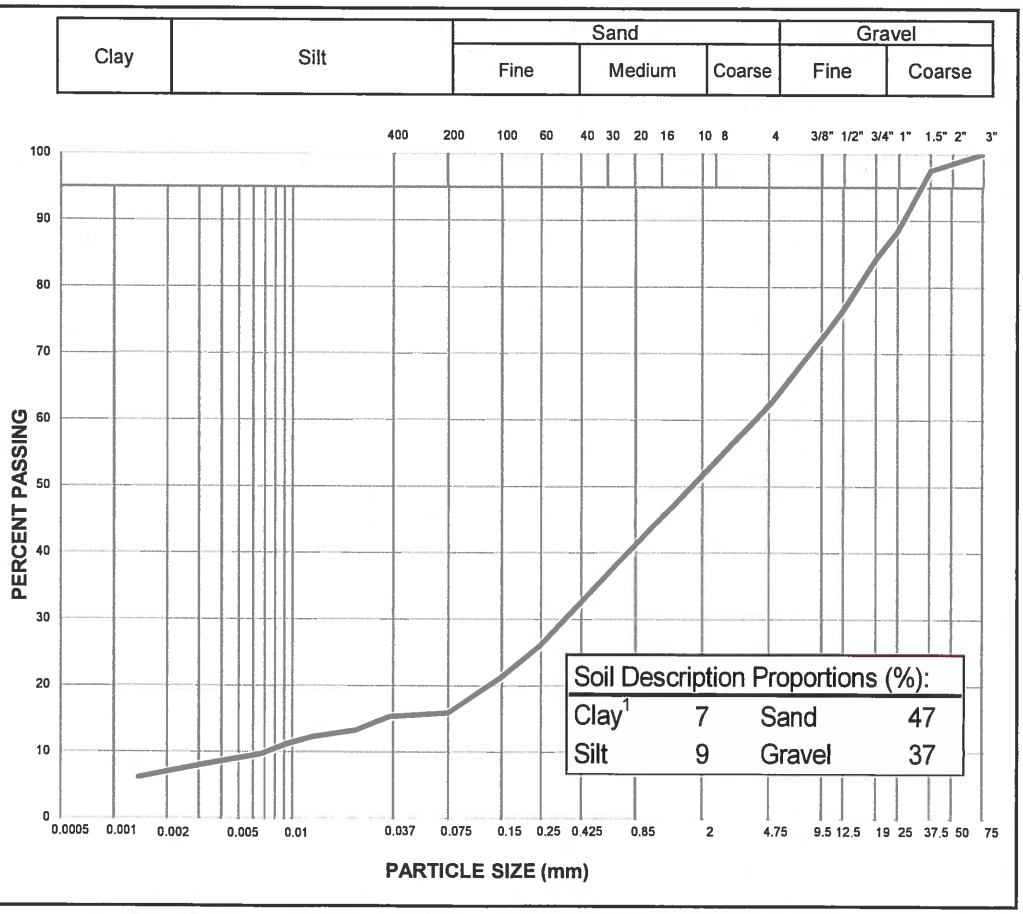
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP36-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	South Latte
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.0 - 1.7 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 22, 2018 By: AT/GK	Date Sampled:	September 22, 2018
		Sampled By:	JL
		USC Classification:	Cu: 591.6
Moisture Content:	17.4%		Cc: 4.1

Particle Size (mm)	Percent Passing
75	100
50	
38	97
25	88
19	84
12.5	77
10	73
5	63
2	52
0.85	41
0.425	33
0.25	26
0.15	21
0.075	15.9
0.0353	15.3
0.0226	13.3
0.0131	12.3
0.0093	11.2
0.0067	9.7
0.0033	8.2
0.0014	6.1



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

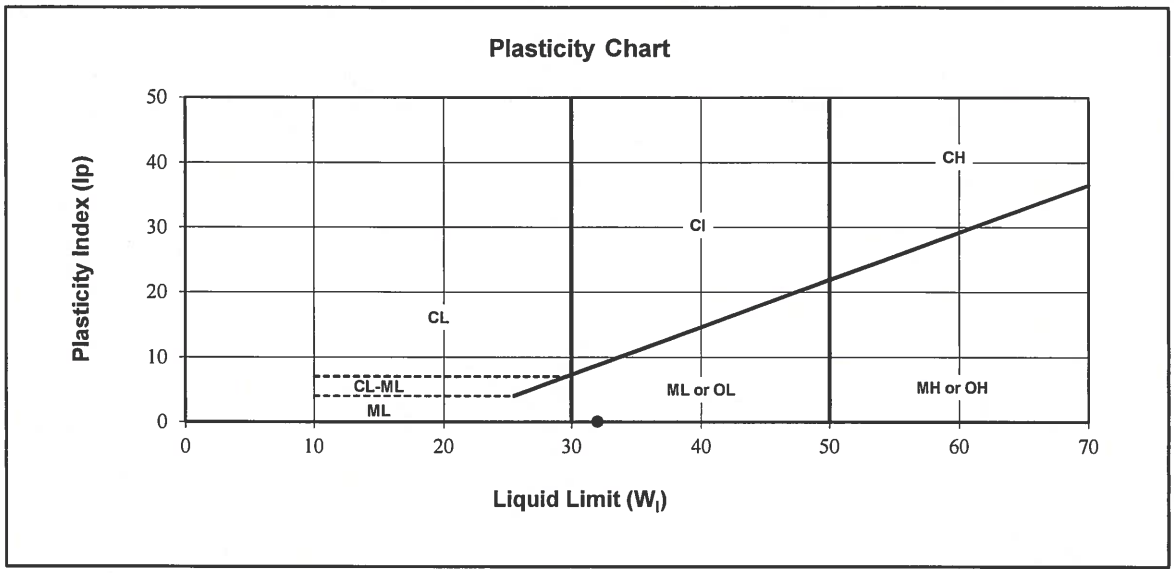
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Fall 2018 Testpitting Program	Sample Number:	TP36-02
		Sample Location:	South Latte
Project No:	ENG.EARC03094-06.003	Depth:	1.0 - 1.7 m
Client:	JDS Energy & Mining Inc.	Sampled By:	JL Tested By: AT
Attention:	Leigh Sawchyn	Date Sampled:	September 22, 2018
Email:	leighs@jdsmining.ca	Date Tested:	November 22, 2018

Sample Description: SAND and GRAVEL, some silt



Liquid Limit ($W_{1)}$:	32	Natural Moisture (%)	
Plastic Limit :	0	Soil Plasticity:	NP
Plasticity Index (Ip) :	0	Mod.USCS Symbol:	ML

Remarks:

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

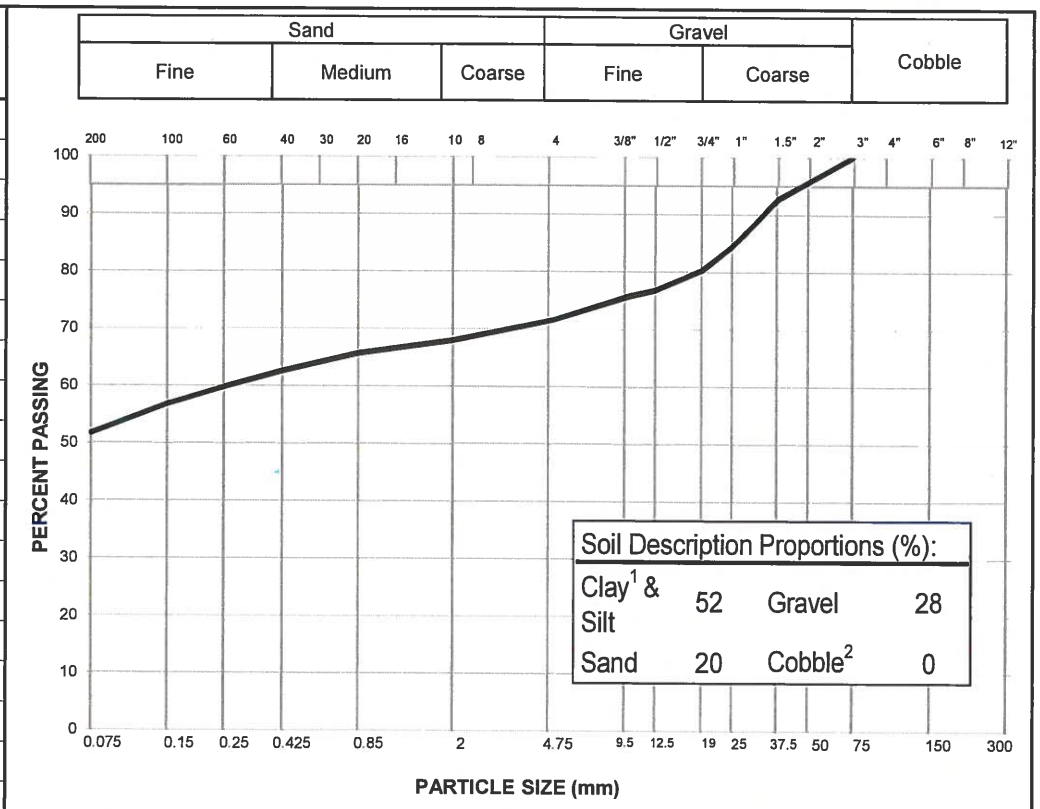
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP38-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	South Latte
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.4 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 16, 2018 By: GK	Date Sampled:	September 22, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	48.3%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	93
25	84
19	80
12.5	77
10	76
5	72
2	68
0.85	66
0.425	63
0.25	60
0.15	57
0.075	51.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

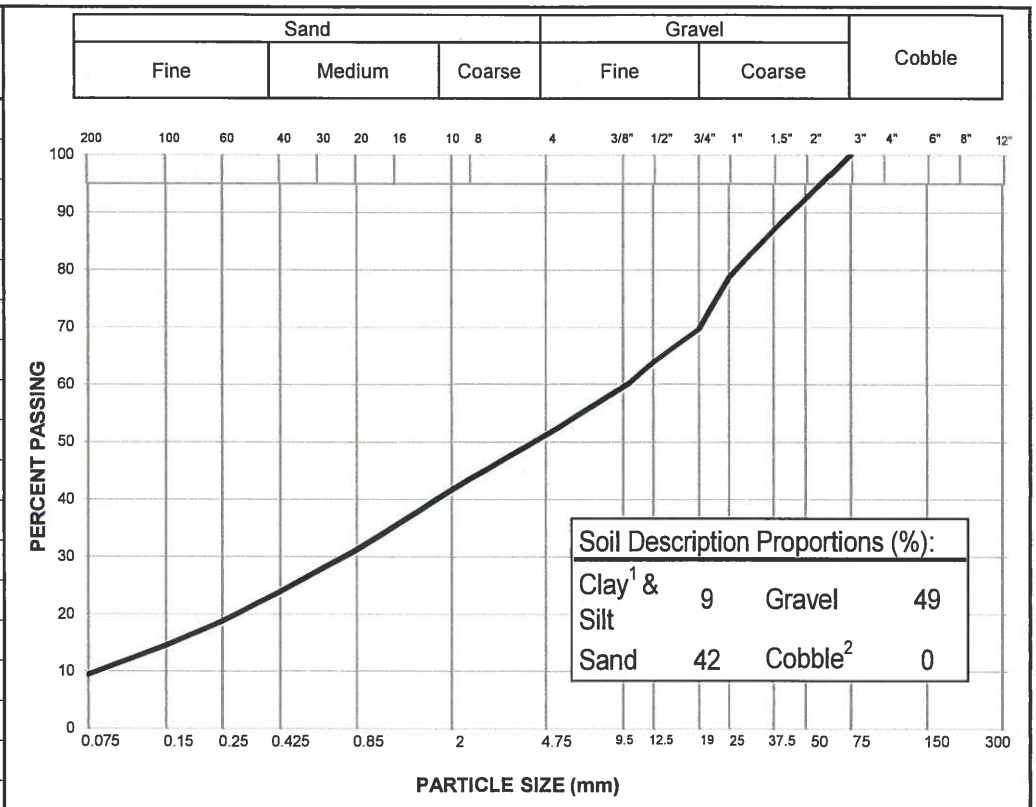
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP40-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Facility Pond Area
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.3 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 20, 2018 By: GK	Date Sampled:	September 21, 2018
		Sampled By:	JL
		USC Classification:	Cu: 118.4
Moisture Content:	8.9%		Cc: 0.7

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	87
25	79
19	70
12.5	64
10	60
5	52
2	42
0.85	31
0.425	24
0.25	19
0.15	15
0.075	9.4



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

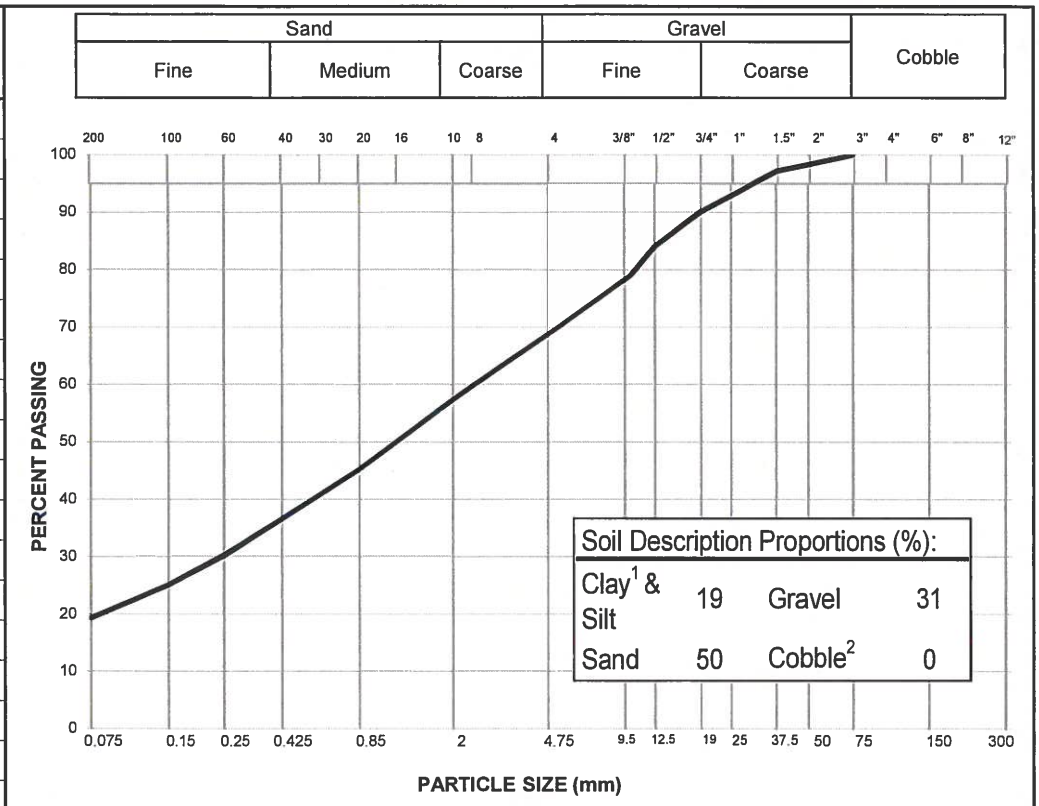
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP42-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Facility Pond Area
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.4 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 20, 2018 By: GK	Date Sampled:	September 20, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	19.3%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	97
25	93
19	90
12.5	84
10	79
5	69
2	57
0.85	45
0.425	37
0.25	30
0.15	25
0.075	19.3



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

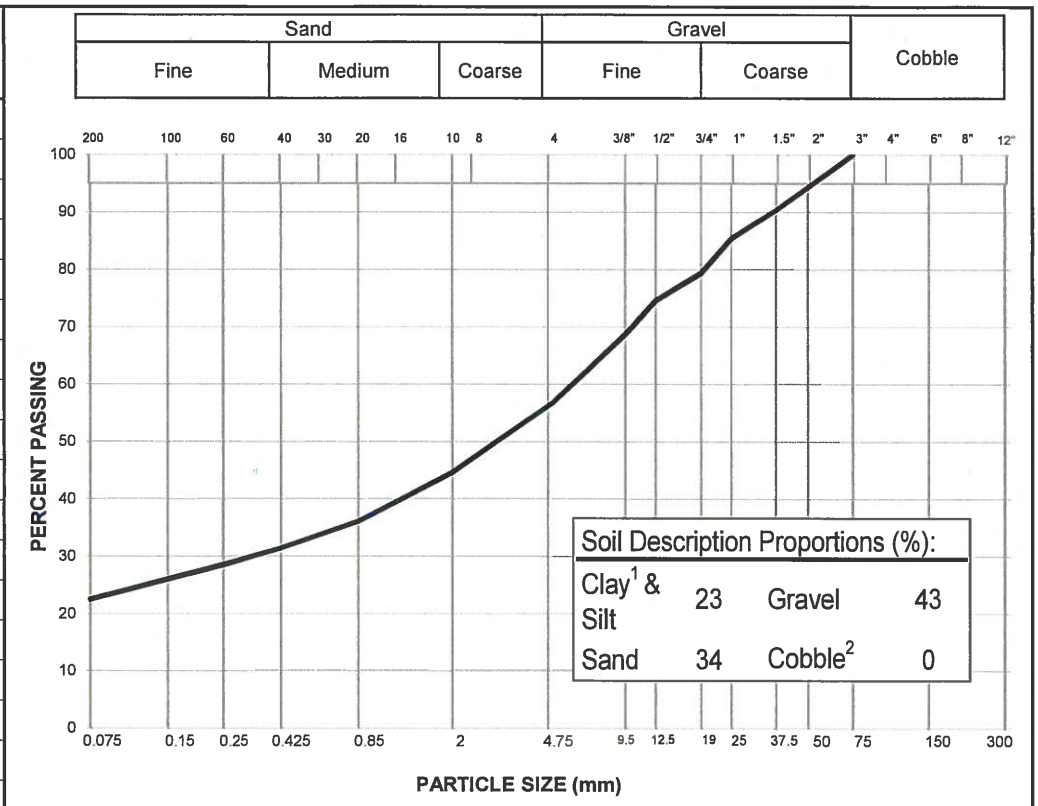
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP43-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Facility Pond Area
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.2 - 0.8 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 19, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	12.5%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	91
25	85
19	79
12.5	75
10	70
5	57
2	45
0.85	36
0.425	31
0.25	28
0.15	26
0.075	22.5



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

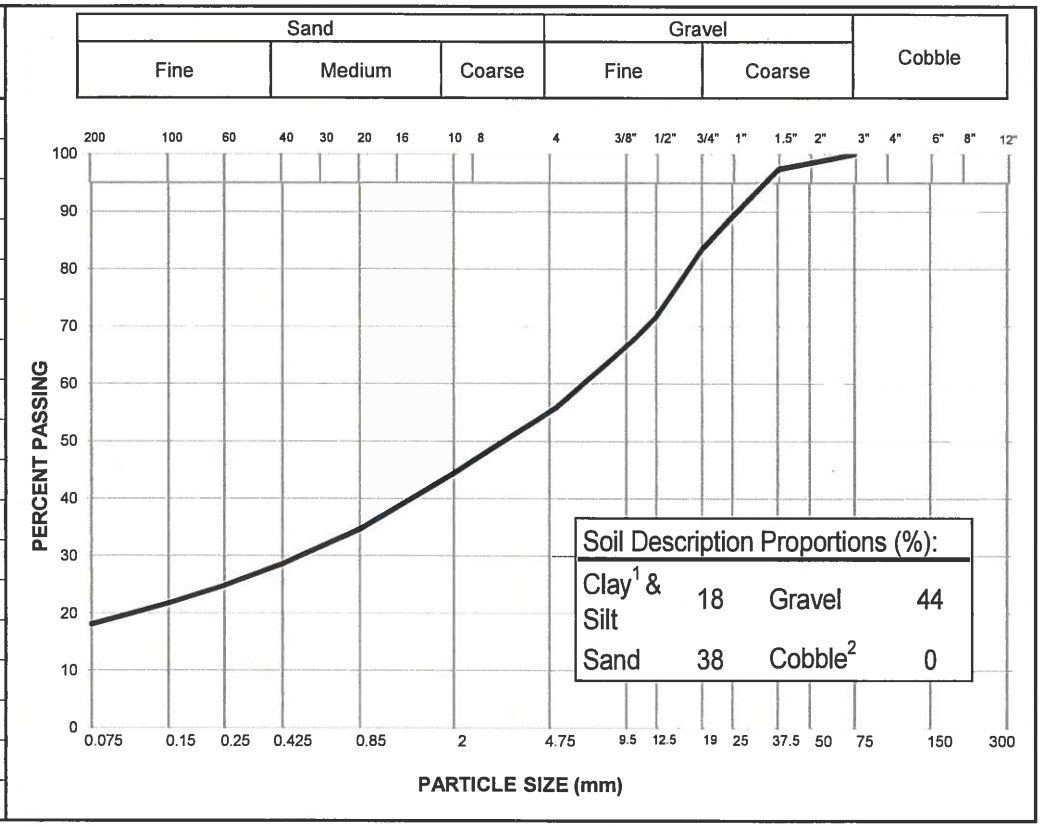
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP48-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Facility Pond Area
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.3 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 20, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	15.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	97
25	89
19	83
12.5	72
10	67
5	56
2	44
0.85	35
0.425	29
0.25	25
0.15	22
0.075	18.1



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

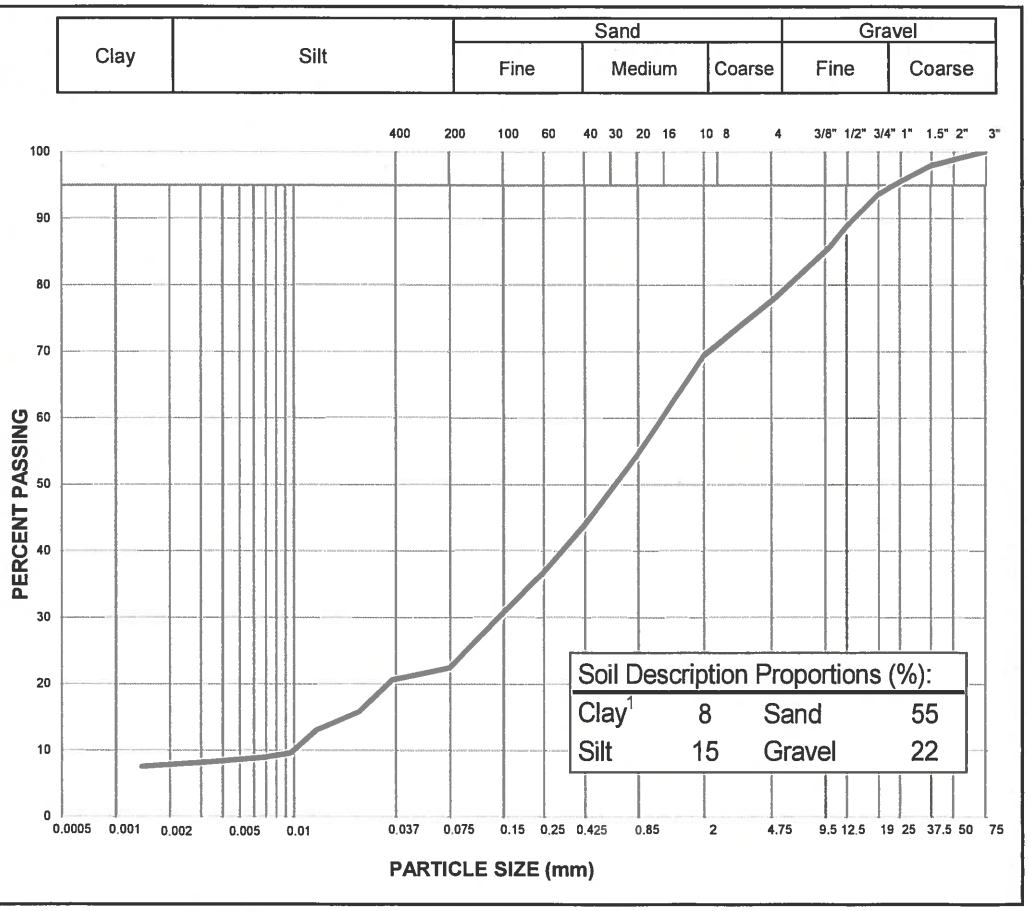
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP49-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Facility Pond Area
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.4 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 22, 2018 By: AT/GK	Date Sampled:	September 22, 2018
		Sampled By:	JL
		USC Classification:	Cu: 126.8
Moisture Content:	11.6%		Cc: 1.6

Particle Size (mm)	Percent Passing
75	100
50	
38	98
25	95
19	94
12.5	89
10	86
5	78
2	69
0.85	55
0.425	44
0.25	37
0.15	31
0.075	22.5
0.0353	20.6
0.0228	15.8
0.0133	13.1
0.0096	9.6
0.0068	8.9
0.0033	8.2
0.0014	7.6



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

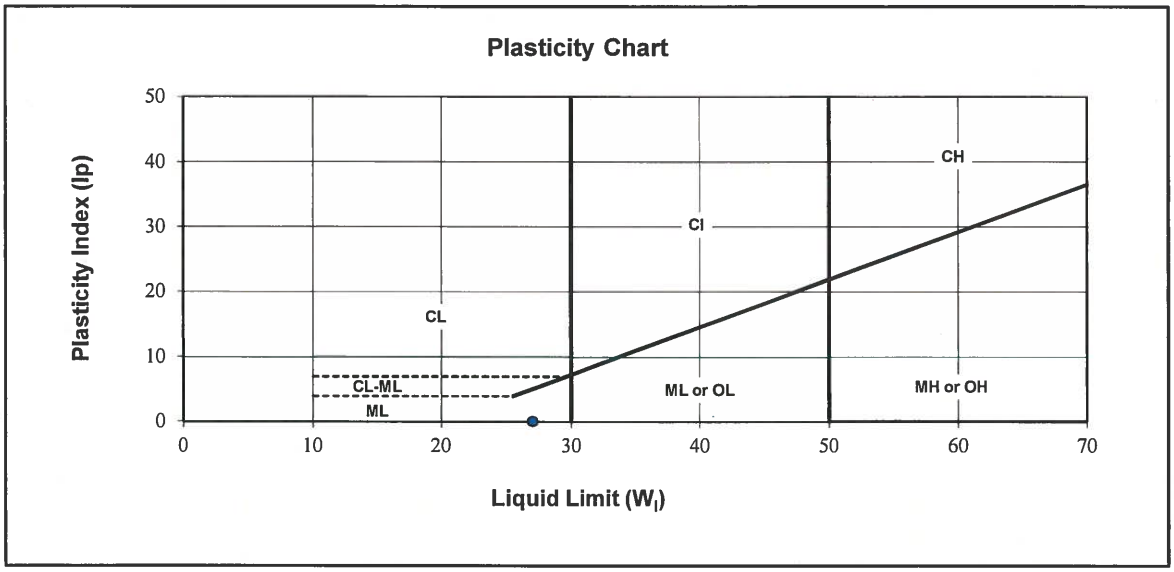
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Fall 2018 Testpitting Program	Sample Number:	TP49-01
		Sample Location:	Facility Pond Area
Project No:	ENG.EARC03094-06.003	Depth:	0.4 - 1.0 m
Client:	JDS Energy & Mining Inc.	Sampled By:	JL Tested By: AT
Attention:	Leigh Sawchyn	Date Sampled:	September 22, 2018
Email:	leighs@jdsmining.ca	Date Tested:	November 22, 2018

Sample Description: SAND, silty, gravelly



Liquid Limit ($W_{1)}$:	27	Natural Moisture (%)	
Plastic Limit :	0	Soil Plasticity:	NP
Plasticity Index (Ip) :	0	Mod.USCS Symbol:	ML

Remarks:

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

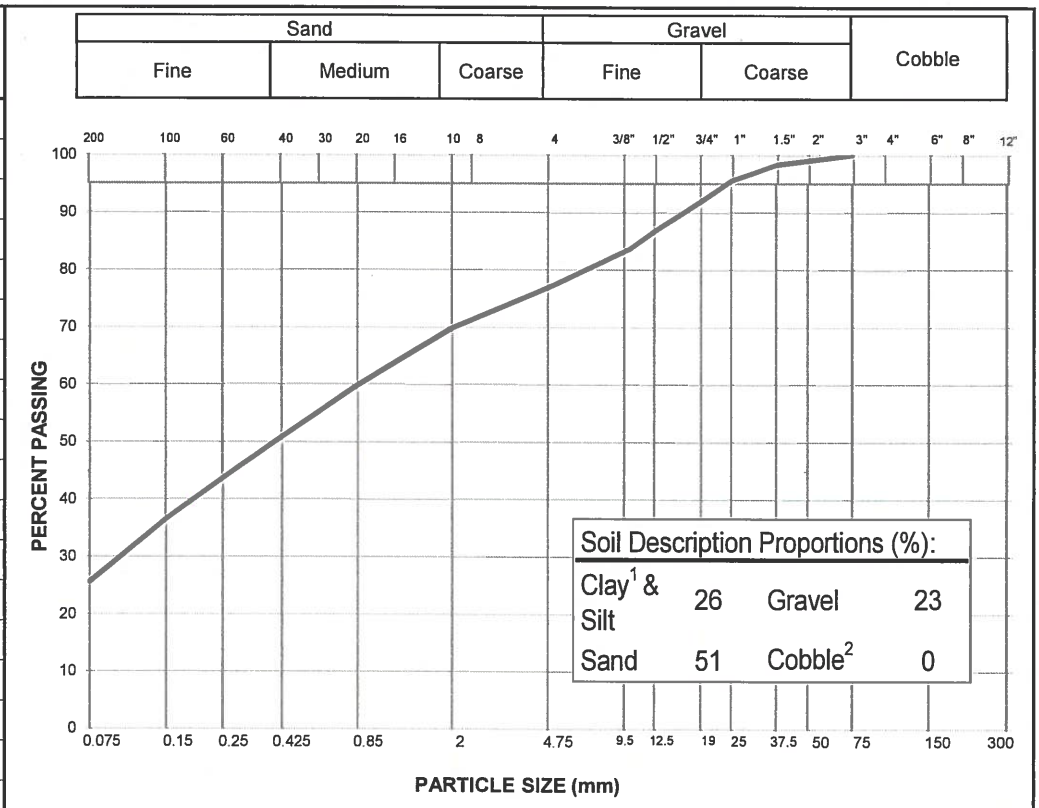
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP51-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Latte Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.5 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 16, 2018 By: GK	Date Sampled:	September 22, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	17.8%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	98
25	95
19	92
12.5	87
10	84
5	77
2	70
0.85	60
0.425	51
0.25	44
0.15	36
0.075	25.6



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

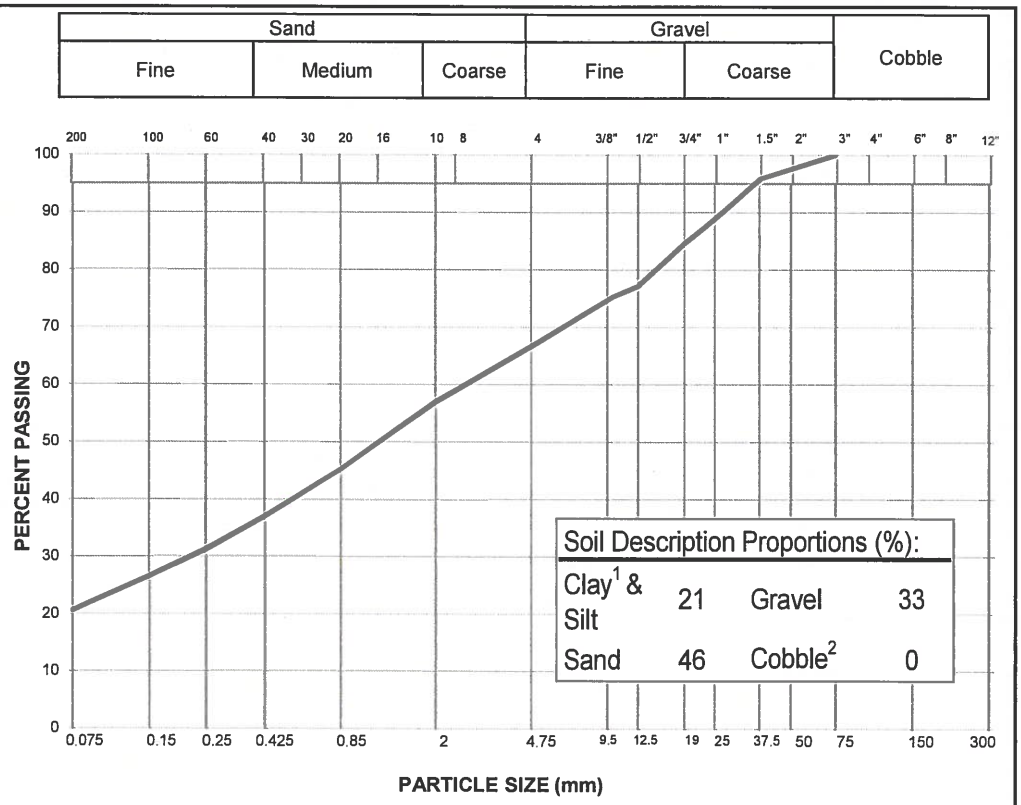
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP52-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Latte Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.45 - 1.0 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 17, 2018 By: GK	Date Sampled:	September 22, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	14.4%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	96
25	89
19	85
12.5	77
10	75
5	67
2	57
0.85	45
0.425	37
0.25	31
0.15	27
0.075	20.6



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

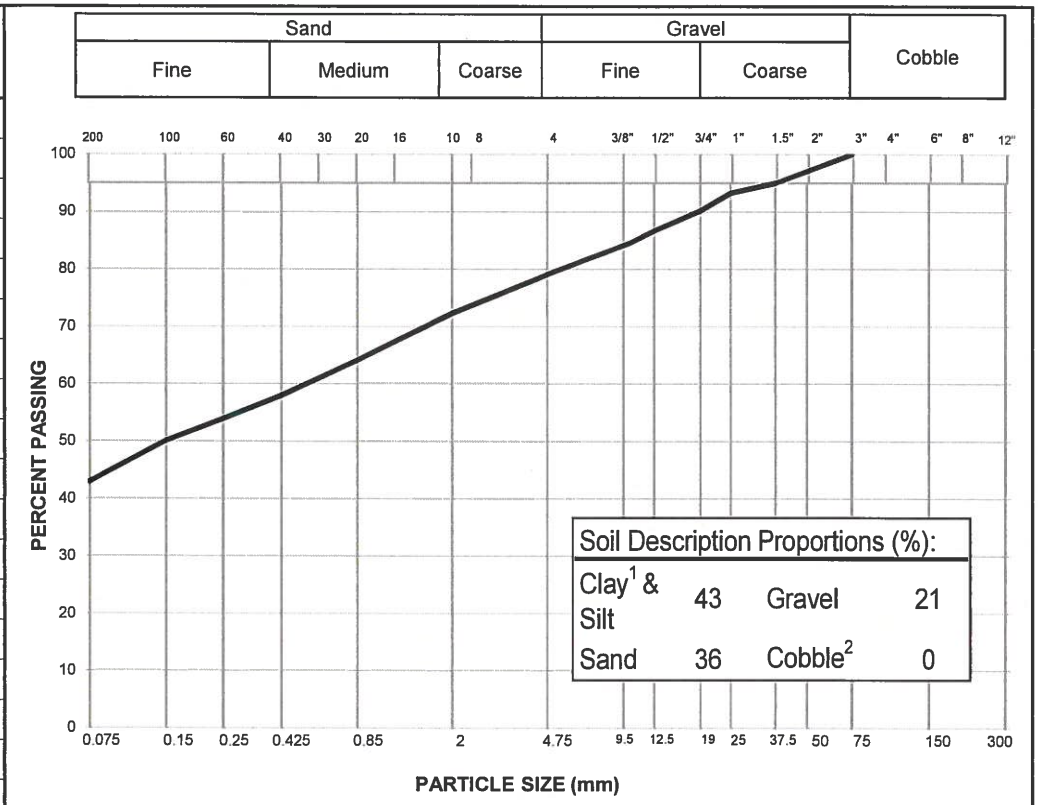
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP58-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Latte Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.6 - 1.3 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 13, 2018 By: GK	Date Sampled:	September 19, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	25.2%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	95
25	93
19	90
12.5	87
10	84
5	79
2	72
0.85	64
0.425	58
0.25	54
0.15	50
0.075	43.0



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

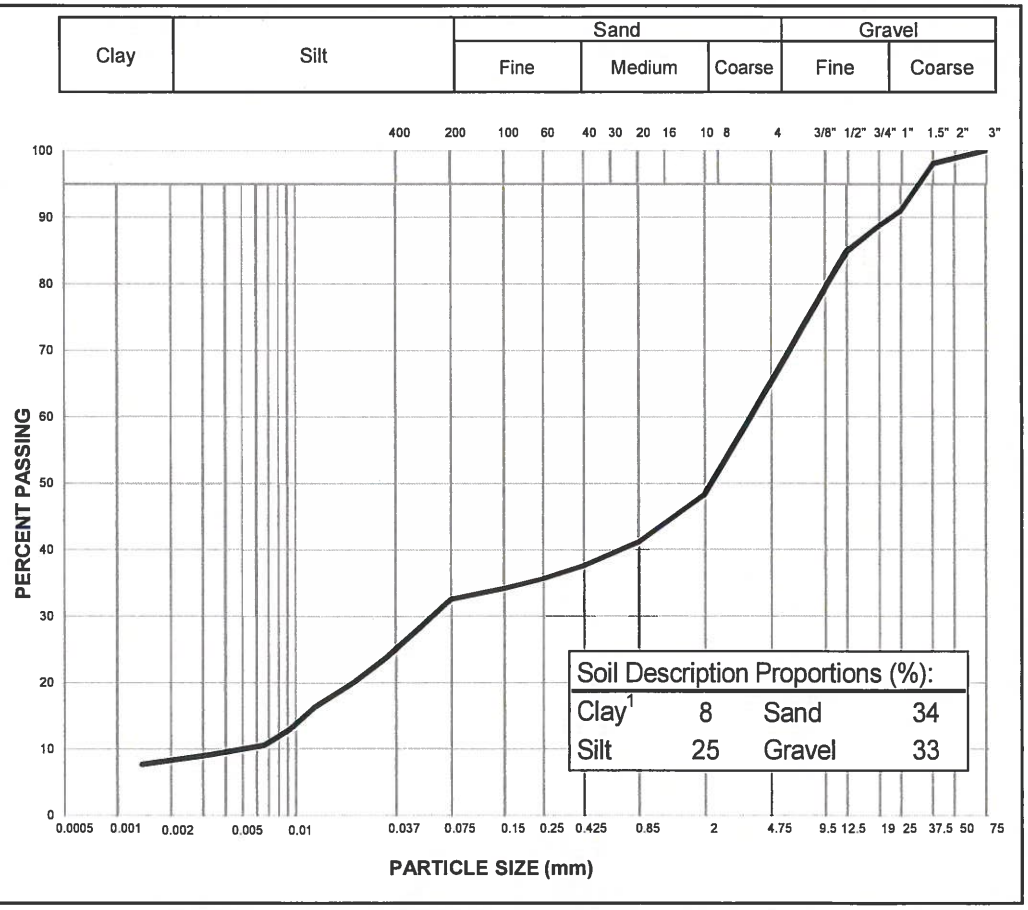
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP59-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Latte Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.35 - 1.30 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 22, 2018 By: AT/GK	Date Sampled:	September 19, 2018
		Sampled By:	JL
		USC Classification:	Cu: 735.5
Moisture Content:	11.4%		Cc: 0.2

Particle Size (mm)	Percent Passing
75	100
50	
38	98
25	91
19	89
12.5	85
10	81
5	66
2	48
0.85	41
0.425	38
0.25	36
0.15	34
0.075	32.6
0.0332	23.9
0.0216	20.1
0.0128	16.3
0.0092	12.9
0.0066	10.5
0.0033	9.1
0.0014	7.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

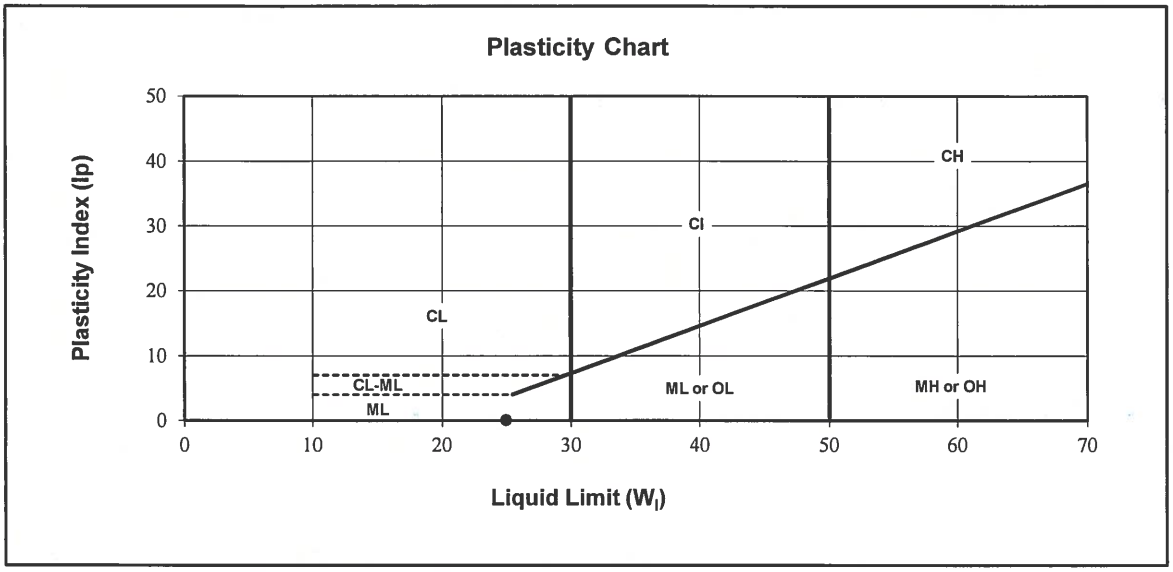
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Fall 2018 Testpitting Program	Sample Number:	TP59-01
		Sample Location:	Latte Diversion
Project No:	ENG.EARC03094-06.003	Depth:	0.35 - 1.30 m
Client:	JDS Energy & Mining Inc.	Sampled By:	JL Tested By: AT
Attention:	Leigh Sawchyn	Date Sampled:	September 19, 2018
Email:	leighs@jdsmining.ca	Date Tested:	November 22, 2018

Sample Description: SAND, gravelly, silty



Liquid Limit (W_1) :	25	Natural Moisture (%)	
Plastic Limit :	0	Soil Plasticity:	NP
Plasticity Index (Ip) :	0	Mod.USCS Symbol:	ML

Remarks:

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

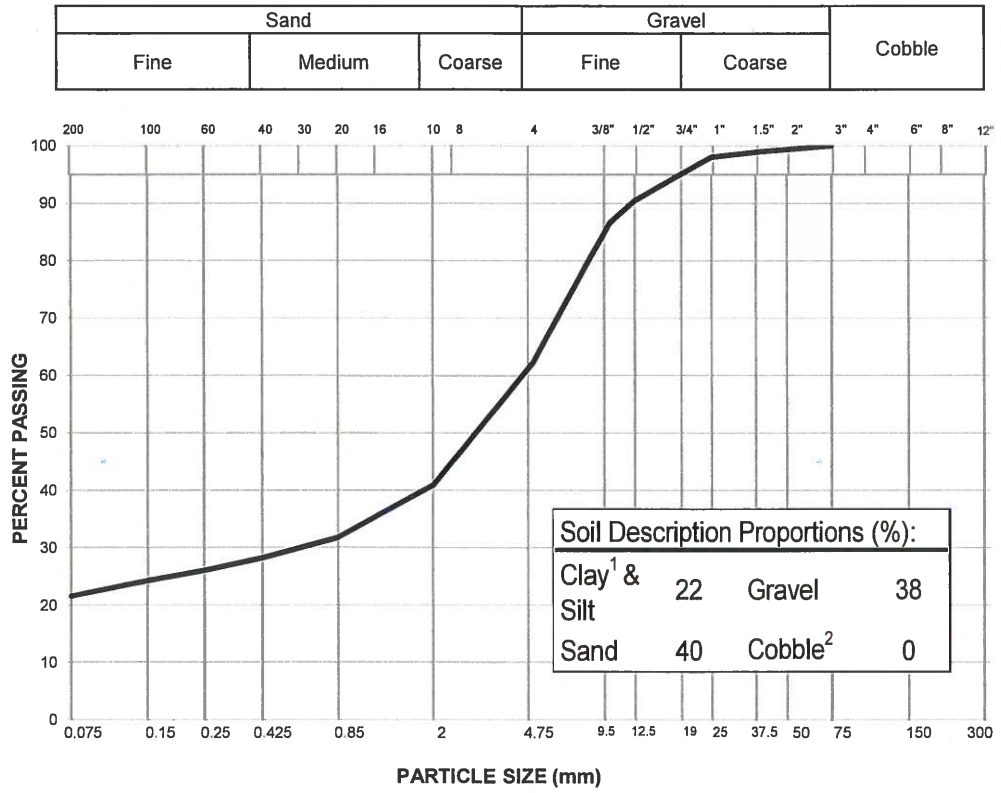
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP59-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Latte Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.3 - 2.3 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 22, 2018 By: GK	Date Sampled:	September 19, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	8.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	99
25	98
19	95
12.5	90
10	87
5	62
2	41
0.85	32
0.425	28
0.25	26
0.15	24
0.075	21.5



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

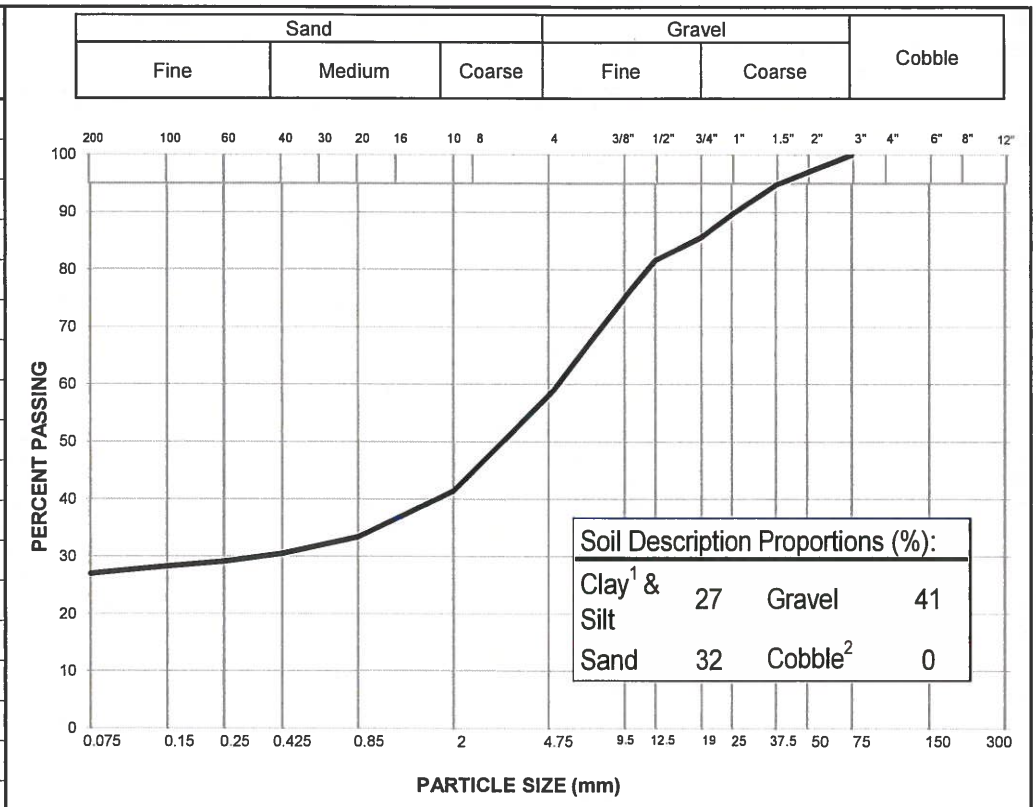
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP62-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Latte Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.45 - 1.30 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 22, 2018 By: GK	Date Sampled:	September 18, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	11.7%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	95
25	90
19	86
12.5	82
10	76
5	59
2	41
0.85	33
0.425	30
0.25	29
0.15	28
0.075	27.0



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

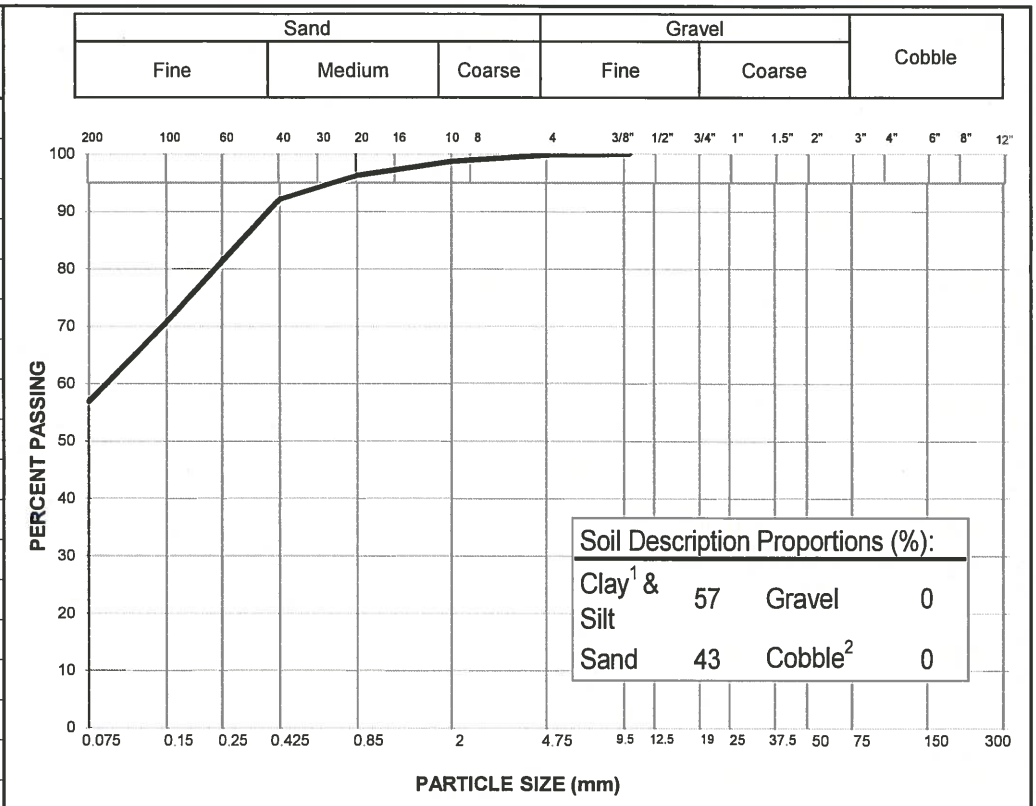
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP64-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Halfway Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.25 - 0.50 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 8, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	194.7%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	100
5	100
2	99
0.85	96
0.425	92
0.25	81
0.15	71
0.075	56.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

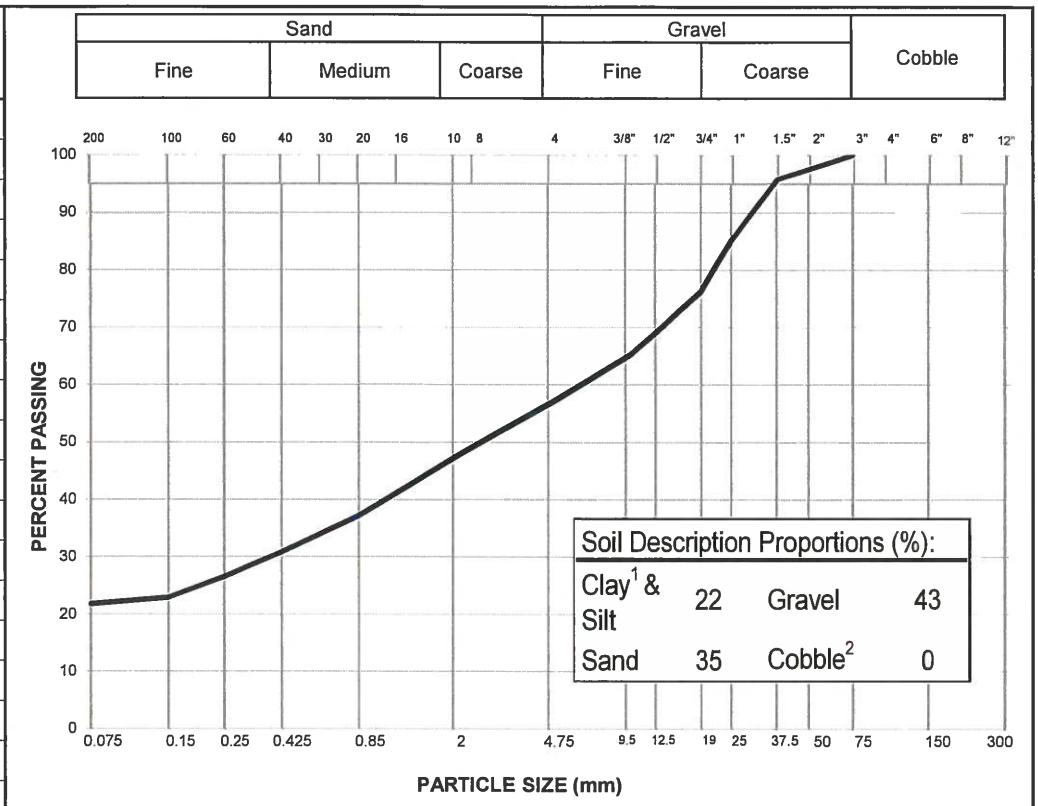
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP65-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Halfway Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.2 - 0.5 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 9, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	35.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	96
25	85
19	76
12.5	69
10	65
5	57
2	47
0.85	37
0.425	31
0.25	27
0.15	23
0.075	21.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

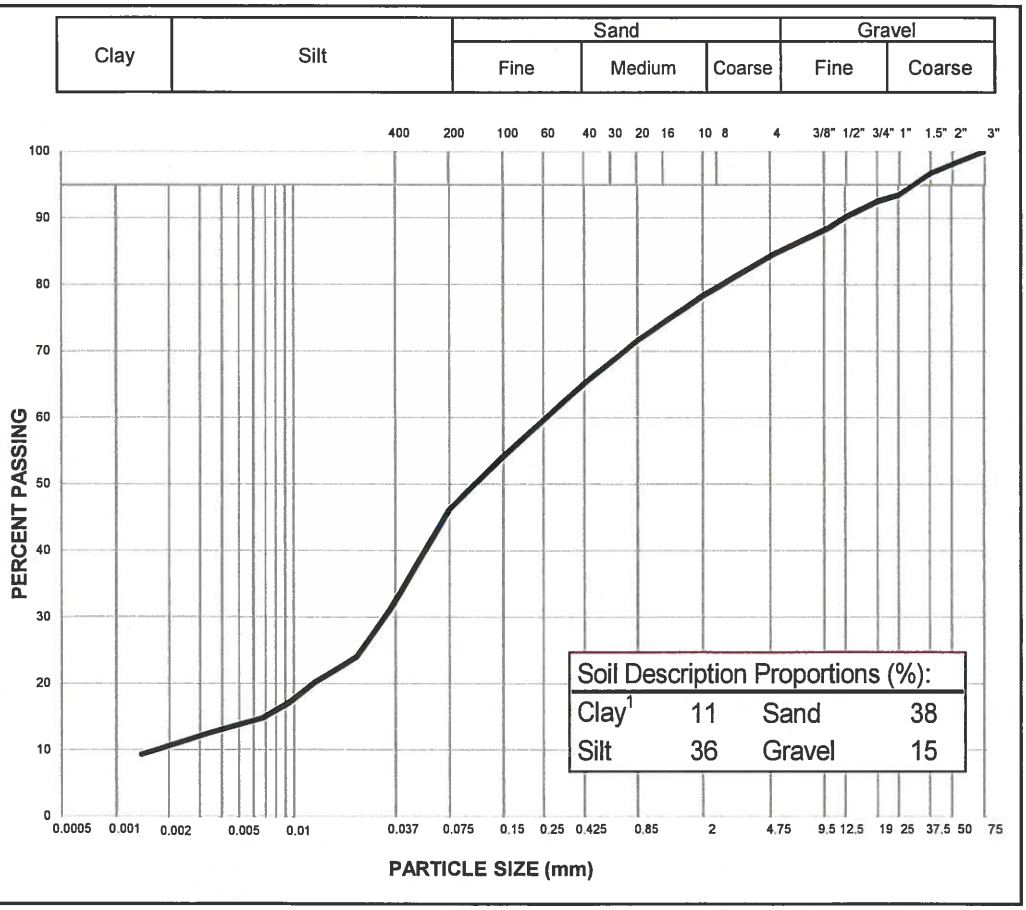
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP66-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Halfway Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.5 - 0.7 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 22, 2018 By: AT/GK	Date Sampled:	September 10, 2018
		Sampled By:	JL
		USC Classification:	Cu: 143.8
Moisture Content:	19.0%		Cc: 2.2

Particle Size (mm)	Percent Passing
75	100
50	
38	97
25	93
19	92
12.5	90
10	88
5	85
2	78
0.85	72
0.425	65
0.25	60
0.15	54
0.075	46.2
0.0343	31.0
0.0223	24.0
0.0131	20.2
0.0093	17.1
0.0067	14.7
0.0033	12.4
0.0014	9.3



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

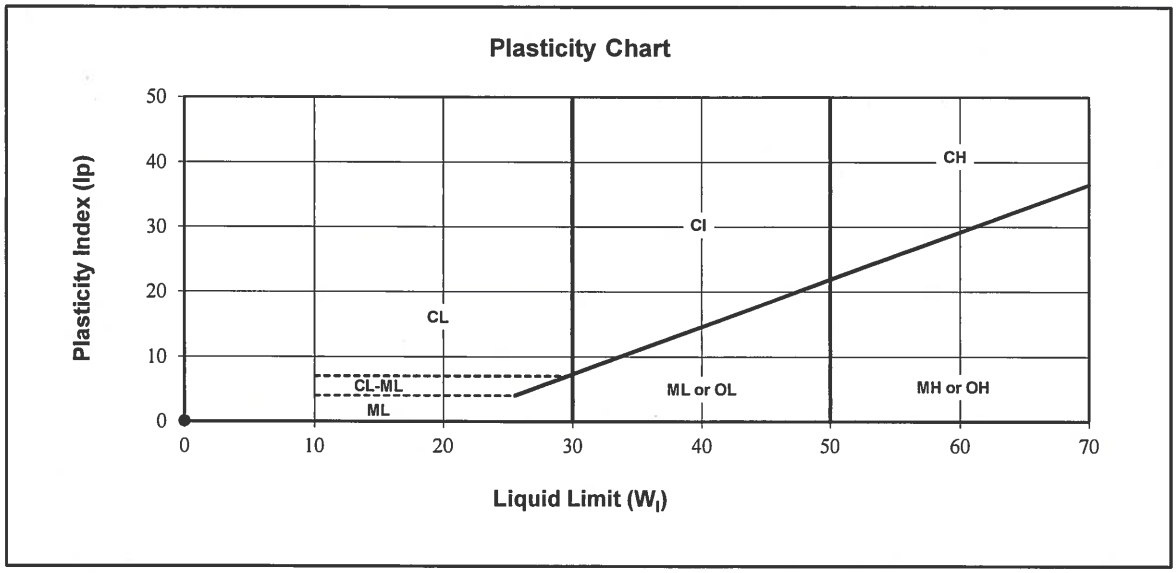
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Fall 2018 Testpitting Program	Sample Number:	TP66-01
		Sample Location:	Halfway Diversion
Project No:	ENG.EARC03094-06.003	Depth:	0.5 - 0.7 m
Client:	JDS Energy & Mining Inc.	Sampled By:	JL Tested By: AT
Attention:	Leigh Sawchyn	Date Sampled:	September 10, 2018
Email:	leighs@jdsmining.ca	Date Tested:	November 22, 2018

Sample Description: SILT and SAND, some gravel



Liquid Limit ($W_{1)}$:	0	Natural Moisture (%)	
Plastic Limit :	0	Soil Plasticity:	NP
Plasticity Index (Ip) :	**0**	Mod.USCS Symbol:	ML

Remarks: Sample is non-plastic

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

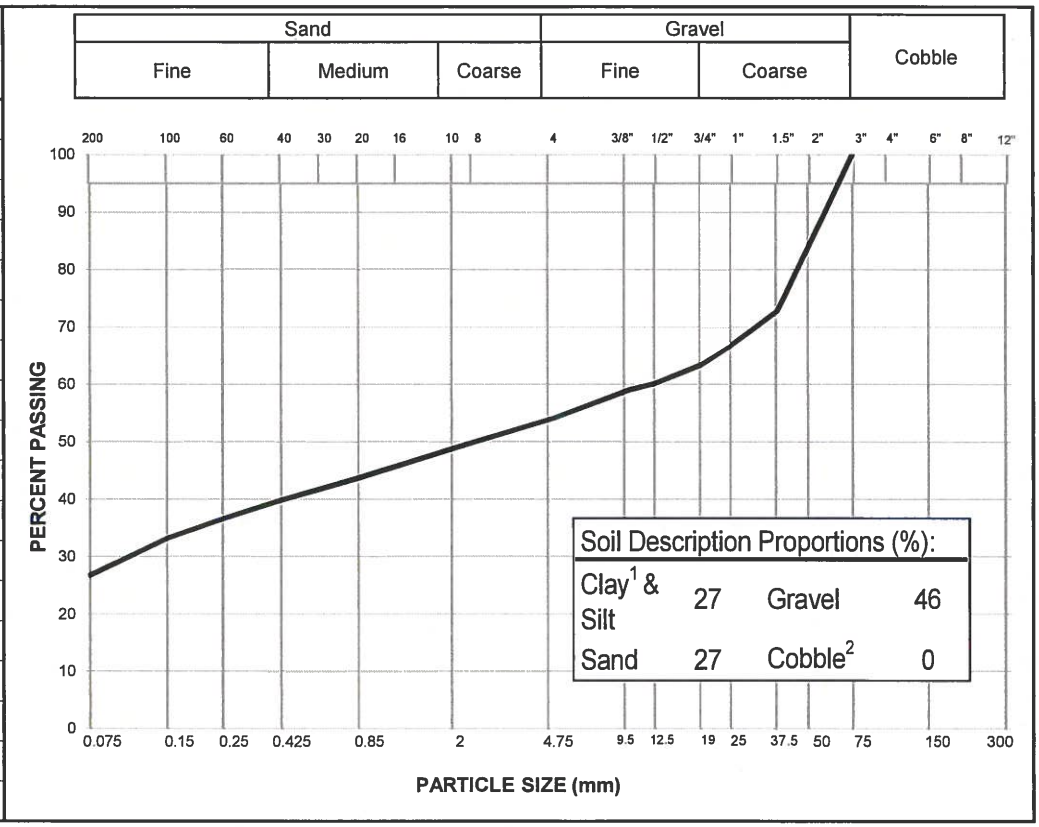
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP66-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Halfway Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.7 - 1.1 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 23, 2018 By: GK	Date Sampled:	September 10, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	41.9%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	73
25	67
19	63
12.5	60
10	59
5	54
2	49
0.85	44
0.425	40
0.25	37
0.15	33
0.075	26.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

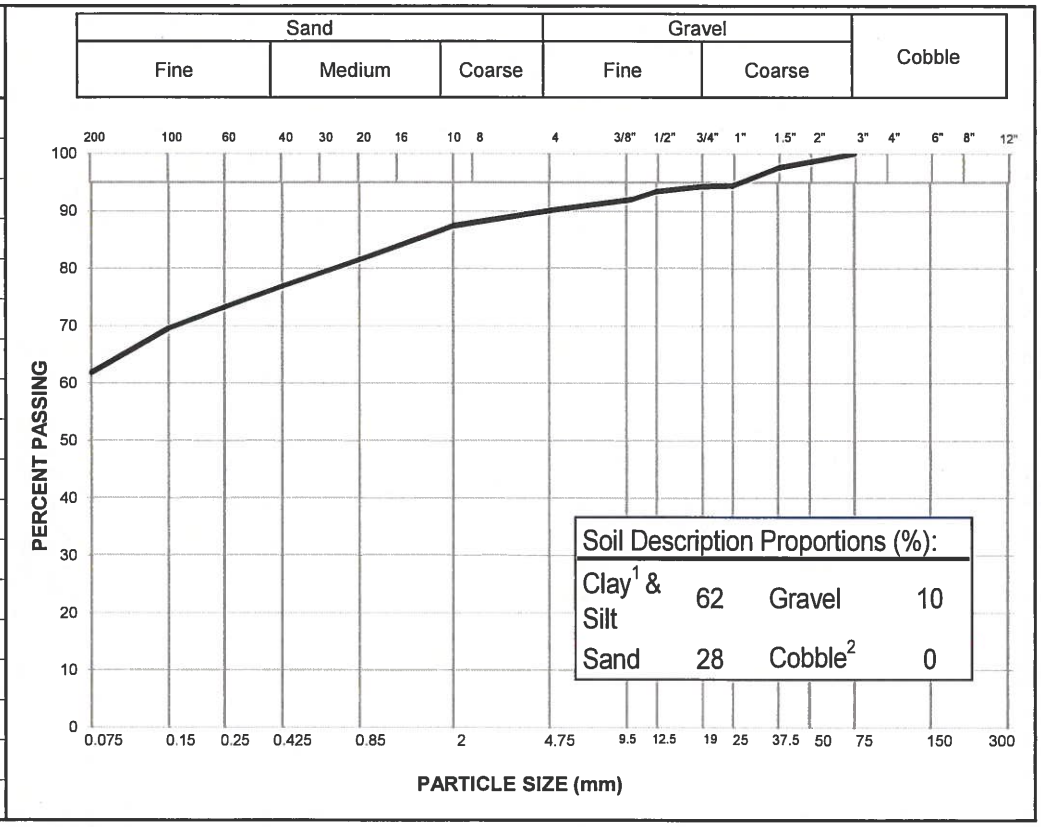
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP67-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Halfway Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.5 - 0.8 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 11, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	28.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	98
25	94
19	94
12.5	93
10	92
5	90
2	87
0.85	82
0.425	77
0.25	73
0.15	70
0.075	61.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

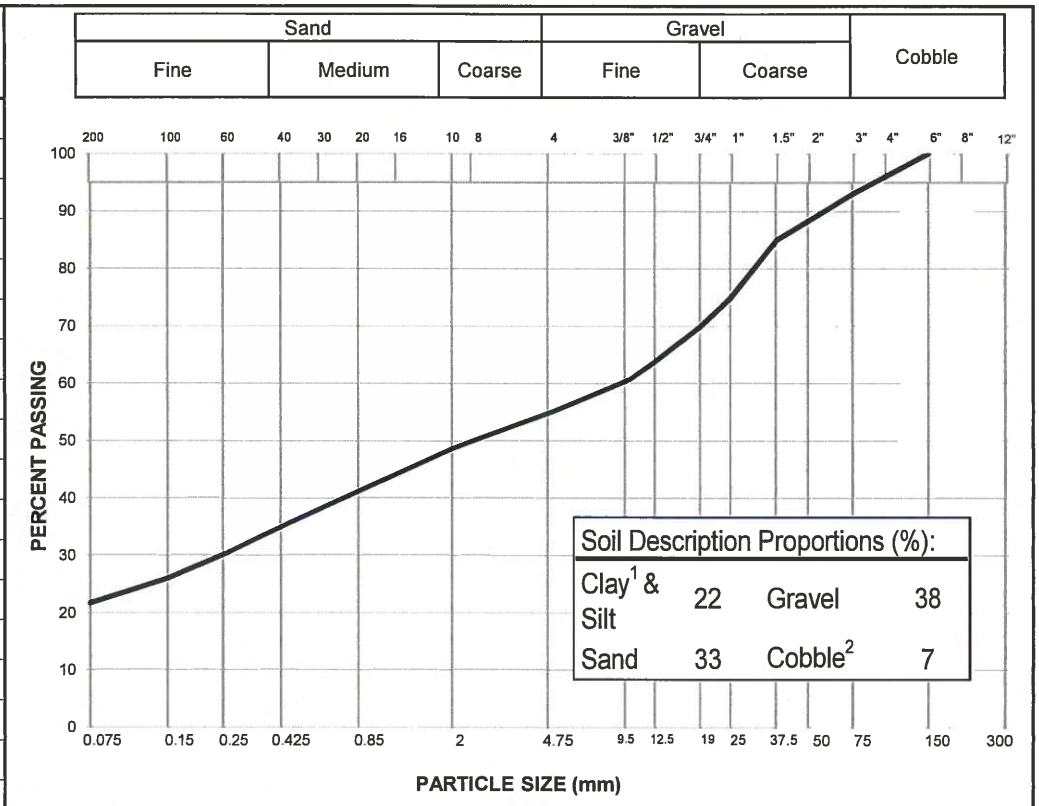
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP68-02
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Halfway Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.45 - 0.90 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 21, 2018 By: GK	Date Sampled:	September 12, 2018
		Sampled By:	JL
		USC Classification:	Cu: #N/A
Moisture Content:	9.5%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	100
100	
75	93
50	
38	85
25	75
19	70
12.5	64
10	61
5	55
2	49
0.85	41
0.425	35
0.25	30
0.15	26
0.075	21.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

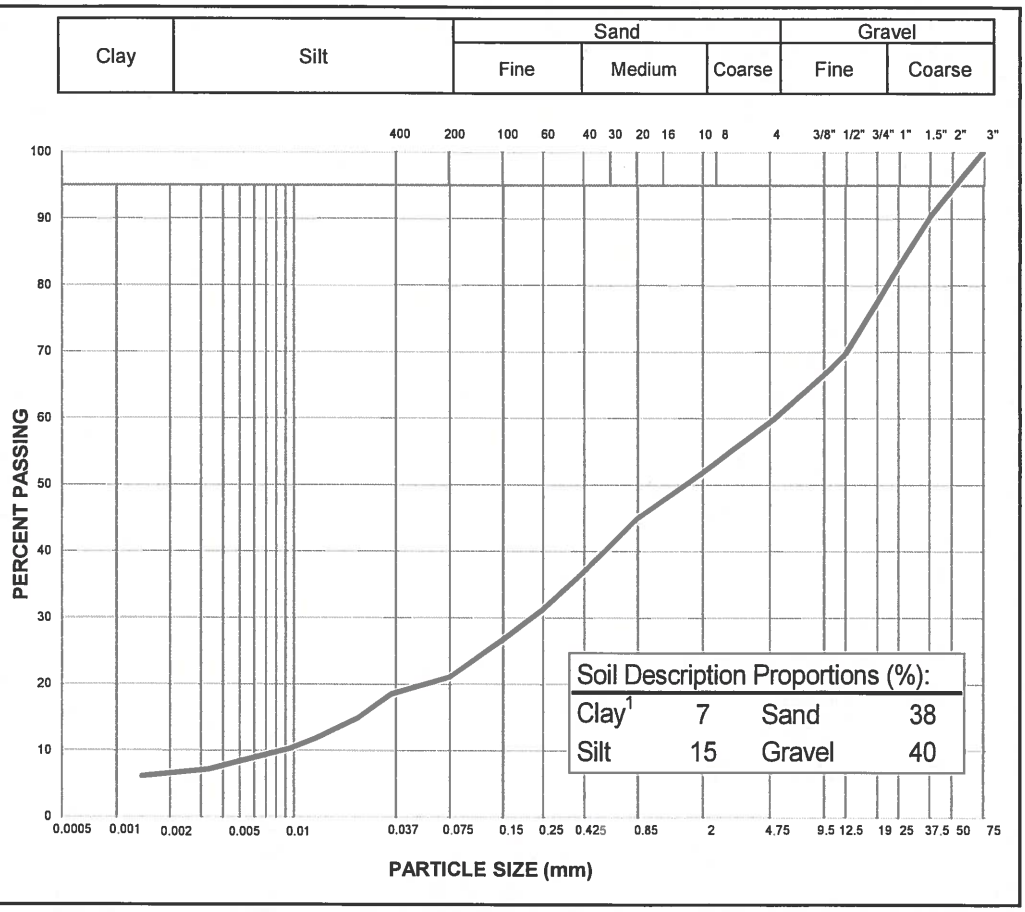
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP68-03
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	Halfway Diversion
Client:	JDS Energy & Mining Inc.	Sample Depth:	0.9 - 1.2 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 22, 2018 By: AT/GK	Date Sampled:	September 12, 2018
		Sampled By:	JL
		USC Classification:	Cu: 583.0
Moisture Content:	10.3%		Cc: 1.1

Particle Size (mm)	Percent Passing
75	100
50	
38	90
25	83
19	77
12.5	70
10	67
5	60
2	52
0.85	45
0.425	37
0.25	31
0.15	27
0.075	21.0
0.0347	18.5
0.0224	14.9
0.0132	11.8
0.0094	10.3
0.0067	9.2
0.0033	7.2
0.0014	6.2



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

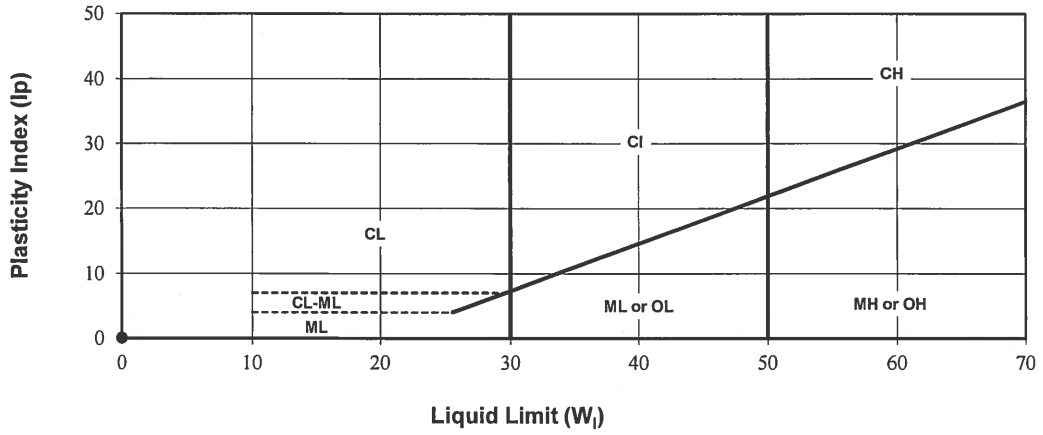
ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Fall 2018 Testpitting Program	Sample Number:	TP68-03
		Sample Location:	Halfway Diversion
Project No:	ENG.EARC03094-06.003	Depth:	0.9 - 1.2 m
Client:	JDS Energy & Mining Inc.	Sampled By:	JL Tested By: AT
Attention:	Leigh Sawchyn	Date Sampled:	September 12, 2018
Email:	leighs@jdsmining.ca	Date Tested:	November 22, 2018

Sample Description: GRAVEL and SAND, silty

Plasticity Chart



Liquid Limit (W_1) :	0	Natural Moisture (%)	
Plastic Limit :	0	Soil Plasticity:	NP
Plasticity Index (Ip) :	**0**	Mod.USCS Symbol:	ML

Remarks: Sample is non-plastic

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

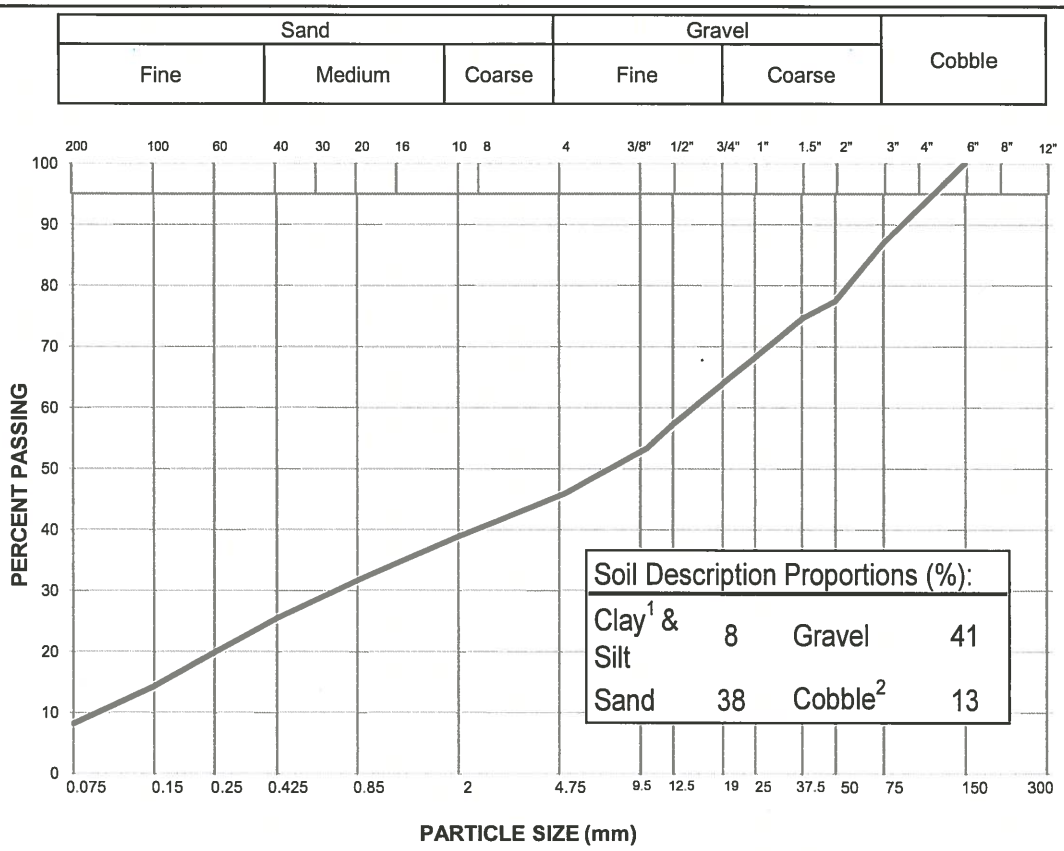
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP70-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	2-3km/6-7km Borrow Sources
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.50 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 15, 2018 By: GK	Date Sampled:	-
		Sampled By:	Client
		USC Classification:	Cu: 156.2
Moisture Content:	5.0%		Cc: 0.4

Particle Size (mm)	Percent Passing
300	
200	
150	100
100	
75	87
50	77
38	75
25	68
19	64
12.5	57
10	53
5	46
2	39
0.85	32
0.425	25
0.25	20
0.15	14
0.075	8.2



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

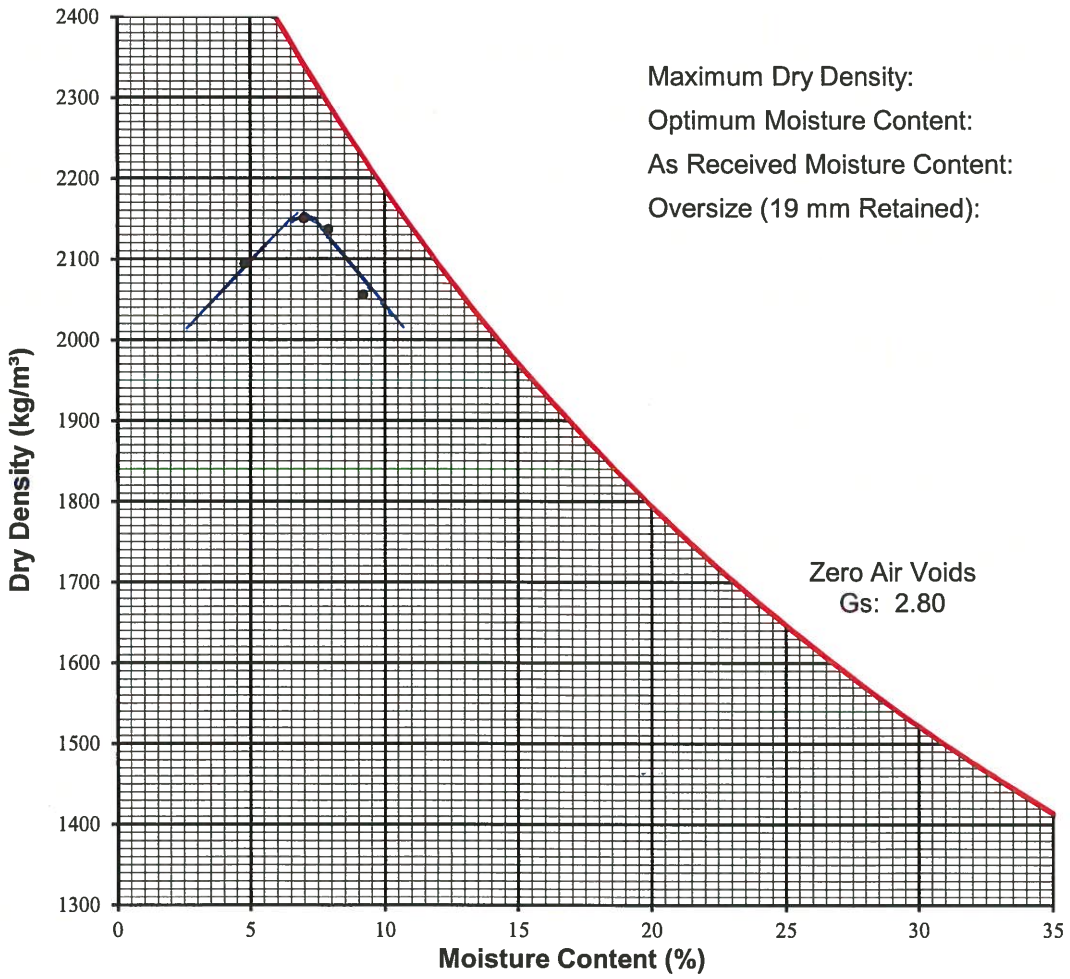
Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D1557 (Modified Proctor)

Project:	Fall 2018 Testpitting Program	Sample No.:	TP70-01
Project No.:	ENG.EARC03094-06.003	Sampled By:	Client
Client:	JDS Energy & Mining Inc.	Date Received:	-
Attention:	Leigh Sawchyn	Test Date:	13-Nov-18
E-mail:	leighs@jdsmining.com	Test By:	BK
Source:	2-3km and 6-7km Borrow Sources	Test Method:	C (Manual)
Sample Location:	-		
Sample Description:	GRAVEL and SAND, some cobbles, trace silt		



Maximum Dry Density:	**2150**	kg/m³
Optimum Moisture Content:	**7.0**	%
As Received Moisture Content:	5.0	%
Oversize (19 mm Retained):	35	%

Remarks:

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

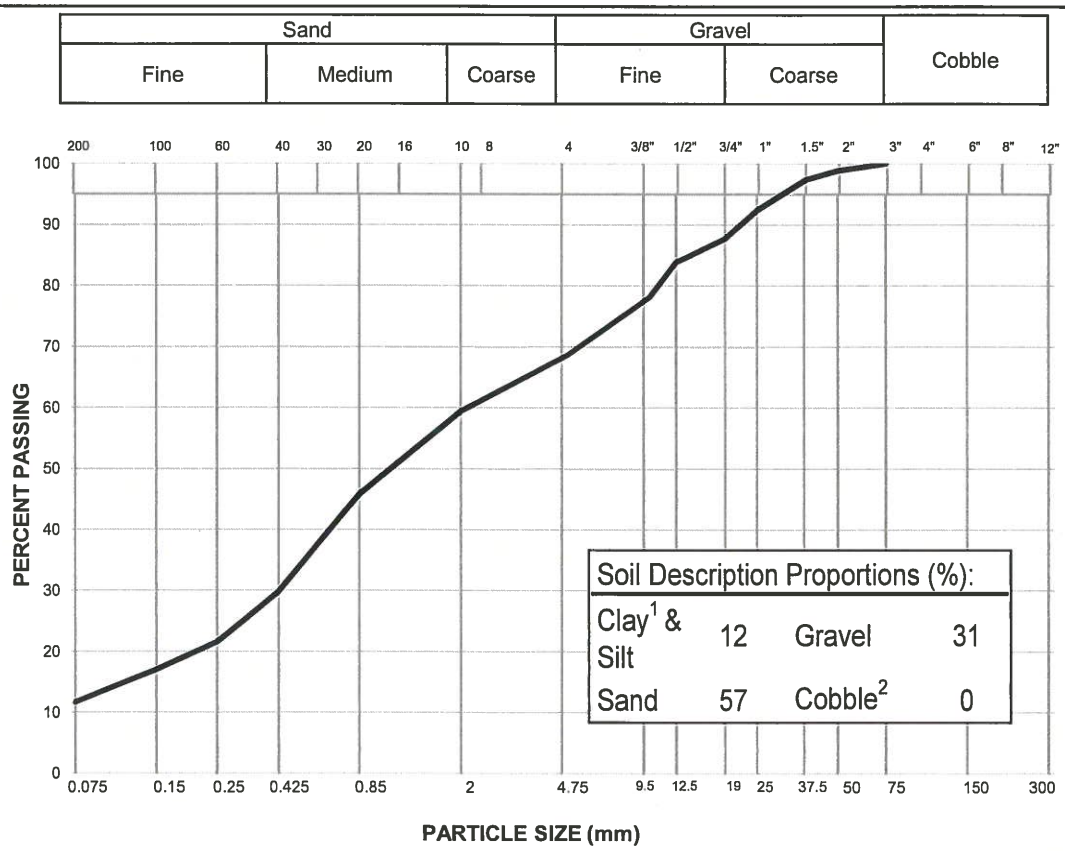
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP71-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	2-3km/6-7km Borrow Sources
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.50 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 15, 2018 By: GK	Date Sampled:	-
		Sampled By:	Client
		USC Classification:	Cu: #N/A
Moisture Content:	7.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	99
38	97
25	92
19	88
12.5	84
10	78
5	69
2	59
0.85	46
0.425	30
0.25	22
0.15	17
0.075	11.6



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

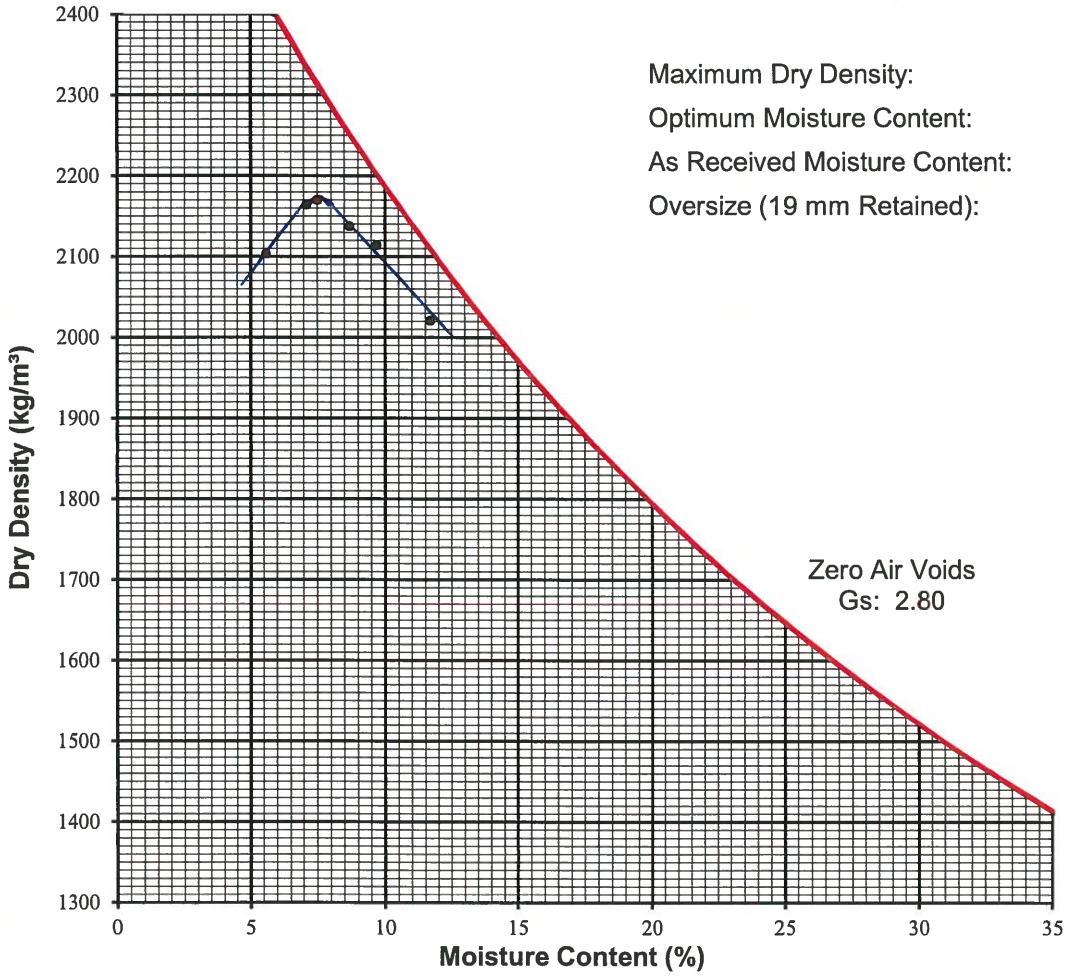
Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D1557 (Modified Proctor)

Project:	Fall 2018 Testpitting Program	Sample No.:	TP71-01
Project No.:	ENG.EARC03094-06.003	Sampled By:	Client
Client:	JDS Energy & Mining Inc.	Date Received:	-
Attention:	Leigh Sawchyn	Test Date:	15-Nov-18
E-mail:	leighs@jdsmining.com	Test By:	GM
Source:	2-3km and 6-7km Borrow Sources	Test Method:	C (Manual)
Sample Location:	-		
Sample Description:	SAND, gravelly, some silt		



Maximum Dry Density:	**2170**	kg/m³
Optimum Moisture Content:	**7.5**	%
As Received Moisture Content:	7.1	%
Oversize (19 mm Retained):	15	%

Remarks:

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

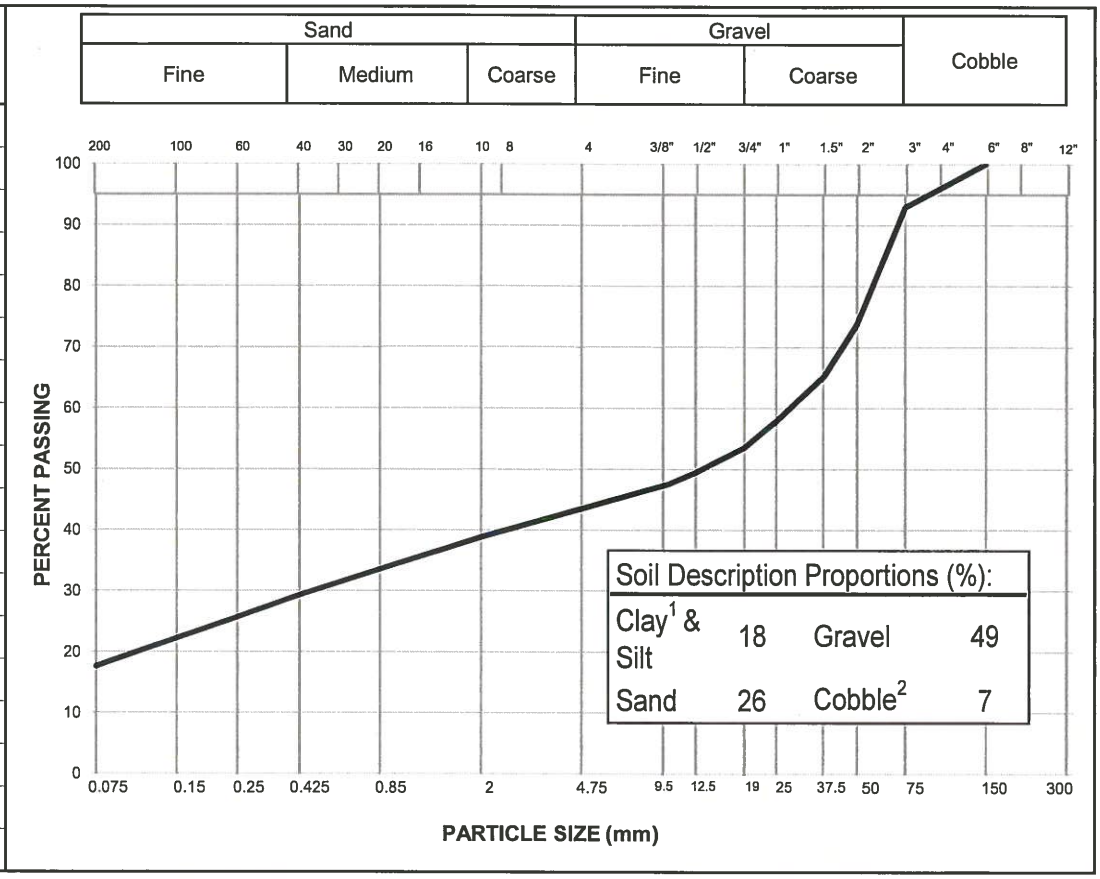
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP72-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	2-3km/6-7km Borrow Sources
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.50 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 15, 2018 By: GK	Date Sampled:	-
		Sampled By:	Client
		USC Classification:	Cu: #N/A
Moisture Content:	12.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	100
100	
75	93
50	74
38	65
25	58
19	54
12.5	49
10	48
5	44
2	39
0.85	34
0.425	29
0.25	26
0.15	22
0.075	17.6



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

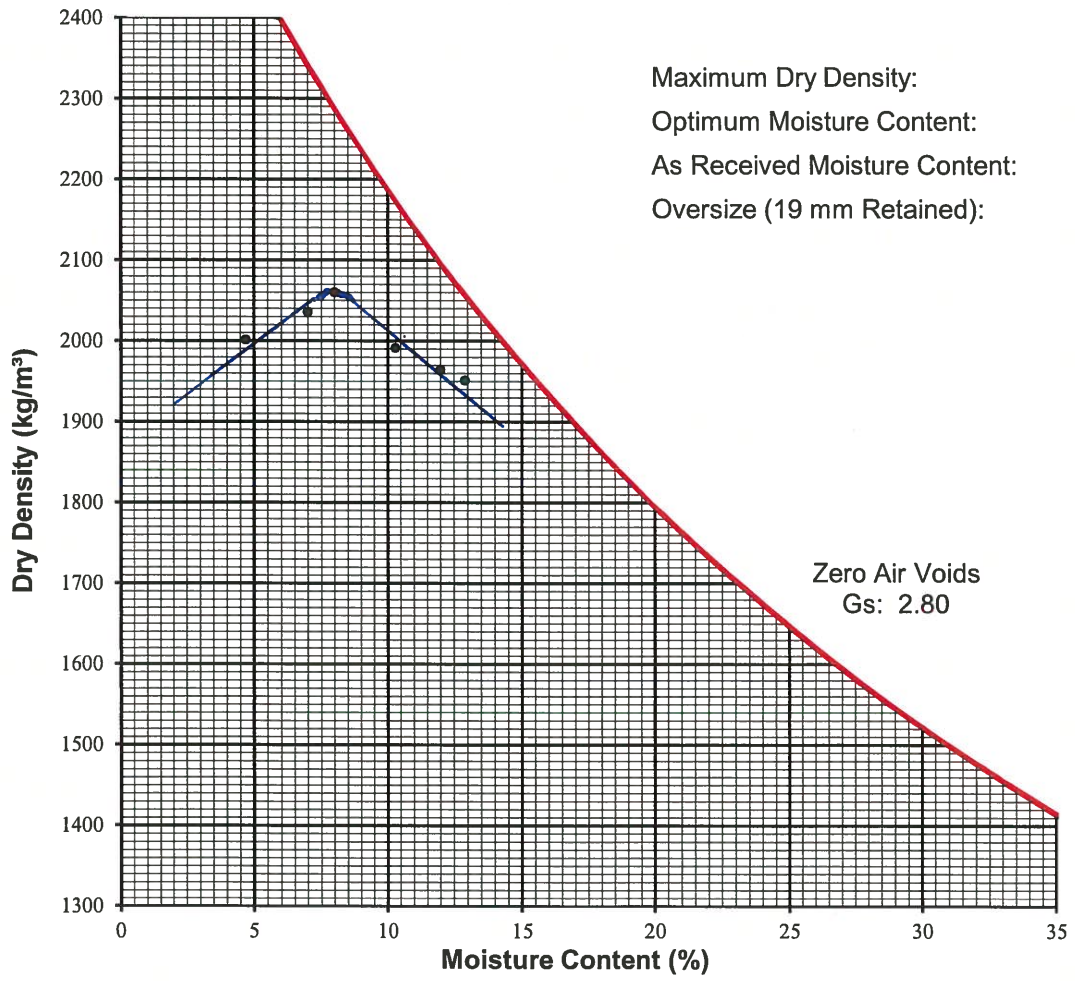
Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D1557 (Modified Proctor)

Project:	Fall 2018 Testpitting Program	Sample No.:	TP72-01
Project No.:	ENG.EARC03094-06.003	Sampled By:	Client
Client:	JDS Energy & Mining Inc.	Date Received:	-
Attention:	Leigh Sawchyn	Test Date:	15-Nov-18
E-mail:	leighs@jdsmining.com	Test By:	GM
Source:	2-3km and 6-7km Borrow Sources	Test Method:	C (Manual)
Sample Location:	-		
Sample Description:	GRAVEL, sandy, some silt, trace cobbles		



Maximum Dry Density:	**2060**	kg/m³
Optimum Moisture Content:	**8.0**	%
As Received Moisture Content:	12.6	%
Oversize (19 mm Retained):	45	%

Remarks:

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

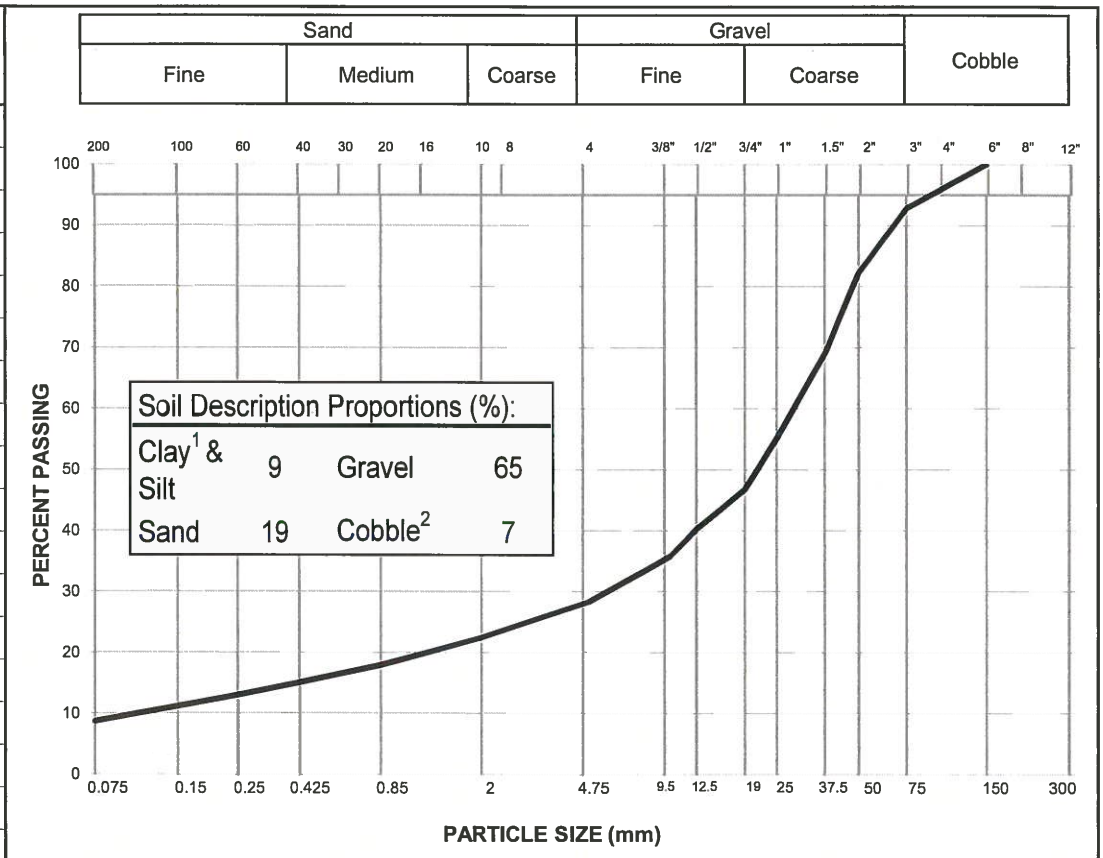
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP73-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	2-3km/6-7km Borrow Sources
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.50 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 14, 2018 By: GK	Date Sampled:	-
		Sampled By:	Client
		USC Classification:	Cu: 257.0
Moisture Content:	4.8%		Cc: 11.1

Particle Size (mm)	Percent Passing
300	
200	
150	100
100	
75	93
50	82
38	69
25	55
19	47
12.5	40
10	36
5	28
2	22
0.85	18
0.425	15
0.25	13
0.15	11
0.075	8.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

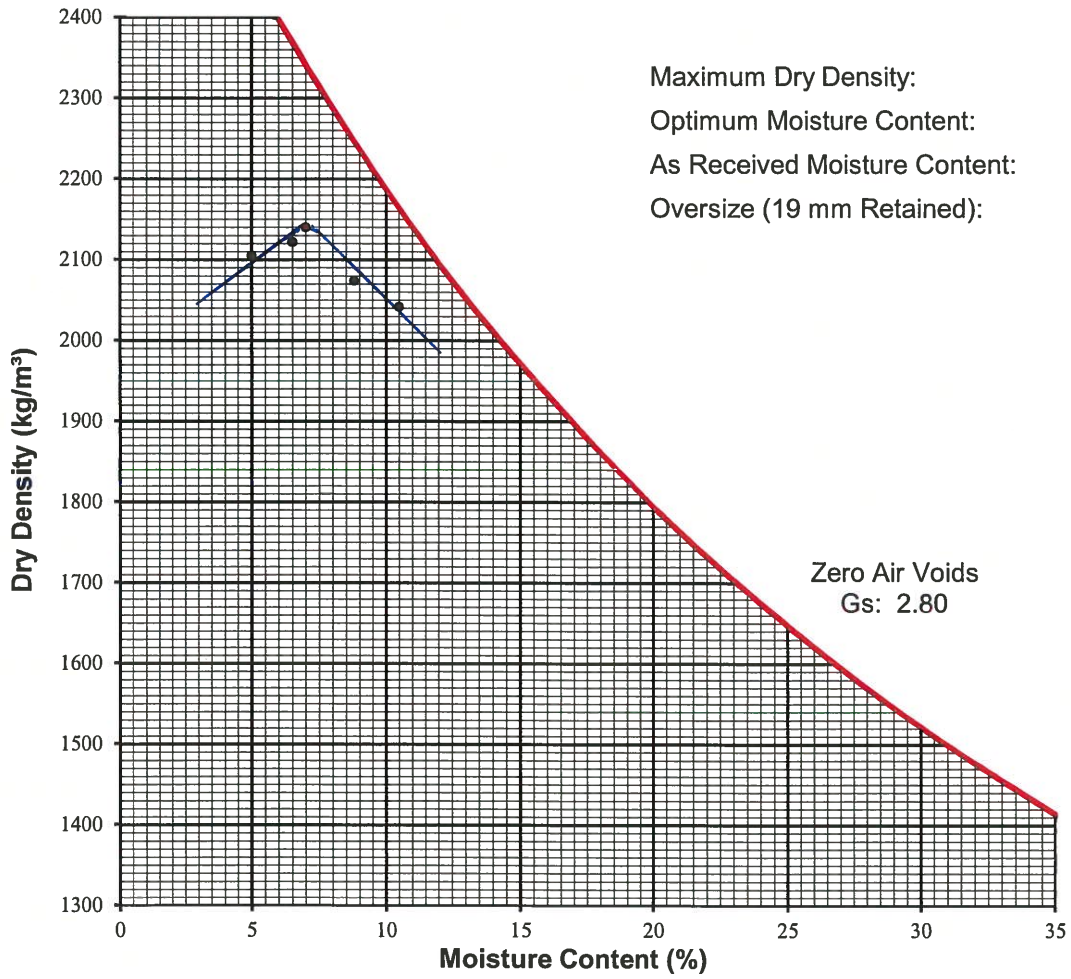
MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D1557 (Modified Proctor)

Project:	Fall 2018 Testpitting Program	Sample No.:	TP73-01
Project No.:	ENG.EARC03094-06.003	Sampled By:	Client
Client:	JDS Energy & Mining Inc.	Date Received:	-
Attention:	Leigh Sawchyn	Test Date:	14-Nov-18
E-mail:	leighs@jdsmining.com	Test By:	BK/TH
Source:	2-3km and 6-7km Borrow Sources	Test Method:	C (Manual)

Sample Location: -

Sample Description: GRAVEL, some sand, trace silt, trace cobbles



Maximum Dry Density:	**2140**	kg/m³
Optimum Moisture Content:	**7.0**	%
As Received Moisture Content:	4.8	%
Oversize (19 mm Retained):	50	%

Remarks:

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

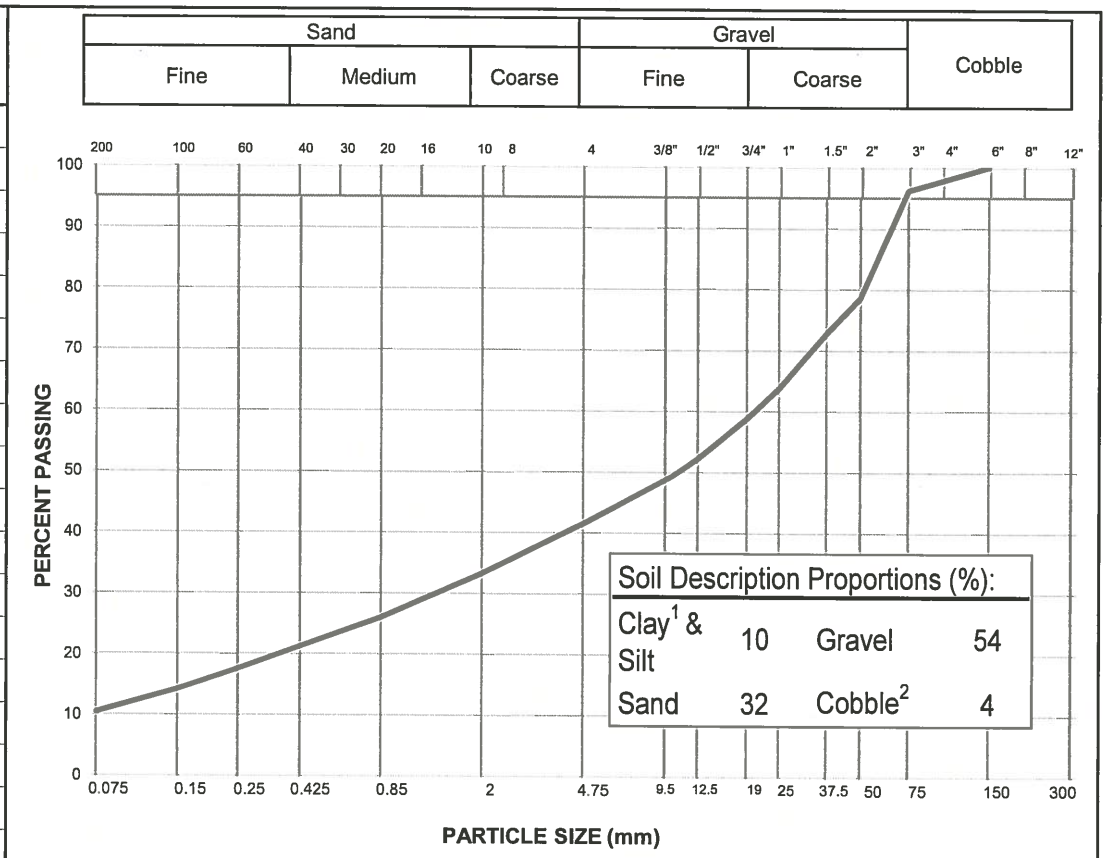
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Fall 2018 Testpitting Program	Sample No.:	TP74-01
Project No.:	ENG.EARC03094-06.003	Material Type:	-
Site:	Coffee Gold Mine, YT	Sample Loc.:	2-3km/6-7km Borrow Sources
Client:	JDS Energy & Mining Inc.	Sample Depth:	1.50 m
Client Rep.:	Leigh Sawchyn	Sampling Method:	Grab
Date Tested:	November 15, 2018 By: GK	Date Sampled:	-
		Sampled By:	Client
		USC Classification:	Cu: #N/A
Moisture Content:	9.9%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	100
100	
75	96
50	79
38	73
25	64
19	59
12.5	52
10	49
5	42
2	33
0.85	26
0.425	21
0.25	18
0.15	14
0.075	10.5



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

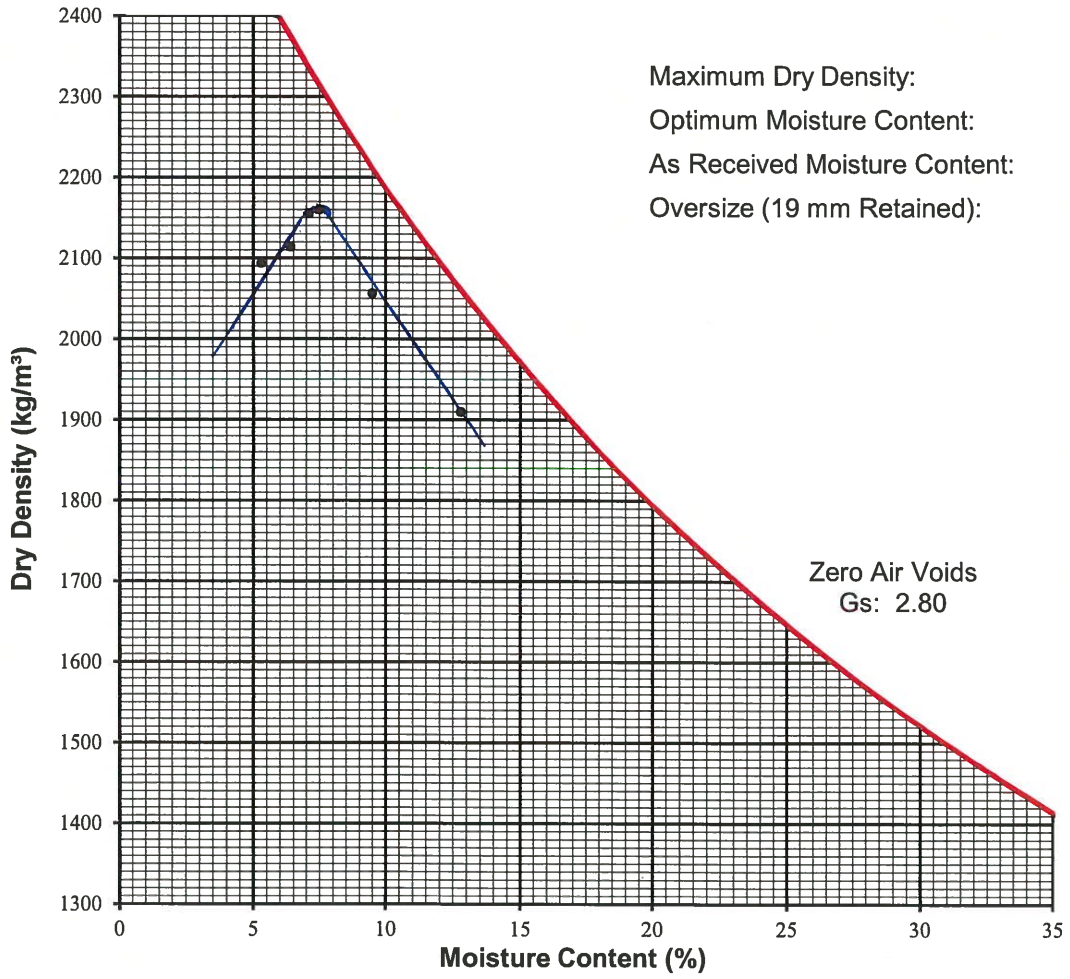
Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D1557 (Modified Proctor)

Project:	Fall 2018 Testpitting Program	Sample No.:	TP74-01
Project No.:	ENG.EARC03094-06.003	Sampled By:	Client
Client:	JDS Energy & Mining Inc.	Date Received:	-
Attention:	Leigh Sawchyn	Test Date:	15-Nov-18
E-mail:	leighs@jdsmining.com	Test By:	BK/GM/TH
Source:	2-3km and 6-7km Borrow Sources	Test Method:	C (Manual)
Sample Location:	-		
Sample Description:	GRAVEL, sandy, trace silt, trace cobbles		



Maximum Dry Density:	**2160**	kg/m³
Optimum Moisture Content:	**7.5**	%
As Received Moisture Content:	9.9	%
Oversize (19 mm Retained):	40	%

Remarks:

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

MOISTURE CONTENT, EXCESS ICE CONTENT, & BULK UNIT WEIGHT TEST RESULTS

ASTM D2216

Project:	Fall 2018 Testpitting Program	Sample No.:	See Below
Project Number:	ENG.EARC03094-06.003	Date Tested:	-
Client:	JDS Energy & Mining Inc.	Tested By:	-
Project Manager:	Coffee Gold Mine, YT	Page:	-

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
Halfway Diversion	TP69-01	529.0	
	TP69-02	277.2	
	TP69-03	313.7	

B.H. Number	Sample Number	Excess Ice Content (%)	Visual Description of Soil
Halfway Diversion	TP66-01	0.0	
	TP66-02	29.9	
	TP69-01	41.7	
	TP69-02	34.9	
	TP69-03	34.4	

B.H. Number	Sample Number	Weight in Air (g)	Weight in Water (g)	Visual Description of Soil
Halfway Diversion	TP66-01	7871.6	4158.2	
	TP69-01	481.2	1.4	

Reviewed By: _____ P.Eng.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of Tetra Tech. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, Tetra Tech will provide it upon written request.

TETRA TECH

APPENDIX 2-J

Initial Ecohydrological Modelling in support of Coffee Gold Reclamation

IEG
Integral Ecology Group
iegconsulting.com

MEMORANDUM

January 16, 2019

TO:	Jennie Gjertsen, Goldcorp Inc.
FROM:	Justin Straker
RE:	Initial ecohydrological modelling in support of Coffee Gold reclamation, 2019
COPY:	Ryan Herbert, Goldcorp; Pamela O'Hara, EcoWest

Per our approved scope of work of November-December 2018, please find below results of our initial ecohydrological modelling for the Coffee Gold project. These results address:

- target ecosystems;
- expected outcomes and potential revisions to the current reclamation-cover plan; and
- ecohydrological implications.

We also discuss potential next steps in this work and data gaps.

Target ecosystems

We analyzed ecosystem mapping provided by EDI Environmental Dynamics Inc. (2017) to understand pre-development conditions and potential post-closure reclamation targets. To do so, we focussed on mapping that includes the current planned project footprint and what is described by EDI as a minimum 1000-m buffer around this footprint. Mapping around access and infrastructure features was not included in our analysis. This approach yielded a study area of approximately 8100 ha, which is divided roughly 60% in the Boreal High bioclimate zone and 40% into the Subalpine bioclimate zone (Environment Yukon, 2016).

Ecosystems in the Boreal High bioclimate zone can be depicted on a two-dimensional edatopic grid, where the vertical axis represents soil moisture regime (SMR) and the horizontal axis represents soil nutrient regime (SNR) – a simplified version of the edatopic grid used by EDI in their mapping is shown in Figure 1. Our analysis of EDI's data indicates that over 90% of the assessed study area is composed of ecosystems with mesic or wetter SMRs[1], with only about 7% of the assessed area occupied by ecosystems with SMRs of submesic or drier. This analysis should be refined in future based on actual boundaries of currently planned mine facilities, rather than on this analysis of a

[1] The 01 and 30 ecosites occur in a range of submesic-mesic, but have a mean SMR in the mesic class, and are counted here as mesic ecosystems.

1% FOR THE PLANET

buffered local study area, but suggests that the initial targets for reclamation are predominantly mesic or wetter. This information is summarized in Table 1, below.

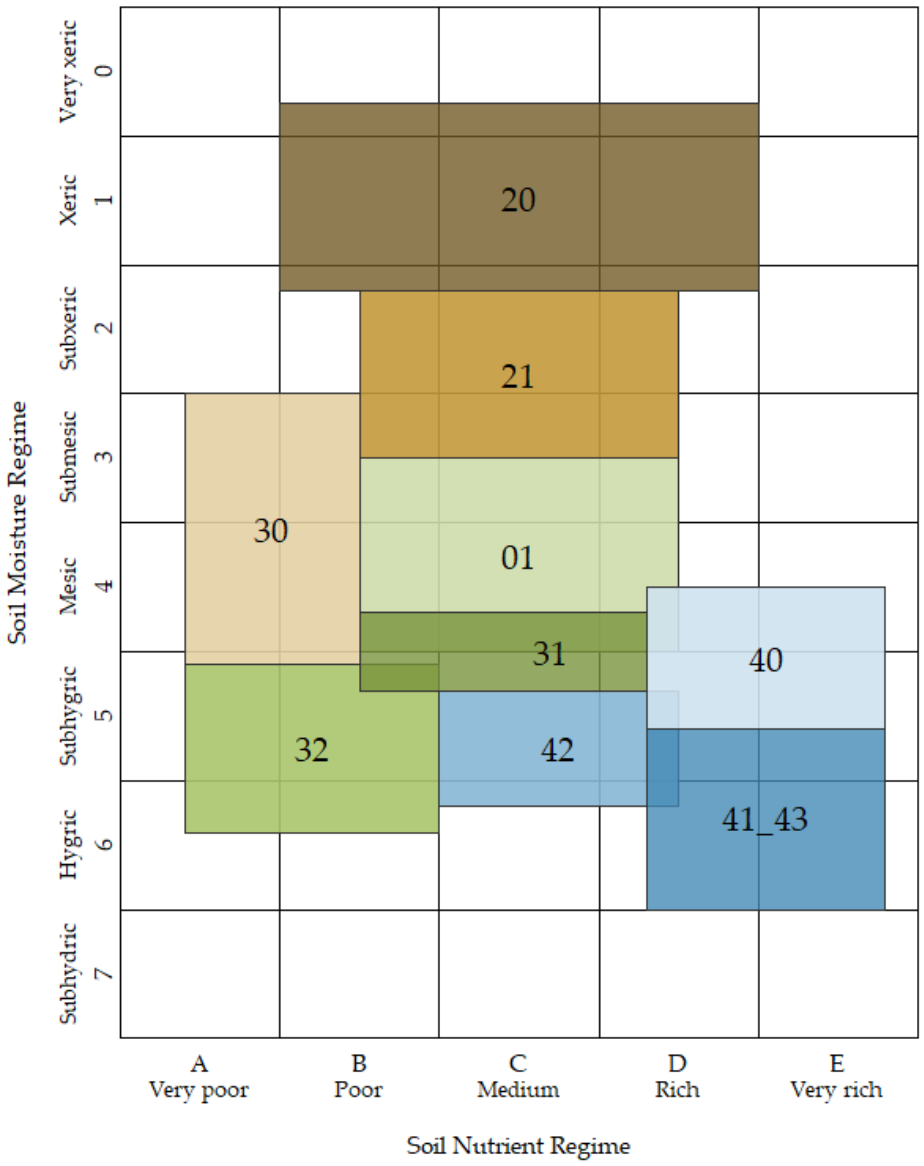


Figure 1. Edatopic grid for the Yukon Boreal High bioclimate zone. Different ecosystems, called ecosites, are labelled with two-digit numbers, and occupy the conditions delineated by coloured boxes associated with the labels.

Table 1. Proportions of ecosystems by soil moisture class in the mine local study area. Associated ecosites for the Boreal High bioclimate zone, corresponding to Figures 1-4, are shown in parentheses. Values in the table are derived from data for both the Boreal High and Subalpine bioclimate zones.

SMR	%
Xeric (20)	1
Subxeric (21)	3
Submesic (Subalpine only)	3
Mesic (01, 30)	55
Subhygric and wetter (31, 40, etc.)	39

Current reclamation-cover plan

Our understanding of the current reclamation-cover plan and its core assumptions is based largely on the Oct. 25, 2018 JDS memo on surface material for reclamation. Key assumptions from this work include the following:

- the reclamation salvage program will involve recovery within footprints of selected facilities such that organics and upper silt layers are overstripped 20 cm into lower gravels – this material is defined as "topsoil";
- the area-weighted average depth of topsoil salvage is ~100 cm, resulting in an assumed over-stripped mix that is approximately 80% organics + upper silt and 20% lower gravels;
- JDS assumes a potential recovery of 3.35M m^3 of topsoil;
- the topsoil mix will be replaced at a depth of 30 cm on the following features:
    - Haul Roads
    - Mine Service Roads
    - Java Airstrip
    - Coffee Airstrip
    - ROM Stockpile Pad
    - Crusher Pad
    - Bulk Explosive Storage Area
    - Laydowns and Storage Areas
    - Heap Leach Facility
    - Alpha Waste Rock Storage Facility
    - Plant Site, Truck Shop, Fuel Storage Pads

resulting in a demand-side balance of 2.09M m^3, and thus a projected surplus in the reclamation materials balance.

In addition, we derived information on particle-size distributions (PSDs) for upper silts and lower gravels from Tetra Tech's 2017 test-pitting report; information on waste-rock PSDs and "topsoil" organic-matter contents were provided by David Flather and John Dockrey of Lorax Environmental Services Ltd.

We modelled these assumptions. Based on our work, we make the following observations:

1. Given current PSD data, all waste-rock types (gneiss, schist, and granite) hold negligible water over a range of plant-available tensions, due to the lack of particles less than 1 mm in diameter – this information represents a critical data gap in our work, and we need better information on the anticipated full particle-size distributions of waste-rock types at Coffee. At this time, perhaps in part due to a lack of information, our work is not sensitive to assumptions on waste-rock types.
2. Our current analysis suggests that replacement of the dominant target ecosystems (e.g., those with SMRs of mesic or wetter) will require more than the currently planned 30 cm of cover.[2] Projected ecosystem outcomes for 30 cm of cover (with mean PSDs) overlying waste rock are shown for flat, north-facing, and south-facing slopes in Figure 2. For the bulk of the ecosystems that we need to try to replace through reclamation at Coffee (i.e., 01, 30[3]), 30 cm of cover is insufficient to provide the required soil-water conditions. Even on a north slope, where the projected SMR edges into edaphic conditions associated with the 01 ecosite, the projection is right on the boundary of the ecosite delineation, and we would generally use more cover to try to reconstruct this ecosite. Thirty-centimetre covers will support re-establishment of subxeric ecosystems, but our current analysis indicates that these ecosystems form a very small proportion of the pre-development landscape.
3. Based on our current understanding of likely waste-rock characteristics, direct revegetation of these materials – i.e., without a reclamation cover – is very likely to be highly ineffective.

[2] Our modelling includes effects of textural discontinuities that retard water drainage through the reclamation-cover system.

[3] Most of the submesic-mesic ecosystems are 01s, with 30s a much smaller component.

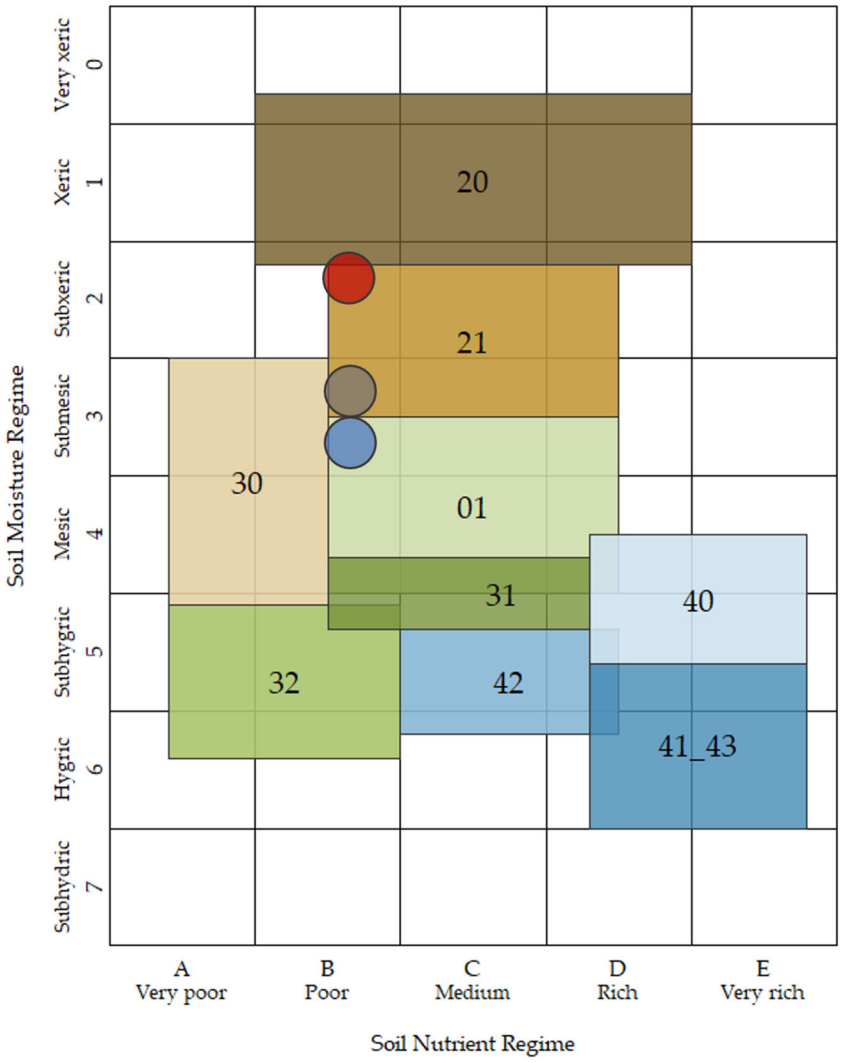


Figure 2. Projections for reclamation outcomes modelled with 30 cm of topsoil cover over waste rock. The grey dot represents the projected outcome for mean PSDs for cover and waste-rock materials, while the blue dot represents the projected outcome for a 27-degree north-facing slope, and the red dot represents the projected outcome for a 27-degree south-facing slope.

In order to meet soil-water requirements for replacement of mesic ecosystems, we estimate that a cover depth of 50 cm will be required, on all slopes (possibly more on south-facing slopes), which is shown in Figure 3. These are the dominant ecosystems in the pre-development landscape. Even this relatively small increase of cover depth

from 30 to 50 cm has substantial implications for the demand side of the reclamation balance – if this increased cover depth were applied ubiquitously across the reclaimed landscape, cover demand (~3.48M m^3) would exceed currently projected supply (3.35M m^3).

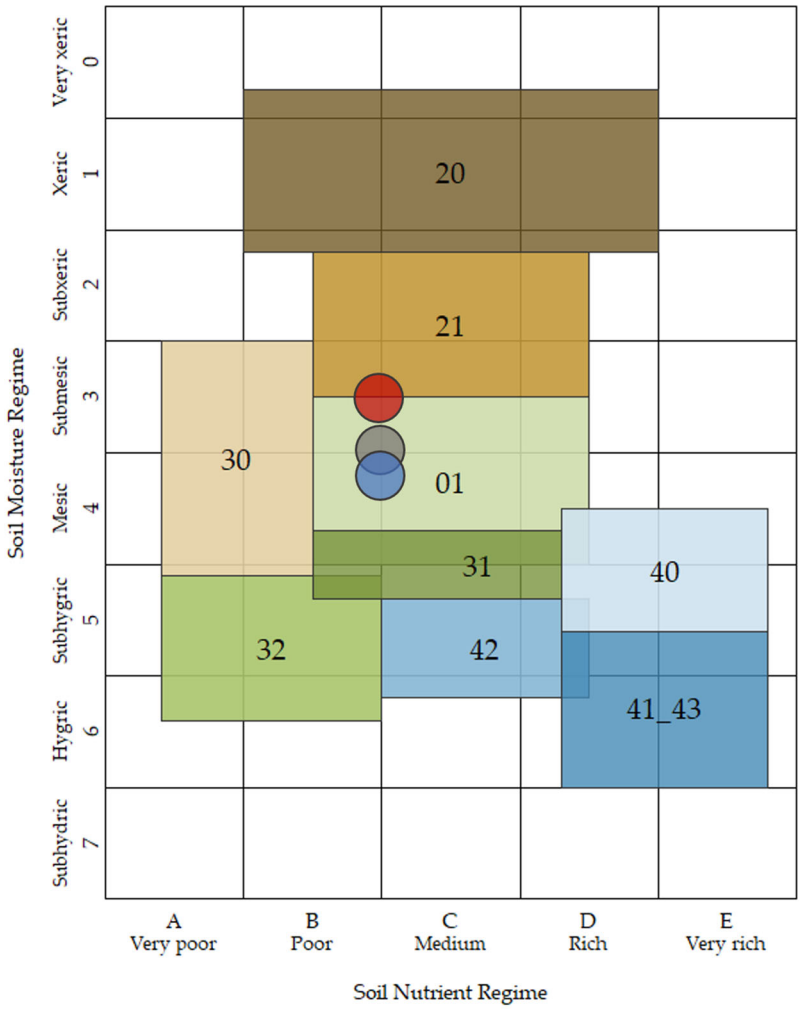


Figure 3. Projections for reclamation outcomes modelled with 50 cm of topsoil cover over waste rock. The grey dot represents the projected outcome for mean PSDs for cover and waste-rock materials, while the blue dot represents the projected outcome for a 27-degree north-facing slope, and the red dot represents the projected outcome for a 27-degree south-facing slope.

Subhygric and wetter ecosystems require inputs of groundwater, which are uncommon on waste-rock landforms, and/or very high soil-water storage capacity.

Relying solely on soil-water storage as the mechanism for supporting these ecosystems, assuming a lack of input groundwater, replacement of these ecosystems would require a cover depth in excess of 80 cm (Figure 4).

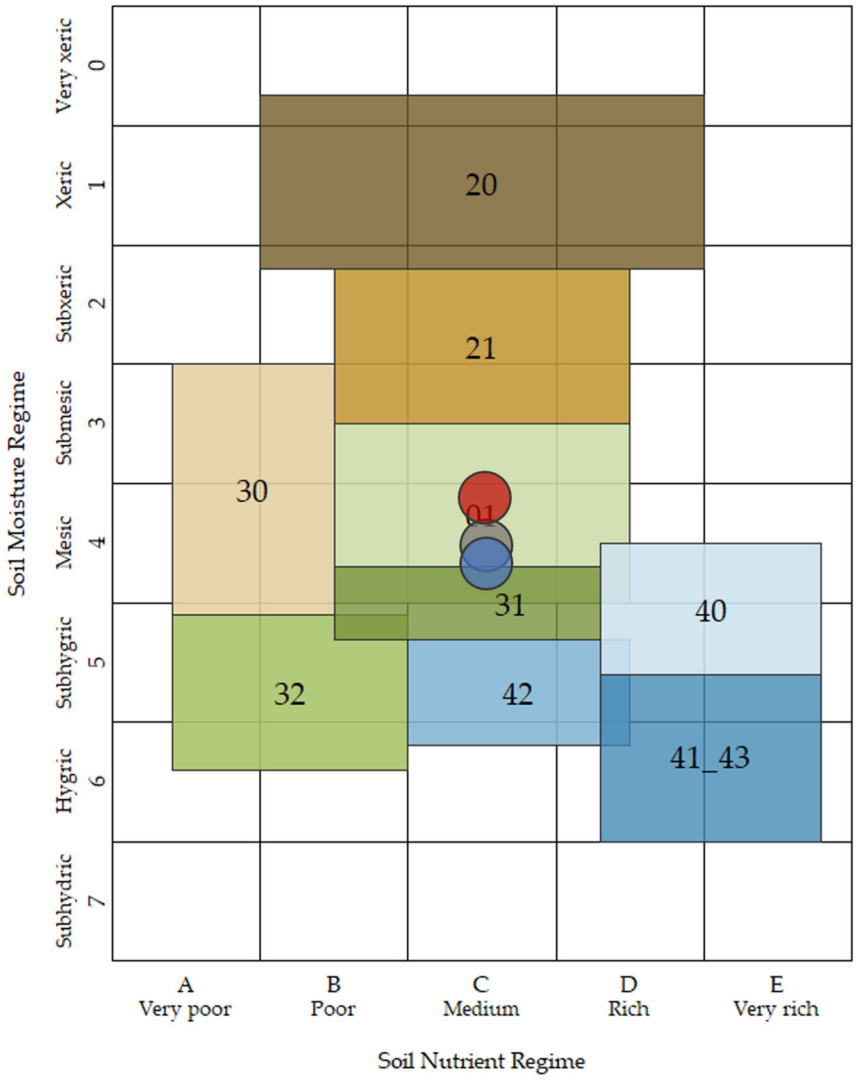


Figure 4. Projections for reclamation outcomes modelled with 50 cm of topsoil cover over waste rock. The grey dot represents the projected outcome for mean PSDs for cover and waste-rock materials, while the blue dot represents the projected outcome for a 27-degree north-facing slope, and the red dot represents the projected outcome for a 27-degree south-facing slope.

Ecohydrological implications of reclamation

Lorax states in their water-balance report (2017) that they assume, for the purpose of their work, that evapotranspiration on site is 182 mm/yr. Our work[4] suggests that this value can be raised on fully revegetated reclamation sites, perhaps as high as 260-290 mm/yr (Figure 5 and Figure 6 show modelled surface-water-balance terms, including evapotranspiration, for a 30-cm and 50-cm cover, respectively). Our estimates are likely to overestimate evapotranspiration, as our simple model assumes capture and use of all growing-season precipitation, but they still suggest that generation of "excess water" – i.e., the difference of $P - E$ (where P is precipitation and E is evaporation, including evapotranspiration) – will be lower on fully vegetated reclamation sites than the value used in the Lorax water-balance model. This suggestion is supported by data from direct measurement of evapotranspiration by eddy-covariance techniques at a research site near Whitehorse. This subalpine site shows annual evapotranspiration values of approximately 250 mm[5], and while it is located at lower latitude, it is also located at higher altitude than the Coffee site, and is thus likely to be substantially comparable. A comparison of projected results for the 30-cm and 50-cm cover suggests that evapotranspiration can be increased by approximately 10% through addition of 20 cm of cover to the 30-cm base case.

[4] For this work we used climate information from ClimateWNA (http://www.climatewna.com/). This dataset is similar to both Lorax's measured and reconstructed data, but generally shows lower temperature, precipitation, and potential evapotranspiration than the Lorax datasets. Use of the Lorax datasets in our model results in higher evapotranspiration numbers, so for now we have retained the ClimateWNA data in order to be more conservative in our evapotranspiration estimates.

[5] Sean Carey, McMaster University, personal communication.

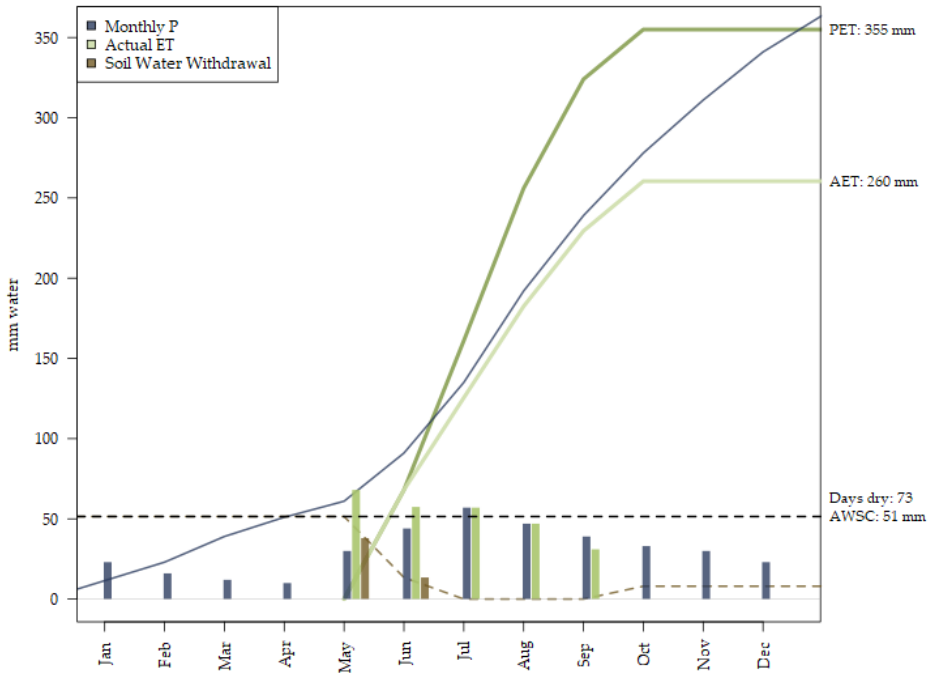


Figure 5. Modelled surface-water-balance terms over a mean climate year for a flat reclamation site with 30 cm of topsoil cover at 1100 m elevation. Modelled evapotranspiration is shown as a light green line with an annual value of 260 mm. Stored soil water is shown as a dashed brown line, and shows that stored soil water is substantially depleted by the end of June, limiting evapotranspiration for the remainder of the growing season. These projections assume full vegetation coverage.

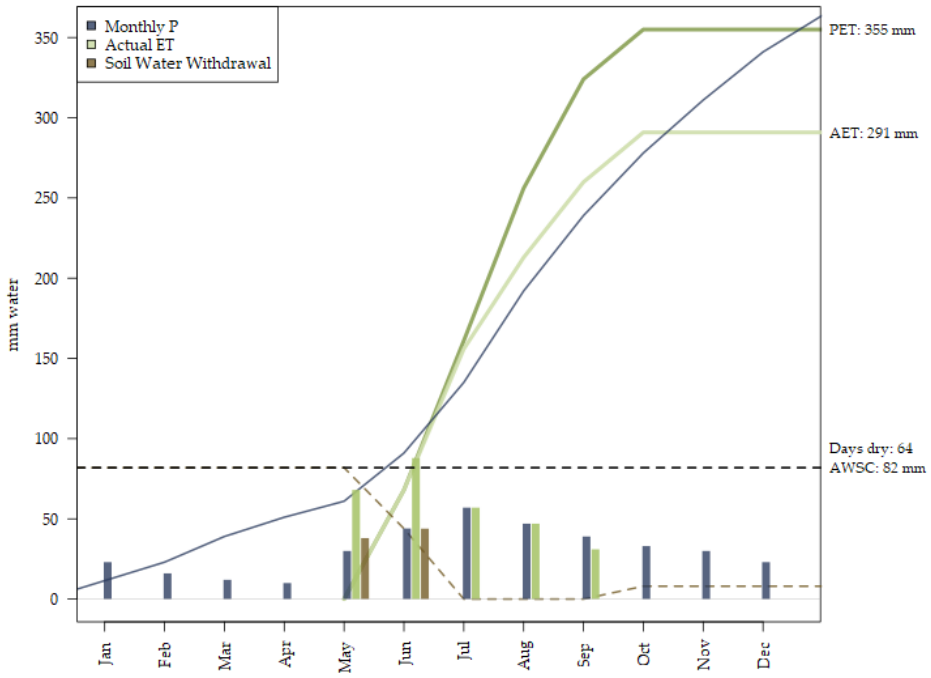


Figure 6. Modelled surface-water-balance terms over a mean climate year for a flat reclamation site with 50 cm of topsoil cover at 1100 m elevation. Modelled evapotranspiration is shown as a light green line with an annual value of ~290 mm. Stored soil water is shown as a dashed brown line, and shows that stored soil water is depleted in July, limiting evapotranspiration for the remainder of the growing season. These projections assume full vegetation coverage.

We are not claiming that our evapotranspiration numbers are correct and that Lorax's are not, but simply highlighting that a very different way of examining this issue yields a different estimate, and that is in our opinion worth some discussion between the technical teams working on this project. We should also emphasize that our evapotranspiration projections assume full vegetation coverage, which may take many years to achieve on reclamation sites at the Coffee project, given the site's high latitude and altitude.

Discussion

Our analysis indicates that the majority of the pre-development landscape, and thus the initial targets for reclamation, is composed of ecosystems with mesic and wetter soil moisture regimes, and that conditions supportive of these ecosystems cannot be replaced using the currently assumed 30-cm cover depth, at least not directly over waste-rock substrates. Replacement of these ecosystems generally requires minimum

cover depths of 50 cm, and the current supply side of the reclamation materials balance would constrain the ubiquitous use of this cover depth. Cover depths of 30 cm can be used to support local ecosystems, but with a frequency distribution that does not approximate the pre-development landscape, as it skewed towards drier ecosystems than previously existed.

Although replacement through reclamation of similar proportions of ecosystems as those present prior to development is an initial target for closure planning, it is a target that is generally not possible to meet, for all projects, due to changes that mining imposes on local landforms. An approach to coming as close as possible to meeting this target for the Coffee project would involve increasing cover use and depths across the project, which would involve use of all the currently identified reclamation material, and even exploration of sourcing additional reclamation materials. It is possible that the materials balances could be adjusted to supply greater cover quantities by stripping deeper into the lower gravel layers, but this would need to be confirmed through additional evaluation of information on local surficial materials. However, even this approach "maximum-cover" approach would result in disparity between pre-development and post-closure ecosystems, and Goldcorp is not obliged to take this approach. Goldcorp could maintain the current cover plan, or some modification of it, and show greater disparity between pre-development and post-closure conditions. Some discussion of this topic is likely required at Goldcorp, and perhaps between Goldcorp and its external stakeholders, to examine the costs and benefits of uses of thicker covers to maximize replacement of pre-development ecosystems.

Our work also suggests that evapotranspiration may be higher on fully vegetated covers than the value of 182 mm/yr used in the Lorax report. We believe that this suggestion warrants further discussion between disciplines working on the closure plan, and may have implications for cover design and performance. In general, increasing cover depths over the range of depths discussed in this report will increase evapotranspiration and decrease generation of excess water that would be expressed as runoff, interflow (over a heap-leach liner), and/or infiltration into mine waste materials underlying cover layers.

Suggested next steps

Our current work is meant as an initial exploration of conditions on the Coffee Gold project area, and has associated limitations. In order to address these limitations and make this work stronger, we suggest the following:

1. The analysis of pre-development ecosystem occurrence should be based on ecological mapping clipped to the current projected mine footprint, rather than on a buffered local study area. This analysis is straightforward and not time consuming, but would require provision of shapefiles for the current mine plan.

2. In this work we applied an aspatial analysis of cover-system requirements for ecosystem replacement. The next iteration should employ a spatial analysis complete with delineation of reclamation polygons based on a full-build-out mine footprint and associated digital elevation model for mine facilities.
3. Our work is based on limited information on cover-material characteristics and very little information on waste-material characteristics. More in-depth work should be supported with increased information for these materials. Data gaps are discussed further below.
4. Our ecohydrological work on surface water balances could be augmented to include analysis of climate-change projections.

Data gaps

Key data gaps that affect our initial work include the following:

1. We require additional information on cover-material properties and volumes – ideally we would have information from more samples across areas that will potentially be stripped for mine development. As part of this, we need better information on the ratio of organics to silt in the upper layers of potentially salvaged material, and on the characteristics of those organic materials.
2. We need to try to generate additional information on the probable post-placement characteristics of waste rock generated by the Coffee project. Current information indicates a material with very low ability to store water over a range of plant-available tensions, and we are likely currently underestimating waste-rock contributions to soil moisture regime. It is possible that this underestimation is not substantial, but it would be good to confirm or reject this possibility.
3. Current ecological classification for the Coffee project is not consistent with more recent development of the Yukon Ecological Landscape Classification system – ideally we would have an analysis of plot data conducted to update the classification scheme.

Closure

We thank Goldcorp for the opportunity to be involved in reclamation and closure planning for the Coffee Gold project. Please feel free to be in touch any time via jstraker@iegconsulting.com, or at 250 701 0600, to discuss any aspect of this work.

References

EDI Environmental Dynamics Inc. 2017. Coffee Gold Mine: Vegetation Baseline Report. Prepared for Kaminak Gold Corporation.

Environment Yukon. 2016. Flynn, N. and Francis. S., editors. Yukon Ecological and Landscape Classification and Mapping Guidelines. Version 1.0. Whitehorse (YT): Department of Environment, Government of Yukon.

Lorax Environmental. 2017. Appendix 12-C, Coffee Gold Project, Water balance and water quality model report.

Tetra Tech Canada Inc. 2017. Fall 2017 testpitting program, Coffee Mine Site. Prepared for JDS Energy & Mining Inc.

APPENDIX 2-K
Closure Alternatives Assessment Report

REPORT

Coffee Alternatives Assessment Report

Coffee Gold Mine

Submitted By:

Goldcorp Kaminak Ltd.
3260-666 Burrard Street
Vancouver, BC V6C 2X8

November 23, 2023

REVISION TRACKING LOG

Revision Tracking Log			
Version	**Date**	**Section Updated**	**Description of Update**
0	November 2023	-	First submission of the Coffee Alternatives Assessment Report
1			
2			

TABLE OF CONTENTS

1.0 ALTERNATIVES ASSESSMENT OVERVIEW 5

2.0 STEP 1: IDENTIFY FEASIBLE ALTERNATIVE MEANS 7

2.1 Technical Feasibility Criteria 7
2.2 Economic Feasibility Criteria 8
2.3 Feasibility Screening 8
2.3.1 Backfill Alternatives for Open Pits 12
2.3.2 Waste Rock Storage Facilities Location Alternatives 16
2.3.3 Waste Rock Storage Facilities Cover Alternatives 20
2.3.4 Heap Leach Facility Location Alternatives 22
2.3.5 Heap Leach Facility Cover Alternatives 25
2.3.6 Water Management Infrastructure Decommissioning Alternatives 27
2.3.7 Northern Access Route Decommissioning Alternatives 28

3.0 STEP 2: IDENTIFY POTENTIAL EFFECTS OF ALTERNATIVE MEANS ON COFFEE GOLD MINE CLOSURE VALUES 29

3.1 Relative Effects Evaluation of Alternatives 34

4.0 STEP 3: EVALUATION AND IDENTIFICATION OF BASE CASE DESIGN 49

4.1 Open Pit Backfilling 52
4.1.1 Latte Pit 52
4.1.2 Double Double 52
4.1.3 Kona 52
4.1.4 Supremo 53
4.2 Waste Rock Storage Location 53
4.3 Waste Rock Cover 53
4.4 HLF Location 53
4.5 HLF Cover 54
4.6 Water Management Infrastructure Decommissioning 54
4.7 NAR Decommissioning 55

5.0 STEP 4: FAILURE MODES AND EFFECTS ANALYSIS OF BASE CASE ALTERNATIVE MEANS 55

6.0 REFERENCES 56

LIST OF TABLES

Table 2-1 Feasibility Screening of Alternative Means Relevant to Project Closure 10
Table 2-2 Open Pit Backfilling Alternatives - Technical and Economic Feasibility Evaluation 13
Table 2-3 Waste Rock Storage Facility Location Alternatives – Technical and Economic Feasibility Evaluation 18
Table 2-4 Waste Rock Storage Facility Cover Alternatives – Technical and Economic Feasibility Evaluation 21
Table 2-5 Heap Leach Facility Location Alternatives – Technical and Economic Feasibility Evaluation 24
Table 2-6 Heap Leach Facility Cover Alternatives - Technical and Economic Feasibility Evaluation 26
Table 2-7 Water Management Infrastructure Decommissioning Alternatives - Technical and Economic Feasibility Evaluation 27
Table 2-8 NAR Decommissioning Alternatives - Technical and Economic Feasibility Evaluation 28
Table 3-1 Coffee Mine Reclamation and Closure Values and Associated Project ICs and VCs 31
Table 3-2 Alternative Means and Project IC and VC Interaction Matrix 33
Table 3-3 Evaluation of Feasible Open Pit Backfilling Alternatives - Tro'ndëk Hwëch'in 35
Table 3-4 Evaluation of Feasible Open Pit Backfilling Alternatives - Selkirk First Nation 36
Table 3-5 Evaluation of Feasible WRSF Location Alternatives - Tro'ndëk Hwëch'in 37
Table 3-6 Evaluation of Feasible WRSF Location Alternatives - Selkirk First Nation 38
Table 3-7 Evaluation of Feasible WRSF Cover Alternatives- Tro'ndëk Hwëch'in 39
Table 3-8 Evaluation of Feasible WRSF Cover Alternatives - Selkirk First Nation 40
Table 3-9 Evaluation of Feasible HLF Location Alternatives - Tro'ndëk Hwëch'in 41
Table 3-10 Evaluation of Feasible HLF Location Alternatives - Selkirk First Nation 42
Table 3-11 Evaluation of Feasible HLF Cover Alternatives - Tro'ndëk Hwëch'in 43
Table 3-12 Evaluation of Feasible HLF Cover Alternatives - Selkirk First Nation 44
Table 3-13 Evaluation of Feasible Water Management Infrastructure Decommissioning Alternatives - Tro'ndëk Hwëch'in 45
Table 3-14 Evaluation of Feasible Water Management Infrastructure Decommissioning Alternatives - Selkirk First Nation 46
Table 3-15 Evaluation of Feasible NAR Decommissioning Alternatives - Tro'ndëk Hwëch'in 47
Table 3-16 Evaluation of Feasible NAR Decommissioning Alternatives - Selkirk First Nation 48
Table 4-1 Step 3 Evaluations 50
Table 4-2 Preferred Means for Project Closure 51

LIST OF FIGURES

Figure 2-1 Evaluated WRSF General Locations - West (Alpha), South, and North 16
Figure 2-2 Heap Leach Facility Location Alternatives 23

ACRONYMNS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
EMR	Yukon Government Department of Energy, Mines and Resources
FMEA	Failure Modes and Effects Analysis
GCL	Geosynthetic clay liner
HHRA	Human health risk assessment
HLF	Heap Leach Facility
H:V	Horizontal to vertical
IC	Intermediate components
MAA	Multiple Accounts Analysis
MRMF	Mine Rock Management Facility
Mt	Million tonnes
NAR	Northern Access Route
OPS	Operational Policy Statement
RCP	Reclamation and Closure Plan
SCP	Stakeholder consultation and permitting
VC	Valued components
WRSF	Waste Rock Storage Facility
YESAA	*Yukon Environmental and Socioeconomic Act*
YESAB	Yukon Environmental and Socioeconomic Board
YG	Yukon Government
YWB	Yukon Water Board

1.0 ALTERNATIVES ASSESSMENT OVERVIEW

The proposed Coffee Gold Mine (the Project) is an open-pit gold mine owned by Goldcorp Kaminak Ltd, a subsidiary of Newmont, located in the White Gold District of west-central Yukon, approximately 130 km south of the City of Dawson, 140 km west of Pelly Crossing, 95 km south-west of Beaver Creek, and 330 km northwest of Whitehorse. Throughout the closure planning process, Newmont has identified alternative options for closing and reclaiming the major mine components to achieve the Project-specific closure objectives as well as the closure vision for the site. As the End Land Use Plan for the Project is advanced, the final closure measures may be re-evaluated to ultimately result in a final landform that reflects the interests of all stakeholders, First Nations, and the local community. As such, this alternatives assessment process may be advanced based on the End Land Use Plan that is developed for the site.

Alternative means are the various technically and economically feasible ways under consideration by Newmont that would allow the Project to be reclaimed and closed. This report presents the assessment process that was carried out to evaluate the alternative means for closing the major mine components, and to identify the options that meet expectations for consideration as the 'base case' for the Project. The Project mine plan is designed to integrate closure considerations into the planning and operational processes; therefore, this assessment includes both the location of facilities and infrastructure as well as the measures to close them. Specifically, the following aspects have been assessed, as relevant to the major mine components:

- Component location for supporting mine development and Coffee Gold Mine closure objectives.
- Means of reclaiming and closing or decommissioning components to meet Coffee Gold Mine closure objectives.
- Timing of closure, involving the reclaiming and closing components either progressively or post-mining.

In the absence of specific Yukon guidance on the assessment of alternatives, this alternatives assessment has been conducted based on the guidance provided in the *Canadian Environmental Assessment Act, 2012* (*CEAA;* Government of Canada 2012) and the Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under CEAA 2012 (OPS; Government of Canada 2015). The four steps outlined in OPS to determine the preferred means are as follows:

- Step 1: Identify technically and economically feasible alternative means
- Step 2: List their potential effects on valued component
- Step 3: Select the approach for the analysis of alternative means
- Step 4: Assess the environmental effects of alternative means.

These steps were modified in this assessment to evaluate relevant aspects of each component (i.e., both component location and closure measures), optimize and integrate workshop discussions, and to identify base case closure options. Step 2 of this assessment was carried out through a collaborative discussion to identify the potential effects of the alterative means on the Project-specific closure values. Step 3 of the assessment advanced various evaluations to identify the preferred alternative means. The options were then advanced for further evaluation in a workshop through the failure modes and effects analysis (FMEA) process under Step 4 of the assessment.

The following alternatives were considered in this assessment:

- Backfilling of open pits
- Location of waste rock storage facilities
- Cover for water rock storage facilities
- Location of heap leach facility
- Cover for heap leach facility
- Decommissioning of water management infrastructure including the Alpha dam/pond and west diversion
- Decommissioning of the Northern Access Route (NAR).

Alternatives to the location and/or closure of other Project components such as mine site roads, haul roads, and buildings have not been evaluated further than what was described in the Yukon Environmental and Socioeconomic Act (YESAA) Project Proposal, as this type of infrastructure is currently planned to be decommissioned and reclaimed as per Yukon Government requirements or guidelines (YG 2006, EMR and YWB 2013).

2.0 STEP 1: IDENTIFY FEASIBLE ALTERNATIVE MEANS

Technical feasibility relates to the appropriateness of an alternative from an engineering or operational perspective and incorporates aspects of known performance, reliability, and implementation for the Project. Economic feasibility of an alternative relates to the overall costs including capital, operating, and maintenance, as relevant to the closure aspect. The following steps were taken to identify and describe technically and economically feasible alternative means of closing the Project:

- Select potential alternative means
- Develop criteria to measure the technical and economic feasibility of the alternative mean
- Identify the alternative means that are technically and economically feasible based on qualitative evidence and professional judgment
- Document the rationale for the alternative means retained for further consideration in the assessment.

In general, alternatives were selected and assessed based on a review of available reports, consultation with qualified professionals, as well as input from various levels of government and First Nations in support of the Yukon Environmental and Socioeconomic Board (YESAB) Executive Committee Project Proposal. Through this process, Newmont has received comments and recommendations that relate to reclamation and closure alternatives. For example, First Nations have requested that Newmont develop a closure scenario that does not include long-term pit lakes. These comments and recommendations have been integrated into this assessment process, as well as feedback received from Newmont consultants and regulatory agencies during various assessments conducted for and during Project review under *YESAA*, including:

- The YESAB Project Proposal which included the alternative means of developing the Project.
- The Preliminary Project FMEA completed in March 2018 on a conceptual level of design for the Project for key site facilities (Appendix 2-K of the RCP). The objective of this analysis was to identify and prioritize key Project risks in order to incorporate risks and failure modes into detailed design and maximize risk control resources. The analysis focused on key site facilities and infrastructure, including open pits, waste storage facilities and material stockpiles, heap leach facility components, and water management facilities. All Project components were assessed as being low or moderate risk, except for a potential slope failure around the Alpha Pond, which was identified as a moderately high risk based on an almost certain likelihood of occurrence and a minor consequence.
- A heap leach facility (HLF) Alternatives Assessments was completed in August 2018, based on recommendations documented in the Preliminary Project FMEA and feedback during Project consultation, to refine and optimize the closure configuration with respect to maintaining long-term stability of the heap slopes and function of diversion ditches. The assessment included a Multiple Accounts Analysis (MAA) in accordance with Environment and Climate Change Canada guidance to determine the preferred closure alternative for the HLF; the report is provided in the RCP (Appendix 2-L).

2.1 Technical Feasibility Criteria

The evaluation that was carried out to determine the technical feasibility of the closure alternatives included comparison of the alternatives against a series of general technical criteria that are defined below. The evaluation also considered whether the potential alternatives (either individually or collectively) would be

able to meet the Coffee Gold Mine closure objectives outlined in Section 4.1.2 of the RCP. The following criteria were used where relevant to evaluate the technical feasibility of each alternative:

- Long-term chemical and/or geochemical stability
- Long-term physical stability of infrastructure or facilities
- Physical stability of cover material
- Quantity of natural cover material available
- Ability to meet technical design criteria
- Ability to be progressively reclaimed
- Supports the mine development plan with respect to mining stages
- Location or design provides required capacity/storage
- Does not impound water.

The technical feasibility assessment identified the relevant technical criteria for each evaluated component and determined the ability of each alternative to meet the criteria. If an alternative was considered to not meet one or more technical criteria, it was considered not technically feasible, did not proceed to the economic feasibility screening, and was eliminated from further consideration.

2.2 Economic Feasibility Criteria

The economic feasibility assessment for closure alternatives qualitatively considered the acceptability of conceptual-level costs. Alternatives were considered unfeasible if the cost was unreasonably excessive when evaluated within the context of the following economic criteria:

- Cost to implement is acceptable
- Will not result in resource sterilization
- Maintenance liability is finite.

Where technical and economic feasibility screening identified only one feasible closure option, this option was advanced as the base case, and no further evaluation was conducted. Where more than one feasible closure option was identified, the options were advanced to Step 2 for further evaluation. If an alternative did not meet the economic criteria listed above, it was no longer considered a viable option and was not advanced to Step 2.

2.3 Feasibility Screening

A summary of the feasibility screening results is provided in

Table 2-1, and the rationale for the feasibility determinations is described in detail in the following sections.

Table 2-1 Feasibility Screening of Alternative Means Relevant to Project Closure

Alternative Means Considered			Feasibility Screening
Open Pit Backfilling	Latte Pit	No backfill	Not technically feasible
		Partial backfill- backfill used as haul roads	Feasible
		Partial backfill- backfill for other purpose	Feasible
		Complete backfill – progressively	Feasible
		Complete backfill – end of mine life	Feasible
	Double Double	No backfill	Feasible
		Partial backfill	Feasible
		Complete backfill	Feasible
	Kona	No backfill	Feasible
		Partial backfill	Feasible
		Complete backfill	Feasible
	Supremo	No backfill	Not technically feasible
		Partial backfill- backfill used to optimize mine development	Feasible
		Partial backfill- backfill for other purpose	Not economically feasible
		Complete backfill	Not economically feasible
Waste Rock Storage Location(s)	Location(s) for non-Kona waste	3 WRSFs – West, South & North (as per FS)	Not technically feasible
		2 WRSFs - West & South	Feasible
		2 WRSFs – North & South	Not technically feasible
		2 WRSFs - West & North	Not technically feasible
		1 WRSF - Alpha	Feasible
		1 WRSF - North	Not technically feasible
		1 WRSF - South	Not technically feasible
		1 WRSF – West & maximized in-pit backfill	Not economically feasible
		1 WRSF – North & maximized in-pit backfill	Not technically feasible
		1 WRSF – South & maximized in-pit backfill	Not economically feasible
		No WRSF (no permanent ex-pit storage)	Not economically feasible
	Waste storage duration for Kona waste	Temporary Beta WRSF Location	Feasible – linked to Kona pit backfilling alternatives assessment
		Permanent Beta WRSF Location	Feasible – linked to Kona pit backfilling alternatives assessment
		All Kona waste rock to primary WRSF	Feasible

Alternative Means Considered			Feasibility Screening
Waste Rock Cover	Overall slope steeper than 3:1 but flatter than angle of repose	No cover	Feasible
		Partial cover on flats	Feasible
		Complete cover	Not technically feasible
	Overall slope 3:1*	No cover	Feasible
		Partial cover on flats	Feasible
		Complete cover	Feasible
	Overall slope flatter than 3:1**	No cover	Feasible
		Complete cover	Feasible
HLF Location	Ridgetop A & B leach pads		Not technically feasible
	2016 Feasibility Study leach pad		Feasible, linked to HLF cover alternatives assessment
	Valley C leach pad		Feasible, linked to HLF cover alternatives assessment
	KP Valley leach pad		Not technically feasible
HLF Cover	No cover required as heap used to backfill open pits (temporary facility)		Not economically feasible
	2016 Feasibility Study leach pad	No cover	Not technically feasible
		Partial cover:	Feasible
		• (1) 2.5:1 construction and closure slopes; GCL installed on flat surfaces progressively	
		• (5b) 2.5:1 construction and 3:1 closure slopes by regrading during closure (wings); GCL installed on flat surfaces progressively and on wings at closure	
		• (8, 8a) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on flat surfaces progressively	
		Complete cover:	Feasible
		• (5a) 2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively	
		• (4) 3:1 construction and closure slopes; all surfaces covered with GCL progressively	
		• (7) 2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes	
		• (8b) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces	
	Valley C leach pad	No cover	Not technically feasible
		Partial cover	Feasible
		Complete cover	Feasible

Alternative Means Considered			Feasibility Screening
Decommissioning of Water Management Infrastructure	Alpha Dam/Pond	Remove dam completely	Feasible
		Create channel without completely removing dam materials	Feasible
		Do nothing, allow excess water to overflow via spillway designed and installed for closure	Not technically feasible
	West Diversion	Leave in place	Not technically feasible
		Partial decommissioning at natural depression drainages	Feasible
		Complete decommissioning (re-grade to slope)	Feasible
Decommissioning of NAR	Decommission Project-associated NAR sections (37 km)		Feasible
	Leave Project-associated NAR sections (37 km) in place		Feasible
	Close additional road sections beyond those that are Project-specific		Feasible

Notes: * Internal slopes are <3:1, but overall slope is 3:1; ** Assumes re-grading of slopes and no benches

2.3.1 Backfill Alternatives for Open Pits

The alternatives considered for backfilling of each pit were chosen to evaluate the potential to achieve the post-mine vision for the Project, including returning the site to conditions as close as possible to pre-mining (i.e., no pit lakes). The Project includes four open pits: Latte, Double Double, Supremo, and Kona (RCP; Figure 1-2). To maximize economic returns and achieve the target throughput of approximately 9.0 Mt per year during the 10-year Operation Phase, the open pit mining sequence is planned to begin with the Latte pit, Double Double pit, and Supremo pit. Smaller Supremo pit sections, Kona, and Latte Phase 2 and 3 will be mined toward the end of mine life. Although Latte and Supremo have multiple phases and pushbacks due to their size, Double Double and Kona are both planned to be mined in a single phase. Additional information on pit sizes and waste material volumes is provided in Section 5 of the RCP.

A portion of the waste rock is planned to be backfilled into mined out pits at Latte, Supremo and Double Double in order to create causeways and facilitate shorter ore haulage routes to the crusher. Table 2-2 summarizes the feasibility screening for backfilling options based on technical and economic criteria, which were selected to allow for a comparative analysis, as well as the rationale.

Table 2-2 Open Pit Backfilling Alternatives - Technical and Economic Feasibility Evaluation

Open Pit	Alternatives	Feasibility Evaluation						Alternative feasible?
		Technical Criteria				Economic Criteria		
		Long-term chemical stability	Long-term physical stability	Progressively reclaimed	Supports mine development plan	Implementation costs	Resource sterilization	
Latte	No Backfill	Yes	Yes	N/A	No - waste rock/ backfill required to build haul roads to connect Supremo to the plant site	N/A, not technically feasible		No, based on technical criteria
	Partial Backfill - backfill used as haul roads	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Partial backfill - backfill for haul roads and other purpose (based on closure objectives)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Complete Backfill - progressive reclamation	Yes	Yes	Yes	Maybe - May need water storage in Latte for HLF rinse water	Yes	Maybe	Yes
	Complete Backfill - end of mine life	Yes	Yes	N/A	N/A	Yes	N/A - Mining complete	Yes
Double Double	No Backfill	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Partial Backfill	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Complete Backfill	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Open Pit	Alternatives	Feasibility Evaluation						Alternative feasible?
		Technical Criteria				Economic Criteria		
		Long-term chemical stability	Long-term physical stability	Progressively reclaimed	Supports mine development plan	Implementation costs	Resource sterilization	
Kona	No Backfill	Maybe - 20% of pit wall is PAG.	Yes	Yes - would be flooded with water to prevent ARD.	Yes	Yes	Yes	Yes
	Partial Backfill	Maybe - 20% of pit wall is PAG. Partial backfill would cover the PAG portion. Backfill would be non-ML/ARD leaching in sub-aqueous conditions.	Yes	Yes	Maybe	Maybe - cost to transport gneiss waste rock may be cost prohibitive	Yes	Yes
	Complete Backfill	Maybe - Backfill cannot be granite waste rock	Yes	Yes	Yes	Maybe - cost to transport gneiss waste rock may be cost prohibitive	Yes	Yes
Supremo	No Backfill	Yes	Yes	N/A	No, need backfill for haul routes.	N/A, not technically feasible		No, based on technical criteria
	Partial Backfill - backfill used to optimize mine development	Yes	Yes	Yes	Yes	Yes	Maybe - but could be economically acceptable	Yes
	Partial backfill - backfill for other purpose (based on closure objectives)	Yes	Yes	Yes	Yes	Yes	No - resource is open at depth (not feasible based on current understanding of the resource).	No, based on economic criteria

Open Pit	Alternatives	Feasibility Evaluation						Alternative feasible?
		Technical Criteria				Economic Criteria		
		Long-term chemical stability	Long-term physical stability	Progressively reclaimed	Supports mine development plan	Implementation costs	Resource sterilization	
	Complete Backfill	Yes	Yes	Yes - partially, through to Stage 5. Filling of Stage 5 would require re-handling waste	Yes	No - Stage 5 filling re-handle would be cost prohibitive	No	No, based on economic criteria

2.3.2 Waste Rock Storage Facilities Location Alternatives

Over the life of mine, a total of approximately 300 – 330 Mt of waste rock will be excavated from the open pits. An evaluation of Waste Rock Storage Facility (WRSF) location alternatives for waste from Latte, Double Double, and Supremo was conducted as part of the YESAB Project Proposal and included three sites: Alpha (referred to as West), South, and North. One large and multiple smaller facilities were evaluated. Figure 2-1 illustrates the general location of the WRSF locations that were evaluated, noting that the size of the facilities would change depending on the number of storage sites ultimately used and the volume of rock backfilled into pits. Figure 2-1 displays the proposed mine layout at the time of the feasibility assessment; the layout has since been updated and is presented in Figure 1-2 of the RCP.

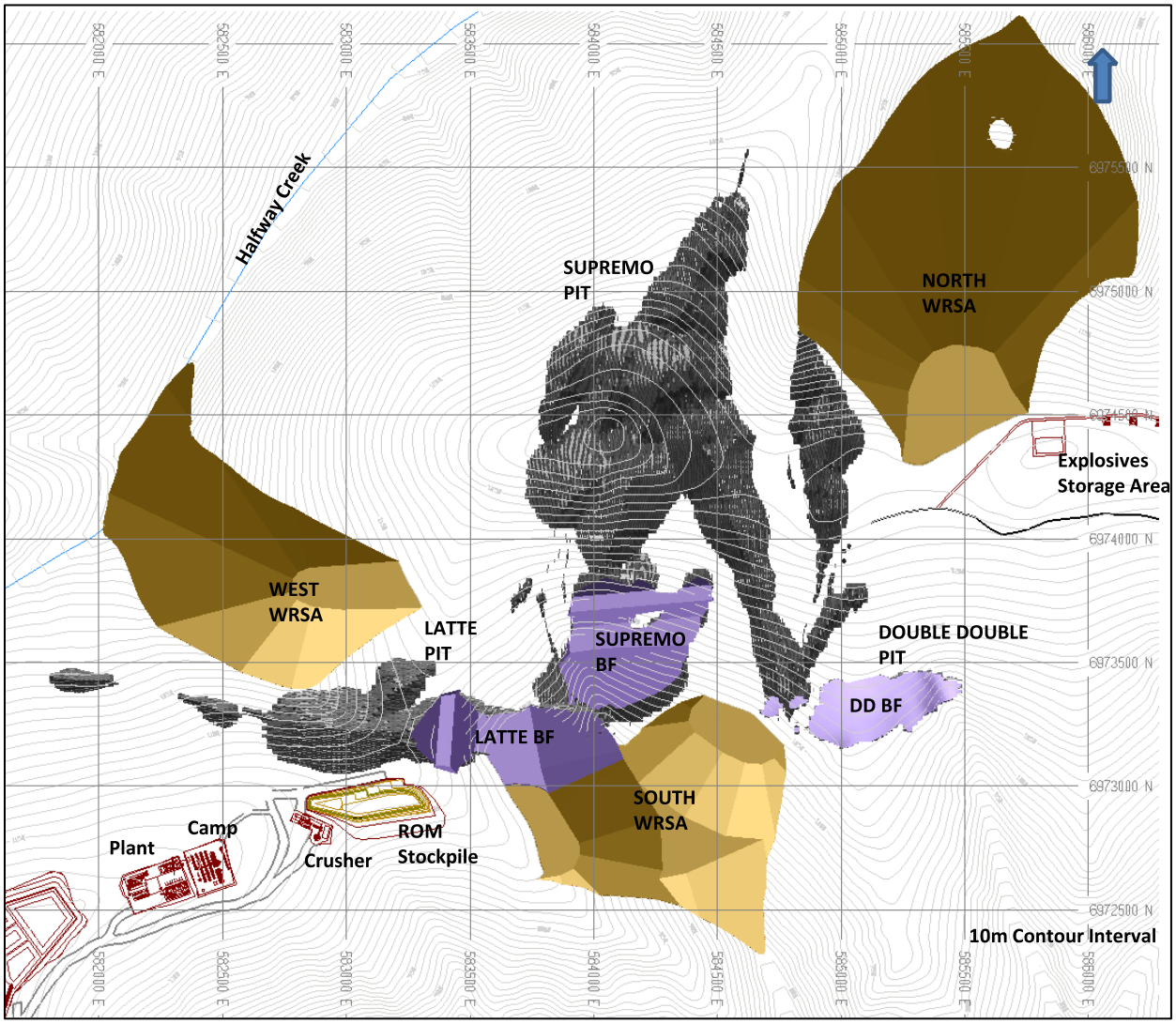


Figure 2-1 Evaluated WRSF General Locations - West (Alpha), South, and North

Geotechnical investigations and subsequent analyses indicate that the foundation conditions are considered conducive to construction of the Alpha (labeled as West in Figure 2-1), South, and North WRSFs. Permafrost is deep beneath the Alpha and North WRSFs and non-existent to shallow beneath the South WRSF. Depending on the configuration, the WRSFs may be constructed on permafrost soils, which are expected to provide suitable foundation conditions for WRSFs, provided the foundation soils remain frozen.

The Alpha WRSF would be built from the bottom up (i.e., hauling to the base of the dump and constructing the dump upwards in lifts) by placing material at its natural angle of repose in 40-m lifts. The toe of each subsequent lift would be set back 60 m from the crest of the previous lift, resulting in an overall angle of 3.0:1 (H:V). Flow-through rock drains would be required beneath the WRSF.

The South WRSF would be constructed from the top (ultimate crest) downward as bottom-up construction is not considered practical due to the large elevation difference and steep terrain between the pits and the ultimate toe of the WRSFs. Individual lifts of waste rock should not exceed 50 m in height except for the first lifts of the South WRSF where thicker bottom lifts will be required due to the steep terrain and valley inverts. Approximately 56-m-wide berms would be left between each lift resulting in an overall slope angle of 2.5:1 (H:V). Flow-through rock drains would be required beneath the WRSF.

The North WRSF would be constructed from the bottom up and may pose technically challenging conditions. It would be necessary to ensure the foundation remains frozen by placing the first lift (approximately 5 m) during the winter season. Access would be required to the toe of the facility and long-term facility stability may be difficult to achieve.

Table 2-3 summarizes the feasibility evaluation of WRSF location alternatives (both as individual sites and in combination to achieve the required storage volume) based on differentiating technical and economic criteria.

Table 2-3 Waste Rock Storage Facility Location Alternatives – Technical and Economic Feasibility Evaluation

Alternatives		Feasibility Evaluation				Alternative feasible?
		Technical Criteria		Economic Criteria		
		Long-term physical stability	Sufficient Storage	Implementation costs	Resource sterilization	
Location(s) for non-Kona Pit waste	3 WRSFs - West, South & North (as per FS)	No - North WRSF not physically stable	Yes	N/A, not technically feasible		No, based on technical criteria
	2 WRSFs - West & South	Yes	Yes	Yes	Yes	Yes
	2 WRSFs - North & South	No - North WRSF not physically stable	Maybe	N/A, not technically feasible		No, based on technical criteria
	2 WRSFs - West & North	No - North WRSF not physically stable	Yes	N/A, not technically feasible		No, based on technical criteria
	1 WRSF - Alpha	Yes	Yes	Maybe - highest cost configuration based on preliminary assessment	Yes	Yes
	1 WRSF - North	No - North WRSF not physically stable	No	N/A, not technically feasible		No, based on technical criteria
	1 WRSF - South	Yes	No - insufficient storage with a single facility	N/A, not technically feasible		No, based on technical criteria
	1 WRSF: West & maximized in-pit backfill	Yes	Yes	Maybe	No - because backfill will sterilize resources	No, based on economic criteria
	1 WRSF: North & maximized in-pit backfill	No - North WRSF not physically stable	Yes	N/A, not technically feasible		No, based on technical criteria
	1 WRSF: South & maximized in-pit backfill	Yes	Yes	Maybe	No - because backfill will sterilize resources	No, based on economic criteria

Alternatives		Feasibility Evaluation				Alternative feasible?
		Technical Criteria		Economic Criteria		
		Long-term physical stability	Sufficient Storage	Implementation costs	Resource sterilization	
	No WRSF - no permanent ex-pit storage	Yes	Yes - if stored above grade	Maybe - might have unacceptable re-handling costs	No	No, based on economic criteria
	Double Double Waste Rock Storage	Yes	Yes, but not for all waste generated	Yes	Yes, backfilling would be done post mining	Yes, linked to Double Double pit backfilling alternatives assessment
Waste storage duration for Kona Pit waste	Temporary Beta WRSF	Yes	Yes	Yes	Yes	Yes, linked to Kona pit backfilling alternatives assessment
	Permanent Beta WRSF	Yes	Yes	Yes	Yes	Yes, linked to Kona pit backfilling alternatives assessment
	All Kona Pit waste rock to primary WRSF*	Yes	Yes	Yes	Yes	Yes, further evaluation required.

***** Alternative was added during Step 2 of the assessment.

2.3.3 Waste Rock Storage Facilities Cover Alternatives

The cover system for the WRSF will ultimately depend upon the WRSF location as well as component-specific closure objectives. Cover system planning for the WRSF includes material balance evaluations that would inform the quantity of material that is available, as well as the suitability of material, to cover the WRSF. Current material balance estimates indicate sufficient quantity of reclamation material for a WRSF cover; however, these estimates will require field confirmation during mining operations and the WRSF cover options will be re-evaluated at that time.

Three alternatives were selected for WRSF configuration, which would then inform an assessment of the WRSF cover design. The configurations include:

- Overall slope steeper than 3:1 but flatter than angle of repose
- Overall slope 3:1
- Overall slope flatter than 3:1.

Each configuration was then evaluated for the application of either no cover, partial cover on flats, or complete cover, with the exception of the overall slope flatter than 3:1, which was did not include an evaluation for partial cover on flats. Table 2-4 summarizes the feasibility evaluation of WRSF cover alternatives.

Table 2-4 Waste Rock Storage Facility Cover Alternatives – Technical and Economic Feasibility Evaluation

Alternatives		Feasibility Evaluation						Alternative feasible?
		Technical Criteria					Economic Criteria	
		Long-term physical stability	Long-term chemical stability	Physical stability/erosion potential of the cover	Sufficient cover material available	Progressively reclaimed	Implementation costs	
Overall slope steeper than 3:1 but flatter than angle of repose	No cover	Yes	Yes	N/A	N/A	Yes	Yes	Yes
	Partial cover on flats	Yes	Yes	Yes	Maybe	Yes	Maybe	Yes
	Complete cover	Yes	Yes	No	Maybe	Yes	N/A, not technically feasible	No, based on technical criteria
Overall slope 3:1	No cover	Yes	Yes	N/A	N/A	Yes	Yes	Yes
	Partial cover on flats	Yes	Yes	Yes	Maybe	Yes	Maybe	Yes
	Complete cover	Yes	Yes	Maybe	Maybe	Yes	Maybe	Yes
Overall slope flatter than 3:1	No cover	Yes	Yes	N/A	N/A	Yes	Yes	Yes
	Complete cover	Yes	Yes	Yes	Maybe	Yes	Maybe	Yes

2.3.4 Heap Leach Facility Location Alternatives

An assessment of alternative locations for the HLF was conducted as part of the YESAA Project Proposal. The location of the HLF is relevant to this closure alternatives assessment, as the HLF location is an important consideration for achieving the overall vision for the Project post-mining and site-specific closure objectives.

Two leach pad technologies were previously evaluated for the Project: including conventional free-draining pads and valley fills. Investigations of the two technologies led to four HLF location options, as shown in Figure 2-2, including:

- Ridgetop A and B Leach Pads (Option 1) – Two conventional, multi-lift (nominally 10 m), free-draining ridge-top leach pads, with the shortest haul distance from the crushing plant compared to other options. The combined capacity would be 60 Mt, with the Ridgetop A pad having a starter capacity of 5 Mt and a total capacity of 25 Mt. Construction would involve cut and fill and the maximum pad slope would be 5%. Ridgetop B would commence operations in about Year 5.
- 2016 FS Leach Pad (Option 2) - One ridgetop leach pad consisting of a conventional, multi-lift free-draining heap over a gently sloping heap leach pad, which would extend along the axis of the ridge to the west of the process plant. The leach pad would be constructed on a graded area in stages, with each stage providing capacity for 1.5 to 3 years of operation. The nominal capacity of the HLF is 61.4 Mt with capacity to expand to approximately 67 Mt.
- Valley C Leach Pad (Option 3) - A free draining configuration was selected at this location as there is room for conventional external ponds. This option would involve management of steep slopes primarily on the southern abutment side, as well as permafrost removal. The ultimate capacity would be 61 Mt.
- KP Valley Leach Pad (Option 4) - An impounding (in-heap pond) valley leach pad that would require at least two full summer seasons for starter pad construction, primarily due to site preparation activities on steep slopes. The starter capacity would be an estimated 12 Mt, with an ultimate capacity of 60 Mt. Approximately 3 Mt of pre-production waste would be used to construct the impoundment dam and platform, and permafrost removal would be required.

In the original evaluation, Options 3 and 4 were evaluated as being unfeasible as, among other reasons, the facilities were not amendable to progressive reclamation, which would increase the overall closure risk. Option 1 was also deemed unfeasible, as using two heap leach pads rather than one would increase the complexity of construction, operation, and reclamation and closure activities. Option 2 was subsequently incorporated into the mine design.

These location alternatives have been re-evaluated with respect to technical and economic feasibility, the results of which are provided in Table 2-5. The feasibility evaluation of HLF cover alternatives is provided in Table 2-6.

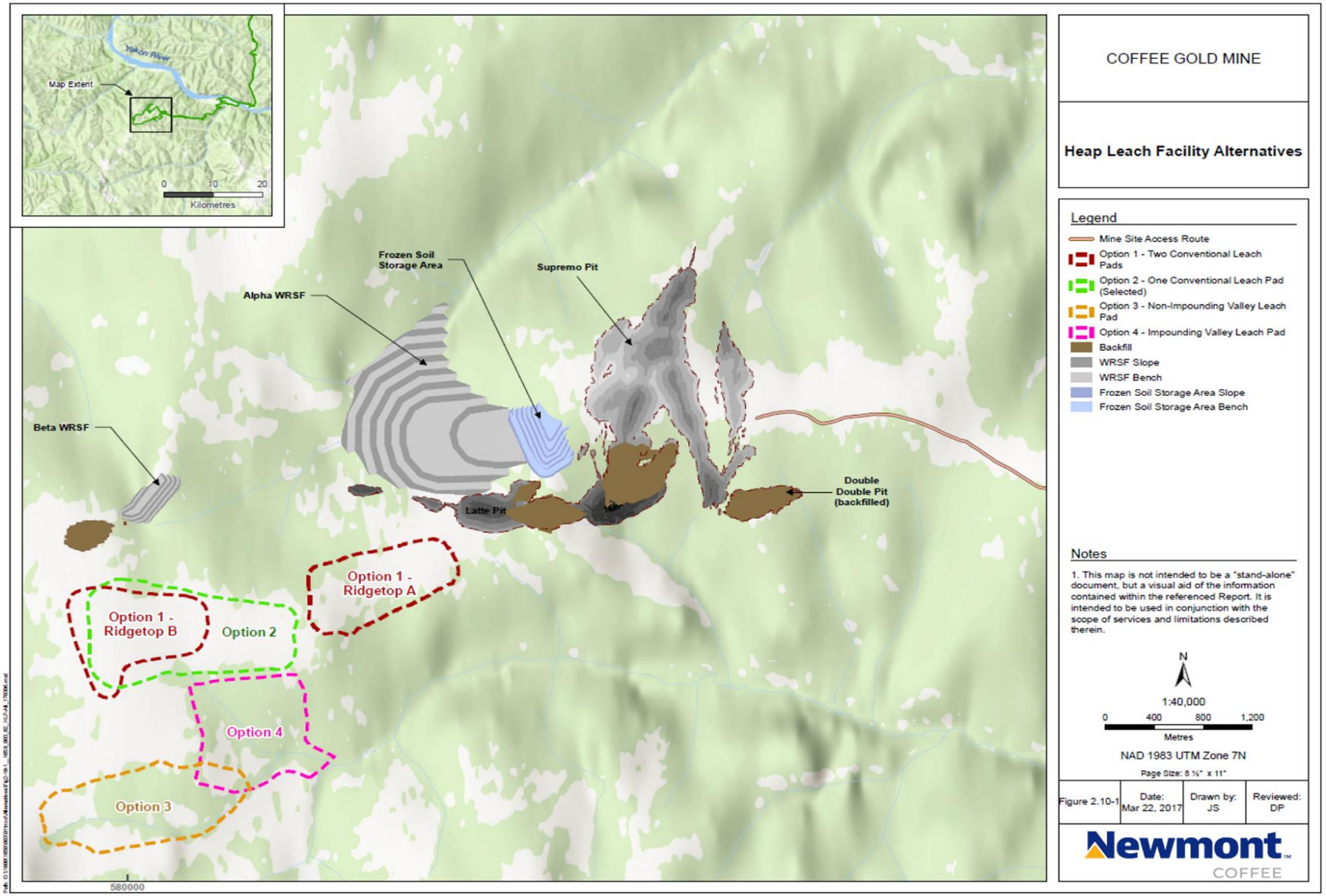


Figure 2-2 Heap Leach Facility Location Alternatives

Table 2-5 Heap Leach Facility Location Alternatives – Technical and Economic Feasibility Evaluation

Alternatives	Feasibility Evaluation					Alternative feasible?
	Technical Criteria			Economic Criteria		
	Long-term physical stability	Meets technical design criteria	Sufficient storage	Implementation costs	Resource sterilization	
Ridgetop A and B Leach Pads	Yes	No	Yes	N/A, not technically feasible		No, based on technical criteria
2016 FS Leach Pad	Yes	Yes	Yes	Yes	Maybe	Yes, linked to HLF cover alternatives assessment
Valley C Leach Pad	Yes	Yes	Yes	Yes	Yes	Yes, linked to HLF cover alternatives assessment
KP Valley Leach Pad	Maybe	No	Maybe	N/A, not technically feasible		No, based on technical criteria

2.3.5 Heap Leach Facility Cover Alternatives

An assessment of cover alternatives for the HLF was previously conducted through a 2018 HLF Alternatives Assessment and was advanced to determine the base case design that would best reflect the interests of stakeholders, Project partners, and First Nations. The cover system for the HLF was evaluated based on the base case HLF location that would ultimately be identified through the alternatives assessment process, and also included an evaluation of a temporary HLF facility (i.e., spent material would be moved to backfill the open pits) that would not require a cover.

The HLF cover alternatives assessment evaluated the options of no cover, partial cover, and complete cover at both the 2016 FS Leach Pad and the Valley C Leach Pad locations. The alternatives for partial cover and complete cover at the 2016 FS Leach Pad location were advanced further by identifying specific cover configurations for these scenarios at this location. The specific configurations for partial cover and complete cover at the 2016 FS Leach Pad location include:

- Partial cover:
  - (1) 2.5:1 construction and closure slopes; GCL installed on flat surfaces progressively.
  - (5b) 2.5:1 construction and 3:1 closure slopes by regrading during closure (wings); GCL installed on flat surfaces progressively and on wings at closure.
  - (8, 8a) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on flat surfaces progressively.
- Complete cover:
  - (5a) 2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively.
  - (4) 3:1 construction and closure slopes; all surfaces covered with GCL progressively.
  - (7) 2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes.
  - (8b) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces.

The feasibility screening for the HLF cover alternatives presented in Table 2-6 was carried out at the level of cover scenario (i.e., no cover, partial cover, complete cover), and was therefore not carried out on the specific cover configurations.

Table 2-6 Heap Leach Facility Cover Alternatives - Technical and Economic Feasibility Evaluation

Alternatives		Feasibility Evaluation			Alternative feasible?
		Technical Criteria		Economic Criteria	
		Long-term geochemical stability	Sufficient cover material available	Implementation costs	
No cover required as heap used to backfill open pits (temporary facility)		Maybe	N/A	No	No, based on economic criteria
2016 FS Leach Pad	No cover	No	N/A	N/A, not technically feasible	No, based on technical criteria
	Partial cover:	Yes	Yes	Yes	Yes
	• (1) 2.5:1 construction and closure slopes; GCL installed on flat surfaces progressively				
	• (5b) 2.5:1 construction and 3:1 closure slopes by regrading during closure (wings); GCL installed on flat surfaces progressively and on wings at closure				
	• (8, 8a) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on flat surfaces progressively				
	Complete cover:	Yes	Yes	Maybe	Yes
	• (5a) 2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively				
	• (4) 3:1 construction and closure slopes; all surfaces covered with GCL progressively				
	• (7) 2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes				
	• (8b) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces				
Valley C Leach Pad	No cover	No	N/A	N/A, not technically feasible	No, based on technical criteria
	Partial cover	Yes	Yes	Yes	Yes
	Complete cover	Yes	Yes	Maybe	Yes

Note: Feasibility evaluations were conducted at a high level for the partial/complete cover alternatives. The specific options were not individually assessed for feasibility.

2.3.6 Water Management Infrastructure Decommissioning Alternatives

Table 2-7 summarizes the feasibility evaluation of water management infrastructure decommissioning alternatives, including the Alpha dam/pond and the West Diversion, based on differentiating technical and economic criteria.

Table 2-7 Water Management Infrastructure Decommissioning Alternatives - Technical and Economic Feasibility Evaluation

Water Management Infrastructure	Alternatives	Feasibility Evaluation			Alternative feasible?
		Technical Criteria		Economic Criteria	
		Long-term physical stability	Does not impound water	Implementation costs	
Alpha Dam/Pond	Remove dam completely	Yes	Yes	Yes	Yes
	Create channel without completely removing dam materials	Yes	Yes	Yes	Yes
	Do nothing, allow excess water to overflow via spillway designed and installed for closure	Yes	No	N/A, not technically feasible	No, based on technical criteria
West Diversion	Leave in place	No	N/A	N/A, not technically feasible	No, based on technical criteria
	Partial decommissioning at natural depression drainages	Maybe	N/A	Yes	Yes
	Complete decommissioning (re-grade to slope)	Yes	N/A	Yes	Yes

2.3.7 Northern Access Route Decommissioning Alternatives

Table 2-8 summarizes the feasibility evaluation of NAR decommissioning alternatives, based solely on differentiating economic criteria (i.e., from a technical standpoint, criteria were not differentiating).

Table 2-8 NAR Decommissioning Alternatives - Technical and Economic Feasibility Evaluation

Alternatives	Feasibility Evaluation			Alternative Feasible
	Technical Criteria	Economic Criteria		
	N/A	Implementation costs	Finite liability	
Decommission the Project-associated NAR sections (37 km) and barge landings	Yes	Yes	Yes	Yes
Leave Project-associated NAR sections (37 km) and barge landings in place	Yes	Yes	Maybe	Yes
Close additional road sections beyond those that are Project-specific*	Yes	Yes	Yes	Yes, limited by regulatory regime

***** Alternative was added during Step 2 of the assessment.

3.0 STEP 2: IDENTIFY POTENTIAL EFFECTS OF ALTERNATIVE MEANS ON COFFEE GOLD MINE CLOSURE VALUES

Alternative closure measures that were identified as feasible during Step 1 were advanced for further consideration in Step 2 to compare the merits of each alternative in relation to valued components that may be adversely (or beneficially) affected by them, in accordance with the OPS (Government of Canada 2015). Rather than valued components, the Coffee Gold Mine closure values were applied for comparison in this step of the assessment based on input from TH as well as a close linkage of closure values to both intermediate components (ICs) and valued components (VCs), as described below. The assessment was carried out at a level sufficient to distinguish the relative merits of the different options based on the consideration of the advantages and disadvantages of each. The following steps were taken in Step 2 to advance the evaluation of feasible alternatives that were identified in Step 1.

- Identify the key closure values potentially affected by the alternative means; and
- Examine the relative potential effects each alternative may have on the closure values (with the intent of relating the potential effect of the alternative under consideration on ICs and VCs).

The following closure values were selected to represent Project ICs and VCs in the Step 2 analysis:

- Physical and chemical stability
- Health and safety
- Ecological processes and functions
- Land use
- Socio-economics
- Aesthetics.

It is important to recognize that Project alternatives are inter-connected, and that decisions with respect to component location or closure measure may be linked. There is also a decision-making chronology to Project development that influences the ultimate identification and selection of Project alternatives relevant to closure. This context was brought into the assessment where appropriate.

Table 3-1 summarizes the Project ICs and VCs that are assumed to be associated with each of the Coffee Gold Mine closure values. The green cells indicate the closure values selected for the Step 2 analysis. The rationale for omission of the other closure values from this evaluation process is also provided in Table 3-1. Notes: Green cells indicate the closure values that were selected for the potential effects evaluation (Step 2**)**

Table 3-2 provides the IC/VC and alternative matrix to illustrate how Project ICs and VCs are represented in the analyses that follows.

Table 3-1 Coffee Mine Reclamation and Closure Values and Associated Project ICs and VCs

Closure Value	Closure Objectives	Associated Project ICs and VCs	Rationale for Omission of Closure Value from Evaluation
Physical and Chemical Stability	All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events. Protect and maintain the land, air, and water in a condition that provides for sustainable use. Ensure water remains substantially unaltered from pre-mining conditions to the extent practicable with respect to quantity, quality, and rate of flow, including seasonal rate of flow.	Surficial Geology, Terrain and Soils Surface Water Quality Surface Hydrology Groundwater Quality Air Quality and Greenhouse Gases Vegetation Fish and Fish Habitat Aquatic Organisms Wildlife and Wildlife Habitat Birds and Bird Habitat	Not applicable as closure value considered
Health and Safety	Protect the health and safety of people and area wildlife using and accessing the site by emulating pre-mining conditions to the extent practicable.	Surface Water Quality Noise Fish and Fish Habitat Aquatic Organisms Wildlife and Wildlife Habitat Birds and Bird Habitat Land and Resource Use Social Economy Community Health and Well-being	Not applicable as closure value considered
Ecological Processes and Functions	Protect or enhance ecological processes and functions in order to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities, with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions.	Surficial Geology, Terrain and Soils Surface Water Quality Surface Hydrology Groundwater Quality Air Quality and Greenhouse Gases Vegetation Fish and Fish Habitat Aquatic Organisms Wildlife and Wildlife Habitat Birds and Bird Habitat	Not applicable as closure value considered
Land Use	Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development. Restore lands affected by mine-related activities to allow for future land use similar to surrounding areas to the extent practicable. Ensure the site and specific assets are available for use post-closure.	Land and Resource Use Social Economy Community Infrastructure and Services (NAR)	Not applicable as closure value considered
Economics	Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic sustainability during and beyond the life of mine.	Education Services Economic Conditions	Note: This value is included but may not be not differentiating enough for the alternatives. (number of jobs, supply and procurement benefits)
Aesthetics	Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land.	Land and Resource Use Social Economy (learning, teaching on the land; traditional economy)	Not applicable as value considered
Country Food and Traditional Economy	To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources.	Community Health and Well-being Land and Resource Use Social Economy	If the land is healthy and safe, the ecological processes and functions as well as aesthetics are maintained (both of these values are considered), this value will be achieved.
Participation and Positive Relationship	Maintain ongoing positive relationships or partnerships between Newmont and Yukon First Nations through closure and post-closure Ensure participation of Yukon First Nations in project planning and incorporate First Nations knowledge and experience in closure planning and implementation.	N/A	Not applicable as this value is not differentiating between the alternatives
Culture and Heritage	Recognize, protect and foster the culture and tangible and intangible heritage of Yukon First Nations for the benefit of future generations.	Heritage Resources (tangible only) Community Health and Well-being Education and Training Land and Resource Use Social Economy	This value will be achieved with respect to the site if land use, aesthetics, ecological processes and functions are maintained (these values are considered). Non-site based aspects of heritage are not differentiating for the alternatives.

Closure Value	Closure Objectives	Associated Project ICs and VCs	Rationale for Omission of Closure Value from Evaluation
Community Health and Well-Being	Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. Protect and promote the well-being of other Yukon residents and the interests of the public.	Demographics Community Health and Well-being Community Infrastructure and Services	This value is not site based and therefore is not differentiating for the alternatives.
Long-term Certainty	Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management). Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks.	N/A	N/A – all preferred means of closure will be economically feasible.

Notes: Green cells indicate the closure values that were selected for the potential effects evaluation (Step 2)

Table 3-2 Alternative Means and Project IC and VC Interaction Matrix

Project Intermediate and Valued Components	Alternative Means						
	Open Pit Backfilling	WRSF Location	WRSF Cover	HLF Location	HLF Cover	Water Management	NAR
Groundwater	□	□	□	□	□	□	□
Hydrology	□	□	□	□	□	□	□
Air Quality and Greenhouse Gas Emissions	x	x	x	x	x	x	□
Noise	x	x	x	x	x	x	□
Surficial Geology, Terrain and Soils	x	□	□	□	□	□	□
Surface Water Quality	□	□	□	□	□	□	□
Fish and Fish Habitat	□	□	x	□	x	□	□
Periphyton and Benthic Invertebrates	x	□	x	□	x	□	□
Vegetation	x	□	□	□	□	□	□
Wildlife and Wildlife Habitat	□	□	□	□	□	□	□
Birds	□	□	□	□	□	□	□
Demographics	x	x	x	x	x	x	x
Economic Conditions	□	x	□	x	□	x	
Social Economy	□	□	□	□	□	□	□
Community Infrastructure	x	x	x	x	x	x	□
Education Services	x	x	x	x	x	x	x
Land and Resource Use	□	□	□	□	□	□	□
Community Health and Well-being	x	x	x	x	x	x	□
Heritage	x	x	x	x	x	x	x

Note: □ = likely interaction with alternative means and IC/VC; x = no interaction with alternative means and IC/VC

3.1 Relative Effects Evaluation of Alternatives

The Step 2 evaluations were carried out through workshops held with Tro'ndëk Hwëch'in and Selkirk First Nation in August 2018. The evaluations used a six-point scale (with 1 being least preferred and 6 meaning closest to or achieving pre-mining conditions, or achievement towards highest economic/skills benefits) to indicate the relative effects on each closure value between alternatives (i.e., a comparative analysis of potential effects). A weight score on a scale of 0 to 2 was assigned to each closure objective during the Step 2 workshop with Tro'ndëk Hwëch'in, and 0 to 6 during the workshop with Selkirk First Nation to provide a relative scoring matrix for analysis of the feasible alternatives against potentially affected closure objectives. Closure objectives that represent significant perceived importance to the alternative being evaluated were be weighted higher (i.e., 2) than objectives that represent minimal perceived importance (i.e., 0).

Table 3-3 to Table 3-15 provide the results of the Step 2 potential effects evaluation, with separate tables for Tro'ndëk Hwëch'in and Selkirk First Nations for each component evaluated. The relative effects evaluation of feasible open pit backfilling alternatives is summarized in Table 3-3 and Table 3-4. The relative effects evaluations of WRSF location and cover alternatives are summarized in Table 3-5 to Table 3-8. The relative effects evaluations of HLF location and cover alternatives are summarized in Table 3-9 to Table 3-12. The relative effects evaluations of decommissioning of water management infrastructure including the Alpha dam/pond and west diversion are summarized in Table 3-13 and Table 3-14. The relative effects evaluation of decommissioning of the NAR is summarized in Table 3-15 and Table 3-16.

Based on the descriptors of the advantages and disadvantages of each alternative, the preferred alternative(s) was identified and further evaluated in Step 3 of the assessment.

Table 3-3 Evaluation of Feasible Open Pit Backfilling Alternatives - Tro'ndëk Hwëch'in

Alternatives		Relative Closure Values Evaluation - Tro'ndëk Hwëch'in											Relative Total Score
		Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
		Weight											
		2	2	1	2	0	1	0	0	0	1	1	
Latte	Partial Backfill - backfill used as haul roads	3	2	1	1	-	4	-	-	-	2	2	21
	Partial backfill - backfill with other purpose (based on end mine use objectives)	3	3	2	1	-	4	-	-	-	2	2	24
	Complete Backfill - progressive reclamation	5	6	5	5	-	6	-	-	-	4	3	50
	Complete Backfill - end of mine life	4	6	4	4	-	6	-	-	-	4	3	45
Double Double	No Backfill	3	1	1	1	-	4	-	-	-	2	2	19
	Partial Backfill	4	3	3	3	-	4	-	-	-	2	2	31
	Complete Backfill	5	6	5	5	-	6	-	-	-	4	3	50
Kona	No Backfill	1	1	1	1	-	4	-	-	-	2	6	19
	Partial Backfill	3	3	3	3	-	4	-	-	-	2	2	29
	Complete Backfill	5	6	5	5	-	6	-	-	-	4	4	51

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.
Notes: Physical and chemical stability both included as part of technical criteria in feasibility evaluation; also included in this evaluation due to importance.
For Latte pit backfill, Supremo material would be used; assume partial backfill does have a pit lake (elevation difference between spill point and pit elevation is ~100m).
Country food and traditional economy value not relevant for pit backfilling as pit areas are relatively small compared to area used and relative effects captured under land use.
Culture and heritage, community health and well-being, economic closure values considered to be non-differentiating at this scale (weighting set to zero).

Table 3-4 Evaluation of Feasible Open Pit Backfilling Alternatives - Selkirk First Nation

Alternatives		Relative Closure Values Evaluation - Selkirk First Nation												Relative Total Score
		Physical Stability	Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
		Weight												
		3	6	2	3	2	1	3	1	0	0	2	4	
Latte	Partial Backfill - backfill used as haul roads	4	6	4	3	4	4	5	4	-	-	4	5	124
	Partial backfill - backfill with other purpose (based on end mine use objectives)	5	5	4	3	4	4	5	4	-	-	4	5	121
	Complete Backfill - progressive reclamation	6	4	6	6	5	5	6	6	-	-	5	4	137
	Complete Backfill - end of mine life	6	4	6	6	5	5	6	6	-	-	5	4	137
	Weight	3	6	2	3	2	1	3	1	0	0	2	4	
Double Double	No Backfill	4	6	4	1	3	4	6	4	-	-	4	6	111
	Partial Backfill	5	4	4	3	3	4	4	4	-	-	4	5	95
	Complete Backfill	6	3	6	6	5	5	3	6	-	-	5	4	104
	Weight	2	3	2	2	2	1	3	1	0	0	2	5	
Kona	No Backfill	4	5	4	1	3	4	5	4	-	-	4	3	92
	Partial Backfill	5	2	4	3	3	4	4	4	-	-	4	3	75
	Complete Backfill – non granite	6	6	6	6	5	5	6	6	-	-	5	6	139
	Complete Backfill – granite	6	1	6	6	5	5	1	6	-	-	5	2	74

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 6 scale relative to other values based on perceived importance to evaluation.

Table 3-5 Evaluation of Feasible WRSF Location Alternatives - Tro'ndëk Hwëch'in

Alternatives	Relative Closure Values Evaluation - Tro'ndëk Hwëch'in											Relative Total Score
	Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
	Weight											
	2	1	1	1	0	0	0	0	0	2	1	
2 WRSFs - West & South	2	2	2	2	-	-	-	-	-	2	2	16
1 WRSF - Alpha	3	3	4	4	-	-	-	-	-	3	4	27
Temporary Beta WRSF (Kona waste only)	3	4	5	5	-	-	-	-	-	5	5	35
Permanent Beta WRSF (Kona waste only)	3	3	1	3	-	-	-	-	-	2	3	20
No Beta WRSF - Kona waste to primary facility	4	6	6	6	-	-	-	-	-	6	6	44
Double Double Waste Rock Storage (Portion of waste only)	See Pit Backfilling Alternative											

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).

Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.

Notes: For comparison of 2 WRSFs to 1 WRSF locations, protection of Latte and Coffee Creeks favored over protection of Halfway Creek in relative scoring.

Beta WRSF alternatives linked to Kona pit backfilling alternatives assessment.

Double Double Waste Rock Storage linked to Double Double pit backfilling alternatives assessment.

Country food and traditional economy, Participation and positive relationships, Culture and heritage, Community health and well-being, and Economic closure values considered to be non-differentiating amongst alternatives (weighting set to zero).

For Community health and well-being, arsenic not above threshold level based on human health risk assessment (HHRA), and community access to facilities will be deterred/restricted

Table 3-6 Evaluation of Feasible WRSF Location Alternatives - Selkirk First Nation

Alternatives	Relative Closure Values Evaluation - Selkirk First Nation												Relative Total Score
	Physical Stability	Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
	Weight												
	6	6	3	3	3	3	6	3	3	0	4	6	
2 WRSFs - West & South	3	2	3	2	3	3	2	3	3	-	3	3	123
1 WRSF - Alpha	5	5	4	4	4	5	5	5	5	-	5	4	215
Weight	4	6	2	2	1	1	3	0	0	0	2	4	
Temporary Beta WRSF (Kona waste only)	6	3	5	4	4	5	3	-	-	-	5	3	100
Permanent Beta WRSF (Kona waste only)	5	4	4	3	3	4	3	-	-	-	2	5	98
No Beta WRSF - Kona waste to primary facility	5	5	4	4	4	4	5	-	-	-	4	5	117
Double Double Waste Rock Storage (Portion of waste only)	See Pit Backfilling Alternative												

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 6 scale relative to other values based on perceived importance to evaluation.

Table 3-7 Evaluation of Feasible WRSF Cover Alternatives- Tro'ndëk Hwëch'in

Alternatives[a]		Relative Closure Values Evaluation[f] - Tro'ndëk Hwëch'in											Relative Total Score
		Physical and Chemical Stability[d,e]	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
		Weight											
		1	1	1	1	0	0	0	0	0	2	1	
Overall slope steeper than 3:1 but flatter than angle of repose	No cover	3	2	2	2	1	-	-	-	-	1	1	12
	Partial cover on flats	4	2	3	3	2	-	-	-	-	2	1	17
Overall slope 3:1[b]	No cover	2	3	2	2	1	-	-	-	-	1	2	13
	Partial cover on flats	3	3	3	3	2	-	-	-	-	2	1	17
	Complete cover	4	3	4	4	3	-	-	-	-	3	1	22
Overall slope flatter than 3:1[c]	No cover	1	4	3	3	2	-	-	-	-	4	3	22
	Complete cover	3	4	5	5	4	-	-	-	-	5	2	29

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.
Notes: a. For partial or complete cover alternatives, assume 30 cm cover for purposes of revegetation and minor reduction in infiltration until further investigations are complete.
b. Internal slopes <3:1, but overall slope 3:1.
c. Assumes re-grading and no benches
d. Physical and chemical stability both included as part of technical criteria in feasibility evaluation; also included in this evaluation due to importance.
e. For Physical and chemical stability closure value, assume chemical stability more important than physical stability; longer slope means greater area and more contact water therefore lower relative score; long-term physical stability concerns (e.g., erosion) captured under Long-term Certainty closure value.
f. Participation and positive relationship, Culture and heritage, Community health and well-being, and Economic closure values considered to be non-differentiating for these alternatives (weighting set to zero)

Table 3-8 Evaluation of Feasible WRSF Cover Alternatives - Selkirk First Nation

Alternatives		Relative Closure Values Evaluation - Selkirk First Nation												Relative Total Score
		Physical Stability	Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
		Weight												
		6	6	2	4	3	3	4	0	0	0	3	4	
Overall slope steeper than 3:1 but shallower/flatter than angle of repose	No cover	4	3	2	2	2	3	3	-	-	-	3	4	106
	Partial cover on flats	4	4	4	3	3	4	4	-	-	-	4	3	129
Overall slope 3:1	No cover	5	3	3	3	3	3	3	-	-	-	3	5	125
	Partial cover on flats	5	4	5	4	4	4	4	-	-	-	4	3	144
	Complete cover	4	6	5	6	6	5	5	-	-	-	5	4	178
Overall slope flatter than 3:1	No cover	6	2	4	3	3	3	3	-	-	-	3	5	127
	Complete cover	5	5	6	6	6	5	5	-	-	-	5	5	184

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 6 scale relative to other values based on perceived importance to evaluation.
Notes: assume vegetative cover that slightly reduces infiltration

Table 3-9 Evaluation of Feasible HLF Location Alternatives - Tro'ndëk Hwëch'in

Alternatives	Relative Closure Values Evaluation[a] - Tro'ndëk Hwëch'in											Relative Total Score
	Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
	Weight											
	2	1	1	1	1	0	0	0	0	2	2	
2016 FS Leach Pad	4	3	3	3	3	-	-	-	-	1	4	30
Valley C Leach Pad	3	3	1	1	2	-	-	-	-	4	2	25

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.
Notes: a. Participation and positive relationship, Culture and heritage, Community health and well-being, and Economic closure values considered to be non-differentiating for these alternatives (weighting set to zero)

Table 3-10 Evaluation of Feasible HLF Location Alternatives - Selkirk First Nation

Alternatives	Relative Closure Values Evaluation - Selkirk First Nation											Relative Total Score
	Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
	Weight											
	6	0	5	5	0	6	5	5	0	5	0	
2016 FS Leach Pad	5	-	5	4	-	5	5	5	-	3	-	170
Valley C Leach Pad	3	-	3	3	-	3	3	3	-	5	-	121

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 6 scale relative to other values based on perceived importance to evaluation.

Table 3-11 Evaluation of Feasible HLF Cover Alternatives - Tro'ndëk Hwëch'in

Alternatives			Relative Closure Values Evaluation[d] - Tro'ndëk Hwëch'in											Relative Total Score
			Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Land Use	Economics*	Aesthetics	Long-term Certainty	
			Weight											
			2	1	1	0	0	0	0	0	0	1	1	
	Partial cover													
2016 FS Leach Pad[a]	1	2.5:1 construction and closure slopes; GCL installed on flat surfaces progressively	2	3	3	-	-	-	-	-	-	3	2	15
	5b	2.5:1 construction and 3:1 closure slopes by regrading during closure (wings); GCL installed on flat surfaces progressively and on wings at closure	3	4	4	-	-	-	-	-	-	4	3	21
	8	2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on flat surfaces progressively[b]	2	4	5	-	-	-	-	-	-	5	4	22
	Complete cover													
	5a	2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively	5	4	2	-	-	-	-	-	-	3	3	22
	4	3:1 construction and closure slopes; all surfaces covered with GCL progressively	5	4	2	-	-	-	-	-	-	3	5	24
	7	2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes	4	3	2	-	-	-	-	-	-	2	1	16
Weight			2	1	1	0	1	0	0	1	0	1	1	
Valley C Leach Pad[c]	Partial cover (Flat surfaces only)		2	3	3	-	3	-	-	3	-	4	3	23
	Complete cover		4	3	2	-	4	-	-	4	-	3	4	28

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.

Notes: Alternative #4 included at TH request

a. For 2016 FS Leach Pad closure details, refer to JDS August 2018 HLF Alternatives Assessment Report
b. For Chemical and physical stability value, assume that additional buttress rock runoff draining towards Latte Creek meets use protection of Latte Creek and non-degradation of Coffee Creek
c. For Participation and positive relationship value, relative scoring based on perception of water quality
d. Closure values with weighting of 0 considered to be non-differentiating for these alternatives.

Table 3-12 Evaluation of Feasible HLF Cover Alternatives - Selkirk First Nation

Alternatives			Relative Closure Values Evaluation - Selkirk First Nation											Relative Total Score
			Physical Stability	Chemical Stability	Ecological Processes and Functions	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Land Use	Economics*	Aesthetics	Long-term Certainty	
			Weight											
			6	6	3	0	0	0	0	1	0	4	4	
	Partial cover													
2016 FS Leach Pad	1	2.5:1 construction and closure slopes; GCL installed on flat surfaces progressively	3	4	5	-	-	-	-	5	-	4	4	94
	5b	2.5:1 construction and 3:1 closure slopes by regrading during closure (wings); GCL installed on flat surfaces progressively and on wings at closure	5	3	5	-	-	-	-	5	-	5	4	104
	8a	2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on flat surfaces progressivelyb	6	3	3	-	-	-	-	4	-	3	5	99
	Complete cover													
	5a	2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively	4	6	4	-	-	-	-	5	-	5	4	113
	4	3:1 construction and closure slopes; all surfaces covered with GCL progressively	4	6	4	-	-	-	-	5	-	5	4	113
	7	2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes	2	6	2	-	-	-	-	5	-	4	3	87
	8b	2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces	6	5	3	-	-	-	-	4	-	3	5	111
		Weight	6	6	3	0	0	0	0	0	0	0	4	
Valley C Leach Pad	Partial cover		5	3	5	-	-	-	-	-	-	-	4	79
	Complete cover		4	5	4	-	-	-	-	-	-	-	5	86

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 6 scale relative to other values based on perceived importance to evaluation.

Notes: Alternative #4 included at TH request

Table 3-13 Evaluation of Feasible Water Management Infrastructure Decommissioning Alternatives - Tro'ndëk Hwëch'in

Alternatives		Relative Closure Values Evaluation[a,b] - Tro'ndëk Hwëch'in											Relative Total Score
		Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
		Weight											
		1	1	1	0	0	0	0	0	0	1	1	
Alpha Dam/Pond	Remove dam completely	5	6	6	-	-	-	-	-	-	5	4	26
	Create channel without completely removing dam materials	3	4	4	-	-	-	-	-	-	3	3	17
West Diversion	Partial decommissioning at natural depression drainages	4	2	2	-	-	-	-	-	-	2	3	13
	Complete decommissioning (re-grade to slope)	4	4	4	-	-	-	-	-	-	5	4	21

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).

Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.

Notes: a. Country food and traditional economy, Participation and positive relationship, Culture and heritage, and Community health and well-being closure values not included in evaluation due to small scope of decommissioning activity (i.e., no or negligible interaction).

b. Land use and Economics closure values applicable, but considered to be non-differentiating for these alternatives (weighting set to zero).

Table 3-14 Evaluation of Feasible Water Management Infrastructure Decommissioning Alternatives - Selkirk First Nation

Alternatives		Relative Closure Values Evaluation - Selkirk First Nation											Relative Total Score
		Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
		Weight											
		2	0	0	1	0	0	0	0	0	2	2	
Alpha Dam/Pond	Remove dam completely	6	-	-	5	-	-	-	-	-	5	5	37
	Create channel without completely removing dam materials	5	-	-	4	-	-	-	-	-	3	4	28
Weight		2	0	1	1	0	0	0	0	0	2	2	
West Diversion	Partial decommissioning at natural depression drainages	3	-	3	3	-	-	-	-	-	3	3	24
	Complete decommissioning (re-grade to slope)	5	-	5	5	-	-	-	-	-	4	5	38

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.
Notes: for Alpha Dam/Pond assume material is totally gone or channel is removed that everything flows through; for future - potentially evaluate very small dam to act as a sedimentation pond

Table 3-15 Evaluation of Feasible NAR Decommissioning Alternatives - Tro'ndëk Hwëch'in

Alternatives[a]	Relative Closure Values Evaluation[b,c,d] - Tro'ndëk Hwëch'in											Relative Total Score
	Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
	Weight											
	2	2	2	2	1	0	1	0	1	1	0	
Decommission the Project-associated NAR sections (37 km) and barge landings	5	5	5	4	5	-	4	-	2	4	-	53
Leave Project-associated NAR sections (37 km) and barge landings in place	2	2	1	3	1	-	3	-	1	3	-	24
Close additional road sections beyond those that are Project-specific	6	6	6	4	6	-	4	-	3	4	-	61

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).

Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.

Notes: a. Existing road sections will remain in place. Assume no maintenance requirements for sections not reclaimed.

b. Assume that ability to access is captured under Land Use value and quality of resources is captured under Country food and traditional economy values.

c. Community health and well-being value not included in evaluation as duplicative to Land use/Country foods and traditional economy values; Participation and positive relationship not included as not relevant for this evaluation.

d. Long-term certainty closure value considered to be non-differentiating for these alternatives (weighting set to zero).

Table 3-16 Evaluation of Feasible NAR Decommissioning Alternatives - Selkirk First Nation

Alternatives	Relative Closure Values Evaluation - Selkirk First Nation											Relative Total Score
	Physical and Chemical Stability	Health and Safety	Ecological Processes and Functions	Land Use	Country Food and Traditional Economy	Participation and Positive Relationship	Culture and Heritage	Community Health and Well-being	Economics*	Aesthetics	Long-term Certainty	
	Weight											
	0	1	2	1	2	1	1	0	0	0	0	
Decommission the Project-associated NAR sections (37 km) and barge landings	-	5	5	5	5	6	5	-	-	-	-	41
Leave Project-associated NAR sections (37 km) and barge landings in place	-	4	4	2	1	2	1	-	-	-	-	19
Close additional road sections beyond those that are Project-specific	-	6	6	6	6	6	6	-	-	-	-	48

Scoring: 1 = least preferred to 6 = closest to or achieves pre-mining conditions (or *achievement towards highest economic/skills benefits).
Weighting: Ranked on 0 to 2 scale relative to other values based on perceived importance to evaluation.

Notes: If don't decommission road - would likely revert to government agency control and maintenance; assumption that road will be decommissioned properly.

4.0 STEP 3: EVALUATION AND IDENTIFICATION OF BASE CASE DESIGN

Following the Step 1 feasibility screening and the Step 2 relative consideration of effects, technical and economic evaluations were advanced for select alternatives that were identified as requiring additional evaluation. The intent of Step 3 of the assessment was to inform the selection of alternatives that would be identified as the base case closure approach. A process to identify and conduct the evaluations for the alternative means was developed through consultation with qualified professionals and First Nations. These evaluations were carried out to advance the alternatives assessment process for the closure plan based on the current mine plan and Project-specific closure objectives. Advancement of the mine plan and/or development of the End Land Use Plan may require further evaluation and consideration of alternatives that were not identified as the base case for closure during this Step 3 evaluation.

The evaluations that were carried out under Step 3 of the assessment are described below along with the resulting preferred means of closure for each major mine component. The evaluations that were conducted for the assessment were carried out in a priority sequence to allow for the development of required model inputs. The technical evaluations focused on the development of a water quality/balance model, material balance assessment, cover material performance, and water management infrastructure evaluations. In addition, a ranking exercise of disturbed areas within the Mine Site footprint identified the priority areas for reclamation material, which is included in the Heap Leach Facility Cover Design Report (Appendix 7-A of the RCP). The material balance evaluations will be advanced throughout operations to confirm the outcomes of the current material balance projections. The alternatives identified as requiring further evaluation as well as the evaluations that were carried out are listed in Table 4-1. The resulting preferred closure means for major mine components are summarized in Table 4-2.

Additional assessments will be conducted as part of the reclamation research program throughout operations in existing site conditions to optimize the performance of reclamation material. The reclamation research program will include evaluations of cover thickness/type, as well as cover system revegetation capacity and infiltration. Results will be integrated into the closure plan to optimize site reclamation activities. Further details of the reclamation research program are provided in Section 2.3.1 of the RCP.

Table 4-1 Step 3 Evaluations

Alternative Identified as Requiring Further Evaluation			Evaluation
Open Pit Backfilling	Latte Pit	Complete backfill – progressively	• Economic evaluation • Water Management Evaluation
		Complete backfill – end of mine life	
	Double Double	No backfill	• Economic evaluation
	Kona	Complete backfill	• Water quality/geochemical evaluation
Waste Rock Cover	Overall slope 3:1	Partial cover on flats	• Material balance evaluation • Cover material performance • Cover material prioritization • Cover slope/sediment and erosion stability • Revegetation assessment (reclamation research program)
		Complete cover	
	Overall slope flatter than 3:1	Complete cover	
HLF Cover	2016 Feasibility Study Leach Pad	(8,8a) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on flat surfaces progressively	• Material balance evaluation • Water quality/balance model • Heap seepage rate • Infiltration/draindown model • Cover slope stability evaluation • Sediment and erosion stability • Trade-off Study
		(5a) 2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively	
		(4) 3:1 construction and closure slopes; all surfaces covered with GCL progressively	
		*(7) 2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes	
		(8b) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces	
Water Management Infrastructure Decommissioning	Alpha Dam/Pond	Remove dam completely	• Economic evaluation • Stability Analysis of Partial removal
	West Diversion	Partial decommissioning at natural depression drainages	• Long-term maintenance evaluation

*Option 7 for HLF Cover not flagged for evaluation; however, it was included with other alternatives being evaluated

Table 4-2 Preferred Means for Project Closure

Preferred Closure Means		
Open Pit Backfilling	Latte Pit	Partial backfill - backfill used as haul roads
	Double Double	Complete backfill
	Kona	Complete backfill
	Supremo	Partial backfill- backfill used to optimize mine development
Waste Rock Storage Location(s)	Location(s) for non-Kona waste	One WRSF - Alpha
	Waste storage duration for Kona waste	All Kona waste rock to primary WRSF
Waste Rock Cover	Overall slope 3:1[1]	No cover
HLF Location	2016 Feasibility Study leach pad	
HLF Cover	Partial Cover	2.5:1 construction and closure slopes; geosynthetic clay liner (GCL) installed on flat surfaces progressively
Decommissioning of Water Management Infrastructure	Alpha Dam/Pond	Create channel without completely removing dam materials
	West Diversion	Complete decommissioning (re-grade to slope)
Decommissioning of NAR	Decommission Project-associated NAR sections (37 km)	

[1] Internal slopes are <3:1, but overall slope is 3:1

4.1 Open Pit Backfilling

4.1.1 Latte Pit

The feasible alternatives for the Latte Pit backfill that were identified for additional evaluation include:

- Complete backfill – progressively
- Complete backfill – end of mine life.

An economic evaluation was carried out to assess the option of complete backfill at the end of mine life. The results of this evaluation determined that this alternative would be uneconomical based on the volume of material and rehandling costs that would be required to fill the pit at the end of mine life. A water management evaluation was also carried out through the advancement of the Water Management Plan which determined that the Latte pit will be required for contingency water storage during operations; therefore, progressive complete pit backfill for the Latte Pit is unlikely to be feasible. Additionally, the partially backfilled Latte pit will be utilized for road access to the Supremo pit via a waste rock bridge within the pit. Supremo material would be used for pit backfill, and it is assumed that the partially backfilled pit does have a pit lake (elevation difference between spill point and pit elevation is ~100m). The current preferred closure option for the Latte pit that was advanced as the base case is therefore partial backfill, with the backfill used as haul roads.

4.1.2 Double Double

The feasible alternatives for the Double Double Pit backfill that were identified for additional evaluation include:

- No backfill.

Evaluations carried out to assess closure options for the Double Double pit included the development of a water quality model to verify that acceptable impacts to water quality would occur from backfilled material. The evaluation determined that water quality would not be significantly impacted by complete backfill; therefore, this option was advanced as the base case for the Double Double pit.

4.1.3 Kona

The feasible alternatives for Kona Pit backfill that were identified for additional evaluation include:

- Complete backfill

Evaluations carried out to assess closure options for the Kona pit were identified during the Step 2 potential effects evaluation ranking exercise. The ranking for this alternative was dependent on a geochemical evaluation of the backfill material and development of a water quality model. Should the geochemical evaluation determine the backfill material to be granite, then complete backfill would receive the lowest ranking. If it was determined to be non-granite, this alternative would receive the highest ranking. The evaluation determined that the material that would be utilized for backfill of Kona pit (i.e., Supremo pit material) is non-granite; therefore, complete backfill was determined it to be the preferred closure option and was selected as the base case for closure of the Kona Pit.

4.1.4 Supremo

Step 1 of the assessment identified 'partial backfilling, with the backfill being utilized for mine development optimization' as the only feasible option for the Supremo Pit. This alternative was therefore the option selected as the base case for closure of the Supremo Pit.

4.2 Waste Rock Storage Location

During the Step 2 potential effects evaluation, the option of one WRSF location (Alpha WRSF) was determined to be the preferred option among all parties and was therefore selected as the base case location of non-Kona pit waste rock. Updates to the general mine plan eliminated the Beta WRSF location; therefore, Kona waste options involving the Beta WRSF were eliminated from further consideration. All Kona waste rock reporting to primary WRSF was determined to be the preferred option among all parties and is therefore the selected base case option for Kona generated waste rock.

4.3 Waste Rock Cover

The feasible alternatives for the Waste Rock cover that were identified for additional evaluation include:

- Overall slope 3:1
  - Partial cover on flats
  - Complete cover
- Overall slope flatter than 3:1
  - Complete cover

A material balance evaluation was carried out to determine the quantity of cover material that would be available for use in reclamation and closure, as well as a priority sequence for placement of the cover material at various mine components in closure. The priority sequence exercise identified the Alpha WRSF as a high priority item for reclamation material placement following the HLF.

The current proposed closure option for the waste rock cover is 'no-cover' with an overall slope of 3:1, which was selected based on uncertainties related to available cover material and the prioritization of the HLF for cover. Revegetation assessments, including metals uptake on bare waste rock, will be carried out through the reclamation research program to inform revegetation strategies on the WRSF. The material balance evaluation will be updated during operations to confirm available cover material quantities, and a WRSF cover may be re-evaluated during operations. Development of the End Land Use Plan will ultimately inform the final landform design, which may also lead to the re-evaluation of the WRSF cover as the mine plan advances.

4.4 HLF Location

During Step 2 potential effects evaluation of the HLF location, the 2016 Feasibility Study leach pad location was determined to be the preferred option and is therefore the selected as the base case for the location of the HLF.

4.5 HLF Cover

The feasible alternatives for the HLF cover that were identified for additional evaluation include:

- Partial cover:
  - (Option 8a) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; geosynthetic clay liner (GCL) installed on flat surfaces progressively.
- Complete cover:
  - (Option 5a) 2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively.
  - (Option 4) 3:1 construction and closure slopes; all surfaces covered with GCL progressively.
  - (Option 7) 2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes.
  - (Option 8b) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces.

Step 2 of the assessment assigned a low rank to Option 8b (complete cover; 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces); therefore, this alternative was not evaluated further. Option 4 (complete cover; 3:1 construction and closure slopes; all surfaces covered with GCL progressively) was initially eliminated during the Step 1 feasibility screening; however, this option was reopened for consideration following consultation with First Nations.

Several interdependent evaluations were carried out to assess the HLF cover alternatives, including an analytical water balance, numerical water balance, water quality model, slope stability evaluations of the cover material, sediment and erosion stability evaluations, and a trade-off study. The analytical water balance determined that a GCL cover on the slopes would reduce net percolation (NP) to very low compared to a store-and-release cover system. Lateral drainage above the GCL however would require surface water management features in order to meet stability requirements. The erosion stability evaluation indicated reduced potential long-term annual erosion for flatter slopes compared to steeper slopes. Details for the evaluations are provided in the Heap Leach Facility Cover Design Report (Appendix 7-A of the RCP) and the Heap Leach Facility Closure Trade-off Study (Appendix 2-M of the RCP).

Through these evaluations as well as through collaborative discussion, Option 1 (partial cover: 2.5:1 construction and closure slopes; GCL progressively installed on flat surfaces) was selected as the base case option for the HLF cover. The Heap Leach Facility Cover Design Report further evaluated the base case HLF cover option, confirmed feasibility, and finalized and advanced the design to subsequent project planning stages. This report is provided in Appendix 7-A of the RCP.

4.6 Water Management Infrastructure Decommissioning

The feasible alternatives for water management infrastructure decommissioning identified for additional evaluation include:

- Alpha Dam/Pond:
  - Remove dam completely.
- West Diversion:
  - Partial decommissioning at natural depression drainages.

An economic evaluation of the complete removal of Alpha Dam was carried out and determined that full removal of the Dam would result in a 64% higher cost compared to partial removal. Engineering of partial decommissioning of the Alpha Dam/Pond has been completed, and in some instances has indicated partial decommissioning as beneficial to buttress/insulate permafrost slopes. Creating a channel without completely removing dam materials was therefore selected as the base case for closure of the Alpha Dam/Pond.

Based on a long-term maintenance evaluation on the partial decommissioning option for closure of the West Diversion, complete decommissioning was selected as the base case closure option for this infrastructure.

4.7 NAR Decommissioning

Public roads that are not intrinsically associated with the Project are not governed by Newmont, and decisions regarding the closure of additional road sections are outside of Newmont's scope. It was therefore determined unlikely to be feasible to close additional road sections beyond new road sections that are constructed for the Project. Decommissioning of the new road sections was identified as the preferred option during the Step 2 potential effects evaluation and is therefore the selected closure option for the NAR.

5.0 STEP 4: FAILURE MODES AND EFFECTS ANALYSIS OF BASE CASE ALTERNATIVE MEANS

The objective of the FMEA was to identify and prioritize key Project risks of the base case design in order to outline strategies for risk mitigation and maximize risk control resources. The analysis applied Project-specific metrics, including timeframes, likelihood definitions, and consequence definitions, for assessing the risks associated with the preferred alternative means for closing the Project components within the near-, short-, and long-term. A workshop was held in February 2022 to collaboratively rank the failure modes that were identified with respect to the overall objectives for the Project.

The FMEA workshop identified ten failure modes that were evaluated as severe or high-risk. No identified failure modes were evaluated as a fatal flaw that would require modification of the base case design. A residual risk assessment determined that all unacceptable risks can be mitigated, with the exception of three high-risk rankings related to major life of project cost consequences. These cost consequences were identified as acceptable given the current Project definition, and as they will not have effects on the environment, Stakeholder consultation and permitting (SCP), or legal consequence categories. The outcomes of the FMEA verified confidence in the base case design for the Project, and the failure modes and effects pathways will continue to be monitored as the project advances. The FMEA Summary Report is provided in Appendix 7-A of the RCP (Heap Leach Facility Cover Design Report).

6.0 REFERENCES

Government of Canada. 2015. Operational Policy Statement: Addressing “Purpose of” and “Alternative Means” under Canadian Environmental Assessment Act 2012 (OPS). Available at: https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/addressing-purpose-alternative-means-under-canadian-environmental-assessment-act-2012.html. Accessed April 2022.

Yukon Government Department of Energy, Mines & Resources (EMR). 2006. Yukon Mine Site Reclamation and Closure Policy. Available at: https://yukon.ca/sites/yukon.ca/files/emr/emr-forms/emr-yukon-mine-site-reclamation-closure-policy.pdf. Accessed April 2022.

Yukon Water Board (YWB) and EMR. 2013. Reclamation and Closure Planning for Quartz Mining Projects. Available at: https://yukon.ca/sites/yukon.ca/files/emr/emr-forms/emr-reclamation-closure-planning-quartz-mining-projects-plan-requirements-closure-costing-guidance.pdf. Accessed April 2022.

APPENDIX 2-L

2018 Preliminary Project Failure Modes and Effects Analysis

Preliminary Project Failure Modes and Effects Analysis
Coffee Gold Mine Project

March 2018

Table of Contents

1.0 Introduction 3
2.0 Scope 3
3.0 Methods 4
4.0 FMEA Process 7
4.1 Session Structures 7
4.2 Risk Rating Process 9
5.0 Results 10
5.1 Open Pits 10
5.2 Waste Storage Facilities & Material Stockpiles 11
5.3 Heap Leach Facilities 13
5.4 Water Management Facilities 16
6.0 Limitations 19
7.0 Conclusion 19

List of Tables

Table 1. Consequence – Severity Matrix 7
Table 2. Likelihood Ratings 8
Table 3. FMEA Coffee Project Risk Matrix 8
Table 4. Results of FMEA - Risk Ratings for Open Pits 10
Table 5. Results of FMEA - Risk Ratings for Waste Storage Facilities & Material Stockpiles 11
Table 6. Results of FMEA - Risk Ratings for Heap Leach Facilities 13
Table 7. Results of FMEA - Risk Ratings for Alpha Pond 17
Table 8. Results of FMEA - Risk Ratings for Facility Pond, and Water Diversions and Rock Drain 17

1.0 Introduction

As part of the planning stages for the Coffee Gold Project, the Coffee Project team has conducted a Failure Modes and Effects Analysis (FMEA) to identify and prioritize key Project risks. This will allow the Project to incorporate risks and Failure Modes into detailed design and to maximize risk control resources. At the present stage, a qualitative FMEA has been conducted at a conceptual level so that the outcomes can guide decision making in the detailed planning stages and provide information to support sound decision making for construction, operations and closure. The results of the FMEA will also inform future similar evaluations or other analyses that will continue as the project advances towards licensing and into mine operations.

2.0 Scope

The scope of the FMEA sessions covered key site facilities, focusing on infrastructure covered in a draft document provided by Yukon Government *Mine licensing Improvement Initiative – Guidelines for Mine Waste Management Facilities*[1]. The preliminary designs for the identified facilities were reviewed, risks were identified, and each risk was evaluated for risk attributes including: relevant Project phases, description, and consequence category.

The early stage FMEA is intended to identify potential Failure Modes and risks, focusing on downstream impacts, in the early stages of planning for incorporation into detail design. More detailed Hazard and Operability Studies (HAZOP) sessions will be performed for all critical facilities after the designs have been progressed in more detail.

Key Facilities selected for the FMEA include:

- Open Pits:
  - Double Double;
  - Latte;
  - Supremo; and
  - Kona.
- Waste Storage Facilities & Material Stockpiles:
  - Alpha Waste Rock Storage Facility;
  - Beta Waste Rock Storage Facility;
  - Frozen Material Stockpile;
  - Overburden Stockpile; and
  - ROM Stockpile.
- Heap Leach Facilities:

[1] Energy Mines and Resources. 2017. *Guidelines for Mine Waste Management Facilities*. Draft for Discussion Purposes, April 2017.

- Heap Leach Pad; and
- Events Ponds.

- Water Management Facilities:
  - Alpha Pond;
  - Facility Pond;
  - Diversions; and
  - Rock Drain.

3.0 Methods

Several multi-party FMEA session were held over the course of two weeks. The first session was held the week of February 12, 2018, and consisted of a risk identification and screening exercise. At this session, the format of the subsequent FMEA sessions and risk rating tools were developed.

The Consequence Categories, Consequence-Severity Matrix, Likelihood Chart and Risk Matrix were developed to align with the Goldcorp risk profile. Project-specific adjustments were made so that the register output would be relevant to external Project stakeholders.

The multidisciplinary FMEA sessions allowed for a holistic review of all the identified facilities; generating a comprehensive list of risks. An outcome of this multidisciplinary approach was that the interconnectivity of various facilities were scrutinized in detail, allowing for the identification of cascading failures and a better understanding of the correlated nature of many failure provoking events. Though Failure Modes for each facility were broken down into three categories: “Water Management”, “Physical Stability” and “Chemical Stability”[2], it was clear that there was a high level of interdependency between various categories. Risks stemming from this interdependency were either duplicated, or referenced as appropriate, as described in the “Session Structures” Section above.

Each session began with a review of the Consequence-Severity Matrix, the Likelihood Chart and the Risk Matrix (see Section 4.0). This was followed by a high-level summary of prior sessions so that all attendees were clear on the format.

The Risk Register that was developed as an outcome of these sessions is included in Appendix A.

The workshops conducted for this study are documented below.

Risk Identification and Screening Session – February 14

Attendees:

- James Scott – Goldcorp
- Jennie Gjertsen – Goldcorp

[2] Risks stemming from ML/ARD, along with other geochemical impacts, were frequently identified over the course of the FMEA sessions. ML/ARD has been used in the risk register as an all-encompassing term that may include other geochemical impacts that are not strictly ML/ARD related.

- Jeet Basi – Goldcorp
- Kelly Bateman – JDS Energy & Mining
- Trevor Herd – JDS Energy & Mining
- Lisa DeSandoli – JDS Energy & Mining
- Carly Church – JDS Energy & Mining

After the structure was developed, a copy of the risk register was distributed to participating individuals for review prior to the individual Facility-specific FMEA sessions. Four Facility-specific sessions were held the week of February 12 and February 19, 2018 with participants attending in person or via remote conference. The details of the individual sessions are outlined below.

Open Pit Waste Storage Facilities & Material Stockpiles - February 15

Attendees:

- Dino Pilotto – JDS Energy & Mining
- Trevor Herd – JDS Energy & Mining
- Kelly Bateman – JDS Energy & Mining
- Carly Church – JDS Energy & Mining
- Mike Levy – JDS Energy & Mining

This session reviewed the Failure Modes of the open pits, the waste storage facilities and material stockpiles.

Water Management Facilities – February 19

Attendees:

- Carly Church – JDS Energy & Mining
- Lisa DeSandoli – JDS Energy & Mining
- Trevor Herd – JDS Energy & Mining
- Kim Doerksen – JDS Energy & Mining
- David Flather – Lorax Environmental Services
- Scott Jackson – Lorax Environmental Services
- John Dockery – Lorax Environmental Services
- Tom Sharp – SRK
- John Kurylo – SRK
- Sarah Portelance - SRK

This session reviewed the Failure Modes of the Water Management Infrastructure.

Heap Leach Facility – February 19

Attendees:

- Mark Smith – RRD International
- Doug Bright – Hemmera
- David Flather – Lorax Environmental Services
- Scott Jackson – Lorax Environmental Services
- John Dockery – Lorax Environmental Services
- Carly Church – JDS Energy & Mining
- Lisa DeSandoli – JDS Energy & Mining
- Trevor Herd – JDS Energy & Mining

This session reviewed the Failure Modes of the Heap Leach Facility, including the Heap Leach Pad and Events Ponds.

Water Quality and Human Health Effects Analysis – February 21

Attendees:

- Doug Bright – Hemmera
- David Flather – Lorax Environmental Services
- Scott Jackson – Lorax Environmental Services
- John Dockery – Lorax Environmental Services
- Carly Church – JDS Energy & Mining
- Lisa DeSandoli – JDS Energy & Mining
- Trevor Herd – JDS Energy & Mining

This session was scheduled to focus on the Water Quality and Human Health Effects and impacts across all facilities. Though the Human Health Effects were reviewed in the individual sessions, a separate session was held with a subject matter expert in this area (Doug Bright), in order to prioritize these impacts and ensure they were adequately captured.

Goldcorp acknowledges that by not having invited participation from external parties (First Nations, 3rd party reviewers or other stakeholders)that there are limitations to the findings of the FMEA, particularly the consequence severities related to Traditional Use and Community/ Media/ Reputation categories. These limitations will be considered in future FMEAs or other similar or complementary decision-making/risk analyses. Goldcorp expects to extend an invite to external parties where it deems appropriate when conducting these analyses.

4.0 FMEA Process

4.1 Session Structures

The Consequence-Severity breakdown, Likelihood Descriptions and Risk Matrix that were developed in the Risks Identification and Screening sessions are shown in Table 1 to Table 3 below. The Consequence Categories and Severity Descriptors as described in Table 1 are generally consistent with Goldcorp's internal risk assessment and management approach.

Table 1. Consequence – Severity Matrix

	Severity Descriptors				
Consequence Categories	**Insignificant**	**Minor**	**Moderate**	**Major**	**Severe**
Environmental Impact (EA)	• On-site environmental damage; and • Does not require containment and clean-up.	• On-site environmental damage; and • Containment or clean-up efforts completed within 1 shift.	• Off-site environmental damage with quick clean-up; or • On-site environmental damage requiring greater than 1 shift to complete containment or clean-up.	• Off-site environmental damage; and • Requires prolonged containment or clean-up, or prolonged public health monitoring and intervention.	• Off-site environmental damage; and • Requires long-term containment or clean-up, or long-term public health monitoring or intervention.
Traditional Use (TU)	• Some disturbance but no impact to traditional land use.	• Minor or perceived impact to traditional land use.	• Some mitigable impact to traditional land use.	• Significant temporary impact to traditional land use.	• Significant permanent impact on traditional land use.
Regulatory and Legal (RL)	• Informal advice from a regulatory agency.	• Technical / Administrative non-compliance with permit, approval or regulatory requirement. Warning letter issued.	• Breach of regulations, permits, or approvals (e.g. 1 day violation of discharge limits). • Order or direction issued.	• Substantive breach of regulations, permits or approvals (e.g. multi-day violation of discharge limits). • Prosecution.	• Major breach of regulation – wilful violation. • Court order issued.
Consequence Costs (CC)	• < $10M	• $10M to $30M	• $30M to $60M	• $60M to $120M	• > $120M
Community/ Media/ Reputation (CMR)	• Local concerns, but no local complaints or adverse press coverage.	• Public concern restricted to local complaints or local adverse press coverage.	• Heightened concern by local community, criticism by NGOs or adverse local / regional media attention.	• Significant adverse national public, NGO or media attention.	• Serious public outcry / demonstrations or adverse International NGO attention or media coverage.

Human Health and Safety (HSS)	• Low-level short-term subjective symptoms. No measurable physical effect. No medical treatment.	• Objective but reversible disability / impairment and/or medical treatment injuries requiring hospitalization.	• Moderate irreversible disability or impairment to one or more people.	• Severe irreversible disability or impairment to one or more people.	• Single fatality or multiple fatalities.

Table 2. Likelihood Ratings

Likelihood	Probability (Life of Project)	Frequency Descriptor
Almost Certain	> 98%	High frequency (more than once every 5 years)
Likely	84 – 89%	Event does occur, has a history, once every 15 years
Possible	16 – 84%	Occurs once every 40 years
Unlikely	2 – 16%	Occurs once every 200 years
Rarely	< 2%	Occurs once every 1000 years

Table 3. FMEA Coffee Project Risk Matrix

Risk Matrix						
Likelihood		Consequence Severity				
		Insignificant	Minor	Moderate	Major	Severe
		1	2	3	4	5
Almost Certain	5	**Moderate**	**Moderately High**	**High**	**Very High**	**Very High**
Likely	4	**Moderate**	**Moderate**	**Moderately High**	**High**	**Very High**
Possible	3	**Low**	**Moderate**	**Moderate**	**Moderately High**	**High**
Unlikely	2	**Low**	**Low**	**Moderate**	**Moderate**	**Moderately High**
Rarely	1	**Low**	**Low**	**Low**	**Moderate**	**Moderate**

Each facility was broken out into several different risk categories to ensure completeness: Water Management, Chemical Stability, and Physical Stability. The group then worked through each risk category to identify potential Failure Modes and the resulting consequences. Each Failure Mode was categorized with a Project Phase (Construction, Operations, Reclamation and Closure) and a Consequence Category. If the Failure Mode was relevant across multiple phases, then all relevant phases were selected. If the consequence impact or likelihood for a Failure Mode was meaningfully different in different phases, then they were itemized as separate Failure Modes.

For any individual Failure Mode, it is possible that there could be multiple independent, contributing factors. All identified contributing factors are listed in the "Leading Factors" column in the Risk Register. All contributing factors were considered when determining the Consequence Rating and Likelihood, with the scored likelihood derived from the most likely leading factor. For example, overtopping and embankment failure of the Alpha Dam from a rain event higher than 1 in 200 year event is more likely than embankment failure due to an earthquake, so the 1 in 200 year event was considered for determining likelihood. Failure Modes with multiple leading factors were only combined on the risk register in the manner described above when the Failure Mode and maximum credible consequences were meaningfully similar. Otherwise they were listed as separate Failures and the consequences and likelihoods were evaluated separately.

Due to the correlative nature of many of the facilities within the Project, Failure Modes of any individual facility may have resulting consequences, inducing cascading impacts on other facilities. As a result, certain Failure Modes may be listed as Leading Factors for other Failure Modes within the register. Additionally, for completeness, several Failure Modes are duplicated across multiple facilities in order to identify, track and emphasize the association among facilities.

4.2 Risk Rating Process

The Maximum Credible Consequence was identified for each Failure Mode, to assist in identifying the appropriate Consequence-Severity ranking. Where a Failure Mode had a meaningful consequence across multiple consequence categories, the Failure Mode was listed separately for each Consequence Category so that each consequence could be evaluated individually. Consistent with the guidance in *Appendix E: Risk Assessment Approach of the Draft Guidelines for Mine Waste Management Facilities*[3]; all risks were evaluated on the basis that planned controls were in place (i.e. a slope stability monitoring program is in place to monitor pit wall stability), so that the resulting risk scores identified the residual risk of each Failure Mode. This provides a more meaningful risk ranking, upon which future risk treatment planning can be prioritized. Planned Controls that were considered are indicated in the "Risk Management Controls in Place" column in the Risk Register (Appendix A).

When identifying the Consequence-Severity rating for a listed Failure Mode, the classification was based on the incremental consequence of the identified failure. This is consistent with hazard classification procedure as outline in the *Canadian Dam Safety Guidelines*[4] and provides the indicative assessment of the overall impact specifically stemming from the identified Failure Mode. In general, the incremental consequence of failure is defined as the total damage from an event with the facility failure incorporated, less the damage that would have resulted from the same event (i.e. large flood event) had the facility not experienced the identified failure.

The Consequence-Severity and likelihood rankings were recorded on the Risk Register spreadsheet, and the overall residual risk ranking was generated based on the Risk Matrix and identified on the spreadsheet. The Risk Register is included in Appendix A.

[3] Energy Mines and Resources. 2017. *Guidelines for Mine Waste Management Facilities*. Draft for Discussion Purposes, April 2017.

[4] Canadian Dam Association. 2007 updated in 2013. *Canadian Dam Safety Guidelines 2007 (updated 2013)*.

5.0 Results

The FMEA identified 159 Failure Modes; 75 of these were evaluated as Low risk, 83 were evaluated as Moderate risk, and 1 was identified as Moderately High risk. No identified Failure Modes were evaluated as High or Very High risk. The key Failure Modes are discussed below by Project component.

5.1 Open Pits

Nineteen Failure Modes were identified for the Open Pits (Table 4). 10 Failure Modes were evaluated as being Moderate risk, and 9 were evaluated as being Low risk. Five Failure Modes were identified for Water Management (W), seven were identified for Physical Stability (P), and 8 were identified for Chemical Stability (C).

Table 4. Results of FMEA - Risk Ratings for Open Pits

Likelihood						
	5					
	4	1.1W2 1.1W3				
	3		1.1P1			
	2	1.1W4 1.1P7 1.1C6	1.1C3 1.1C4 1.1C7	1.1C5 1.1C8	1.1C2	
	1	1.1W1 1.1P6	1.1P4		1.1C1	1.1P2 1.1P3 1.1P5
		1	2	3	4	5
		Consequence				

Notes: Open Pits (1.1)

The most significant risks identified (with a risk rating of 6) at this phase of Project development are **1.1P2**, **1.1P3**, and **1.1P5**. These risks are further summarized below:

- **1.1P2**. Pit wall failure – mass. Operations phase.
  - *Identified leading factors*: unanticipated rainfall volume, earthquake, geotechnical characteristics (different than anticipated)
  - *Consequence*: loss of life (multiple fatalities)
  - *Consequence Category*: Human Health and Safety
  - *Likelihood*: Rarely. Consequence Severity: Severe. Risk Rating: Moderate.
  - *Risk management controls*: Factor of safety in Open Pit Design, slope stability monitoring, Operations Management Plan
- **1.1P3**. Pit wall failure – mass. Reclamation and Closure phase.

- *Identified leading factors*: unanticipated rainfall volume, earthquake, geotechnical characteristics (different than anticipated)
- *Consequence*: loss of life (multiple fatalities)
- *Consequence Category*: Human Health and Safety
- *Likelihood*: Rarely. Consequence Severity: Severe. Risk Rating: Moderate
- *Risk management controls:* Factor of safety in Open Pit Design

- **1.1P5**. Pit wall failure – localized. Operations phase.
  - *Identified leading factors*: unanticipated rainfall volume, earthquake, geotechnical characteristics (different than anticipated)
  - *Consequence*: loss of life (multiple fatalities)
  - *Consequence Category*: Human Health and Safety
  - *Likelihood*: Rarely. Consequence Severity: Severe. Risk Rating: Moderate
  - *Risk management controls*: Factor of safety in Open Pit Design, Operations Management Plan

5.2 Waste Storage Facilities & Material Stockpiles

Forty three individual Failure Modes were identified for the WRSFs and material stockpiles (Table 5): 16 Failure Modes were evaluated as being Moderate risk, and 27 were evaluated as being Low risk. For all facilities, no Water Management (W) Failure Modes were identified.

For the Alpha WRSF, six Failure Modes were identified for Physical Stability (P), and 8 were identified for Chemical Stability (C). For the Beta WRSF, seven Failure Modes were identified for Physical Stability (P), and six were identified for Chemical Stability (C). For the Run of Mine (ROM) Stockpile, five Failure Modes were identified for Physical Stability (P), and one for Chemical Stability (C). For the Frozen Material Stockpile, two Failure Modes were identified for Physical Stability (P), and three for Chemical Stability (C). For the Overburden Stockpile, one Failure Mode was identified for Physical Stability (P), and four for Chemical Stability (C).

Table 5. Results of FMEA - Risk Ratings for Waste Storage Facilities & Material Stockpiles

Likelihood						
	5					
	4					
	3	2.1P6 2.2P7				

	2		2.1P1 2.1C4 2.2P1 2.2C6 2.4C1 – 3 2.5C4	2.1C1 – 3 2.2C3 – 5 2.3P1 2.3P3 2.3P4 2.5C1 – 3		
	1	2.2P2 2.2P4 2.2P5	2.2P6 2.3P2 2.3P5 2.3C1 2.4P1 2.4P2 2.5P1	2.1P4 – 5 2.1C6 – 8 2.2C1 – 2	2.1C5	2.1P2 2.1P3 2.2P3
		1	2	3	4	5
		Consequence				

Notes: Alpha Waste Rock Storage Facility (2.1) and Beta Waste Rock Storage Facility (2.2); Run of Mine (ROM) Stockpile (2.3); Frozen Material Stockpile (2.4); Overburden Stockpile (2.5)

The most significant risks identified (with a risk rating of 6) at this phase of project development are **2.1P2**, **2.1P3**, and **2.2P3**. These risks are further summarized below:

- **2.1P2.** Mass slope failure – Alpha WRSF. Operations phase.
    - *Identified leading factors*: unanticipated rainfall volume, earthquake, geotechnical characteristics that are different than anticipated, unanticipated changes to permafrost, blockage of rock drain causing increased pore pressures in the WRSF
    - *Consequence*: failure of the facility resulting in no location to place waste rock
    - *Consequence Category*: Consequence Cost
    - *Likelihood*: Rarely. Consequence Severity: Severe. Risk Rating: Moderate
    - *Risk management controls*: Factor of safety in Alpha WRSF design, slope stability monitoring, Operations Management Plan
- **2.1P3.** Mass slope failure – Alpha WRSF. Operations phase.
    - *Identified leading factors*: unanticipated rainfall volume, earthquake, geotechnical characteristics (different than anticipated), unanticipated changes to permafrost, or blockage of rock drain increasing pore pressures in the WRSF
    - *Consequence*: failure of the facility resulting in fatalities to workers below
    - *Consequence Category*: Human Health and Safety
    - *Likelihood*: Rarely. Consequence Severity: Severe. Risk Rating: Moderate
    - *Risk management controls*: Factor of safety in Alpha WRSF design, slope stability monitoring, and Operations Management Plan
- **2.2P3.** Mass slope failure – Beta WRSF. Operations phase.
    - *Identified leading factors*: mass slope failure caused by unanticipated rainfall volume, earthquake, or geotechnical characteristics (different than anticipated) in the WRSF

- *Consequence*: failure of the facility resulting in fatalities to workers below
- *Consequence Category*: Human Health and Safety
- *Likelihood*: Rarely. Consequence Severity: Severe. Risk Rating: Moderate
- *Risk management controls*: Factor of safety in Beta WRSF design, slope stability monitoring, Operations Management Plan

5.3 Heap Leach Facilities

Forty seven individual Failure Modes were identified for the Heap Leach Facility and Event Ponds (Table 6): forty two Failure Modes were evaluated as being moderate risks, and five were evaluated as being low risk.

For the Heap Leach Facility, five Failure Modes were identified related water management, sixteen Failure Modes related to Physical Stability (P), and nine related Chemical Stability (C). For the Event Ponds, twelve Failure Modes were identified related Physical Stability (P), and five related to Chemical Stability (C). No Water Management (W) Failure Modes were identified for the Event Ponds.

Table 6. Results of FMEA - Risk Ratings for Heap Leach Facilities

Likelihood						
	5					
	4		3.2P12			
	3		3.1W2,3.1W4, 3.1P14, 3.1C1,3.2P9, 3.2C3	3.1W3 3.1W5 3.1P13 3.1P15		
	2		3.2P10 – 11 3.2C4 – 5	3.1P4 – 5, 3.1P9 – 12 3.1C6 – 9 3.2P7 – 8 3.2C1 – 2	3.1W1 3.1P1 – 3 3.1P6 – 7 3.1P16 3.1C3 – 4	
	1	3.1C2			3.2P2 – 6	3.1P8 3.1C5 3.2P1
		1	2	3	4	5
		Consequence				

Notes: Heap Leach Facility (3.1); Event Ponds (3.2)

The most significant risks identified (with a risk rating of 6) at this phase of project development are 3.1W1, 3.1W3, 3.1W5, 3.1P1, 3.1P2, 3.1P3, 3.1P6, 3.1P7, 3.1P8, 3.1P13, 3.1P15, 3.1P16, 3.1C3, 3.1C4, 3.1C5, 3.2P1, 3.2P12. These risks are further summarized below:

- **3.1W1.** Too much water in HLF (impact of raincoats), impacting the Event Pond's ability to hold PMP event. Operations phase.

- *Identified leading factors*: increased precipitation compared to the Water Balance Model (i.e., experienced rainfall higher than current climate model suggests).
- *Consequence*: mine operations would cease until the PMP capacity of the HLF is restored.
- *Consequence Category*: Regulatory and Legal.
- *Likelihood*: Unlikely. Consequence Severity: Major. Risk Rating: Moderate.
- *Risk management controls*: Water Balance Model to be updated dynamically, and Operations Management Plan.

- **3.1W3.** Insufficient water in HLF. Operations phase.
  - *Identified leading factors*: drought, insufficient water quantities not being captured at freshet, or not optimizing planning.
  - *Consequence*: delay in the start of leaching ore.
  - *Consequence Category*: Human Health and Safety.
  - *Likelihood*: Moderate. Consequence Severity: Possible. Risk Rating: Moderate.
  - *Risk management controls*: Operations Management Plan.
- **3.1W5.** Freezing of heap. Operations phase.
  - *Identified leading factors*: experiencing temperatures consistently below anticipated temperatures.
  - *Consequence*: limit ability to stack ore on the HLF to six months per year.
  - *Consequence Category*: Consequence Cost.
  - *Likelihood*: Possible. Consequence Severity: Moderate. Risk Rating: Moderate.
  - *Risk management controls*: Robust thermal modelling and appropriate equipment sizing.
- **3.1P1 – 3.1P3.** Slope Failure of HLF. Operations, Reclamation and Closure phase, slope destabilization due to ground characterization, changing ground conditions (i.e. permafrost), high rain events, earthquake, or loss of permeability of heap causes a significant slope failure significant so that ore leaves containment and contaminates Latte or Halfway Creek.
  - *Identified leading factors*: slope destabilization due to ground characterization, changing ground conditions (i.e. permafrost), high rain events, earthquake, loss of permeability of heap.
  - *Consequence*: contamination of Latte Creek, cleanup and abandonment of the HLF (**3.1P3** only).
  - *Consequence Category*: Environmental Impact (**3.1P1**), Legal and Regulatory (**3.1P2**), and Consequence Cost (**3.1P3**).
  - *Likelihood*: Unlikely. Consequence Severity: Major. Risk Rating: Moderate.
  - *Risk management controls*: Adequate site investigations and Factor of Safety in HLF design, Operations Management Plan, monitoring systems in operations.

- **3.1P6 – 3.1P8.** Failure of liner at base of HLF. Operations phase, Reclamation and Closure phase (**3.1P6** only).
    - *Identified leading factors*: undetected construction defects, damage during ore stacking, damage due to slope failure, leak detection system.
    - *Consequence*: contamination of groundwater, direct contamination of Latte and/or Halfway Creeks, remediation required and abandonment of section of HLF (**3.1P8** only).
    - *Consequence Category*: Environmental Impact (**3.1P6**), Legal and Regulatory (**3.1P7**), and Consequence Cost (**3.1P8**).
    - *Likelihood*: Unlikely. Consequence Severity: Major. Risk Rating: Moderate.
    - *Risk management controls*: Adequate site investigations and Factor of Safety in HLF design, Operations Management Plan, monitoring systems in operations.
- **3.1P13, 3.1P15.** Failure of HLF pumping system causing uncontrolled discharge of process solution. Operations phase.
    - *Identified leading factors*: manufacturing, earthquake, freezing conditions, or site interactions.
    - *Consequence*: localized contamination of surface sediments.
    - *Consequence Category*: Environmental Impact (**3.1P13**), and Legal and Regulatory (**3.1P15**).
    - *Likelihood*: Possible. Consequence Severity: Moderate. Risk Rating: Moderate.
    - *Risk management controls*: Secondary containment and maintaining surrounding vegetation for passive filtration.
- **3.1P16.** Loss of permeability leading to loss of production and early closure. Operations phase.
    - *Identified leading factors*: ore behaviour different than anticipated, compaction during stacking.
    - *Consequence*: loss of Net Present Value due to section of heap being abandoned.
    - *Consequence Category*: Consequence Cost.
    - *Likelihood*: Unlikely. Consequence Severity: Major. Risk Rating: Moderate.
    - *Risk management controls*: Monitoring of HLF, Operations Management Plan.
- **3.1C3 – 3.1C5.** Release of process solution from containment. Operations phase.
    - *Identified leading factors*: liner failure, large scale slope failure, pumping or piping system failure.
    - *Consequence*: contamination of groundwater, or direct contamination of Halfway or Latte creeks due to a release of process solution, remediation required and abandonment of section of HLF (**3.1C5** only).

- *Consequence Category*: Environmental Impact (**3.1C3**), Legal and Regulatory (**3.1C4**), and Consequence Cost (**3.1C5**).
- **3.1C3**, **3.1C4**. *Likelihood*: Unlikely. *Consequence Severity*: Major. *Risk Rating*: Moderate.
- **3.1C5**. *Likelihood*: Rarely. *Consequence Severity*: Severe. *Risk Rating*: Moderate.
- *Risk management controls*: Adequate site investigations and Factor of Safety in HLF design, Operations Management Plan, and monitoring systems in operation.

- **3.2P1.** Embankment failure of HLF. Operations phase.
  - *Identified leading factors*: slope failure due to instability, ground conditions not properly characterized, earthquake, overtopping due to excessive water in HLF, precipitation event larger than the PMP.
  - *Consequence*: sudden and large release of process solution, flooding the process plant or camp area and leading to loss of life.
  - *Consequence Category*: Human Health and Safety.
  - *Likelihood*: Rarely. Consequence Severity: Severe. Risk Rating: Moderate.
  - *Risk management controls*: Operations Management Plan, monitoring of Event Ponds in operations, Factor of Safety incorporated into Event Pond design.
- **3.2P12.** Freezing of Event Ponds. Operations phase.
  - *Identified leading factors*: insufficient water volume in ponds prior to winter and/or winter temperatures significantly lower than anticipated causing water in event ponds to freeze fully.
  - *Consequence*: shortage of water causing delayed irrigation of ore in the spring.
  - *Consequence Category*: Consequence Costs.
  - *Likelihood*: Likely. Consequence Severity: Minor. Risk Rating: Moderate.
  - *Risk management controls*: Operations Management Plan.

5.4 Water Management Facilities

Fifty individual Failure Modes were identified for the Water Management Facilities (Table 7 and Table 8): one Failure Mode was evaluated as being moderately high risk, fifteen Failure Modes were evaluated as being Moderate risks, and thirty four were evaluated as being Low risk.

For the Alpha Pond, seventeen Failure Modes were identified related to Physical Stability (P), and four related to Chemical Stability (C). For the Facility Pond, five Failure Modes were identified related Physical Stability (P), and four related to Chemical Stability (C). For the Water Diversions, eight Failure Modes were identified related to Physical Stability (P). For the Rock Drains, nine Failure Modes were identified related Physical Stability (P), and three related to Chemical Stability (C).

Table 7. Results of FMEA - Risk Ratings for Alpha Pond

Likelihood						
	5		**4.1P9**			
	4					
	3					
	2		4.1P2 4.1P4 4.1P13 4.1C4	4.1P3 4.1P17 4.1C1 – 3	4.1P1	
	1		4.1P6 4.1P8 4.1P11 4.1P15	4.1P7 4.1P12 4.1P16	4.1P5 4.1P10 4.1P14	
		1	2	3	4	5
		Consequence				

Notes: Alpha Pond (4.1)

Table 8. Results of FMEA - Risk Ratings for Facility Pond, and Water Diversions and Rock Drain

Likelihood						
	5					
	4					
	3					
	2	4.5C1	4.2C1 – 4 4.3P2 4.3P4 – 8 4.5C2	4.2P1 – 2 4.3P3	4.3P1	
	1		4.2P3 – 5 4.5P2 4.5P4 – 5	4.5P3 4.5P8 – 9 4.5C3	4.5P1	4.5P6 – 7
		1	2	3	4	5
		Consequence				

Notes: Facility Pond (4.2); Water Diversions (4.3); Rock Drain (4.4)

The most significant risks identified at this phase of Project development (with a risk rating of 7) is 4.1P9, which is described here:

- **4.1P9**. Alpha Pond slope destabilization (above/below). Construction, Operations, and Reclamation and Closure phases.
    - *Identified leading factors*: heavy rainfall, permafrost degradation.
    - *Consequence*: increased sediment load into the pond and high TSS concentrations.

- *Consequence Category*: Environmental Impact.
- *Likelihood*: Almost Certain. Consequence Severity: Minor. Risk Rating: Moderately High.
- *Risk management controls*: Pre-design geotechnical testing, Operations Management plan, erosion control measures.

The other most significant risks identified (with a risk rating of 6) are 4.1P1, 4.3P1, 4.5P6, and 4.5P7. These risks are further summarized below:

- **4.1P1**. Alpha Pond dam embankment failure. Construction, Operations, and Reclamation and Closure phases.
  - *Identified leading factors*: greater than 200 year storm, earthquake, unanticipated impact of changes to permafrost (beyond expected / planned slow long-term permafrost degradation), embankment failure of event ponds when full, mischaracterized geotechnical conditions, excessive seepage through foundations.
  - *Consequence*: Environmental deposition of embankment materials in Halfway Creek and temporary increase in downstream flow rates and loading, leading to high flows, erosion of channel, habitat loss, sediment deposition and increase in turbidity levels.
  - *Consequence Category*: Environmental Impact.
  - *Likelihood*: Unlikely. Consequence Severity: Major. Risk Rating: Moderate.
  - *Risk management controls*: Dam design as per CDA guidelines, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures, regular monitoring and maintenance to ensure deformation from permafrost degradation can be observed and repaired if/ as needed (rates of degradation expected to be slow).
- **4.3P1** – Embankment failure of the Westside Diversion. Construction, Operations, and Reclamation and Closure phases.
  - *Identified leading factors*: permafrost degradation, rainfall higher than design, channel blockage due to ice or debris, freezing or blockage of rock drain causing overtopping and increase flow rates into the diversion causing increased waterflow into Alpha dam.
  - *Consequence*: Environmental deposition of embankment materials in Halfway Creek and temporary increase in downstream flow rates and loading, leading to high flows, erosion of channel, habitat loss, sediment deposition and increase in turbidity levels.
  - *Consequence Category*: Environmental Impact.
  - *Likelihood*: Unlikely. Consequence Severity: Major. Risk Rating: Moderate.
  - *Risk management controls*: Dam design as per CDA guidelines, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures.
- **4.5P6, 4.5P7** – Ponding water on upstream of rock drain leads to slope failure on Alpha WRSF. Operations phase.
  - *Identified leading factors*: permafrost degradation due to static water pond.
  - *Consequence*: fatalities (**4.5P7**), closure of the mine (**4.5P6**).

- *Consequence Category*: Human Health and Safety (**4.5P7**), Consequence Cost (**4.5P6**).
- *Likelihood*: Rarely. Consequence Severity: Severe. Risk Rating: Moderate.
- *Risk management controls*: Factor of Safety in design, Operations Management Plan, slope stability monitoring.

6.0 Limitations

The FMEA is intended to be a valuable exercise in identifying key Failure Modes and their resulting impacts across the Facilities, there are inherent limitations to the process that should be considered when reviewing the results.

- The structure of the assessment makes the identification and assessment of multiple Failure Modes or a combination of modes challenging. The group attempted to account for this by including a "Leading Factors" column, which generated discussion on multiple Failure Modes; however, there are still limitations in properly assessing a combination of Failure Modes concurrently.
- As each risk is evaluated for its maximum credible consequence, the FMEA focuses on the extreme but rare outcomes and impacts. As a result, Failure Modes with less severe consequences, but higher likelihoods, are not necessarily captured in the assessment.

7.0 Conclusion

The FMEA conducted for the Project identified 158 Failure Modes for primary Project components: 157 of which were assessed as Low or Moderate Risk. One Failure Mode was identified as Moderately High risk: a potential slope failure around the Alpha Pond. This Failure Mode was assessed as having an Almost Certain likelihood with a Minor consequence.

The FMEA and associate Risk Register described here will be updated and refined during the detailed Project design and planning, including during the development of the detailed Reclamation and Closure Plan for Project licensing.

Appendix A – Coffee Project Risk Register

RISK IDENTIFICATION						RISK MANAGEMENT ACTIVITIES IN PLACE		LOCATION LEVEL RISK ASSESSMENT						
								Risk Impact			Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence	Likelihood of Occurrence	Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
1 - Open Pits														
W - Water Management														
	1.1W1	Water inflow higher than predicted into pits.	Higher than anticipated rainfall, Failure of pit perimeter ditches	pit fills up with water, resulting in inability to mine the bottom of the pit.	2 week loss of production	Operations	Factor of Safety in perimeter ditches design, adequate in pit water management (in pit sumps/pumping)	Consequence Costs (CC)	Insignificant	Rarely	1	1	2	Low
	1.1W2	Water inflow higher than predicted into pits.	Higher than anticipated rainfall, Failure of pit perimeter ditches	pit fills up with water, resulting in inability to mine the bottom of the pit.	Increased discharge rates to the receiving environment	Operations	Factor of Safety in perimeter ditches design, adequate in pit water management (in pit sumps/pumping), Operations Management Plan	Environmental Impact (EA)	Insignificant	Likely	1	4	5	Moderate
	1.1W3	Water inflow higher than predicted into pits.	Higher than anticipated rainfall, Failure of pit perimeter ditches	pit fills up with water, resulting in inability to mine the bottom of the pit.	Increased discharge rates to the receiving environment	Operations	Factor of Safety in perimeter ditches design, adequate in pit water management (in pit sumps/pumping), Operations Management Plan	Traditional Use (TU)	Insignificant	Likely	1	4	5	Moderate
	1.1W4	Water inflow higher than predicted into pits.	Higher than predicted rainfall over closure period	Pit lakes fill up and spill faster than anticipated	Increased discharge rates to the receiving environment	Closure	Closure monitoring plan	Environmental Impact (EA)	Insignificant	Unlikely	1	2	3	Low
P - Physical Stability														
	1.1P1	Pit Wall Failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	slope failure leading to loss of production	3 months loss of production	Operations	Factor of Safety in Pit design, Operational Management plans, slope stability monitoring	Consequence Costs (CC)	Minor	Possible	2	3	5	Moderate
	1.1P2	Pit Wall Failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	slope failure leading to loss of life	Multiple fatalities	Operations	Factor of Safety in Pit design, Operational Management plans, slope stability monitoring	Human Health and Safety (HSS)	Severe	Rarely	5	1	6	Moderate
	1.1P3	Pit Wall Failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	slope failure leading to loss of life	Multiple fatalities	Closure	Factor of Safety in Pit design	Human Health and Safety (HSS)	Severe	Rarely	5	1	6	Moderate
	1.1P4	Pit Wall Failure - mass (Supremo, Latte)	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	slope failure leading to mass water displacement (in closed pits) leading to downstream water quality issues.	short period of increased volume in discharge channel	Closure	Factor of Safety in Pit design, Operational Management plans, slope stability monitoring	Environmental Impact (EA)	Minor	Rarely	2	1	3	Low
	1.1P5	Pit Wall Failure - localized	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	localized bench failure resulting in fatality	Single Fatality	Operations	Operational Management plans, Factor of Safety in design	Human Health and Safety (HSS)	Severe	Rarely	5	1	6	Moderate
	1.1P6	Failure of backfill causeways	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, construction defects	failure of causeway integrity leading to obstruction of access.	3 month loss of production, loss of access	Operations	Operational Management plans, construction monitoring, stability monitoring	Consequence Costs (CC)	Insignificant	Rarely	1	1	2	Low
	1.1P7	Failure of main haul road	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	failure of haul road integrity	loss of production	Operations	Operational Management plans, monitoring	Consequence Costs (CC)	Insignificant	Unlikely	1	2	3	Low
C - Chemical Stability														
	1.1C1	ML/ARD higher than expected in pits impacts water quality	Geochemical makeup of ore/waste different from anticipated	resulting in inability to meet discharge criteria.	Impact to local watershed	Operations	Geochemical testing during planning stage, Operational Management plans, monitoring	Regulatory and Legal (RL)	Major	Rarely	4	1	5	Moderate

RISK IDENTIFICATION							RISK MANAGEMENT ACTIVITIES IN PLACE	LOCATION LEVEL RISK ASSESSMENT						
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Risk Impact		Likelihood of Occurrence	Location Residual Risk Score			
								Consequence Categories	Consequence		Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	1.1C2	ML/ARD higher than expected in pits impacts water quality	Geochemical makeup of ore/waste different from anticipated	resulting in inability to meet discharge criteria.	Discharge non-compliant water	Closure	Geochemical testing during planning stage, Operational Management plans, monitoring	ommunity/ Media/ Reputation (CMF	Major	Unlikely	4	2	6	Moderate
	1.1C3	ML/ARD higher than expected in pits impacts water quality	Geochemical makeup of ore/waste different from anticipated	requirement to construct water treatment plant	Cost of WTP	Operations	Geochemical testing during planning stage, monitoring	Consequence Costs (CC)	Minor	Unlikely	2	2	4	Low
	1.1C4	ML/ARD higher than expected in pits impacts water quality	Geochemical makeup of ore/waste different from anticipated	Water quality of discharge from Pit lakes is different than anticipated	Impact water balance in local watersheds	Closure	Geochemical testing during planning stage, Operational Management plans, monitoring	Environmental Impact (EA)	Minor	Unlikely	2	2	4	Low
	1.1C5	ML/ARD higher than expected in pits impacts water quality	Geochemical makeup of ore/waste different from anticipated	requirement to construct water treatment process	Cost	Closure	Geochemical testing during planning stage, monitoring	Consequence Costs (CC)	Moderate	Unlikely	3	2	5	Moderate
	1.1C6	Failure of ARD mitigation in Kona Pit	Combined failure of multiple mitigation factors including backfill of pit, sulphide materials are not submerged	Increase in Kona lake acidity	Minor leakage into underlying groundwater system	Closure	Geochemical testing during planning stage, monitoring, closure management plan	Environmental Impact (EA)	Insignificant	Unlikely	1	2	3	Low
	1.1C7	Water Quality in Double Double at closure does not meet objectives	Geotechnical characteristics of backfill material different than anticipated	Water quality in pit lake not desirable	Impact water balance in local watersheds	Closure	Geochemical testing during planning stage, monitoring, closure management plan	Environmental Impact (EA)	Minor	Unlikely	2	2	4	Low
	1.1C8	Water Quality in Double double at closure does not meet objectives	Geotechnical characteristics of backfill material different than anticipated	Water quality in pit lake not desirable	Impact water balance in local watersheds	Closure	Geochemical testing during planning stage, monitoring, closure management plan	Consequence Costs (CC)	Moderate	Unlikely	3	2	5	Moderate
1 - Alpha Waste Rock Storage Facility														
P - Physical Stability														
	2.1P1	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost , blockage of rock drain increasing pore pressures in WRSF	failure of the facility	increased footprint	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Environmental Impact (EA)	Minor	Unlikely	2	2	4	Low
	2.1P2	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost , blockage of rock drain increasing pore pressures in WRSF	failure of the facility resulting in no location to place waste.	Ultimate closure of the mine	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Consequence Costs (CC)	Severe	Rarely	5	1	6	Moderate
	2.1P3	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost , blockage of rock drain increasing pore pressures in WRSF	failure of facility with workers below.	Fatality	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Human Health and Safety (HSS)	Severe	Rarely	5	1	6	Moderate
	2.1P4	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost , blockage of rock drain increasing pore pressures in WRSF	Failure of the facility	Order issued until resolved	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Regulatory and Legal (RL)	Moderate	Rarely	3	1	4	Low

RISK IDENTIFICATION						RISK MANAGEMENT ACTIVITIES IN PLACE		LOCATION LEVEL RISK ASSESSMENT						
								Risk Impact			Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence	Likelihood of Occurrence	Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	2.1P5	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost , blockage of rock drain increasing pore pressures in WRSF	Failure of the facility	Regional negative publicity	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	ommunity/ Media/ Reputation (CM	Moderate	Rarely	3	1	4	Low
	2.1P6	Slope failure - localized	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost ,	crest failing	temporary loss of access	Operations	Factor of Safety in design, Operations management plan	Consequence Costs (CC)	Insignificant	Possible	1	3	4	Low
C - Chemical Stability														
	2.1C1	Water Quality in Alpha pond doesn't meet discharge limits	ML/ARD higher than expected on WRSF (Waste)	Out of compliance water released into environment	Discharge elicits chronic toxicity response	Operations	Pump back to pits of other holding facilities; water treatment	Environmental Impact (EA)	Moderate	Unlikely	3	2	5	Moderate
	2.1C2	Water Quality in Alpha pond doesn't meet discharge limits	ML/ARD higher than expected on WRSF (Waste)	Out of compliance water released into environment	Not allowed to be discharging; suspend permit to operate	Operations	Pump back to pits of other holding facilities; water treatment	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate
	2.1C3	Water Quality in Alpha pond doesn't meet discharge limits	ML/ARD higher than expected on WRSF (Waste)	Out of compliance water released into environment	Regional (Yukon) negative publicity	Operations	Pump back to pits of other holding facilities; water treatment; proactive communication	ommunity/ Media/ Reputation (CM	Moderate	Unlikely	3	2	5	Moderate
	2.1C4	Water Quality in Alpha pond doesn't meet discharge limits	ML/ARD higher than expected on WRSF (Waste)	Out of compliance water released into environment	Build water treatment plant	Operations	Pump back to pits of other holding facilities; water treatment; proactive communication	Consequence Costs (CC)	Minor	Unlikely	2	2	4	Low
	2.1C5	Downstream water quality degrades over time after closure	ML/ARD higher than expected on WRSF (Waste)	Downstream water quality degradation after the removal of Alpha Pond	Water Quality no longer meets discharge limits	Closure	Geochemical testing during planning, closure plans, monitoring	Environmental Impact (EA)	Major	Rarely	4	1	5	Moderate
	2.1C6	Downstream water quality degrades over time after closure	ML/ARD higher than expected on WRSF (Waste)	Downstream water quality degradation after the removal of Alpha Pond	Water Quality no longer meets discharge limits so requires treatment and/or cover of WRSF	Closure	Geochemical testing during planning, closure plans, monitoring	Consequence Costs (CC)	Moderate	Rarely	3	1	4	Low
	2.1C7	Higher arsenic materials left at surface	Higher than anticipated arsenic content in Waste rock	Potential for direct contact exposure for people using the land after closure	Potential for increased health risk due to increased arsenic exposure	Closure	Geochemical testing during planning, closure plans, monitoring	Human Health and Safety (HSS)	Moderate	Rarely	3	1	4	Low
	2.1C8	Higher arsenic materials left at surface	Higher than anticipated arsenic content in Waste rock	Potential for direct contact exposure for people using the land after closure	Potential for increased health risk due to increased arsenic exposure	Closure	Geochemical testing during planning, closure plans, monitoring	Traditional Use (TU)	Moderate	Rarely	3	1	4	Low
2 - Beta Waste Rock Storage Facility														
P - Physical Stability														
	2.2P1	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	Erosion into watershed that reports to alpha pond	Increased TSS in Alpha Pond	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Environmental Impact (EA)	Minor	Unlikely	2	2	4	Low
	2.2P2	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	Failure of the facility onto the slope below	Remediation and alternative source for Kona backfill	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Consequence Costs (CC)	Insignificant	Rarely	1	1	2	Low
	2.2P3	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	Failure of the facility onto the slope below	fatality	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Human Health and Safety (HSS)	Severe	Rarely	5	1	6	Moderate
	2.2P4	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	rehandling of waste material for backfill	Loss time injury	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Human Health and Safety (HSS)	insignificant	Rarely	1	1	2	Low

RISK IDENTIFICATION						RISK MANAGEMENT ACTIVITIES IN PLACE		LOCATION LEVEL RISK ASSESSMENT						
								Risk Impact			Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence	Likelihood of Occurrence	Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	2.2P5	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	rehandling of waste material for backfill	additional haulage cost	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Consequence Costs (CC)	Insignificant	Rarely	1	1	2	Low
	2.2P6	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	Failure of the facility	Order issued until resolved	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Regulatory and Legal (RL)	Minor	Rarely	2	1	3	Low
	2.2P7	Slope failure - localized	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	crest failing	temporary loss of access	Operations	Factor of Safety in design, Operations management plan	Consequence Costs (CC)	Insignificant	Possible	1	3	4	Low
C - Chemical Stability														
	2.2C1	Higher arsenic materials left at surface	Higher than anticipated arsenic content in Waste rock	Potential for direct contact exposure for people using the land after closure	Potential for increased health risk due to increased arsenic exposure	Closure	Geochemical testin during planning, closure plans, monitoring	Human Health and Safety (HSS)	Moderate	Rarely	3	1	4	Low
	2.2C2	Higher arsenic materials left at surface	Higher than anticipated arsenic content in Waste rock	Potential for direct contact exposure for people using the land after closure	Potential for increased health risk due to increased arsenic exposure	Closure	Geochemical testin during planning, closure plans, monitoring	Traditional Use (TU)	Moderate	Rarely	3	1	4	Low
	2.2C3	Water Quality in Alpha pond doesn't meet discharge limits	ML/ARD higher than expected on WRSF (Waste)	Out of compliance water released into environment	Discharge illicits chronic toxicity response	Operations	Pump back to pits of other holding facilities; water treatment	Environmental Impact (EA)	Moderate	Unlikely	3	2	5	Moderate
	2.2C4	Water Quality in Alpha pond doesn't meet discharge limits	ML/ARD higher than expected on WRSF (Waste)	Out of compliance water released into environment	Not allowed to be discharging; suspend permit to operate	Operations	Pump back to pits of other holding facilities; water treatment	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate
	2.2C5	Water Quality in Alpha pond doesn't meet discharge limits	ML/ARD higher than expected on WRSF (Waste)	Out of compliance water released into environment	Regional (Yukon) negative publicity	Operations	Pump back to pits of other holding facilities; water treatment; proactive communication	ommunity/ Media/ Reputation (CMI	Moderate	Unlikely	3	2	5	Moderate
	2.2C6	Water Quality in Alpha pond doesn't meet discharge limits	ML/ARD higher than expected on WRSF (Waste)	Out of compliance water released into environment	Build water treatment plant	Operations	Pump back to pits of other holding facilities; water treatment; proactive communication	Consequence Costs (CC)	Minor	Unlikely	2	2	4	Low
3 - ROM Stockpile														
P - Physical Stability														
	2.3P1	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	failure of the facility	Erosion and sediment into Latte Creek	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Environmental Impact (EA)	Moderate	Unlikely	3	2	5	Moderate
	2.3P2	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	failure of the facility	Remediation of Erosion and sediment into Latte Creek, construction of alternative stockpile	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Consequence Costs (CC)	Insignificant	Unlikely	1	2	3	Low
	2.3P3	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	failure of facility into Coffee watershed.	Erosion and sediment into Latte Creek	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate
	2.3P4	Slope failure - mass	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	failure of facility into Coffee watershed.	Regional negative publicity	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	ommunity/ Media/ Reputation (CMI	Moderate	Unlikely	3	2	5	Moderate
	2.3P5	Slope failure - localized	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	crest failure	Remediation of crest	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Consequence Costs (CC)	Insignificant	Unlikely	1	2	3	Low
C - Chemical Stability														

RISK IDENTIFICATION						RISK MANAGEMENT ACTIVITIES IN PLACE	LOCATION LEVEL RISK ASSESSMENT						
							Risk Impact			Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence	Likelihood of Occurrence	Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	2.3C1	Water quality in Facility pond	ML/ARD higher than expected (Ore)	Increased pumping for Facility pond to Heap	Increased pumping from Facility Pond	Operations, Closure	Operations Management plan, Geochemical testing during planning	Environmental Impact (EA)	Insignificant	Unlikely	1	2	3	Low
4 - Frozen Material Stockpile														
P - Physical Stability														
	2.4P1	Slope failure	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	slope failure into Alpha Dump	increased sediment loading in Alpha Pond	Operations	Operations management plan, erosion control measures	Environmental Impact (EA)	Insignificant	Unlikely	1	2	3	Low
	2.4P2	Localized failure	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	Localize failure resulting in loss of use	Loss of use	Operations	Operations management plan, erosion control measures	Environmental Impact (EA)	Insignificant	Unlikely	1	2	3	Low
C - Chemical Stability														
	2.4C1	Increased TSS in Alpha pond	Higher than anticipated erosion off Frozen material stockpile at the time of high rainfall event	High TSS water released into environment	Increased sediment into halfway creek	Operations	Pump back to pits of other holding facilities; water treatment	Environmental Impact (EA)	Minor	Unlikely	2	2	4	Low
	2.4C2	Increased TSS in Alpha pond	Higher than anticipated erosion off Frozen material stockpile at the time of high rainfall event	High TSS water released into environment	Not allowed to be discharging; suspend permit to operate	Operations	Pump back to pits of other holding facilities; water treatment	Regulatory and Legal (RL)	Minor	Unlikely	2	2	4	Low
	2.4C3	Increased TSS in Alpha pond	Higher than anticipated erosion off Frozen material stockpile at the time of high rainfall event	High TSS water released into environment	Regional (Yukon) negative publicity	Operations	Pump back to pits of other holding facilities; water treatment; proactive communication	ommunity/ Media/ Reputation (CMI	Minor	Unlikely	2	2	4	Low
5 - Overburden Stockpile														
P - Physical Stability														
	2.5P1	Slope failure	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated	failure resulting in temporary loss of access to Kona (road obstruction)	loss of access to Kona for 1 week	Operations	Operations Management plan, pre-use geotechnical testing,	Consequence Costs (CC)	Insignificant	Unlikely	1	2	3	Low
C - Chemical Stability														
	2.5C1	Water Quality in Alpha pond doesn't meet discharge limits	Overburden stockpile slope failure, or unanticipated geochemical properties	Out of compliance water released into environment	Discharge elicits chronic toxicity response	Operations	Pump back to pits of other holding facilities; water treatment	Environmental Impact (EA)	Moderate	Unlikely	3	2	5	Moderate
	2.5C2	Water Quality in Alpha pond doesn't meet discharge limits	Overburden stockpile slope failure, or unanticipated geochemical properties	Out of compliance water released into environment	Not allowed to be discharging; suspend permit to operate	Operations	Pump back to pits of other holding facilities; water treatment	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate
	2.5C3	Water Quality in Alpha pond doesn't meet discharge limits	Overburden stockpile slope failure, or unanticipated geochemical properties	Out of compliance water released into environment	Regional (Yukon) negative publicity	Operations	Pump back to pits of other holding facilities; water treatment; proactive communication	ommunity/ Media/ Reputation (CMI	Moderate	Unlikely	3	2	5	Moderate
	2.5C4	Water Quality in Alpha pond doesn't meet discharge limits	Overburden stockpile slope failure, or unanticipated geochemical properties	Out of compliance water released into environment	Build water treatment plant	Operations	Pump back to pits of other holding facilities; water treatment; proactive communication	Consequence Costs (CC)	Minor	Unlikely	2	2	4	Low
1 - Heap Leach Pad														
W - Water Management														
	3.1W1	Too much water in HLF (impact of raincoats)	Increased precipitation compared to Water balance model, Experienced rainfall higher than climate model suggests	Increase of water in the HLF impacts the event ponds ability to hold PMP event	Operations cease until PMP capacity is restored	Operations	Updating of Water Balance model to be updated dynamically, Operational Management Plans	Regulatory and Legal (RL)	Major	Unlikely	4	2	6	Moderate
	3.1W2	Too much water in HLF (impact of raincoats)	Increased precipitation compared to Water balance model, Experienced rainfall higher than climate model suggests	Water balance model shows less water then experienced	Water Treatment plant required sooner than anticipated and requires greater capacity	Operations, Closure	Updating of Water Balance model to be updated dynamically, Operational Management Plans	Consequence Costs (CC)	Minor	Possible	2	3	5	Moderate
	3.1W3	Not enough water in HLF	Drought, sufficient quantities not captured at freshet, planning not optimized	Not enough water to supply the heap for the year	Delay in starting of leaching ore	Operations	Operational Management Plans	Consequence Costs (CC)	Moderate	Possible	3	3	6	Moderate

RISK IDENTIFICATION							RISK MANAGEMENT ACTIVITIES IN PLACE	LOCATION LEVEL RISK ASSESSMENT						
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Risk Impact		Likelihood of Occurrence	Location Residual Risk Score			
								Consequence Categories	Consequence		Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	3.1W4	Rinsing of heap in closure is not as effective as planned	Geochemical makeup of ore different from anticipated	Rinsing after closure not as effective/taking longer than planned	Improved heap cover at closure required	Closure	Progressive rinsing during operations will allow for early assessment of effectiveness	Consequence Costs (CC)	Minor	Possible	2	3	5	Moderate
	3.1W5	Freezing of heap	Experience temperatures consistently below anticipated temperatures	Heap freezing	Stacking only possible 6 months of year	Operations	Robust thermal modelling and appropriate equipment sizing	Consequence Costs (CC)	Moderate	Possible	3	3	6	Moderate
P - Physical Stability														
	3.1P1	Slope failure of HLF	Slope destabilization due to ground characterization, changing ground conditions (i.e. Permafrost), high rain events, earthquake, loss of permeability of heap	Slope failure significant so that Ore leaves containment	Contamination of Latte or Halfway Creek	Operations, Closure	Adequate site investigations and Factor of Safety in design. Operational Management plans and monitoring systems in operations.	Environmental Impact (EA)	Major	Unlikely	4	2	6	Moderate
	3.1P2	Slope failure of HLF	Slope destabilization due to ground characterization, changing ground conditions (i.e. Permafrost), high rain events, earthquake, loss of permeability of heap	Slope failure significant so that Ore leaves containment	Contamination of Latte or Halfway Creek	Operations, Closure	Adequate site investigations and Factor of Safety in design. Operational Management plans and monitoring systems in operations.	Regulatory and Legal (RL)	Major	Unlikely	4	2	6	Moderate
	3.1P3	Slope failure of HLF	Slope destabilization due to ground characterization, changing ground conditions (i.e. Permafrost), high rain events, earthquake, loss of permeability of heap	Slope failure significant so that Ore leaves containment	Contamination of Latte or Halfway Creek, requiring cleanup and abandonment of HL	Operations, Closure	Adequate site investigations and Factor of Safety in design. Operational Management plans and monitoring systems in operations.	Consequence Costs (CC)	Major	Unlikely	4	2	6	Moderate
	3.1P4	Slope failure of HLF	Slope destabilization due to ground characterization, changing ground conditions (i.e. Permafrost), high rain events, earthquake, loss of permeability of heap	Slope failure significant so that Ore leaves containment	Contamination of Latte or Halfway Creek	Operations, Closure	Adequate site investigations and Factor of Safety in design. Operational Management plans and monitoring systems in operations.	ommunity/ Media/ Reputation (CMI	Moderate	Unlikely	3	2	5	Moderate
	3.1P5	Slope failure of HLF	Slope destabilization due to ground characterization, changing ground conditions (i.e. Permafrost), high rain events, earthquake, loss of permeability of heap	Slope failure significant so that Ore leaves containment	Contamination of Latte or Halfway Creek	Operations, Closure	Adequate site investigations and Factor of Safety in design. Operational Management plans and monitoring systems in operations.	Traditional Use (TU)	Moderate	Unlikely	3	2	5	Moderate
	3.1P6	Failure of liner at base of HLF	Undetected construction defects, damage during ore stacking, damage due to slope failure, Leak detection system fails	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Adequate site investigations and Factor of Safety in design. Operational Management plans and monitoring systems in operations.	Environmental Impact (EA)	Major	Unlikely	4	2	6	Moderate
	3.1P7	Failure of liner at base of HLF	Undetected construction defects, damage during ore stacking, damage due to slope failure, Leak detection system fails	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Regulatory and Legal (RL)	Major	Unlikely	4	2	6	Moderate
	3.1P8	Failure of liner at base of HLF	Undetected construction defects, damage during ore stacking, damage due to slope failure, Leak detection system fails	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks, remediation required and abandonment of section of HLF	Operations	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Consequence Costs (CC)	Severe	Rarely	5	1	6	Moderate
	3.1P9	Failure of liner at base of HLF	Undetected construction defects, damage during ore stacking, damage due to slope failure, Leak detection system fails	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	ommunity/ Media/ Reputation (CMI	Moderate	Unlikely	3	2	5	Moderate
	3.1P10	Failure of liner at base of HLF	Undetected construction defects, damage during ore stacking, damage due to slope failure, Leak detection system fails	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Traditional Use (TU)	Moderate	Unlikely	3	2	5	Moderate

RISK IDENTIFICATION						RISK MANAGEMENT ACTIVITIES IN PLACE		LOCATION LEVEL RISK ASSESSMENT						
								Risk Impact			Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence	Likelihood of Occurrence	Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	3.1P11	Failure of liner at base of HLF	Undetected construction defects, damage during ore stacking, damage due to slope failure, Leak detection system fails	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Closure	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate
	3.1P12	Failure of liner at base of HLF	Undetected construction defects, damage during ore stacking, damage due to slope failure, Leak detection system fails	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Closure	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Consequence Costs (CC)	Moderate	Unlikely	3	2	5	Moderate
	3.1P13	Failure of Pumping system	Physical failure of piping or mechanical failure of equipment due to manufacturing, earthquake, freezing conditions, site interactions	pump or valve failure causing uncontrolled discharge of process solution	Localized contamination of surface sediments (downstream of heap)	Operations	Secondary containment, maintaining surrounding vegetation for passive filtration	Environmental Impact (EA)	Moderate	Possible	3	3	6	Moderate
	3.1P14	Failure of Pumping system	Physical failure of piping or mechanical failure of equipment due to manufacturing, earthquake, freezing conditions, site interactions	pump or valve failure causing uncontrolled discharge of process solution	Localized contamination of surface sediments (downstream of heap)	Operations	Secondary containment, maintaining surrounding vegetation for passive filtration	Consequence Costs (CC)	Minor	Possible	2	3	5	Moderate
	3.1P15	Failure of Pumping system	Physical failure of piping or mechanical failure of equipment due to manufacturing, earthquake, freezing conditions, site interactions	pump or valve failure causing uncontrolled discharge of process solution	Localized contamination of surface sediments (downstream of heap)	Operations	Secondary containment, maintaining surrounding vegetation for passive filtration	Regulatory and Legal (RL)	Moderate	Possible	3	3	6	Moderate
	3.1P16	Loss of permeability	Ore behaviour different than anticipated, compaction during stacking	Loss of production and early closure	Lost NPV due to section of heap being abandoned	Operations	Operational Management Plans, monitoring of HLF	Consequence Costs (CC)	Major	Unlikely	4	2	6	Moderate
C - Chemical Stability														
	3.1C1	ML/ARD higher than expected on HLF (Ore)	Geochemical makeup of ore different from anticipated	Rinsing after closure not as effective/taking longer than planned	Improved heap cover at closure required	Closure	Progressive rinsing during operations will allow for early assessment of effectiveness	Consequence Costs (CC)	Minor	Possible	2	3	5	Moderate
	3.1C2	Insufficient appropriate material to cap the HLF	Geochemical makeup of ore different from anticipated	Rinsing after closure not as effective/taking longer than planned	Improved heap cover at closure required	Closure	Progressive rinsing during operations will allow for early assessment of effectiveness	Consequence Costs (CC)	Insignificant	Rarely	1	1	2	Low
	3.1C3	Release of process solution from containment	Liner failure, large scale slope failure, pumping or piping system failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Adequate site investigations and Factor of Safety in design. Operational Management plans and monitoring systems in operations.	Environmental Impact (EA)	Major	Unlikely	4	2	6	Moderate
	3.1C4	Release of process solution from containment	Liner failure, large scale slope failure, pumping or piping system failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Regulatory and Legal (RL)	Major	Unlikely	4	2	6	Moderate
	3.1C5	Release of process solution from containment	Liner failure, large scale slope failure, pumping or piping system failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks, remediation required and abandonment of section of HLF	Operations	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Consequence Costs (CC)	Severe	Rarely	5	1	6	Moderate
	3.1C6	Release of process solution from containment	Liner failure, large scale slope failure, pumping or piping system failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	ommunity/ Media/ Reputation (CMI	Moderate	Unlikely	3	2	5	Moderate
	3.1C7	Release of process solution from containment	Liner failure, large scale slope failure, pumping or piping system failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Traditional Use (TU)	Moderate	Unlikely	3	2	5	Moderate
	3.1C8	Release of process solution from containment	Liner failure, large scale slope failure, pumping or piping system failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Closure	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate

RISK IDENTIFICATION							RISK MANAGEMENT ACTIVITIES IN PLACE	LOCATION LEVEL RISK ASSESSMENT						
								Risk Impact			Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence	Likelihood of Occurrence	Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	3.1C9	Release of process solution from containment	Liner failure, large scale slope failure, pumping or piping system failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Closure	Adequate Factor of Safety in design, Leak detection system, Construction QC/QA procedures, Operational Management plans	Consequence Costs (CC)	Moderate	Unlikely	3	2	5	Moderate
2 - Event Ponds														
W - Water Management														
P - Physical Stability														
	3.2P1	Embankment Failure	Slope failure due to instability, ground conditions not properly characterized, earthquake. Overtopping due to excessive water in HLF, event larger than the PMP	Sudden and large release of process solution	Process solution flood plant/camp area causing loss of life	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Human Health and Safety (HSS)	Severe	Rarely	5	1	6	Moderate
	3.2P2	Embankment Failure	Slope failure due to instability, ground conditions not properly characterized, earthquake. Overtopping due to excessive water in HLF, event larger than the PMP	Sudden and large release of process solution	Process solution impacting halfway and Latte creeks	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Environmental Impact (EA)	Major	Rarely	4	1	5	Moderate
	3.2P3	Embankment Failure	Slope failure due to instability, ground conditions not properly characterized, earthquake. Overtopping due to excessive water in HLF, event larger than the PMP	Sudden and large release of process solution	Process solution impacting halfway and Latte creeks	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Regulatory and Legal (RL)	Major	Rarely	4	1	5	Moderate
	3.2P4	Embankment Failure	Slope failure due to instability, ground conditions not properly characterized, earthquake. Overtopping due to excessive water in HLF, event larger than the PMP	Sudden and large release of process solution	Process solution impacting halfway and Latte creeks, remediation required, temporary shutdown of mine while ponds are rebuilt	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Consequence Costs (CC)	Major	Rarely	4	1	5	Moderate
	3.2P5	Embankment Failure	Slope failure due to instability, ground conditions not properly characterized, earthquake. Overtopping due to excessive water in HLF, event larger than the PMP	Sudden and large release of process solution	Process solution impacting halfway and Latte creeks	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	ommunity/ Media/ Reputation (CME	Major	Rarely	4	1	5	Moderate
	3.2P6	Embankment Failure	Slope failure due to instability, ground conditions not properly characterized, earthquake. Overtopping due to excessive water in HLF, event larger than the PMP	Sudden and large release of process solution	Process solution impacting halfway and Latte creeks	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Traditional Use (TU)	Major	Rarely	4	1	5	Moderate
	3.2P7	Failure of Liner	Construction defects, Ice freezing causing damage, deformation of foundations	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Environmental Impact (EA)	Moderate	Unlikely	3	2	5	Moderate
	3.2P8	Failure of Liner	Construction defects, Ice freezing causing damage, deformation of foundations	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate
	3.2P9	Failure of Liner	Construction defects, Ice freezing causing damage, deformation of foundations	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks, remediation required and temporary shutdown while liner	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Consequence Costs (CC)	Minor	Possible	2	3	5	Moderate
	3.2P10	Failure of Liner	Construction defects, Ice freezing causing damage, deformation of foundations	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	ommunity/ Media/ Reputation (CME	Minor	Unlikely	2	2	4	Low

RISK IDENTIFICATION						RISK MANAGEMENT ACTIVITIES IN PLACE		LOCATION LEVEL RISK ASSESSMENT						
								Risk Impact			Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence	Likelihood of Occurrence	Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	3.2P11	Failure of Liner	Construction defects, Ice freezing causing damage, deformation of foundations	Excessive leakage through liner	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Traditional Use (TU)	Minor	Unlikely	2	2	4	Low
	3.2P12	Freezing of event ponds	Insufficient water volume in ponds prior to winter, winter temperatures significantly lower than anticipated	Water in event ponds freeze fully causing shortage in water	Delayed irrigation of fresh ore in the spring	Operations	Operational Management plans	Consequence Costs (CC)	Minor	Likely	2	4	6	Moderate
C - Chemical Stability														
	3.2C1	Release of process solution from containment	Failure of liner, embankment failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Environmental Impact (EA)	Moderate	Unlikely	3	2	5	Moderate
	3.2C2	Release of process solution from containment	Failure of liner, embankment failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate
	3.2C3	Release of process solution from containment	Failure of liner, embankment failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks, remediation required and temporary shutdown while liner repaired	Operations	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Consequence Costs (CC)	Minor	Possible	2	3	5	Moderate
	3.2C4	Release of process solution from containment	Failure of liner, embankment failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	ommunity/ Media/ Reputation (CMF	Minor	Unlikely	2	2	4	Low
	3.2C5	Release of process solution from containment	Failure of liner, embankment failure	Release of process solution	Contamination of groundwater, or direct contamination of halfway or latte creeks	Operations, Closure	Operational Management plans, Monitoring of event ponds in operations, Factor of Safety incorporated into design	Traditional Use (TU)	Minor	Unlikely	2	2	4	Low
1 - Alpha Pond														
P - Physical Stability														
	4.1P1	Dam Embankment Failure	Greater than 200 year storm, earthquake, unanticipated impact of changes to permafrost (beyond expected / planned slow longterm permafrost degredation), embankment failure of event ponds when full, mischaracterized geotechnical conditions, excessive seepage through foundations	Environmental deposition of embankment materials in halfway creek and temporary increase in downstream flow rates and loading	high flows; erosion of channel; habitat loss; sediment deposition; increase of turbidity levels	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures. Regular monitoring and maintenance to ensure deformation from permafrost degradation can be observed and repaired if/ as needed (rates of degredation expected to be slow).	Environmental Impact (EA)	Major	Unlikely	4	2	6	Moderate
	4.1P2	Dam Embankment Failure	Greater than 200 year storm, earthquake, unanticipated impact of changes to permafrost (beyond expected / planned slow longterm permafrost degredation), embankment failure of event ponds when full, mischaracterized geotechnical conditions, excessive seepage through foundations	Dam failure; short term damage culturally; detailed as per CDA	clean up and re-build dam	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures. Regular monitoring and maintenance to ensure deformation from permafrost degradation can be observed and repaired if/ as needed (rates of degredation expected to be slow).	Consequence Costs (CC)	Minor	Unlikely	2	2	4	Low

RISK IDENTIFICATION					RISK MANAGEMENT ACTIVITIES IN PLACE			LOCATION LEVEL RISK ASSESSMENT						
								Risk Impact		Likelihood of Occurrence	Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence		Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	4.1P3	Dam Embankment Failure	Greater than 200 year storm, earthquake, unanticipated impact of changes to permafrost (beyond expected / planned slow longterm permafrost degredation), embankment failure of event ponds when full, mischaracterized geotechnical conditions, excessive seepage through foundations	Environmental deposition of embankment materials in halfway creek and temporary increase in downstream flow rates and loading	Regional (Yukon) negative publicity	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures. Regular monitoring and maintenance to ensure deformation from permafrost degradation can be observed and repaired if/ as needed (rates of degredation expected to be slow).	ommunity/ Media/ Reputation (CMF	Moderate	Unlikely	3	2	5	Moderate
	4.1P4	Dam Embankment Failure	Greater than 200 year storm, earthquake, unanticipated impact of changes to permafrost (beyond expected / planned slow longterm permafrost degredation), embankment failure of event ponds when full, mischaracterized geotechnical conditions, excessive seepage through foundations	Environmental deposition of embankment materials in halfway creek and temporary increase in downstream flow rates and loading	high flows; erosion of channel; habitat loss; sediment deposition; increase of turbidity levels	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures. Regular monitoring and maintenance to ensure deformation from permafrost degradation can be observed and repaired if/ as needed (rates of degredation expected to be slow).	Traditional Use (TU)	Minor	Unlikely	2	2	4	Low
	4.1P5	Large scale failure of Alpha WRSF leading to diversions and alpha dam embankment failure	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost	Dam failure; short term damage culturally; detailed as per CDA	clean up and re-build dam	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Environmental Impact (EA)	Major	Rarely	4	1	5	Moderate
	4.1P6	Large scale failure of Alpha WRSF leading to diversions and alpha dam embankment failure	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost	Dam failure; short term damage culturally; detailed as per CDA	clean up and re-build dam	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Consequence Costs (CC)	Minor	Rarely	2	1	3	Low
	4.1P7	Large scale failure of Alpha WRSF leading to diversions and alpha dam embankment failure	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost	Dam failure; short term damage culturally; detailed as per CDA	clean up and re-build dam	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	ommunity/ Media/ Reputation (CMF	Moderate	Rarely	3	1	4	Low
	4.1P8	Large scale failure of Alpha WRSF leading to diversions and alpha dam embankment failure	Unanticipated rainfall volume, earthquake, geotechnical characteristics different than anticipated, unanticipated changes to permafrost	Dam failure; short term damage culturally; detailed as per CDA	clean up and re-build dam	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Traditional Use (TU)	Minor	Rarely	2	1	3	Low
	4.1P9	Slope (around pond) Destabilization (above/below)	Slope destabilization due to heavy rainfall, permafrost degradation	Increased sediment load to the pond	high TSS concentrations	Construction, Operations, Closure	Pre-design geotechnical testing, Operations management plan, erosion control measures	Environmental Impact (EA)	Minor	Almost Certain	2	5	7	Moderately High
	4.1P10	Spillway blockage	Ice build up, sediment deposition, storm debris	Dam failure at less than 1 in 200 years	high flows; erosion of channel; habitat loss; sediment deposition; increase of torridity levels	Construction, Operations, Closure	Operations Management plan, Monitoring system	Environmental Impact (EA)	Major	Rarely	4	1	5	Moderate
	4.1P11	Spillway blockage	Ice build up, sediment deposition, storm debris	Dam failure at less than 1 in 200 years	clean up and re-build dam	Construction, Operations, Closure	Operations Management plan, Monitoring system	Consequence Costs (CC)	Minor	Rarely	2	1	3	Low
	4.1P12	Spillway blockage	Ice build up, sediment deposition, storm debris	Dam failure at less than 1 in 200 years	Regional (Yukon) negative publicity	Construction, Operations, Closure	Operations Management plan, Monitoring system	ommunity/ Media/ Reputation (CMF	Moderate	Rarely	3	1	4	Low
	4.1P13	Spillway blockage	Ice build up, sediment deposition, storm debris	Dam failure at less than 1 in 200 years	high flows; erosion of channel; habitat loss; sediment deposition; increase of torridity levels	Construction, Operations, Closure	Operations Management plan, Monitoring system	Traditional Use (TU)	Minor	Unlikely	2	2	4	Low

RISK IDENTIFICATION							RISK MANAGEMENT ACTIVITIES IN PLACE	LOCATION LEVEL RISK ASSESSMENT						
								Risk Impact			Location Residual Risk Score			
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Consequence Categories	Consequence	Likelihood of Occurrence	Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	4.1P14	Spillway failure due to deformation	Settlement due to ground conditions, erosion	Dam failure at less than 1 in 200 years	high flows; erosion of channel; habitat loss; sediment deposition; increase of torridity levels	Construction, Operations, Closure	Pre-design geotechnical testing, regular maintenance, Operations Management Plan	Environmental Impact (EA)	Major	Rarely	4	1	5	Moderate
	4.1P15	Spillway failure due to deformation	Settlement due to ground conditions, erosion	Dam failure at less than 1 in 200 years	clean up and re-build dam	Construction, Operations, Closure	Pre-design geotechnical testing, regular maintenance, Operations Management Plan	Consequence Costs (CC)	Minor	Rarely	2	1	3	Low
	4.1P16	Spillway failure due to deformation	Settlement due to ground conditions, erosion	Dam failure at less than 1 in 200 years	Regional (Yukon) negative publicity	Construction, Operations, Closure	Pre-design geotechnical testing, regular maintenance, Operations Management Plan	ommunity/ Media/ Reputation (CMF	Moderate	Rarely	3	1	4	Low
	4.1P17	Spillway failure due to deformation	Settlement due to ground conditions, erosion	Dam failure at less than 1 in 200 years	high flows; erosion of channel; habitat loss; sediment deposition; increase of torridity levels	Construction, Operations, Closure	Pre-design geotechnical testing, regular maintenance, Operations Management Plan	Traditional Use (TU)	Minor	Unlikely	2	2	4	Low
C - Chemical Stability														
	4.1C1	Potential for non-complian	Unanticipated Geochemical properties of material in Alpha WRSF, Beta WRSF, Overburden stockpile, receipt of water from the Facility pond due to high rain events, receipt of water from HL event ponds	Out of compliance water released into environment	Discharge elicits chronic toxicity response	Construction, Operations, Closure	Pump back to pits of other holding facilities; water treatment	Environmental Impact (EA)	Moderate	Unlikely	3	2	5	Moderate
	4.1C2	Potential for non-complian	Unanticipated Geochemical properties of material in Alpha WRSF, Beta WRSF, Overburden stockpile, receipt of water from the Facility pond due to high rain events, receipt of water from HL event ponds	Out of compliance water released into environment	Not allowed to be discharging; suspend permit to operate	Construction, Operations, Closure	Pump back to pits of other holding facilities; water treatment	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate
	4.1C3	Potential for non-complian	Unanticipated Geochemical properties of material in Alpha WRSF, Beta WRSF, Overburden stockpile, receipt of water from the Facility pond due to high rain events, receipt of water from HL event ponds	Out of compliance water released into environment	Regional (Yukon) negative publicity	Construction, Operations, Closure	Pump back to pits of other holding facilities; water treatment; proactive communication	ommunity/ Media/ Reputation (CMF	Moderate	Unlikely	3	2	5	Moderate
	4.1C4	Potential for non-complian	Unanticipated Geochemical properties of material in Alpha WRSF, Beta WRSF, Overburden stockpile, receipt of water from the Facility pond due to high rain events, receipt of water from HL event ponds	Out of compliance water released into environment	Build water treatment plant	Construction, Operations, Closure	Pump back to pits of other holding facilities; water treatment; proactive communication	Consequence Costs (CC)	Minor	Unlikely	2	2	4	Low
2 - Facility Pond														
P - Physical Stability														
	4.2P1	Embankment Failure	slope destabilization, Rain event higher than design, event ponds full and unable to pump back into HLF, ROM stockpile failure	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Environmental Impact (EA)	Moderate	Unlikely	3	2	5	Moderate
	4.2P2	Embankment Failure	slope destabilization, Rain event higher than design, event ponds full and unable to pump back into HLF, ROM stockpile failure	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Regulatory and Legal (RL)	Moderate	Unlikely	3	2	5	Moderate

RISK IDENTIFICATION							RISK MANAGEMENT ACTIVITIES IN PLACE	LOCATION LEVEL RISK ASSESSMENT						
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Risk Impact		Likelihood of Occurrence	Location Residual Risk Score			
								Consequence Categories	Consequence		Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	4.2P3	Embankment Failure	slope destabilization, Rain event higher than design, event ponds full and unable to pump back into HLF, ROM stockpile failure	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Consequence Costs (CC)	Minor	Rarely	2	1	3	Low
	4.2P4	Embankment Failure	slope destabilization, Rain event higher than design, event ponds full and unable to pump back into HLF, ROM stockpile failure	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	ommunity/ Media/ Reputation (CMI	Minor	Rarely	2	1	3	Low
	4.2P5	Embankment Failure	slope destabilization, Rain event higher than design, event ponds full and unable to pump back into HLF, ROM stockpile failure	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Traditional Use (TU)	Minor	Rarely	2	1	3	Low
C - Chemical Stability														
	4.2C1	Discharge to Latte from storm greater than pump back system	Rain event higher than design	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Pump back system, Operational Management plan	Environmental Impact (EA)	Minor	Unlikely	2	2	4	Low
	4.2C2	Discharge to Latte from storm greater than pump back system	Rain event higher than design	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Pump back system, Operational Management plan	Regulatory and Legal (RL)	Minor	Unlikely	2	2	4	Low
	4.2C3	Discharge to Latte from storm greater than pump back system	Rain event higher than design	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Pump back system, Operational Management plan	ommunity/ Media/ Reputation (CMI	Minor	Unlikely	2	2	4	Low
	4.2C4	Discharge to Latte from storm greater than pump back system	Rain event higher than design	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Pump back system, Operational Management plan	Traditional Use (TU)	Minor	Unlikely	2	2	4	Low
3 - Water Diversions														
P - Physical Stability														
	4.3P1	Embankment Failure - Westside Diversion	Permafrost degradation, Rainfall higher than design, channel blockage due to ice or debris, freezing or blockage of rock drain causing overtopping and increase flow rates into the diversion	Increased Waterflow into Alpha Pond causing dam failure	high flows; erosion of channel; habitat loss; sediment deposition; increase of torridity levels	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Environmental Impact (EA)	Major	Unlikely	4	2	6	Moderate

RISK IDENTIFICATION						RISK MANAGEMENT ACTIVITIES IN PLACE		LOCATION LEVEL RISK ASSESSMENT						
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Risk Impact		Likelihood of Occurrence	Location Residual Risk Score			
								Consequence Categories	Consequence		Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	4.3P2	Embankment Failure - Westside Diversion	Permafrost degradation, Rainfall higher than design, channel blockage due to ice or debris, freezing or blockage of rock drain causing overtopping and increase flow rates into the diversion	Increased Waterflow into Alpha Pond causing dam failure	clean up and re-build dam	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Consequence Costs (CC)	Minor	Unlikely	2	2	4	Low
	4.3P3	Embankment Failure - Westside Diversion	Permafrost degradation, Rainfall higher than design, channel blockage due to ice or debris, freezing or blockage of rock drain causing overtopping and increase flow rates into the diversion	Increased Waterflow into Alpha Pond causing dam failure	Regional (Yukon) negative publicity	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	ommunity/ Media/ Reputation (CMI	Moderate	Unlikely	3	2	5	Moderate
	4.3P4	Embankment Failure - Westside Diversion	Permafrost degradation, Rainfall higher than design, channel blockage due to ice or debris, freezing or blockage of rock drain causing overtopping and increase flow rates into the diversion	Increased Waterflow into Alpha Pond causing dam failure	high flows; erosion of channel; habitat loss; sediment deposition; increase of torridity levels	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Traditional Use (TU)	Minor	Unlikely	2	2	4	Low
	4.3P5	Embankment Failure - Facility pond Channels	Rainfall higher than design, channel blockage due to ice or debris	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Design criteria, Operational Management plan, passive filtering through undisturbed vegetation	Environmental Impact (EA)	Minor	Unlikely	2	2	4	Low
	4.3P6	Embankment Failure - Facility pond Channels	Rainfall higher than design, channel blockage due to ice or debris	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Design criteria, Operational Management plan, passive filtering through undisturbed vegetation	Consequence Costs (CC)	Minor	Unlikely	2	2	4	Low
	4.3P7	Embankment Failure - Facility pond Channels	Rainfall higher than design, channel blockage due to ice or debris	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Design criteria, Operational Management plan, passive filtering through undisturbed vegetation	ommunity/ Media/ Reputation (CMI	Minor	Unlikely	2	2	4	Low
	4.3P8	Embankment Failure - Facility pond Channels	Rainfall higher than design, channel blockage due to ice or debris	Contact water into Latte Creek	Water quality in Latte Creek exceeds water quality objectives for short duration	Construction, Operations, Closure	Design criteria, Operational Management plan, passive filtering through undisturbed vegetation	Traditional Use (TU)	Minor	Unlikely	2	2	4	Low
5 - Rock Drain														
P - Physical Stability														
	4.5P1	Blockage of rock drain leads to westside diversion failure	Freezing of rock drain, large scale blockage upstream of rock drain	Increased Waterflow into Alpha Pond causing dam failure	high flows; erosion of channel; habitat loss; sediment deposition; increase of torridity levels	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Environmental Impact (EA)	Major	Rarely	4	1	5	Moderate
	4.5P2	Blockage of rock drain leads to westside diversion failure	Freezing of rock drain, large scale blockage upstream of rock drain	Increased Waterflow into Alpha Pond causing dam failure	clean up and re-build dam	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Consequence Costs (CC)	Minor	Rarely	2	1	3	Low
	4.5P3	Blockage of rock drain leads to westside diversion failure	Freezing of rock drain, large scale blockage upstream of rock drain	Increased Waterflow into Alpha Pond causing dam failure	Regional (Yukon) negative publicity	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	ommunity/ Media/ Reputation (CMI	Moderate	Rarely	3	1	4	Low
	4.5P4	Blockage of rock drain leads to westside diversion failure	Freezing of rock drain, large scale blockage upstream of rock drain	Increased Waterflow into Alpha Pond causing dam failure	high flows; erosion of channel; habitat loss; sediment deposition; increase of torridity levels	Construction, Operations, Closure	Dam design as per CDA, pre-design geotechnical testing, Operations Management Plan, Construction QC/QC procedures	Traditional Use (TU)	Minor	Rarely	2	1	3	Low
	4.5P5	Ponding water on upstream of rock drain leads to slope failure on Alpha WRSF	Permafrost degradation due to static water pond	failure of the WRSF	increased footprint	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Environmental Impact (EA)	Minor	Rarely	2	1	3	Low
	4.5P6	Ponding water on upstream of rock drain leads to slope failure on Alpha WRSF	Permafrost degradation due to static water pond	failure of the WRSF facility resulting in no location to place waste.	Ultimate closure of the mine	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Consequence Costs (CC)	Severe	Rarely	5	1	6	Moderate

RISK IDENTIFICATION							RISK MANAGEMENT ACTIVITIES IN PLACE	LOCATION LEVEL RISK ASSESSMENT						
Area	Risk Number	Risk	Leading Factors	Description / Impact	Maximum Credible Consequences	Phase	Risk Management Controls in Place	Risk Impact		Likelihood of Occurrence	Location Residual Risk Score			
								Consequence Categories	Consequence		Consequence Score	Likelihood Score	Location Residual Risk Score	Location Residual Risk Ranking
	4.5P7	Ponding water on upstream of rock drain leads to slope failure on Alpha WRSF	Permafrost degradation due to static water pond	failure of facility with workers below.	Fatality	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Human Health and Safety (HSS)	Severe	Rarely	5	1	6	Moderate
	4.5P8	Ponding water on upstream of rock drain leads to slope failure on Alpha WRSF	Permafrost degradation due to static water pond	failure of the WRSF	Order issued until resolved	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	Regulatory and Legal (RL)	Moderate	Rarely	3	1	4	Low
	4.5P9	Ponding water on upstream of rock drain leads to slope failure on Alpha WRSF	Permafrost degradation due to static water pond	failure of the WRSF	Regional negative publicity	Operations	Factor of Safety in design, Operations management plan, slope stability monitoring	ommunity/ Media/ Reputation (CMF	Moderate	Rarely	3	1	4	Low
C - Chemical Stability														
	4.5C1	Upstream blockage of rock drain	migration of fines from upstream; sediment settling into permafrost; freezing of rock drain	Contact water from Kona WRSF is diverted into non-contact water	Contact water enters into clean water diversion	Operations	Pump it around to Alpha Pond	Environmental Impact (EA)	Insignificant	Unlikely	1	2	3	Low
	4.5C2	Upstream blockage of rock drain	migration of fines from upstream; sediment settling into permafrost; freezing of rock drain	Contact water from Kona WRSF is diverted into non-contact water	Contact water enters into clean water diversion; written letter	Operations	Pump it around to Alpha Pond	Regulatory and Legal (RL)	Minor	Unlikely	2	2	4	Low
	4.5C3	Freezing at the toe creates ponded water at base of WRSF	migration of fines from upstream; sediment settling into permafrost; freezing of rock drain	Out of compliance water released into environment	Discharge elicits chronic toxicity response	Operations, Closure	Timing of building rock drain (summer = reduced risk of trapping cold air)	Environmental Impact (EA)	Moderate	Rarely	3	1	4	Low

APPENDIX 2-M

2022 Coffee Mine FMEA Summary Report

Coffee Mine FMEA Summary Report

March 16, 2022



Newmont™

okane

Integrated Mine Closure and Relinquishment Solutions

Coffee Mine FMEA Summary Report

1075-220-018

March 2022

Prepared for:

Newmont
3-151 Industrial Road
Whitehorse, Yukon
Y1A 2V3

Prepared by:

Mitchell Barteaux
Senior Geoscientist
mbarteaux@okc-sk.com

Okane Consultants Inc.

112 - 112 Research Drive
Saskatoon, SK S7N 3R3
Canada

Telephone: (306) 955 0702
Facsimile: (306) 955 1596
Web: www.okc-sk.com

Rev. #	Rev. Date	Author	Reviewer	PM Sign-off
0	March 16, 2022	GH	DC	MB
1	March 28, 2022	GH	DC	MB
2	April 19, 2022	GH	DC	MB
3	May 19, 2023	BW	MB	MB

DISCLAIMER

This document has been provided by Okane Consultants Inc. (Okane) subject to the following limitations:

1. This document has been prepared for the client and for the particular purpose outlined in the Okane proposal and no responsibility is accepted for the use of this document, in whole or in part, in any other contexts or for any other purposes.
2. The scope and the period of operation of the Okane services are described in the Okane proposal and are subject to certain restrictions and limitations set out in the Okane proposal.
3. Okane did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referred to in the Okane proposal. If a service is not expressly indicated, the client should not assume it has been provided. If a matter is not addressed, the client should not assume that any determination has been made by Okane in regards to that matter.
4. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation, or information provided by the client or a third party and which have not therefore been taken into account in this document.
5. The passage of time will affect the information and assessment provided in this document. The opinions expressed in this document are based on information that existed at the time of the production of this document.
6. The investigations undertaken and services provided by Okane allowed Okane to form no more than an opinion of the actual conditions of the site at the time the site referred to in the Okane proposal was visited and the proposal developed and those investigations and services cannot be used to assess the effect of any subsequent changes in the conditions at the site, or its surroundings, or any subsequent changes in the relevant laws or regulations.
7. The assessments made in this document are based on the conditions indicated from published sources and the investigation and information provided. No warranty is included, either express or implied that the actual conditions will conform exactly to the assessments contained in this document.
8. Where data supplied by the client or third parties, including previous site investigation data, has been used, it has been assumed that the information is correct. No responsibility is accepted by Okane for the completeness or accuracy of the data supplied by the client or third parties.
9. This document is provided solely for use by the client and must be considered to be confidential information. The client agrees not to use, copy, disclose reproduce or make public this document, its contents, or the Okane proposal without the written consent of Okane.
10. Okane accepts no responsibility whatsoever to any party, other than the client, for the use of this document or the information or assessments contained in this document. Any use which a third party makes of this document or the information or assessments contained therein, or any reliance on or decisions made based on this document or the information or assessments contained therein, is the responsibility of that third party.
11. No section or element of this document may be removed from this document, extracted, reproduced, electronically stored or transmitted in any form without the prior written permission of Okane.

EXECUTIVE SUMMARY

Newmont is currently preparing construction and operational licencing applications for the proposed Coffee Mine Project (Project) located in Yukon, Canada. To support the licensing application, Newmont has retained Okane Consultants (Okane) to advance the Heap Leach Facility (HLF) closure design and provide guidance on cover system applications across the site. Okane has facilitated a failure modes and effects analysis (FMEA) workshop with the Project team. The FMEA workshop was utilized to identify inherent risks and opportunities within the Base Case design and outline strategies / future studies to mitigate Newmont's residual risks within the near- short- and long-term.

During the workshop, a predefined framework, developed collaboratively between Newmont and Okane, was used to rank identified failure modes with respect to an overarching statement or 'question'. The overarching question was:

> *"What are the risks to build, operate, and close the Newmont Coffee Project in a way that is implementable, permittable, economical, and provides confidence to all First Nations and Stakeholders that it will achieve acceptable terrestrial and water impacts to the surrounding environment?"*

Prior to the workshop, timeframes, likelihood definitions, and consequence definitions were set in collaboration with Newmont. The consequences and likelihood of a failure mode are dependent on the timeframe that it occurs in; therefore, timeframes of the Project were defined for each failure mode. Additionally, a set of fact sheets outlining all known information pertaining to the Coffee Project was developed and provided to all workshop participants.

During the FMEA workshop ten failure modes were identified to have severe or high risk rankings. To prioritize future studies / additional work, mitigations are sorted by the timeframe they are most likely to occur and then severity of risk ranking being addressed (Table ES).

Table ES.1.1: Summary of Severe and High Risk failure mode mitigations

Failure Mode Description	Timeframe*	Risk Ranking	Mitigation(s)
Proposed base case HLF cover system design is unacceptable to regulatory bodies and Stakeholders, resulting in redesign prior to issuance of water license and Quartz Mining Licence (QML).	Near-term	High	Early collaboration and circulation of base case design with Stakeholders and regulators to understand their acceptance.
Base case HLF cover system design does not match First Nations expectations, resulting in Newmont not meeting returning land use/closure performance criteria.	Near-term	High	Demonstrate why/how the base case design works and can meet returning land use and performance criteria (e.g., vegetation studies, field trials, constructability tests)
Lack of defined performance criteria for the Alpha WRSF leads to Stakeholders and First Nations not accepting the closure measures for the Alpha WRSF.	Near-term	High	Ongoing Stakeholder and First Nations consultation
			Development of end land use objectives and performance criteria
Net percolation through the HLF is in excess of passive treatment system capacity leading to an inability to sufficiently treat water and meet discharge criteria.	Short-term	Severe	Increase system capacity (extra pond/ET cell) to capture excess seepage prior to entering the passive treatment system.
HLF runoff and interflow management features fail, resulting in excessive erosion or slope failure and loss of cover system functionality.	Short-term	High	Develop surface water management design that can effectively transport water off the HLF landform.
Current Alpha WRSF closure configuration does not support target ecosystems and habitats, resulting in Newmont being unable to meet closure commitments.	Short-term	High	Revegetation research program. To date, everything has investigated cover surfaces and not bare waste rock as planned in the current base case design.
			Circulate base case design with Stakeholders, First Nations, and regulators to understand their acceptance.
Alpha Dam water quality is lower quality than predicted, resulting in exceedances of water quality guidelines.	Short-term	High	Pump Alpha Dam water back up to open pits for treatment.
Pit water quality spilling into Latte Creek watershed is of poor quality, resulting in impacts to receiving environments.	Short-term	High	Monitoring of pit water quality during pit filling to indicate any issues.
			Active water treatment if issues are identified during monitoring
			Additional backfill in pit

Failure Mode Description	Timeframe*	Risk Ranking	Mitigation(s)
PRB system is not effective in passively treating water in the long-term, resulting in exceedances of water quality objectives in Halfway Creek.	Long-term	Severe	In the near-term, conduct field trials on a PRB system to understand if this system can work for long-term treatment.
			Monitoring transition between active and passive treatment systems.
Water quality within Alpha Dam does not meet water quality criteria, resulting in inability to proceed with reclamation plan for the Alpha Dam (i.e., breach and decommissioning).	Long-term	High	Pump Alpha Dam water back up to open pits for treatment.

*Near-term = year -3 to year 10; Short-term = year 10 to year 25; Long-term = year 25 onward.

Under Newmont's risk profile no failure modes were identified as a fatal flaw that would require mitigation through altering the Base Case design and at this time all unacceptable risks can be sufficiently mitigated through future studies/work. To demonstrate this, risk was assessed following mitigation to present the residual risk (i.e., what is the risk following carrying out the mitigating work, for unacceptable risks listed in Table ES.1.1). Following mitigation, all residual risks were determined to be as low as reasonably practical within the context of the current project definition. All environmental, Stakeholder consultation, and permitting (SCP), and legal consequences were mitigated to at least moderate risk rankings. Three high risk rankings remained following mitigation due to major life of project cost consequences. The major life of project cost consequences reflects an independent financial cost to Newmont and does not have cascading effects on the environment, SCP, or legal consequence categories. In discussion with Newmont, the residual life of project cost consequences were identified as acceptable given the current project definition. Opportunities to reduce life of project cost risk will be investigated in future iterations of the RCP. Residual risks for unacceptable failure modes, as described above, are located in Section 4, Table 4.1.

Failure modes and effect pathways will be carefully monitored and periodically investigated as the project advances to ensure additional mitigations are not required. The FMEA demonstrated confidence within the Base Case design and can allow Newmont to advance preparation for licencing applications and advance the closure planning at the Coffee Mine.

TABLE OF CONTENTS

1 INTRODUCTION 1
1.1 Workshop Objectives 1
1.2 FMEA Workshop Participants 2
2 BACKGROUND 4
2.1 FMEA Introduction 4
2.2 Coffee Mine FMEA Workshop 4
2.2.1 Timeframes 5
2.2.2 Likelihood Definitions 6
2.2.3 Consequence / Severity of Effects Definitions 6
2.3 Base Case Design for FMEA Evaluation 8
3 FMEA WORKSHOP RESULTS 9
3.1 Heap Leach Facility Evaluation 9
3.1.1 Near-term Failure Modes 9
3.1.2 Short-term Failure Modes 11
3.1.3 Long-term Failure Modes 14
3.2 Alpha WRSF Evaluation 15
3.2.1 Near-term Failure Modes 15
3.2.2 Short-term Failure Modes 16
3.2.3 Long-term Failure Modes 18
3.3 Open Pits Evaluation 19
3.3.1 Near-term Failure Modes 19
3.3.2 Short-term Failure Modes 19
3.3.3 Long-term Failure Modes 20
3.4 Infrastructure Stockpiles and Temporary Closure Evaluation 21
3.4.1 Near-term Failure Modes 21
3.4.2 Short-term Failure Modes 22
4 SUMMARY OF MITIGATIONS AND RESIDUAL RISK 23
5 REFERENCES 26
6 REPORT SIGNATURE PAGE 27

Appendix A: Fact Sheets
Appendix B: FMEA Worksheets
Appendix C: Identified Risk Mitigations

LIST OF TABLES

Table ES.1.1: Summary of Severe and High Risk failure mode mitigations v
Table 1.1: FMEA workshop participants 3
Table 2.1: Definition of likelihood classes for FMEA workshop 6
Table 2.2: Definition of consequence categories for FMEA workshop 7
Table 4.1: Mitigations and Knowledge Gaps for Severe and High-Risk Failure Modes and Corresponding Residual Risk 24

LIST OF FIGURES

Figure 2.1: Newmont's risk profile for derivation of risk rankings 5

1 INTRODUCTION

Newmont is currently preparing construction and operational licensing applications for the proposed Coffee Mine Project (Project) located in Yukon, Canada. To support the licensing applications, Newmont has retained Okane Consultants (Okane) to advance the Heap Leach Facility (HLF) closure design and provide guidance on cover system applications across the site. To date, the Project team has developed a conceptual Base Case closure design based on outcomes from an alternatives assessment (Newmont, 2022). To refine the Base Case design and identify mitigation strategies for unacceptable risks, Okane has facilitated a failure modes and effects analysis (FMEA) workshop with the Project team. Okane's approach to closure planning utilized the FMEA as the primary tool to support risk-based decision making throughout the life of the project. The FMEA workshop was utilized to identify inherent risks and opportunities within the Base Case design and outline strategies / future studies to mitigate Newmont's risks within the near- short- and long-term. From Okane's perspective, the closure planning success of one site domain is inherently reliant on the site as a whole and, therefore, should be considered comprehensively. To facilitate holistic closure planning, the FMEA workshop has evaluated closure configurations for each site domain.

The FMEA process utilized a mutually agreed upon risk matrix and set of risk definitions to rank potential failure modes. All failure modes or risks identified were addressed by determining the necessary risk mitigation measures (in the form of future studies / work or tactical design optimizations) to reduce the risks' probability of occurrence or the severity of the consequences. This report summarizes the FMEA process including evaluation criteria, FMEA results, and Newmont's residual risk following implementation of mitigation strategies for Severe and High risk failure modes.

1.1 Workshop Objectives

The overarching objectives of the FMEA workshop were to:

1) Develop potential failure modes within the Base Case and quantify the risks associated with those failure modes in terms of the likelihood and consequence of the failure;

2) Identify the necessary mitigation measures to reduce the residual risk to an acceptable level; and

3) Prioritize future studies addressing the key risks in the preferred alternative.

To accomplish these objectives, each identified failure mode was evaluated against a common, overarching 'question' which addresses Newmont's closure objectives. The overarching question is essential in that it provides a consistent and focussed basis to evaluate each identified failure mode

against each of the consequence categories. The question was developed collaboratively prior to the workshop and is as follows:

> *"What are the risks to build, operate, and close the Newmont Coffee Project in a way that is implementable, permittable, economical, and provides confidence to all First Nations and Stakeholders that it will achieve acceptable terrestrial and water impacts to the surrounding environment?"*

Prior and within the FMEA workshop, participants were asked to describe what they felt the results of a successful FMEA workshop would be. Four main definitions of workshop success are summarized as:

1) Gain comfortability within the Base Case closure design to fulfill closure objectives;

2) Advance project design and cost estimates for the current version of the Reclamation and Closure Plan (RCP);

3) A vehicle to facilitate future community engagement, and

4) Open communication between different project teams.

1.2 FMEA Workshop Participants

Workshop effectiveness depends on having participants in attendance with the appropriate knowledge and experience. Workshop participants consisted of key personnel from Newmont, Forte Dynamics, JDS Energy & Mining, Lorax Environmental Services, SRK Consulting, Hemmera, Ensero Solutions, and Okane (Table 1.1). The workshop was facilitated by Okane's Senior Technical Advisor, Dave Christensen.

Table 1.1: FMEA workshop participants

Name	Company	Workshop Attendance	
		February 16th	February 17th
Barry Carlson	Forte Dynamics	✓	
Brendan Fetter	Forte Dynamics	✓	
Chandni Kher	Hemmera	✓	✓
Christian Roldan	Newmont	✓	✓
Christine Graves	Ensero Solutions	✓	✓
Clint Green	Forte Dynamics	✓	✓
Daniel Jenkins	JDS Energy & Mining	✓	✓
Dave Christensen	Okane	✓	✓
David Flather	Lorax Environmental Services	✓	✓
Eddie Rideout	Newmont	✓	✓
Graham Hay	Okane	✓	✓
John Kurylo	SRK Consulting	✓	✓
Kai Woloshyn	Ensero Solutions	✓	✓
Mitchell Barteaux	Okane	✓	✓
Ryan Herbert	Ensero Solutions	✓	✓
Scott Jackson	Lorax Environmental Services	✓	✓
Terryn Kuzyk	Okane	✓	✓

2 BACKGROUND

2.1 FMEA Introduction

An FMEA is a top-down, systematic approach to risk appraisal and identification of controls. The aim is to foresee potential risks associated with a system to allow for mitigations to be implemented to reduce the severity of risk to as low are reasonably practical (ALARP). The FMEA methodology has been adapted for many applications over numerous industries. The mining industry has a well documented history of using the FMEA to evaluate residual risks that designs, and closure plans impose on the surrounding environment, First Nations, Stakeholders, regulators, and communities. The FMEA is recognized by numerous international organizations and publications including the International Network for Acid Prevention (INAP, 2014; INAP, 2017), the Mine Environment Neutral Drainage program (MEND, 2012), and the Global Tailings Review (2020) as a primary tool for addressing risk in closure planning.

The FMEA can be used to evaluate potential for failures arising from a 'Base Case' design that could result in environmental impacts, effects to reputation with First Nations and Stakeholders, regulatory action, and human health and safety concerns. A site-specific risk profile can be developed for each area being evaluated. Once the failure modes with the highest risk have been identified, it is possible to prioritize mitigations or alternative designs to reduce risks. Therefore, failure modes and effects analyses are an essential part of any risk- and liability-reduction program.

2.2 Coffee Mine FMEA Workshop

The FMEA workshop was held over two days on February 16th and February 17th, 2022. The variety of experts in the workshop provided valuable insight and well-rounded experience for the risk evaluation process. Concise fact sheets were developed and circulated to participants prior to the start of the workshop to ensure participants shared a common knowledge base from which potential failure modes were identified and evaluated. Fact sheets are included in Appendix A.

The term 'risk' encompasses both concepts of likelihood (i.e., frequency) of failure and the severity of the expected consequence if such failure were to occur. It should be noted that quantifying failure modes is an imprecise exercise as predictive risk assessments rely on foreseeing future events. The FMEA assessment of risk is quantified using a traditional combination of likelihood and consequences. The goal is to provide an assessment of the potential for failure of structures, equipment, or processes leading to a negative outcome. The FMEA analysis technique evaluates effects of such failures on the larger systems of which they are a part.

Once quantified, some failure modes will present either an 'acceptable' or 'unacceptable' risk based on Newmont's unique risk profile (Figure 2.1). Unacceptable risks may be those that rank within the 'Severe' risk rankings (S) and steps should be taken to reduce or mitigate these risks. Failure modes identified as having a 'High' (H) 'Moderate' (Mo), or 'Low' (L) risk levels may be acceptable if they are

'As Low as Reasonably Practical' (ALARP). For a risk to be ALARP, it must be possible to demonstrate that the cost or complexity involved to reduce the risk further would be grossly disproportionate to the benefit gained in the context of the current project definition. Failure modes ranked as having a 'High' 'Moderate' or 'Low' risk ranking can be considered to be ALARP if there is not a practical mitigation that could further reduce the risk.

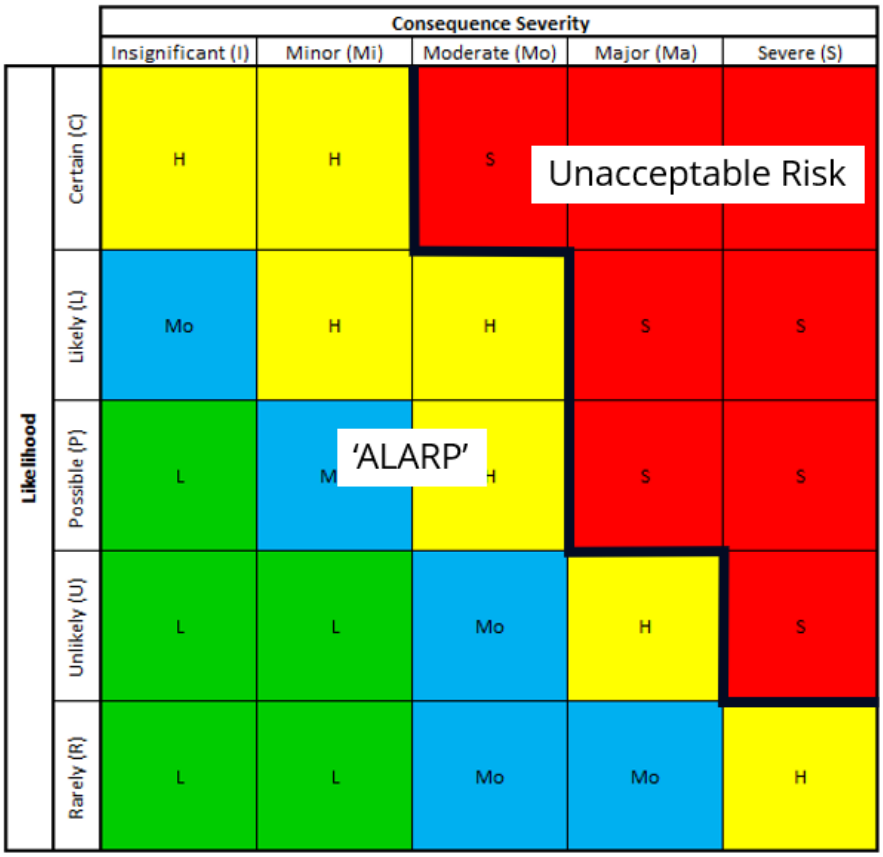


Figure 2.1: Newmont's risk profile for derivation of risk rankings

2.2.1 Timeframes

Failure modes were assessed within the timeframe they are expected to occur in. In collaboration with Newmont, three timeframes were defined:

- Near-term: Defined as Year -3 to Year 10 of the project and based on the timeframe for, active mining operations, progressive reclamation, and temporary closure during operations;
- Short-term: Defined as Year 10 to Year 25 of the project. This timeframe includes closure activities and adaptive management and monitoring periods; and
- Long-term: Defined as Year 25 onward. This timeframe includes proactive and reactive monitoring and management activities that arise in response to events.

2.2.2 *Likelihood Definitions*

The risk matrix definitions for likelihood classes were developed by Newmont (Table 2.1). For purposes of the FMEA workshop, the detailed conceptualization definition was the default application of likelihood, expect in the case where a quantitative likelihood is known for the failure mode (e.g., factor of safety or probability of failure).

Table 2.1: Definition of likelihood classes for FMEA workshop

Likelihood Class	Detailed Conceptualization	Quantitative Criteria
Certain	A similar outcome has arisen several times per year in local operations	• Event will occur • Event could occur daily to monthly • > 90% probability of the event occurring
Likely	A similar outcome has arisen several times per year in the company worldwide or broader industry	• Event expected to occur • Event could occur monthly or annually • 60 to 90% probability of the event occurring
Possible	A similar outcome has arisen at some time previously in local operations	• Event could occur under certain circumstances • Event could occur annually or within a 5-year period • 30 to 60% probability of the event occurring
Unlikely	A similar outcome has arisen at some time previously in the company worldwide or broader industry	• Event has occurred elsewhere • Event could occur within a 5- and 10-year period • 10 to 30% probability of the event occurring
Rarely	No experience of this happening in the broader worldwide industry but theoretically possible	• Event has rarely occurred in the industry or may occur under exceptional circumstances • Event could occur within a 10- and 30-year period • <10% probability of the event occurring

2.2.3 *Consequence / Severity of Effects Definitions*

The assessment of the severity of effects (or consequences) of specific failure modes should be based on evaluations or analysis of expected responses following failure. The estimated consequence for a given failure mode is based on Newmont's definition for each consequence category and professional judgement of the anticipated impact of that specific failure (Table 2.2). Due to the background of participants, traditional use and health and safety categories were not evaluated during the workshop.

Table 2.2: Definition of consequence categories for FMEA workshop

Consequence Categories	Insignificant	Minor	Moderate	Major	Catastrophic
Environmental	Environmental impacts within area already disturbed by operations Addressed and/or remediated as part of routine processes	Environmental impacts within the current or planned disturbance area or isolated offsite impacts Non-routine effort to address and/or remediate	Significant (relating to size, toxicity, location, or other site factors) on-site environmental impact or offsite impact requiring immediate response to contain and/or prevent residual effects Remediation in the short to medium term without any anticipated long-term environmental effects	Environmental impacts with medium to long-term impairment and residual ecosystem effects Localized monitoring to determine extent of environmental impact from the event May require changes to closure liability	Offsite widespread impacts that are extensive and long term Significant impacts on closure planning and liability
Stakeholder Consultation and Permitting	Does not introduce delays in permitting	Minor changes in design required to gain permitting. Additional 1-3 months required	Clarification of changes to the design require an additional 3-12 months to gain permit	Clarification or changes to the design require an additional 1-2 years to receive permit	Sent to panel review and/or receives non-acceptance from Stakeholders
Life of Project Cost	< $50,000	$50,000 to $500,000	$500,000 to $5,000,000	$5,000,000 to $50,000,000	>$50,000,000
Traditional Use	Some disturbance but no impact to traditional use	Minor or perceived impact to traditional land use	Some mitigable impact to traditional land use	Significant temporary impact to traditional land use	Significant permanent impact on traditional land use
Health and Safety	Short-term, low-level injury not affecting work performance and requiring first aid treatment at a maximum Reversible health effects, requiring first aid treatment at maximum	Injury requiring medical treatment or resulting in temporary restrictions to normal work duties Reversible health effects that would typically result in medial treatment or temporary restrictions to normal work duties	Injury resulting in lost workdays Severe, reversible health effects	Single fatality, permanent disability, or multiple lost time injuries Irreversible health effects or disabling illness to multiple personnel	Multiple fatalities or permanent disability to multiple people Permanent irreversible health effects or disabling illness with an impact on multiple people
Legal and Other	Minor technical / legal issue unlikely to attract a third-party response	Technical / legal issue which may attract a low level administrative / regulatory response	Breach of regulation and/or other agreements with possible prosecution and penalties Continuing occurrences of minor breaches with possible prosecution and penalties Threat of legal action against Newmont	Major breach of regulation and/or other agreements resulting in external party investigation Prosecution, penalties, or other action likely Legal action against Newmont	Serious breach of regulation and/or agreements resulting in external party investigation Operation suspended; licenses revoked Legal action against Newmont

2.3 Base Case Design for FMEA Evaluation

The FMEA workshop evaluated a predefined Base Case design for Coffee Mine closure. In general, the Base Case design for site domains consists of:

- The HLF plateau will be covered with a low-permeability barrier layer (e.g., geosynthetic clay liner (GCL)), followed by a 0.5 m store and release cover system. Depending on the texture of the available reclamation material for the store and release cover system a gravel layer may be required over the GCL to provide protection and promote interflow. Net percolation on the plateau is estimated to be approximately 5% of annual precipitation. The HLF slope will be placed at an angle of 2.5H:1V and covered with a 0.5 m store and release cover system. Net percolation on the slope is estimated to be 30% of annual precipitation. The HLF will be progressively reclaimed as opportunities allow and is estimated to begin in Year 8 of operations.

- The Alpha WRSF will be re-sloped as needed to maintain on overall 3H:1V slope and will remain uncovered at closure.

- The Alpha Pond will be drained, and the dam will be breached and transitioned to a drainage channel. The diversion ditch around Alpha Pond will be decommissioned after breach of the Alpha dam.

- Open pits will be either strategically backfilled during operations (Latte and Supremo Pits) or fully backfilled through operations and into closure (Kona and Double Double Pits). Backfilled pits will have flat tops, angle of repose side slopes and will not be covered with reclamation material. Open pits will be passively filled with water at closure.

The Base Case design is detailed in Fact Sheet #2 found in Appendix A.

3 FMEA WORKSHOP RESULTS

The desired outcome of the FMEA was to identify potential failure modes and risks within the Base Case design for the Coffee Mine closure and outline mitigations in the form of additional studies or tactical design optimizations. The current section outlines failure modes and corresponding mitigations for risks not identified as ALARP (see Section 2.2). A summary table is presented at the introduction of each failure mode outlining the likelihood and consequence categories resulting in the highest risk ranking. Mitigations for severe and high-risk failure modes were further investigated following implementation of the mitigations to determine the level of residual risk. When determining the level of residual risk, it was assumed that mitigations resulted in positive outcomes (e.g., a future characterization study confirmed current assumptions and resulted in decreasing the likelihood of a failure mode). If the mitigation resulted in a negative outcome, further mitigations would be required to address the failure mode. A complete list of failure mode rankings and workshop commentary is provided in the FMEA worksheet (Appendix B). Failure modes have been organized by domain and prioritized by the timeframe in which they occur. This structure was chosen to focus common failure modes and mitigations to specific study areas and prioritize future studies and work within the appropriate timeframe.

3.1 Heap Leach Facility Evaluation

3.1.1 Near-term Failure Modes

1) *Proposed base closure cover system design is unacceptable to regulatory bodies, First Nations, and Stakeholders, resulting in design changes prior to issuance of water license and QML (Failure Mode ID #1).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Major	High	Moderate

The Base Case cover system was part of the project design assessed by YESAB, which has received approval to proceed to licencing. The Base Case design has not yet been circulated with regulatory bodies or reviewed by First Nations and Stakeholders. It is thought that regulatory bodies would only not accept the Base Case design if there were a negative effect to water quality and the contamination of downstream receptors. As the Base Case design sufficiently mitigates these risks, it is unlikely the design will be unacceptable to regulators, First Nations and Stakeholders resulting in a delay to water licencing and QML issuance. It would also be unlikely that conditions would be placed within the permit to redesign the Base Case and provide additional financial assurance to ensure sufficient contingency for design improvements. The required redesign could result in a more complex cover system to limit net percolation through the slopes of the heap leach facility and would have major financial consequences. Failure Mode ID #1 resulted in an overall high risk ranking.

To mitigate the high risk, Newmont should initiate collaboration early, and circulate the Base Case design with regulatory bodies, First Nations, and Stakeholders to understand potential concerns prior to permitting submission. Through early collaboration and circulation of the Base Case design, the likelihood that design changes prior to issuance of licences are required decreases from unlikely to rare. Following mitigation, the residual risk of Failure Mode #1 is moderate.

2) *Cover system design tolerances do not meet actual material volumes (including various type), resulting in the need to source additional reclamation material (Failure Mode #7).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Rare	Life of Project Cost	Moderate	Moderate	-

The Base Case design currently consists of a 0.5 m store and release cover system (overlying a GCL on plateau) for the HLF. As store and release cover systems typically have a large acceptable material envelope and the current material balance estimate indicates a surplus of reclamation material volumes, the likelihood of having insufficient suitable material is rare. If it was determined that the available reclamation materials are not sufficient or suitable, there would be a potential need to source additional borrow areas or process material to meet design specifications and result in moderate life of project cost consequences and an overall moderate risk ranking. Near-term mitigations identified include development of a material stockpile management plan, borrow material characterization program, and design criteria for store and release cover systems.

3) *Base Case cover system design does not match First Nation expectations, resulting in Newmont not meeting returning land use/closure performance criteria (Failure Mode #9).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Major	High	Moderate

If First Nations do not agree with the Base Case cover system design of the HLF, an issue will be raised with the Yukon Water Board (YWB) or be dealt with during consultation. It was the mindset of workshop participants that it would be unlikely that this would result in permitting delays of the project; however, the YWB would likely include a condition on the permit for redesign of the Base Case cover system and require additional financial assurance. The redesign would result in a change in the cover system design that further reduces net percolation (e.g., GCL on the entire facility) and would have major life of project cost consequences, resulting in an overall high risk ranking.

To mitigate the failure mode, Newmont can demonstrate that the Base Case design works and can meet returning land use and performance criteria (e.g., vegetation studies, field trials, constructability tests). Demonstration of Base Case performance in the near-term would give confidence in Newmont

achieving First Nations expectations and would decrease the likelihood from unlikely to rare. The demonstration studies would reduce the overall risk ranking to moderate.

3.1.2 Short-term Failure Modes

4) *Actual draindown of the heap leach facility is longer than predicted, leading to extended active water treatment and monitoring / maintenance of discharge (Failure Mode ID #2)*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Moderate	Moderate	-

To date, HLF draindown timeframe and seepage discharge water quality is based on a set of known and assumed hydraulic and chemical material properties in the water balance model. Although it is unlikely that material properties differ largely enough to drastically change the draindown timeframe, it could have moderate life of project cost consequences due to requiring longer active treatment. Therefore, Failure Mode #2 has a moderate risk ranking. Mitigations identified include revisiting HLF source terms, material characterization, and monitoring during operations to reaffirm wetting-up and draindown models.

5) *Characterization of metal leaching / acid rock drainage (ML/ARD) potential of heap material is not consistent with field conditions, leading to water quality exceeding guidelines (Failure Mode ID #3)*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Moderate	Moderate	-

Given the high level of confidence in the project heap material geochemical characterization and water quality model at closure, it is unlikely that mischaracterization of the heap material will result in water quality exceeding guidelines. If exceedances were to occur, it would result in a requirement to actively treat water longer or more aggressively and could have moderate life of project costs. Environmental, Stakeholder consultation and permitting, and legal consequences would all be minor as there is built in capacity in the system to store water on-site in Latte Pit prior to discharge. Failure Mode #3 has an overall moderate risk ranking and can be mitigated through ongoing material characterization of the heap material during operations.

6) *Borrow material quality is inappropriate for use as a cover material on a 2.5H:1V slope, resulting in excessive erosion or physical instability (Failure Mode ID #4).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Possible	Environmental, SCP, Life of Project Cost, Legal	Moderate	Moderate	-

The borrow material associated with other regional mining operations is characterised as a gravely till material. On a 2.5H:1V slope, it is possible that the material can be heavily erodible. If erosion on the HLF slope becomes extensive, there is a possibility that ore will become exposed. However, in the short-term, the erosion would be monitored during routine inspections and gullies / rills can be remedied easily and surface water management infrastructure can be upgraded as necessary to reduce the erosion potential of the cover material. Due to the short-term routine maintenance, there would only be minor environmental, Stakeholder consultation and permitting, life of project cost, and legal consequences, resulting in a moderate risk ranking. One mitigation identified is to ensure a geomorphic landform design is implemented to reduce the erosion potential on the slopes and a proper surface water management infrastructure.

7) *There is insufficient borrow material to cover the heap leach facility, leading to constructing a thinner cover system with higher net percolation rates (Failure Mode ID #5)*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Rare	Life of Project Cost	Moderate	Moderate	-

The current Base Case design consists of a 0.5 m store and release cover system on the HLF (overlying a GCL on the plateau) and an uncovered WRSF. Under this configuration, there is a surplus in reclamation material, and it would be rare that a thinner cover system is constructed due to borrow material volume constraints. If this were to occur, it would result in moderate life of project costs due to sourcing and developing additional borrow areas. To mitigate the severity of effects, Newmont can ensure proper documentation of stripping and material volumes available for reclamation.

8) *Heap leach facility runoff and interflow management features fail, resulting in excessive erosion or slope failure and loss of cover system functionality (Failure Mode ID #8).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Likely	Environmental, Life of Project Cost	Minor	High	Low

Currently no surface water management design has been developed; therefore, it is likely that runoff and interflow will result in excessive erosion and loss of cover system functionality. The loss of material and cover functionality has minor environmental and life of project consequences and resulting in an overall high risk ranking. To mitigate the risk, a surface water management design should be developed in the near-term and implemented during reclamation activities. Following mitigation, the residual risk for this failure mode is Low, as a result of a reduced likelihood of occurrence.

9) *Net percolation through the heap leach facility is in excess of passive treatment system capacity, leading to an inability to sufficiently treat water and meet discharge criteria (Failure Mode ID #11).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Possible	Life of Project Cost	Major	Severe	High

Under the Base Case design, net percolation through the plateau and slopes is expected to be approximately 5% and 30% of annual precipitation, respectively. The passive treatment system is expected to have capacity under most circumstances, but it is possible for exceedances to occur during higher precipitation periods. If the passive treatment system is over capacity, there is minor environmental consequence as contamination levels to downstream receptors would be limited. Additionally, there is built in capacity in the system to hold water on-site prior to discharge. Moderate consequences were also identified for Stakeholder consultation and permitting and legal consequence categories due to the importance placed on water quality in the region. If this were to occur, there would be major life of project consequences due to reconstructing a lower net percolation cover system or upgrading water treatment facilities. This failure mode was identified to have an overall severe risk ranking.

To address the unacceptable risk Newmont can construct a surge pond to capture excess seepage prior to moving through the passive system. Construction of a surge pond would decrease the likelihood of exceeding the capacity of the passive system from possible to unlikely and result in a high residual risk ranking. The high residual risk falls only within life of project cost consequence category and reflects an independent financial cost to Newmont and does not have cascading effects on the environment, SCP, or legal consequence categories. In discussion with Newmont, the residual life of project cost consequences were identified as acceptable given the current project definition.

10) *Unsuitable veneer stability of the heap leach facility cover system, leading to inability to meet performance criteria (Failure Mode ID #14).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Possible	Life of Project Cost, Legal	Moderate	Moderate	-

During the workshop, performance criteria for the context of Failure Mode #14 included all aspects of closure (e.g., visual, surface water quality, net percolation, vegetation, returning land use commitments). Veneer stability of the HLF cover system is heavily reliant on establishing vegetation. When considering analog sites in the region, it is possible for unsuitable veneer stability to occur prior to vegetation establishment. In the short-term, there would be minor life of project and legal consequences as routine monitoring and maintenance is conducted and any veneer instability can be easily remedied. Failure Mode #14 was determined to have an overall moderate risk ranking and can be mitigated through revegetation field trials and erosion modelling as part of on-going reclamation research programs.

3.1.3 Long-term Failure Modes

1) *Passive reactive barrier (PRB) system is not effective in passively treating water in the long-term resulting in exceedance of water quality objectives in Halfway Creek (Failure Mode ID #13).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Possible	Life of Project Cost	Major	Severe	High

A PRB system is planned to support long-term passive treatment of seepage from the HLF as part of the Base Case design. Irrespective of the presence of the PRB, all seepage from the HLF ultimately reports to Latte Pit before reporting to the Alpha WRSF and ultimately Halfway Creek, so the environmental consequence is minor. Moderate consequences were identified for Stakeholder consultation and permitting and legal associated with the potential for Stakeholders and First Nations to not accept the new technology for water treatment. There are major life of project consequences owing to the potential for long-term active water treatment to be required should the PRB not be accepted or not function as designed resulting in an overall severe risk ranking.

Identified mitigations include completing near-term field trials to determine the potential of PRB systems for long-term passive treatment use. Demonstrating the functionality of a PRB system in the near-term would give confidence in the designs ability to treat water, therefore decreasing the likelihood from possible to rare. Additionally, monitoring the transition between active and passive treatment when the site moves from closure to post-closure can mitigate any environmental, SCP, or legal consequences. Following these mitigations, Failure Mode #13 has a moderate residual risk.

3.2 Alpha WRSF Evaluation

3.2.1 Near-term Failure Modes

1) Lack of defined performance criteria for the Alpha WRSF leads to Stakeholders and First Nations not accepting the closure measures for the Alpha WRSF (Failure Mode ID #16).

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Possible	SCP, Life of Project Cost	Moderate	High	Moderate

There has not been detailed work to define specific closure criteria such as metrics for return of flora and fauna, returning traditional land use, aesthetics, etc. that are required to help determine what success of Alpha WRSF closure looks like. Since criteria has not been developed, it is possible that the design performance of the Alpha WRSF at closure is unacceptable to Stakeholders and First Nations. The environmental and legal consequences are minor, as the Base Case design is likely to satisfy performance criteria to be determined in future design stages. There are moderate consequences for SCP and life of project cost as potential mitigations include major re-work of the closure design for the Alpha WRSF to include a cover system or re-sloping. The moderate consequence categories and possible likelihood resulted in an overall high risk ranking.

Identified mitigations include ongoing Stakeholder and First Nations consultation and development of end land use objectives and performance criteria. Once end land use objectives and performance criteria are developed in collaboration with Stakeholders and First Nations, the likelihood decreases from possible to unlikely, and a moderate residual risk ranking.

2) Alpha Dam capacity is exceeded due to a storm event greater than 1:10 year return (design storm), leading to decreased hydraulic residence time and increased downstream loading (Failure Mode ID #26).

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Possible	Environmental, SCP, Life of Project Cost, Legal	Minor	Moderate	-

The Alpha Dam has been designed to accommodate a 1:10 year return period design storm and is considered appropriate by the project team based on the function of the Alpha Dam to manage sediment. It is possible that over the life of mine, this design storm is exceeded. However, the design of the Alpha Dam includes a spillway that would allow for release of any incident precipitation over the design storm, resulting in minor environmental, Stakeholder consultation and permitting, and life of project cost consequences. The legal consequences are insignificant for an overtopping of the Alpha

Dam. Due to the high likelihood, Failure Mode #26 resulted in an overall moderate risk ranking. To enhance the understanding of mitigation strategies for overtopping, evaluation of the need to consider a lower frequency (and therefore higher volume) design storm should be considered.

3.2.2 Short-term Failure Modes

1) *Use of the Alpha WRSF as a flow-through rock drain results in increased metals loading in the Alpha Pond, leading to exceedances of water quality guidelines (Failure Mode ID #17).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	SCP, Legal	Moderate	Moderate	-

The flow-through rock drain underlying the Alpha WRSF acts as a potential pathway to convert otherwise non-contact water into contact water, introducing the increased potential to exceed metal guidelines in water downgradient of the Alpha WRSF. Given the surface area of the proposed rock used to construct the rock drain, it is unlikely that sufficient contact will be achieved to significantly increase metals concentrations in non-contact water prior to discharge. The environmental consequences are minor given the anticipated degree of dilution from mixing with other water through the Alpha WRSF rock drain. The Stakeholder consultation and permitting and legal consequences are moderate, owing to the potential for discharge water exceeding water quality guidelines. A near-term mitigation is to complete a geochemical characterization program while rock placement is underway to better understand the likelihood of exceedances in the long-term.

2) *Characterization of ML/ARD potential of waste rock in the short-term is not consistent with field conditions, leading to exceedances of water quality guidelines (Failure Mode ID #19).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	SCP, Life of Project Cost, Legal	Moderate	Moderate	-

Given the extensive geological and geochemical characterization of the waste rock, and high level of confidence, it is unlikely that the ML/ARD potential is worse than anticipated. In the short term, seepage from the WRSF will report to the Alpha Pond prior to discharging to Halfway Creek, mixing with non-contact water, and reducing concentrations in discharge. Sensitivity analyses completed on-site showed minor disturbances to water quality based on the current characterization but, as they are not related to toxicity, the environmental consequences are minor. Potential exceedances of water quality guidelines have moderate Stakeholder consultation and permitting and legal consequences. The life of project cost consequences are moderate, as potential mitigation includes application of a cover system over the entirety of the Alpha WRSF to limit net percolation through the WRSF. Other mitigation options

include pumping water to Latte Pit in the short term or completing a geochemical characterization program to better understand the likelihood of ML/ARD production while waste rock is being placed.

3) *Current Alpha WRSF closure configuration does not support target ecosystems and habitats resulting in Newmont being unable to meet closure commitments (Failure Mode ID #20).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Possible	SCP, Life of Project Cost	Moderate	High	Moderate

Specific closure criteria have not been developed to define what target ecosystems and habitats look like at closure, making it possible that Newmont will be unable to meet closure commitments as part of the Base Case. While participants acknowledged that the regulatory body has not reviewed the Base Case, it was felt that acceptance would only be withheld if the Base Case design would negatively effect water quality. Should the Yukon Water Board, as the governing regulatory agency, not accept the Base Case design, increases to financial assurance and a redesign of the Alpha WRSF closure configuration may be required. Permitting delays are not anticipated, but a condition may be placed on the permit; therefore, the Stakeholder consultation and permitting consequences are moderate. The environmental and legal consequences are low as the Base Case design has already been accepted by YESAB, and is not anticipated to produce adverse impacts to downstream receptors. Redesign of the Base Case to meet closure commitments represents a moderate life of project cost consequences associated with the cost of design and construction of a cover system for the Alpha WRSF. Failure Mode #20 resulted in an overall high risk ranking.

Since work to date has looked at the performance of a covered surface, which is not planned for the Alpha WRSF, a mitigation was identified to implement a revegetation research program that targets bare waste rock to address how the Alpha WRSF will perform at closure. The Base Case design can also be circulated with Stakeholders, First Nations, and regulators to understand their acceptance. Revegetation research programs and circulation of the Base Case closure configuration would give confidence in the Base Case design to support target ecosystems, therefore decreasing the likelihood from possible to unlikely. Following mitigation, Failure Mode #20 has a moderate residual risk ranking.

4) *Alpha Pond water quality is lower quality than predicted, resulting in exceedances of water quality guidelines (Failure Mode ID #21).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Major	High	High

Under the Base Case design, multiple water streams report to the Alpha pond including groundwater, HLF seepage, and catchment run-on, and cannot be attributed solely to the Alpha WRSF. The

environmental consequences are minor and the probability unlikely, as dilution is anticipated to contribute strongly to discharge from the Alpha Dam. With water quality guideline exceedances expected as part of this failure mode, the Stakeholder consultation and permitting and legal consequences are moderate. The potential requirement of maintaining a water pumping system is anticipated to increase the life of project cost consequences to major, resulting in an overall high risk ranking.

The mitigation to pump Alpha Dam water back up to the open pits for treatment if water quality exceeds guidelines would mitigate any environmental, SCP, or legal consequences; however, a major life of project cost consequence remains. The remaining major financial consequence results in maintaining a high risk ranking, however this risk is considered acceptable given the project definition at this time.

3.2.3 Long-term Failure Modes

1) *Water quality within the Alpha Dam does not meet water quality criteria, resulting in inability to proceed with the reclamation plan for the Alpha Dam (i.e., breach and decommissioning) (Failure Mode ID #22).*

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Major	High	High

At closure, the Base Case design includes breaching the Alpha Dam and decommissioning the structure so that a licensed structure does not remain at closure. Where water behind the Alpha Dam does not meet water quality guidelines for discharge, it would not be possible to decommission the dam because the water could not be released to breach the dam. The FMEA participates felt that it was unlikely that water quality within the Alpha Dam would not meet water quality criteria at closure, and environmental consequences were ranked as minor to reflect the likelihood of dilution and mixing addressing any water quality issues. However, because of the potential for exceedances of the water quality guidelines and the inability to complete closure of the Alpha Dam, Stakeholder consultation and permitting and legal consequences were ranked as moderate.

A mitigation was identified to pump Alpha Dam water back up to the open pits for treatment if water quality exceeds guidelines. Pumping Alpha Dam water back to the open pit would mitigate any environmental, SCP, or legal consequences, however a major life of project cost consequence remains. The remaining major financial consequence results in maintaining a high risk ranking, however this risk is considered acceptable given the project definition at this time.

3.3 Open Pits Evaluation

3.3.1 Near-term Failure Modes

1) Water quality in Alpha Dam requires relocation and temporary storage prior to the availability of Latte Pit (Failure Mode ID #30)

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Moderate	Moderate	-

Under the Base Case design, the Latte Pit is available as a contingency water storage location. There is the potential for the life of mine for the Latte Pit to be extended, resulting in Latte Pit being unavailable for water storage. Workshop participants felt that it was unlikely that water does not meet discharge quality standards for release, and there is the potential for water to be stored in an event pond for up to 30 days. The environmental consequences were ranked as insignificant, as the water would not be released and could be stored in other structures asides from Latte Pit. The Stakeholder consultation and permitting and legal consequences were ranked as minor to reflect the potential for storage of water that did not meeting quality guidelines in locations other than Latte Pit. The applicable mitigations include constructing sumps in an alternate open pit for temporary water storage, resulting in a moderate life of project cost consequence.

3.3.2 Short-term Failure Modes

1) Pit water quality spilling into the Latte Creek watershed is of poor quality, resulting in impacts to receiving environments (Failure Mode ID #27)

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	SCP	Major	High	Moderate

Sensitivity analyses have been completed on long-term loading for material coming out of the pits that is being placed in the Alpha WRSF, which is the same material making up the pit walls and backfill. Therefore, it is unlikely that the water quality in the pits would be significantly different than the water moving through the Alpha WRSF, which is thought to be low risk to environmental receptors. The environmental consequences are minor, because overall water quality is anticipated to be within use protection guidelines in Latte Creek; however, the Stakeholder consultation and permitting consequences are major due to the potential impact on downstream ecosystems (Coffee Creek). The potential for downstream impacts increases the legal consequence to moderate. Failure Mode #27 resulted in an overall high risk ranking.

Potential mitigations include monitoring during pit filling and implementing in-pit controls as necessary. Monitoring would indicate any water quality issue during pit fill and allow for potential water treatment activities. Implementation of mitigations would reduce Stakeholder consultation and permitting consequences to moderate, resulting in a moderate residual risk ranking.

3.3.3 Long-term Failure Modes

1) Instability of pit backfill if acting as a dam, results in a large discharge of material to downstream environments (Failure Mode #29)

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Rare	Environmental, SCP, Life of Project Cost, Legal	Moderate	Moderate	-

During operations, roadways may be constructed through open pits to shorten haul distances. At closure, these roadways will be reclaimed and regraded for stability, making it rare that instability will occur. The potential for environmental consequences downstream in Coffee Creek were evaluated as moderate as they would be reversible and short-term. Legal and Stakeholder consultation and permitting consequences were also evaluated as moderate due to the optics of a material release to Coffee Creek. The life of project cost consequences were evaluated as a moderate based on mitigations such as regrading the roadways and installing pass-through conveyance structures to reduce likelihood of dam classification and water causing failure.

2) Subsidence of fully backfilled pits results in exposure of the highwall(s), leading to spillage of poor-quality water to Halfway Creek (Failure Mode ID #31).

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Moderate	Moderate	-

Based on the Base Case design, pits will be backfilled with the lowest risk (i.e., highest neutralization potential) material. The workshop participants felt that it was unlikely subsidence adjacent to a highwall resulting in spillage would occur during the life of mine. The environmental and Stakeholder consultation and permitting consequences were evaluated as minor and insignificant, respectively, to reflect dilution effects in the environment and a negligible influence on permitting given the long-term timeframe over which the failure mode is evaluated. The legal consequences are minor, associated largely with the discharge of water not meeting quality guidelines downstream. The life of project cost consequences are moderate, and reflective of the cost to implement a backfill plan that accounts for subsidence and is integrated into the projects material balance as a mitigation.

3.4 Infrastructure Stockpiles and Temporary Closure Evaluation

3.4.1 Near-term Failure Modes

1) Insufficient suitable stockpile material to construct closure cover systems, resulting in additional sourcing or segregation of borrow material (Failure Mode ID #35).

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Moderate	Moderate	-

The material balance for the Base Case design has a surplus of reclamation material. Additionally, as the Alpha WRSF does not require a cover as part of the Base Case design, it is unlikely that additional sourcing or segregation of material would be required to construct a cover system for the HLF. The environmental consequences are insignificant, as all material discussed is anticipated to be borrow and therefore inert. The Stakeholder consultation and permitting and legal consequences are minor to reflect the need to source material elsewhere and therefore increase disturbance, or to accommodate an insufficient material balance. Changes to the cover system design should be considered holistically, from a material balance perspective, and consider what is available on-site. The life of project cost consequences are moderate, as additional material characterization in support of cover system specifications development is a mitigation.

2) Heap Leach Facility freezes during temporary closure leading to issues with water management during temporary closure and resuming production (Failure Mode ID #36).

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Rare	Life of Project Cost	Moderate	Moderate	-

If the HLF freezes, there is the potential for the frozen material to impact lateral flow within the HLF, as well as introduce uncertainties around re-starting leaching operations. The workshop participants felt that this would be a rare occurrence, as there are plans in place and monitoring frequencies to prevent the HLF from freezing. The environmental, Stakeholder consultation and permitting, and legal consequences were all evaluated as being insignificant, as freezing of HLF does not introduce any environmental impacts. The life of project cost consequence category was evaluated as moderate to address the effort required to re-start production if the HLF was frozen. Mitigations include continuous circulation of leach solution in temporary closure, updating the water balance, and heating barren solution from November to March.

3) HLF cannot be maintained as a zero-discharge facility during temporary closure resulting in poor water quality discharged to the receiving environment (Failure Mode ID #37).

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Rare	Environmental, Life of Project Cost, Legal	Moderate	Moderate	-

Within three months of onset of temporary closure, Newmont will provide regulators with an implementation plan for a water treatment plant if it is not operational by that time. Where the HLF cannot be maintained as a zero-discharge facility, the workshop participants felt that a water treatment plant would be needed as soon as possible. A water balance will be completed for temporary closure that provides assurance of additional storage, treatment, and timeframes, making it rare that this failure mode would occur. If a water treatment plant could not be implemented, there would be environmental impacts, resulting in moderate environmental consequences. The Stakeholder consultation and permitting consequence is insignificant, as this failure mode is not anticipated to introduce delays in permitting. The legal consequence of discharge during temporary closure was ranked as moderate, as the leach solution is not suitable for discharge and the inability to meet zero-discharge constitutes a breach of regulations. The life of project cost consequences are moderate because it is assumed that the cost of a water treatment is included in the baseline plan for the site. Potential mitigations include initiating the water treatment plan as soon as practicable, and deploying raincoats as required on the HLF.

3.4.2 Short-term Failure Modes

4) Haul roads are composed of metal leaching or potentially acid generating material resulting in seepage water that does not meet water quality criteria (Failure Mode ID #32).

Likelihood	Highest Consequence Categories	Highest Consequence Ranking	Highest Risk Ranking	Residual Risk Ranking
Unlikely	Life of Project Cost	Moderate	Moderate	-

This failure mode specifically considers Latte Creek, as the majority of the haul roads for the project are located within this catchment, and other catchments are more likely to experience impacts associated with the HLF and Alpha facilities. Given the extensive characterization of the material on-site for placement in the Alpha WRSF, it is unlikely that the material used in constructing haul roads would have ML/ARD characteristics. The environmental, Stakeholder consultation and permitting, and legal consequences are all minor, reflective of the volume of water that would report as seepage or runoff from these structures. The life of project cost consequences are moderate to reflect additional reclamation as potential mitigations, such as application of a cover system or relocation to pits, if necessary.

4 SUMMARY OF MITIGATIONS AND RESIDUAL RISK

During the FMEA workshop, mitigations and knowledge gaps were identified to address potential failure modes. Mitigations can be prioritized by timeframe and then severity of risk ranking being addressed. Prioritizing mitigations allows Newmont to ensure mitigations can be implemented prior to the failure mode effects occurring. Knowledge gaps identified during the FMEA describe missing information within the Base Case design and informs on additional work that must be completed to create and implement a detailed design. These knowledge gaps should be filled based on the timeframe in which they are required to provide sufficient instructions and details on Coffee Mine closure plans.

Mitigations and knowledge gaps for severe and high-risk failure modes were investigated following implementation of the mitigations and filling of knowledge gaps to determine the level of residual risk (Table 4.1). When determining the level of residual risk, it was assumed that mitigations resulted in positive outcomes (e.g., a future characterization study confirmed current assumptions and resulted in decreasing the likelihood of a failure mode). If the mitigation resulted in negative outcomes, further mitigations would be required to address the failure mode. A full list of mitigations identified during the FMEA is presented in Appendix C.

Under Newmont's risk profile no failure modes were identified as a fatal flaw that would require mitigation through altering the Base Case design and at this time all unacceptable risks can be sufficiently mitigated through future studies/work, and implementation of mitigation measures. Following mitigation, all residual risks were determined to be as low as reasonably practical within the context of the current project definition. All environmental, SCP, and legal consequences were mitigated to at least moderate risk rankings. Three high risk rankings remained following mitigation due to major life of project cost consequences. The major life of project cost consequences reflects an independent financial cost to Newmont and does not have cascading effects on the environment, SCP, or legal consequence categories. In discussion with Newmont, the residual life of project cost consequences were identified as acceptable given the current project definition. Failure modes and effect pathways will be carefully monitored and periodically investigated as the project advances to ensure additional mitigations are not required. The FMEA demonstrated confidence within the Base Case design and can allow Newmont to advance licensing applications and advance the closure planning at the Coffee Mine.

Table 4.1: Mitigations and Knowledge Gaps for Severe and High-Risk Failure Modes and Corresponding Residual Risk

ID	Failure Mode Description	Timeframe*	Risk Ranking FMEA Workshop	Mitigation(s)	Assumed Mitigation Effect(s)	Residual Risk
1	Proposed base case HLF cover system design Is unacceptable to regulatory bodies and Stakeholders, resulting in redesign prior to issuance of water license and QML.	Near-term	High	Collaborate early and circulate base case design with Stakeholders and regulators to understand their acceptance.	Through early collaboration and circulation with Stakeholders and regulators the likelihood of the base case design being unacceptable decreases from unlikely to rare.	Moderate
9	Base case HLF cover system design does not match First Nations expectations, resulting in Newmont not meeting returning land use/closure performance criteria.	Near-term	High	Demonstrate why/how the base case design works and can meet returning land use and performance criteria (e.g., vegetation studies, field trials, constructability tests).	Demonstration of base case performance in the near-term would give confidence in Newmont achieving First Nation expectations and would decrease the likelihood from unlikely to rare.	Moderate
16	Lack of defined performance criteria for the Alpha WRSF leads to Stakeholders and First Nations not accepting the closure measures for the Alpha WRSF.	Near-term	High	Ongoing Stakeholder and First Nations consultation Development of end land use objectives and performance criteria	Once end land use objectives and performance criteria are developed in collaboration with Stakeholders and First Nations, the likelihood decreases from possible to unlikely.	Moderate
11	Net percolation through the HLF is in excess of passive treatment system capacity leading to an inability to sufficiently treat water and meet discharge criteria.	Short-term	Severe	Construct a surge pond to capture excess seepage prior to entering the passive treatment system.	Construction of a surge pond would decrease the likelihood of exceeding the capacity of the passive system from possible to unlikely.	High
8	HLF runoff and interflow management features fail, resulting in excessive erosion or slope failure and loss of cover system functionality.	Short-term	High	Develop surface water management design that can effectively transport water off the HLF landform.	Once surface water management plan is developed, the likelihood decreases from likely to unlikely. The surface water management plan should be robust and constructed to future climate conditions.	Low
20	Current Alpha WRSF closure configuration does not support target ecosystems and habitats, resulting in Newmont being unable to meet closure commitments.	Short-term	High	Revegetation research program. To date, everything has investigated cover surfaces and not bare waste rock as planned in the current base case design. Circulate base case design with Stakeholders, First Nations, and regulators to understand their acceptance.	Revegetation research programs and circulation of the base case closure configuration would give confidence in the base case design to support target ecosystems, therefore decreasing the likelihood from possible to unlikely.	Moderate

ID	Failure Mode Description	Timeframe*	Risk Ranking FMEA Workshop	Mitigation(s)	Assumed Mitigation Effect(s)	Residual Risk
21	Alpha Dam water quality is lower quality than predicted, resulting in exceedances of water quality guidelines.	Short-term	High	Pump Alpha Dam water back up to open pits for treatment.	Pumping Alpha Dam water back up to open pits would mitigate any environmental, SCP, or legal consequences. Major financial risk is maintained resulting in a high-risk rankings, however this risk is considered acceptable given the project definition at this time.	High
27	Pit water quality spilling into Latte Creek watershed is of poor quality, resulting in impacts to receiving environments.	Short-term	High	Monitoring of pit water quality during pit filling to indicate any issues. Active water treatment if issues are identified during monitoring Additional backfill in pit	Monitoring would indicate any water quality issue during pit fill and allow for active treatment activities (e.g., in-pit lime treatment).	Moderate
13	PRB system is not effective in passively treating water in the long-term, resulting in exceedances of water quality objectives in Halfway Creek.	Long-term	Severe	In the near-term, conduct field trials on a PRB system to understand if this system can work for long-term treatment. Monitoring transition between active and passive treatment systems.	Demonstrating the functionality of a PRB system in the near-term would give confidence in the designs ability to treat water, therefore decreasing the likelihood from possible to rare. Continuous monitoring of the transition between active and passive treatment systems would also mitigate any environmental, SCP, or legal consequences	Moderate
22	Water quality within Alpha Dam does not meet water quality criteria, resulting in inability to proceed with reclamation plan for the Alpha Dam (i.e., breach and decommissioning).	Long-term	High	Pump Alpha Dam water back up to open pits for treatment.	Pumping Alpha Dam water back up to open pits would mitigate any environmental, SCP, or legal consequences. Major financial risk is maintained resulting in a high risk rankings, however this risk is considered acceptable given the project definition at this time.	High

*Near-term = year -3 to year 10; Short-term = year 10 to year 25; Long-term = year 25 onward.

5 REFERENCES

Global Tailings Review, 2020. Global Industry Standard on Tailings Management. August 2020.

International Network for Acid Prevention, 2014. The Global Acid Rock Drainage Guide. November 2014.

International Network for Acid Prevention, 2017. Global Cover System Design Technical Guidance Document. November 2017.

JDS Energy and Mining Inc., 2019. Heap Leach Facility Alternatives Assessment, Coffee Gold Mine Project. May 31, 2019. Prepared for GoldCorp Coffee Gold.

Mine Environment Neutral Drainage, 2012. Cold Regions Cover System Design Technical Guidance Document. 1.61.5c. July 2021.

Newmont, 2022. Coffee Gold Mine Reclamation and Closure Plan. May

6 REPORT SIGNATURE PAGE

Okane Consultants







Dave Christensen, P.Eng.	Mitchell Barteaux, P.Geo.	Graham Hay, E.I.T.
Senior Engineer	Senior Geoscientist	Intermediate E.I.T.

Date: May 3, 2022

Appendix A

Fact Sheets

Newmont™
COFFEE

FMEA Workshop Fact Sheets

February 16 – 17, 2022



Table of Contents

Fact Sheet #0 - FMEA Information

Fact Sheet #1 – General Information

Fact Sheet #2 – Coffee Mine Base Case Design

Fact Sheet #2A – Coffee Mine Alternatives Assessment

Fact Sheet #3 – Climate Database

Fact Sheet #4 – Geology and Hydrogeology

Fact Sheet #5 – Water Balance

Fact Sheet #6 – Water Management

Fact Sheet #7 – Surface Water Quality Database

Fact Sheet #8 – Reclamation Material Balance

Fact Sheet #9 – Material Properties

Fact Sheet #10 – Geochemistry

Fact Sheet #11 – Regulatory Requirements

Fact Sheet #12 – Closure Commitments

Fact Sheet #13 – HLF Cover Numerical Modeling

Fact Sheet #14 – Temporary Closure

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-002
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #0 – FMEA Information**

Summarizing Reports (References)

- JDS Energy & Mining Inc. (JDS). 2018. Preliminary Project Failure Modes and Effects Analysis, Coffee Gold Mine Project. Prepared for Goldcorp Coffee Gold. March 2018.

FMEA – Expected Outcomes

- The FMEA will systematically step through potential reclamation and closure failure modes of the Base Case design for the Coffee Mine and quantify the risks of those failure modes in terms of the likelihood and consequence of the failure.
- The expected outcome of the FMEA is quantification of key risks of the Base Case design for each of the major mine components (i.e., open pits, waste rock storage facility (WRSF), site infrastructure, Alpha Dam, and heap leach facility (HLF)).
- During the FMEA, mitigation strategies for these risks will be identified and will provide direction for future studies.

Evaluating Question

- The evaluating question is the driver of the of the FMEA workshop. This question should be considered by all workshop participants when developing and evaluating failure modes. This enables workshop

participants to view the stated risk from the same perspective or, more metaphorically, be on the same page. The evaluating question must be holistic and integrate domains from across the site and must be reflective of site- and land-specific objectives. The proposed evaluating question for this FMEA workshop is:

"What are the risks to build, operate, and close the Newmont Coffee Project in a way that is implementable, permittable, and economical, and provides confidence to all stakeholders that it will achieve acceptable terrestrial and water impacts to the surrounding environment?"

FMEA Details

Timeframes

- Timeframes for assessment should be defined to anchor the workshop participants definition of probability and consequence. Defining assessment timeframes is important because failure mode consequences depend on the timeframe in which they occur. Three timeframes for assessment are proposed:
    - Near-term: progressive reclamation during operations
    - Short-term: within the closure period, including the closure works and adaptive monitoring period (i.e., less than 25 years)
        - Includes period(s) for site decommissioning, closure works, and any necessary adaptive management and monitoring.
    - Long-term: Post-closure (i.e., > 25 years)
        - Post-closure, including proactive monitoring and management and reactive monitoring and management activities that arise in response to events.

Risk Matrix

- Some failure modes may represent 'acceptable' risk, while others may be viewed as 'unacceptable' (Figure 1). Unacceptable risks may be those that rank in the 'high' and 'critical' levels and steps must be taken to reduce or mitigate these risks. The 'moderate' and 'moderately high' levels may be acceptable if they are 'As Low as Reasonably Practicable' (ALARP). For a risk to be ALARP, it must be possible to demonstrate that the cost or complexity involved to reduce the risk further would be grossly disproportionate to the benefit gained. The 'low' risk designation is broadly acceptable. Based on the results of the FMEA, further work or action will be recommended for failure modes where the risk ratings are considered 'high' or 'critical'.

Description	Insignificant	Minor	Moderate	Major	Catastrophic
Certain	11	16	20	23	25
Likely	7	12	17	21	24
Possible	4	8	13	18	22
Unlikely	2	5	9	14	19
Rare	1	3	6	10	15

Figure 1: Newmont's risk matrix for derivation of risk rankings.

Likelihood

- The risk matrix definitions for 'likelihood' classes were developed by Newmont (Table 1). For the purposes of the FMEA workshop, the detailed conceptualization definition will be the default application of likelihood, except in the case where a quantitative likelihood is known for the failure mode.

Table 1: Definition of likelihood classes for FMEA.

Likelihood Class	Quantitative Criteria	Detailed Conceptualization
Certain	• Event will occur • Event could occur daily to monthly • >90% probability of the event occurring	A similar outcome has arisen several times per year in local operations
Likely	• Event expected to occur • Event could occur monthly to annually • 60-90% probability of the event occurring	A similar outcome has arisen several times per year in the company worldwide or broader industry
Possible	• Event could occur under certain circumstances • Event could occur annually or within a 5-year period • 30-60% probability of the event occurring	A similar outcome has arisen at some time previously in local operations
Unlikely	• Event has occurred elsewhere • Event could occur within a 5-to-10-year period • 10-30% probability of the event occurring	A similar outcome has arisen at some time previously in the company worldwide or broader industry
Rarely	• Event has rarely occurred in the industry or may occur under exceptional circumstances • Event could occur within a 10-to-30-year period • <10% probability of the event occurring	No experience of this happening in the broader worldwide industry but theoretically possible

Consequences / Severity of Effects

- The assessment of the severity of effects (or consequences) of specific failure modes should be based on evaluations or analysis of expected responses following failure. The estimated consequence for a given failure mode is based on Newmont's definition for each consequence category and professional judgement of the anticipated impact of that specific failure (Table 2).

Table 2: Definition of consequence categories for the FMEA.

Consequence Categories	Insignificant	Minor	Moderate	Major	Catastrophic
Environmental	• Environmental impacts within area already disturbed by operations • Addressed and/or remediated as part of routine processes	• Environmental impact within the current or planned disturbance area or isolated offsite impacts • Non-routine effort to address and/or remediate.	• Significant (relating to size, toxicity, location, or other site factors) on-site environmental impact or offsite impact requiring immediate response to contain and/or prevent residual effects. • Remediation in the short to medium term without any anticipated long-term environmental effects.	• Environmental impacts with medium to long term impairment and residual ecosystem effects • Localized monitoring to determine extent of environmental impact from the event. • May require changes to closure liability	• Offsite widespread impacts that are extensive and long term. • Significant impacts on closure planning and liability.
Stakeholder Consultation and Permitting	• Does not introduce delays in permitting	• Minor changes in design required to gain permitting. Additional 1-3 months required	• Clarification of changes to the design require an additional 3- 12-month to gain permit	• Clarification or changes to the design require an additional 1-2 years to receive permit	• Sent to panel review, and/or receives non-acceptance from stakeholders
Life of Project Cost	• < $50,000	• $50,000 to $500,000	• $500,000 to $5,000,000	• $5,000,000 to $50,000,000	• > $50,000,000
Traditional Use (TU)	• Some disturbance but no impact to traditional land use	• Minor or perceived impact to traditional land use	• Some mitigable impact to traditional land use	• Significant temporary impact to traditional land use	• Significant permanent impact on traditional land use
Health and Safety	• Short-term, low-level Injury not affecting work performance and requiring first aid treatment at a maximum (FAI). • Reversible health effects, requiring first aid treatment at maximum.	• Injury requiring medical treatment or resulting in temporary restrictions to normal work duties. • Reversible health effects that would typically result in medical treatment or temporary restrictions to normal work duties. • Examples include extreme temperature effects, altitude sickness and workplace stress.	• Injury resulting in lost workdays • Severe, reversible health effects. • Can include acute/chronic effects associated with extreme temperature effects, musculoskeletal effects, vibration effects, chronic noise exposure, nervous system effects, some infectious diseases, and non-falciparum malaria.	• Single fatality, permanent disability, or multiple lost time injuries. • Irreversible health effects or disabling illness to multiple personnel. • Can include effects of chemical, physical or biological agents, progressive chronic health conditions and / or long-term impairment or shortened life.	• Multiple fatalities or permanent disability to multiple people. • Permanent irreversible health effects or disabling illness with an impact on multiple people.
Legal & Other	• Minor technical / legal issue unlikely to attract a third-party response.	• Technical / legal issue which may attract a low level administrative / regulatory response.	• Breach of regulation and / or other agreements with possible prosecution and penalties. • Continuing occurrences of minor breaches with possible prosecution and penalties. • Threat of legal action against Newmont	• Major breach of regulation and / or other agreements resulting in external party investigation. • Prosecution, penalties, or other action likely. • Legal action against Newmont.	• Serious breach of regulation and / or agreements resulting in external party investigation. • Operation suspended; licenses revoked. • Legal action against Newmont.

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-003
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #1 – General Information**

Summarizing Reports (References)

- Goldcorp Kaminak, a subsidiary of Newmont Corporation (Newmont). 2019. Coffee Gold Mine YESAB Project Proposal Appendix A – Project Description Overview. December 2019.
- Yukon Environmental and Socioeconomic Assessment Board (YESAB). 2021. Screening Report and Recommendation – Coffee Gold Mine 2017-0211. October 2021.

Location and Site Description

- Located in the White Gold District of west-central Yukon, approximately 130 km south of Dawson.
    - Located wholly within Tr'ondëk Hwëch'in Traditional Territory, partially within Selkirk First Nation and First Nation of Na-cho Nyäk Dun Traditional Territory, and partially within the asserted territory of White River First Nation.
- Located within Coffee Creek, YT-24 and Halfway Creek drainages of the South Yukon River Watershed. Latte Creek, a tributary of Coffee Creek, flows west to east, south of the Mine Site. The main mineralized zone of the Project is located approximately 6 km south of the Yukon River.
- Four open pits (Latte, Double Double, Supremo, and Kona), a heap leach facility (HLF), and waste rock storage facility (WRSF; Alpha WRSF).

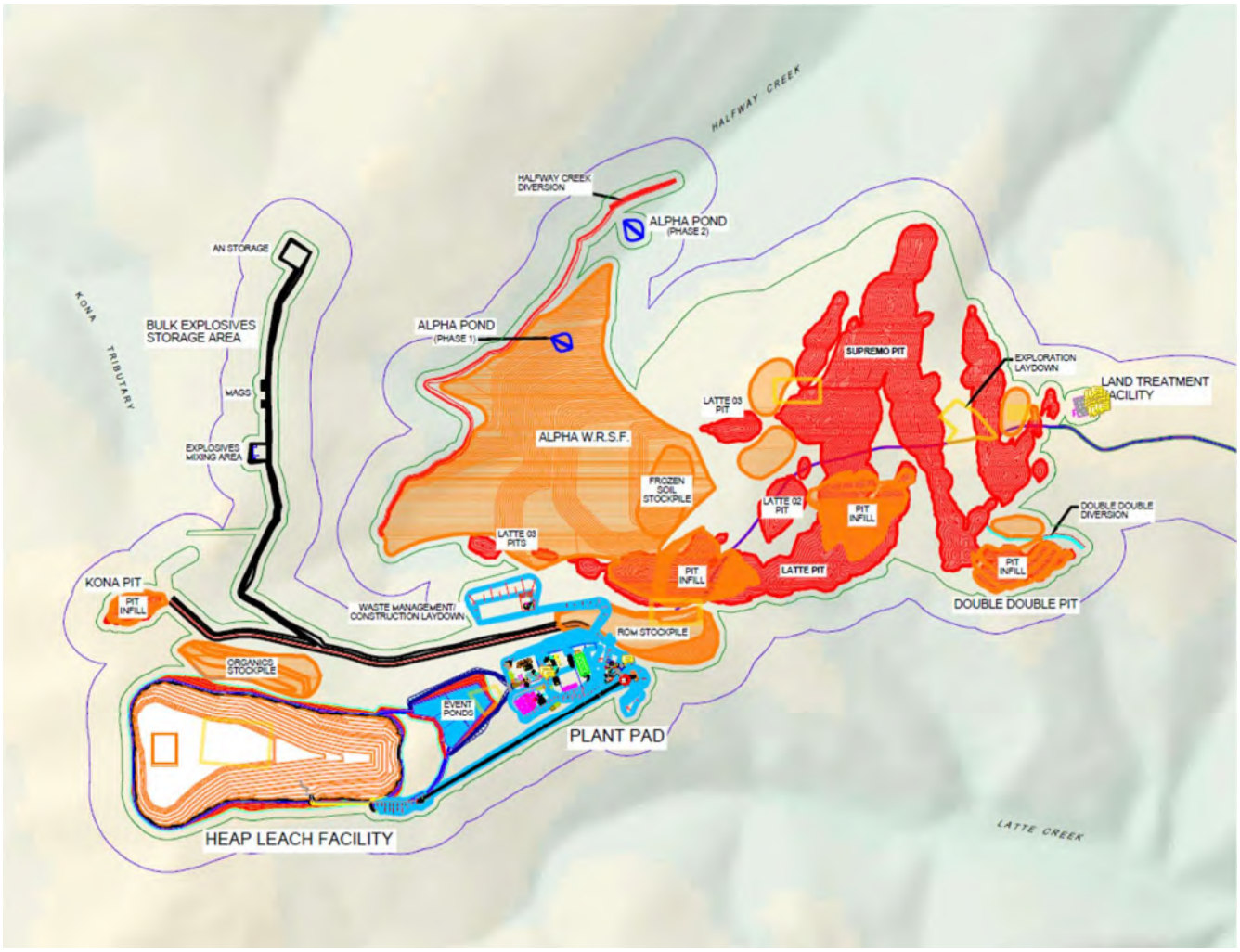


Figure 1: Mine site layout

- As shown in Figure 1, there is also a Frozen Soils Storage Area (FSSA) and run of mine (ROM) stockpile.
- The Project area encompasses 22,000 ha, including areas affected and unaffected by the Project.

Project Schedule

- Construction of mine site components and Northern Access Route (NAR) will take place from Year –3 to end of Year –1 (30 months).
- Operations will take place from Year –1 to end of Year 9 (10 years).
- The reclamation and closure phase for the Project will occur from Year 11 to end of Year 21, including a 6-year Post-mining Closure Stage and a 5-year Active Closure Stage (11 years).
- The post-closure phase will occur from Year 24 onward as determined to be required.

Open Pits

- The four open pits will be developed using standard drill-and-blast methods and mined using conventional truck and shovel methods.
- The average strip ratio for operations is 4.4:1.
- Waste rock will be used to selectively backfill mined out pits.
- An approximate total of 60,150 kt of ore will be mined from the open pits.
- An approximate total of 298,678 kt of waste rock will be produced from open pit mining activities.

Supremo Pit

- The Supremo Pit will be mined from Year -1 to Year 9.
- An approximate total of 36,902 kt of ore will be mined from the Supremo Pit.
- Strategic backfill of the Supremo Pit is planned from east to west to shorten the haul routes on-site.

Latte Pit

- The Latte Pit will be mined from Year -1 to Year 9.
- An approximate total of 20,962 kt of ore will be mined from the Latte Pit.
- Backfill of the Latte Pit from north to south will be completed to shorten the haul routes on-site.

Double Double Pit

- The Double Double Pit will be mined from Year 1 to Year 3.
- An approximate total of 1,340 kt of ore will be mined from the Double Double Pit.
- Double Double Pit will be completely backfilled.

Kona Pit

- The Kona Pit will be mined in Year 8 and Year 9.
- An approximate total of 946 kt of ore will be mined from the Kona Pit.
- Waste rock from the Supremo Pit will be used to backfill the Kona Pit to cover potentially acid generating (PAG) material in the exposed pit wall.
    - Backfilling is planned for the winter as frozen waste rock will be used to promote the re-establishment of permafrost.

Heap Leach Facility

- The HLF is a conventional, multi-lift, free-draining ridge-top leach pad with ponds, a solution distribution network, and collection piping.
- The HLF will run 9 months a year; ROM material will be stockpiled in the three coldest months of the year.
- When complete, the HLF will cover an area of 102 ha with an ultimate design height of 110 m and nominal capacity of 67 Million tonnes (Mt) per Forte design (2022).

HLF Construction

- Construction of the HLF will begin between Year -2 and Year -1 of the life of mine (LOM) plan with the construction of Stage 1, with a capacity of 7.2 Mt. Subsequent stages will have capacity between 8 Mt and 20 Mt, or 1.5 to 4 years of operating capacity (Table 1).

Table 1: HLF Operation Timing, Cumulative Area and Heap Volume by Stage

Heap Leach Pad Stage	Stacking Start Date	Stacking Start Year	Stage Stacking Completion Date	Stacking Completion Year	Cumulative Heap Volume (Mt)[1]	Cumulative Pad Stage Area (ha)[2]
1	4/1/2025	Year -1	7/1/2031	Year 6	12.0	24.6
2	4/1/2026	Year 1	4/1/2032	Year 7	21.9	42.6
3	10/1/2027	Year 2	7/1/2034	Year 9	42.3	69.5
4	10/1/2029	Year 4	10/1/2034	Year 9	60.3	91.7
5	4/1/2032	Year 7	10/1/2034	Year 9	67.7	104.7

1. Total ore in mine plan is 67 (Mt)
2. Lined are to toe of heap, does not include solution collection channels or ponds.

- The HLF will be constructed along the ridge to the west of the process plant and pits, in the southwestern corner of the site.
- It will be double lined with a geosynthetic clay liner (GCL) overlain by a low-density polyethylene (LLDPE) geomembrane. Drainage pipes will be nested in a 500 mm thick layer of permeable gravel at the base of the pad to collect pregnant (i.e., gold bearing) solution from the HLF.
- Ore will be stacked in 10 m lifts at the angle of repose of the ore material.
- HLF stages will be physically divided using ditches or berms to provide hydraulic isolation of heap leach solution between stages. There will also be hydraulic separation by cell, or approximately every 100 m of pad in the long-axis direction. Benches will be constructed as part of the HLF to produce an overall 2.5H:1V or flatter toe-to-crest slope for the stacked ore.

HLF Ponds

- Event ponds have been designed for both contact and non-contact water storage of meteoric run-off and solution. Per YESAB Screening Report commitments, the ponds will be designed to capture concurrent events of the 24-hr Probable Maximum Precipitation (PMP), 72-hr heap drain down, and seasonal solution accumulation, plus additional freeboard.

Table 2: Event and Non-contact Pond Volumes

Pond	Storage Capacity[1,2,3] (1,000 m^3)
EP-1N	112 (122)
EP-1S	89 (97)
EP-2	228 (245)
EP-2 Extension	62
Non-Contact Water	51 (57)

1. Per Goldcorp 2019 Project Proposal Appendix A
2. Pond volumes subject to change as the design advances
3. Storage capacity to freeboard (capacity to crest).

HLF Processing

- The HLF will use dilute cyanide solutions with pH ranging from 10.5 to 11.0.
- Barren leach solution will be irrigated onto the HLF using drip irrigation for approximately 40 days prior to the addition of a new lift of material. Pregnant solution will be conveyed to the processing plant through the collection piping network underlying the HLF and above the liner.

HLF Closure

- The HLF will be progressively closed, including regrading of slopes to an overall slope of 2.5H:1V, beginning in Year 8.
- The flat areas of the HLF will be capped with an infiltration barrier underlying a store-and-release cover system.

Waste Rock Storage Facilities

- Waste rock will be stored in the Alpha WRSF or used selectively as in-pit backfill.

Alpha WRSF

- The Alpha WRSF is located along the southeastern slope of the headwaters of the Halfway Creek watershed.
- The WRSF is located on slopes varying from permafrost-free to perennially ice-poor.
- The organic layer underlying the Alpha WRSF will be left in-place to preserve permafrost conditions.
- The estimated capacity is 250 Mt, with a total footprint of approximately 210 ha.
- The Alpha WRSF will contain the landfill and FSSA.
- A rock drain will be constructed at the base of the WRSF to convey water from the Halfway Creek catchment, as well as infiltration water and groundwater discharge.
- The Alpha WRSF will be built from the bottom-up in 40 m lifts. There is a 60 m setback planned between lifts for an overall slope of 3H:1V.
- Inter-bench slopes will be at the angle of repose (35°; 1.5H:1V), with the exception of the southern edge, where they will be reduced to 26° (2H:1V) to promote stability in ice-rich soils.

Frozen Soil Storage Area

- The FSSA will be constructed on the east side of the Alpha WRSF and will incorporate co-disposal of ice-rich (i.e., >15% visible ice) soils with waste rock.
    - Disposal will be in thin horizontal lifts.
- Approximately 1.0 Mm^3 of frozen soil will be excavated during construction, with 0.2 Mm^3 not likely suitable for use as construction or reclamation material.

Water Management

Alpha Pond

- The Alpha Pond will be located downgradient of the Alpha WRSF and collect water from the Alpha WRSF rock drain as well as meteoric water.
- Contact water collected in the Alpha Pond will be discharged to Halfway Creek beginning in Year -1.
- A diversion channel will be created to divert clean runoff away from the Alpha WRSF to discharge into Halfway Creek downstream of the Alpha Pond.
- The Alpha Pond will be decommissioned at closure.

Facility Ponds

- Two small Facility Ponds (North and South Facility Pond) will be located around the camp and plant pad.

- Camp and plant pad surface will be constructed to grade towards one of the two ponds.
- The North and South Facility Ponds will discharge towards Halfway catchment and Latte catchment, respectively.
- Water captured in the Alpha or Facility Ponds may be used for HLF makeup water, or for other operational needs (e.g., dust suppression).

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-004
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #2 – Coffee Mine Base Case Design**

Summarizing Reports (References)

- Goldcorp Kaminak, a subsidiary of Newmont Corporation (Newmont). 2019. Coffee Gold Mine YESAB Project Proposal Appendix A – Project Description Overview. December 2019.
- SRK Consulting Inc. (SRK) and Lorax Environmental Services Ltd. (Lorax). 2017. Coffee Gold Mine YESAB Project Proposal Appendix 31-C Conceptual Reclamation and Closure Plan. March 2017.
- Yukon Environmental and Socioeconomic Assessment Board (YESAB). 2021. Screening Report and Recommendation – Coffee Gold Mine 2017-0211. October 2021.

General Information

- The Base Case for closure of the mine components associated with the Coffee Mine is based on results from the alternatives assessment that was carried out during reclamation and closure planning (Fact Sheet #2A).

Closure Plan

Heap Leach Facility

- Flat areas of the heap leach facility (HLF) will be covered with a low-permeability barrier such as a geosynthetic clay liner (GCL), followed by a store-and-release (S&R) cover system.
- Estimated Net Percolation (NP) through the GCL cover system is ~5% of annual precipitation (PPT).
- Nominal thickness of the S&R cover system over the GCL is 0.5 m.
- The cover system will be revegetated to meet returning land use objectives including habitat expectations.
- A gravel layer will be placed over the GCL to provide protection, and also promote lateral water movement (interflow).
- The slopes of the HLF will be covered with a S&R cover system (0.5 m). The S&R cover will be placed at an angle of 2.5H:1V.
- Estimated NP through the S&R slope cover system is ~30% of annual PPT.
- Interflow and runoff will be conveyed off the HLF through surface water management channels. Surface water management channel design is TBD.
- The HLF will be closed progressively beginning in Year 8 of operations, when cells have been stacked to the ultimate design elevation and can be rinsed.
- An electro-biochemical reactor (EBR) is proposed for treatment of Phase II rinsate. Treated water from the EBR will be used to flush closed HLF cells.
- Two of the heap leach ponds will be integrated into proposed permeable reactive barriers (PRBs) if required to enhance treatment from the EBR. The ponds will be operated until the end of the water treatment period, at which point the liner will be folded and remaining sludge will be encapsulated with suitable material.

Waste Rock Storage Facility

- The Alpha Waste Rock Storage Facility (WRSF) will be constructed and maintained to meet closure criteria.
- Minor resloping may be required at the end of active dumping to maintain an overall slope of 3H:1V.

Alpha Pond

- The Alpha Pond will be decommissioned at closure.
    - The Alpha Pond will be drained.

  - Accumulated sediment will be either covered in place or removed and disposed of in dedicated areas within the Alpha WRSF or appropriate storage areas.
  - Dam will be breached to create a drainage channel.
  - Material from the dam breach will be used to backfill the pond excavations, cover the inundation footprint, or construct a drainage pathway through the footprint of the former pond and dam.
- The diversion around Alpha Pond will be decommissioned.
  - This involves the re-establishment of drainage patterns to pre-mining conditions, removing culverts, and regrade to slope.

Open Pits

- Sump pumps and pipelines associated with dewatering the various open pits will be cleaned and disposed of in the designated landfill on-site when they are no longer required.
- Boulder fences will be placed around the open pits as they are mined out. Fences will be set back from the final pit crest; their intention is to draw attention to the presence of a pit, not to prevent access.
- Open pits will be allowed to passively fill with natural runoff and precipitation.
- Pit backfills, where completed, will have flat tops, angle of repose side slopes, and safety berms as required.
- Opportunities to cover backfilled pits with reclamation material will be considered. For the Base Case, it is assumed that the backfilled pits (i.e., fully backfilled and partially backfilled) will not have a S&R cover system applied.

Latte Pit

- The Latte Pit will be strategically backfilled to shorten haul routes during operations.
- A boulder fence will be required around the Latte Pit at closure.
- The Latte Pit is expected to flood to a final elevation of 1,009 metres above sea level (masl).
- Overflow from the Latte Pit will discharge into the Alpha rock drain and ultimately to Halfway Creek.

Double Double Pit

- The Double Double Pit will be fully backfilled as part of operations and will not require a boulder fence.

Kona Pit

- The Kona Pit will be fully backfilled with waste rock prior to closure. As such, it will not require a boulder fence in closure.

- Overflow from the Kona Pit will discharge to the Alpha Pond if the runoff quality is appropriate.

Supremo Pit

- Portions of the Supremo Pit will be strategically backfilled to shorten haul routes during operations.
- A boulder fence will be required around the Supremo Pit at closure.
- The Supremo Pit is expected to form several pit lakes in local depressions in the pit floor. Long term water elevations are projected to vary from 939 masl to 1,194 masl.

Northern Access Route

- Sections of the NAR that were constructed to support the Project will be decommissioned (37km), as well as the onsite access road.
- Culverts, bridges, and barge landings will be removed, and the road surfaces will be scarified to promote water infiltration and vegetation re-establishment.
- Contouring of road surfaces will be conduced in accordance with final landscape designs.

Memorandum

To: Coffee Mine FMEA Participants

From: Ensero

Date: February 9, 2022

Re: **FMEA Fact Sheet #2A – Coffee Mine Alternatives Assessment**

General Information

- Alternative closure options were selected and assessed based on review and consultations, as well as input from various levels of government and First Nations.
- Alternatives were developed for the following activities:
    - Backfilling of open pits
    - Location of waste rock storage facilities
    - Cover for waste rock storage facilities
    - Location of heap leach facility
    - Cover for heap leach facility
    - Decommissioning of water management infrastructure including the Alpha dam/pond and west diversion
    - Decommissioning of the NAR
- Steps that were followed to determine the best means of undertaking the Project to achieve the Coffee-specific closure objectives include:
    - Step 1: Identify technically and economically feasible alternative means

  - Step 2: Identify potential effects of alternative means on Coffee Gold Mine Closure Values
  - Step 3: Identify preferred alternative means
  - Step 4: Failure Modes and Effects Analysis of preferred alternative means

- Where feasibility screening in Step 1 led to only one technically and economically feasible option being identified, this option was selected for use.
- The comparative evaluation of feasible alternatives in Step 2 used a six-point scale to indicate the relative effects on each closure value between alternatives.
- Following the feasibility screening and relative consideration of effects, analyses of the feasible alternative means was advanced in 2021 as Step 3 to finalize the preferred closure option for the Project components.

The alternative means that were assessed for the Project along with the relative effects ranking (Step 2) are provided in Table 1.

Table 1: Alternative Means Considered for Major Mine Components

Note: Current preferred closure option bolded

Feasible Alternative Means		Item	Step 2: Relative Effects Ranking	
			TH	SFN
Open Pit Backfilling	Latte	**Partial backfill- backfill used as haul roads**	4	2
		Partial backfill- backfill for other purpose	3	3
		Complete backfill – progressively	1	1
		Complete backfill – end of mine life	2	1
	Double Double	No backfill	3	1
		Partial backfill	2	3
		Complete backfill	1	2
	Kona	No backfill	3	2
		Partial backfill	2	3
		Complete backfill	1	1 or 4
	Supremo	**Partial backfill- backfill used to optimize mine development**	n/a	n/a
Waste Rock Storage Location(s)	Location(s) for non-Kona waste	2 WRSFs - West & South	2	2
		1 WRSF - Alpha	1	1
		Temporary Beta WRSF Location	2	2

	Waste storage duration for Kona waste	Permanent Beta WRSF Location	3	3
		All Kona waste rock to primary WRSF	1	1
Waste Rock Cover	Overall slope steeper than 3:1 but flatter than angle of repose	No cover	5	7
		Partial cover on flats	3	4
	Overall slope 3:1	**No cover**	4	6
		Partial cover on flats	3	3
		Complete cover	2	2
	Overall slope flatter than 3:1	No cover	2	5
		Complete cover	1	1
HLF Location	**2016 Feasibility Study leach pad**		1	1
	Valley C leach pad		2	2
HLF Cover	2016 Feasibility Study leach pad	Partial cover		
		(1) 2.5:1 construction and closure slopes; GCL installed on flat surfaces progressively	5	5
		(5b) 2.5:1 construction and 3:1 closure slopes by regrading during closure (wings); GCL installed on flat surfaces progressively and on wings at closure	5	3
		(8, 8a) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on flat surfaces progressively	2	4

		Complete cover		
		(5a) 2.5:1 construction and 3:1 closure slopes; all surfaces covered with GCL progressively	2	1
		(4) 3:1 construction and closure slopes; all surfaces covered with GCL progressively	1	1
		(7) 2.5:1 construction and closure slopes; all surfaces covered with GCL by keying into slopes	4	6
		(8b) 2.5:1 construction and 3:1 closure slopes by buttressing slopes with waste rock progressively; GCL installed on all surfaces	Not evaluated	2
	Valley C leach pad	Partial cover	2	2
		Complete cover	1	1
Decommissioning of Water Management Infrastructure	Alpha Dam/Pond	Remove dam completely	1	1
		Create channel without completely removing dam materials	2	2
	West Diversion	Partial decommissioning at natural depression drainages	2	2
		Complete decommissioning (re-grade to slope)	1	1
Decommissioning of NAR	**Decommission Project-associated NAR sections (37 km)**		2	2
	Leave Project-associated NAR sections (37 km) in place		3	3
	Close additional road sections beyond those that are Project-specific		1	1

Memorandum

To:	Coffee Mine FMEA Participants
From:	Scott Jackson, Hydrologist – Lorax Environmental
Our ref:	1075-220-005
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #3 – Climate Database**

Summarizing Reports (References)

- Lorax Environmental Services Ltd. (2022). Coffee Gold Project: 2021 Hydro-meteorology Baseline Report. January 2022.

Climate Monitoring

- Monitoring of Project site climatic conditions was initiated in 2012 with the installation of a climate station at Km 11 on the access road (975 m above sea level; masl), and multiple snow courses covering a range of elevations and aspects.
- A second climate station was installed at 1,340 masl near the proposed heap leach facility site in October 2018 to provide additional data representative of the elevation where most Project infrastructure is proposed.
- Both stations record air temperature, precipitation, relative humidity, barometric pressure, solar radiation, wind speed, and wind direction.
- Two tipping buckets were operated at the camp (450 masl) and ridgetop (1,300 masl) from 2015 to 2018 to further refine the understanding of summer rainfall orographic gradients.

- This data was extended with the use of regional climate data collected at the Dawson A station (operated by Environment and Climate Change Canada; ECCC) to develop a long-term synthetic climate dataset for use as input to water balance modelling exercises and engineering design work.

Air Temperature Regime

- Mean annual temperature is -2.6°C, while monthly average air temperatures range from -15.4°C (January) to +11.7°C (July) at the 1,300 masl reference elevation.
- Calculated air temperature lapse rates average -2.6°C/1,000 m over the summer months (April to September), and the average winter (October to March) lapse rate is 6.6°C/1,000 m.
- Pronounced temperature inversions are common at the Project site, with daily air temperatures exceeding the 0°C threshold at least once per year at ridgetop elevations.

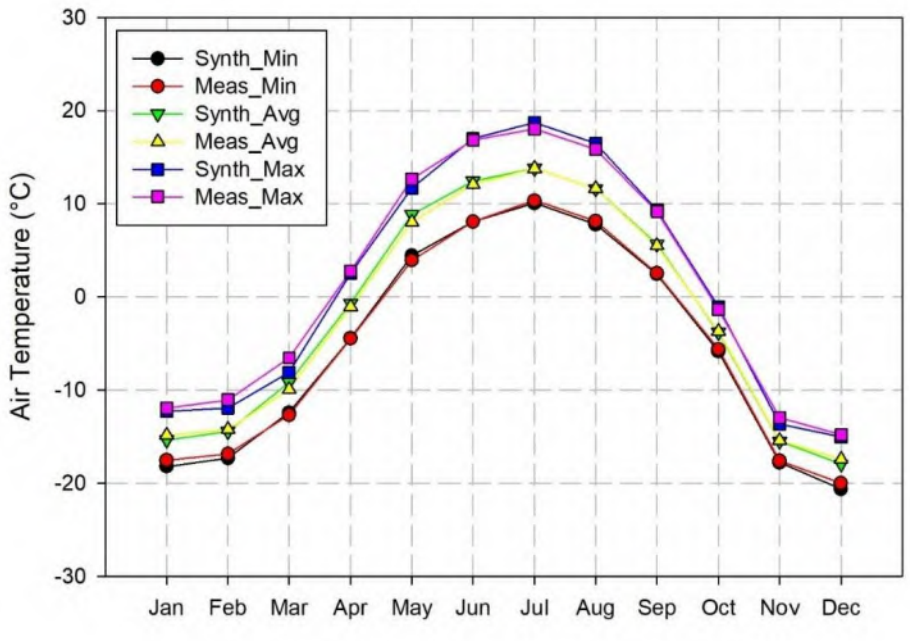


Figure 1: Measured and synthetic monthly average minimum, mean and maximum air temperatures for the Coffee Gold Project site.

Precipitation Regime

- Mean annual precipitation at the reference elevation (1,300 masl) is estimated to be 504 mm, with 67% falling as rain and 33% falling as snow. On average, the highest monthly precipitation depths are realized in July (76 mm), and the lowest precipitation month is April (14 mm).
- Orographic cooling results in higher precipitation at the upper elevations of the Project site, relative to the valley bottoms. Rainfall occurring in the months of April through September increases by 4%/100 m, while snowfall (October through March) increases by 7%/100 m.

- Average maximum annual snow water equivalent is estimated to be 170 mm at 1,300 masl, with sublimation losses estimated to total 40 mm over the winter season, and 20 mm over the snowmelt period.

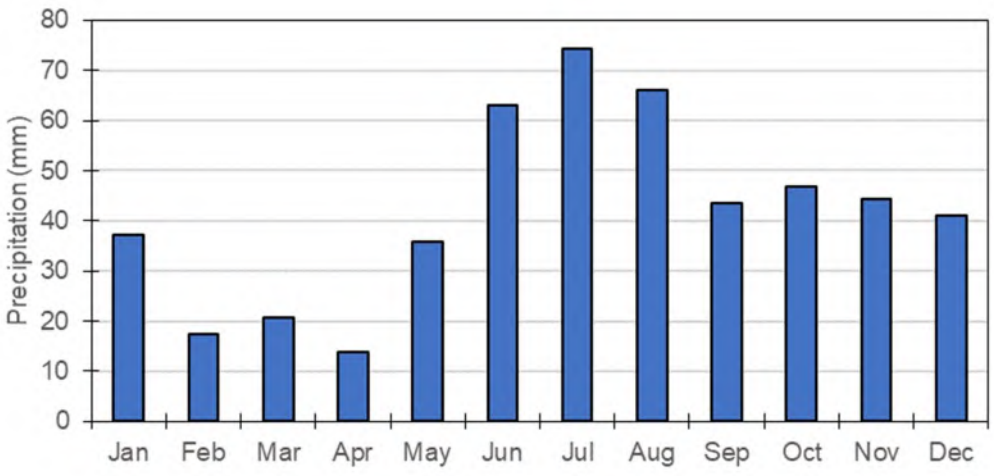


Figure 2: Synthetic monthly average precipitation at 1,300 m.

Rainfall Recurrence Interval Estimates

- 24-hour rainfall event depths were estimated for various recurrence intervals using long-term regional rainfall datasets. These estimates are scaled to representative elevation bands by 4%/100 m increase in elevation.
- The 24-hour probable maximum precipitation (PMP) event estimate of 283 mm (at 1,300 masl) was generated from the same regional dataset.

Table 1: 24-hour rainfall recurrence interval estimates for the Coffee Gold Project, scaled to representative elevations

Elevation (m)	1:2 yr	1:5 yr	1:10 yr	1:25 yr	1:50 yr	1:100 yr	1:200 yr
600	29	43	51	61	68	74	80
700	30	44	53	63	70	77	83
800	32	46	55	66	73	80	87
900	33	48	57	68	76	83	90
1,000	34	50	60	71	79	87	94
1,100	36	52	62	74	82	90	98
1,200	37	54	65	77	86	94	102
1,300	38	56	67	80	89	98	106

Potential Evaporation

- Potential evaporation (PE) is calculated using the Hargreaves-Samani method for input to all water balance modelling efforts.
- Annual PE is estimated to be 470 mm at the reference elevation, with peak daily rates of approximately 3.3 mm/day in June and July, corresponding with peak temperatures and solar radiation inputs.

Wind Speed and Direction

- Monthly average wind speeds at 1,300 masl range from 3.7 to 5.1 m/s, gusting in excess of 20 m/s in all months.
- Wind speeds are higher in the months of April through September compared to October through March.
- The dominant annual wind vector is from the southwest, with secondary vectors from the southeast through east.

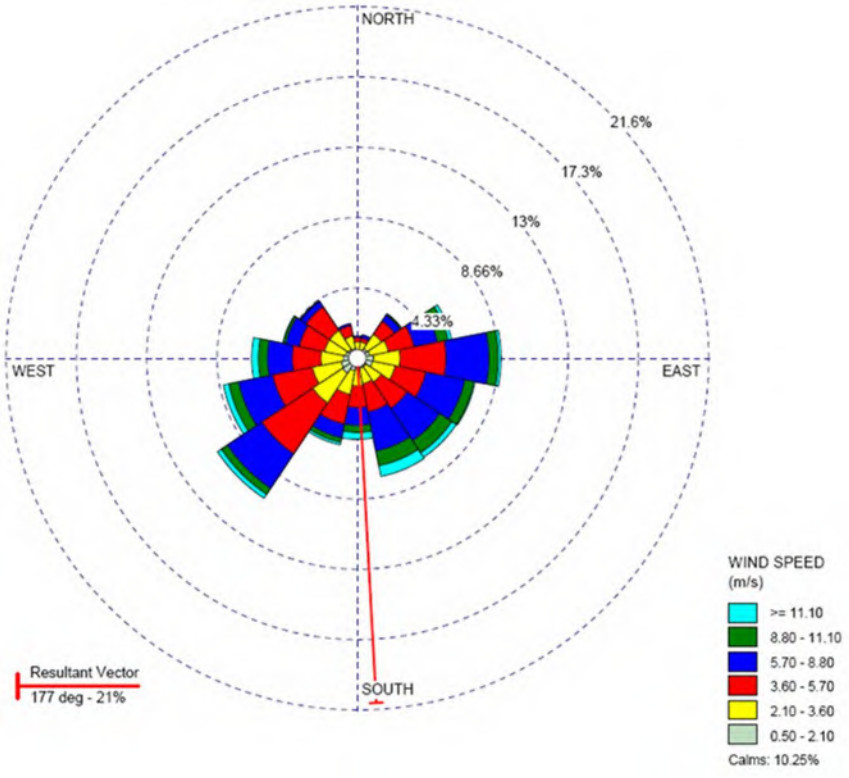


Figure 3: Annual wind rose for the proposed heap leach facility site. Wind directions are 'blowing from'.

Climate Change

- Average annual temperatures are projected to rise significantly in the Project area over the next century. Present day annual average temperature is approximately -2.5°C at the Project site, and the annual average is forecasted to rise by 2.5 to 5°C by the end of the century (Table 2).

- Net precipitation in the vicinity of the Coffee Gold Mine is projected to increase by 20% to 35% over the course of this century, where summer and winter can be expected to be slightly wetter in the future, and spring and fall seasons are projected to see little net change in precipitation abundance.
- Climate change projections are incorporated into the model input climate series as a base case assumption. The climate input data are scaled to reflect the projected changes in precipitation, minimum, mean and maximum air temperature.

Table 2: Decadal statistics for the Coffee Gold Project water balance model climate inputs, reflecting the RCP6.0 climate change scenario projections.

Decade	Minimum Air Temperature (°C)	Mean Air Temperature (°C)	Maximum Air Temperature (°C)	Precipitation (mm)
2010-2019	-4.4	-2.6	2.7	504.0
2020-2029	-3.0	0.5	3.9	538.1
2030-2039	-2.8	0.6	3.9	510.5
2040-2049	-3.3	0.4	3.9	567.0
2050-2059	-1.9	1.6	4.9	573.3
2060-2069	-1.7	1.7	4.9	543.2
2070-2079	-2.2	1.5	4.9	602.5
2080-2089	-0.8	2.7	5.9	608.5
2090-2099	-1.8	1.6	4.7	564.7
Change (from 2015 to 2095)	**2.6**	**4.2**	**2.0**	**60.7**
Trend (per decade)	**0.33**	**0.44**	**0.29**	**10.0**

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-006
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #4 – Geology and Hydrogeology**

Summarizing Reports (References)

- Lorax Environmental Services. (Lorax). 2021. Coffee Gold Baseline Hydrogeological Assessment 2019 Update. Prepared for Newmont Coffee. December 2021.
- Lorax. 2019. Coffee Gold Project: 2019 Hydro-meteorology Baseline Report. Prepared for Newmont Goldcorp. September 2019.
- JDS Energy & Mining Inc. (JDS). 2016. NI 43-101 Feasibility Study Technical Report for the Coffee Gold Project, Yukon Territory, Canada. Prepared for Kaminak Gold Corp. February 2016.
- MacWilliam, Kathryn R. G. 2018. The Geology and Genesis of the Coffee Gold Deposit in West-Central Yukon, Canada: Implications for the Structural, Magmatic, and Metallogenic Evolution of the Dawson Range and Gold Exploration Models. Thesis. University of British Columbia.
- Tetra Tech. 2017. Fall 2017 Test Pitting Program, Coffee Mine Site Phase 1: Proposed Infrastructure Footprints, Phase 2: Proposed Open Pit Areas. Prepared for JDS Energy & Mining.
- Tetra Tech and Lorax. 2018. Information Requests Related to Permafrost Conditions and Degradation Coffee Gold Project. Technical Memorandum Issued for Use (Revision 1) to JDS Mining and Energy. February 2018.

Geological Setting

- Topography is characterized by stream erosion resulting in gently rounded hills with tightly incised valleys. Elevations range from 400 to 1,500 meters above sea level (masl). The project is situated at an elevation of 1,300 masl.
- The Coffee Mine is located in an area of relatively low seismic activity in the St. Elias region where the Pacific plate is being subducted beneath the North American plate.
    - Creek traces in the area are interpreted to be representative of permeable fault structures.

Surficial Geology

- Surficial units include:
    - Atypical loess (i.e., aeolian silt) infills and silt, with silt thickening towards the southwest side of the mountains.
    - Weathered bedrock.
    - Schist weathering to micaceous sand in the east.
    - Granitoid weathering to gravel in the west.
    - Colluvium containing air voids occurs on steep slopes and is likely to be coarse-grained. Ice-rich re-sedimented loess and peat form colluvial aprons on lower slopes. Fluvial deposits occur in valleys.
    - Peat occurs locally and in discontinuous lenses, and acts as an insulator. Where peat is present, frozen ground/ice exists approximately 0-50 cm below the peat.
    - In the west, frost jacked granitic boulders overlie peat forming a boulder layer that is especially prevalent underneath the HLF.
- Landforms in the Project area include tors and pingos (intact and collapsed).

Bedrock Geology

- Metamorphosed rocks of the YTT includes the sulfur creek suite, the klondike schist, and the snowcap assemblage, shown in Figure 1.
- Outcrops are scarce in the Project area.
- Depth to bedrock is variable across the site (Table 1).

Table 1: Bedrock Depths by Mine Area

Mine Area	Depth to Bedrock (mbgs)	Bedrock Type
HLF	0.8 to 1.8	Faulted and jointed weathered granite
Alpha WRSF	1.0 on NW side; 3.7 on E side	Granite or Gneiss

JDS, 2016

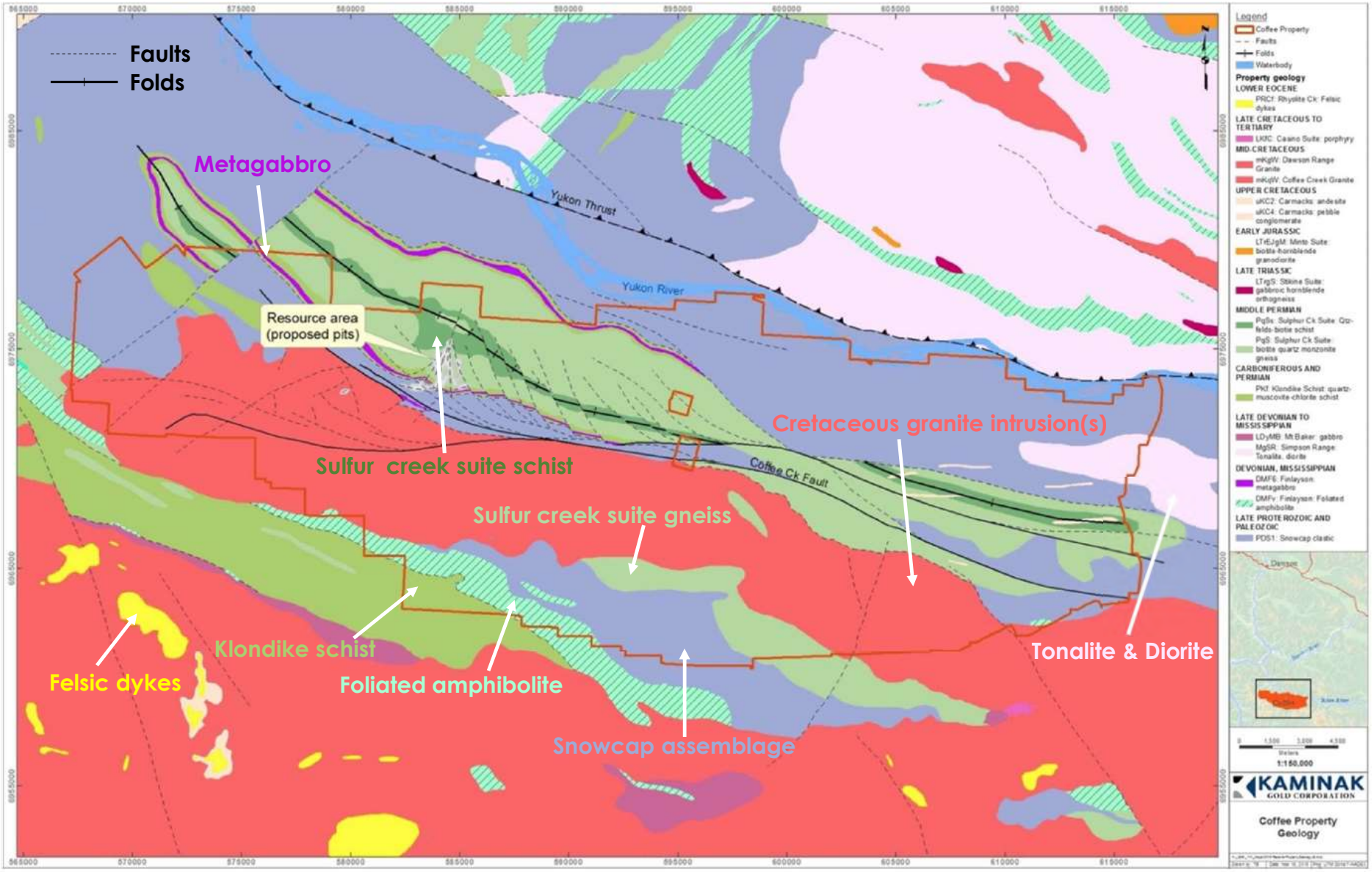


Figure 1: Bedrock geology at the Project site

Baseline Hydrogeological Setting

- The hydrogeological framework in the Project area is controlled by a combination of permafrost, fractures, and large-scale geologic structures, resulting in a complex groundwater system.

Watersheds

- Precipitation is the only significant source of water for the Project. There are four catchment basins that are part of the Yukon River watershed (Figure 2):
    - Halfway Creek Catchment.
    - YT-24 Catchment.
    - Latte Creek Catchment.
    - Coffee Creek Catchment.

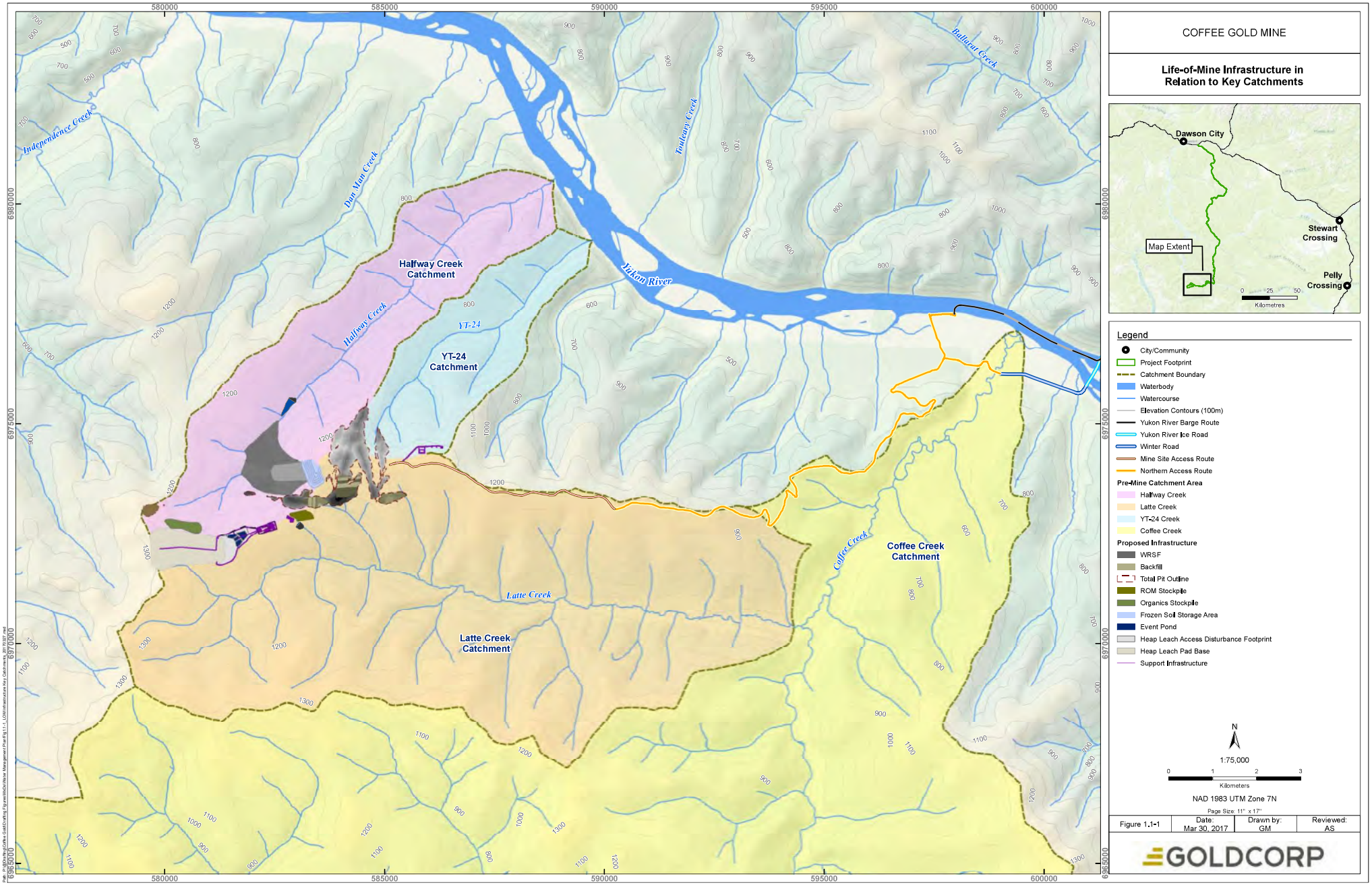


Figure 2: Catchment basins near Coffee Mine

Permafrost

- Lenses of discontinuous permafrost occur under approximately 60% of the site, which acts as a confining layer to the groundwater below (Figure 3).
- Frozen soils are predominately on the north- and west-facing slopes and in valleys and thickest on higher elevation north-facing slopes (30-165 m thick).
    - Ice-poor permafrost is common in upland settings along ridges and on moderately steep valley sides with convex or straight slopes.
    - Ice-rich permafrost is more common in areas with higher organic accumulation and silt-rich sediments in fluvial valley bottoms.
    - Approximately 34% of the project area is underlain by ice-poor permafrost, 27% by permafrost with visible excessive ice, and 1% by ice-rich permafrost.
- Permafrost-related processes active on-site include solifluction, active layer detachment, slope creep, frost heave, and thermal erosion.
- The warmest permafrost temperatures (-0.6ºC) occur at the bottom of the Halfway Creek valley. The coldest permafrost temperatures (-2.0ºC) occur at the bottom of YT-24 Creek and on the north-facing slope of the upper Halfway Creek valley.
- The permafrost classification for the site is “warm” and accordingly, the ground is sensitive to disturbance.

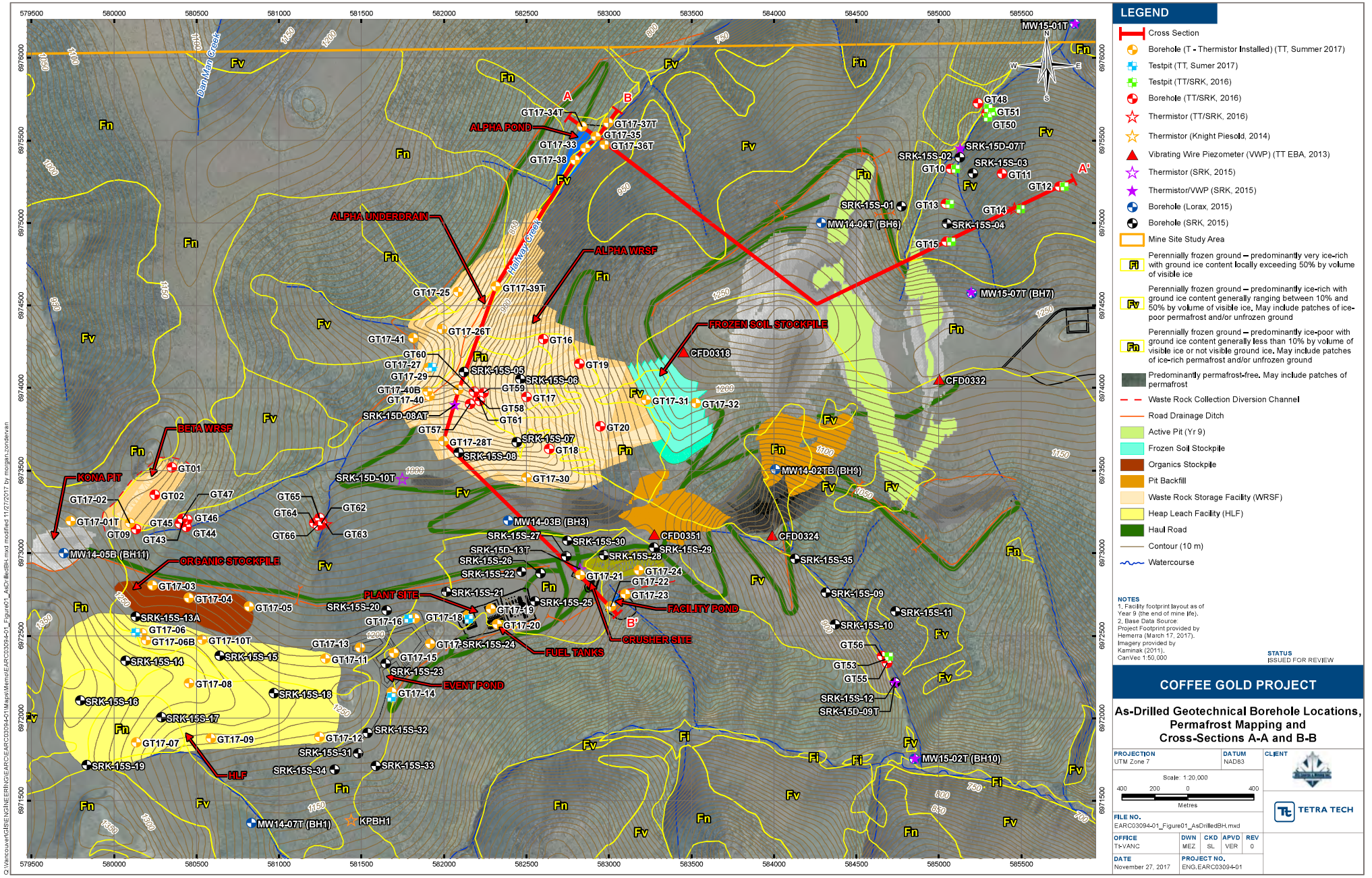


Figure 3: Permafrost Mapping at Coffee Mine

Groundwater

- Groundwater levels in ridge areas range from 130 to > 220 m below ground surface (mbgs), with artesian conditions encountered along the drainages. Groundwater flow generally follows topography, discharging to drainages that are inferred to be permeable fault structures.
    - Groundwater level hydrographs from deeper installations are generally smooth and broadly sinusoidal with one annual maximum that occurs weeks to months after freshet. A few recorded hydrographs from low elevation installations adjacent to creeks show flashier records that correspond to response to rainfall events.
    - At higher elevation installations, the water table resides below the base of permafrost. Water levels are more than 220 mbgs at the northwest extent of the proposed Supremo pit. At high elevation installations near the proposed Kona and Latte pits, water levels are on the order of 110 to 150 m deep.
    - A high elevation installation on the margins of the proposed heap leach facility registers artesian pressures in a faulted area confined by permafrost.
- Vertical hydraulic gradients are variable across the site, influenced by the presence/absence of permafrost and fractures. Horizontal hydraulic gradients follow, and in some cases, exceed topographic gradients.
    - Artesian groundwater pressures are reported at many lower elevation installations in both permafrost and permafrost-free areas.
    - While groundwater pressures may be artesian adjacent to creek traces, often vertical gradients are downwards, suggesting groundwater is under-drained by the intercepted faults. This is particularly true at installations along Latte Creek. Upward hydraulic gradients are measured in the lower reaches of Halfway Creek near the intersection of a crosscutting fault.
- A narrow through talik is present in Halfway Creek, allowing discharge of deeper sub-permafrost groundwater to surface. This open talik is likely one of the significant reasons why icings (aufeis) often occur in the bottom of the Halfway Creek. Similar effects are expected elsewhere if / where a talik is present.
- The average k value from tests located near creek traces where groundwater discharges (along permeable fault structures) is 1×10^{-6} m/s.
- The arithmetic mean of all valley and pit structure k tests is 2×10^{-7} m/s.
- Minimum baseflow measured in late winter is considered equivalent to groundwater discharge and ranges from 0.0 to 0.7 L/s/km

Memorandum

To:	Coffee Mine FMEA Participants
From:	Scott Jackson, Hydrologist – Lorax Environmental
Our ref:	1075-220-007
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #5 – Water Balance**

Summarizing Reports (References)

- Lorax Environmental Services Ltd. (2022). Coffee Gold Project: 2021 Hydro-meteorology Baseline Report. January 2022.
- Lorax Environmental Services Ltd. (2019). Coffee Mine Update Study Water Balance and Water Quality Model. August 2019.
- Lorax Environmental Services Ltd. (2017). Coffee Gold Project: Water Balance and Water Quality Model Report. March 2017.

Site-Wide Water Balance Model

- The site-wide water balance model (WBM) was built using GoldSim.
    - The WBM runs using a daily time step. A synthetic climate time-series is used as a driving input.
- The WBM is applicable to all phases, including post-closure to year 2100.
    - Operations (Year -1 to Year 9)
    - Closure (Year 11 to Year 21)

  - Post-closure (Year 24 onwards)

- Climate change is explicitly considered in the Base Case, with the climate inputs adjusted to reflect the projected upward trends in air temperature and precipitation in the Representative Concentration Pathway (RCP) 6.0 emissions scenario.
- The WBM architecture forms the foundation of the water quality model (WQM), which is used to estimate the effects of mine component loadings on water quality in the receiving water courses of interest (Halfway Creek, YT-24, Latte Creek, Coffee Creek, and the Yukon River).
- The WBM tracks the evolution of mine infrastructure (i.e., open pits, the waste rock storage facility, the heap leach facility, pit backfill, and settling pond construction) on an annual basis.
  - WBM assumptions and results reflect the mine plan presented in the Coffee Mine Update Study (2019).
  - These assumptions will be revised once the updated mine plan is available.

Natural Catchments

- The WBM includes a three-reservoir watershed model, with each reservoir representing the quick flow, interflow, and baseflow components of the local streamflow regime.
  - Quick flow – generated by storm or snowmelt events and often resulting in peak flow events. For tributaries local to the Project, water contributed via this mechanism may report to creeks in less than two days time.
  - Interflow – this refers to the lateral movement of infiltrated meteoric water through the shallow overburden to the stream channel. Flow reporting to creeks along this pathway are often referred to as vadose or unsaturated zone flow.
  - Baseflow – the portion of surface flow derived from groundwater discharge. At the Project site, this composes the majority of streamflow during summer low flow periods and through the winter season.
- The WBM is applied to each natural sub-catchment within the Project site, with precipitation and temperature inputs (i.e., snow accumulation, melt, and potential evaporation) scaled by elevation.
  - Each watershed sub-model was calibrated by basin to match measured streamflow record(s), and to water quality signatures recorded in the local tributaries.
  - This allows key hydrological processes (e.g., the formation of aufeis during winter, freshet initiation, and rapid response to high-magnitude rainfall events) to be accurately represented in the model outputs.
  - Allows strong relationships between streamflow and metals concentrations to be replicated within the WBM and WQM.

Heap Leach Facility

- The heap leach facility (HLF) WBM developed by the Mines Group (2019) is fully integrated into the WBM, which allows the water management linkages (i.e., makeup water demands and sources, draindown treatment and discharge) to be linked with other site water management infrastructure.
- Key aspects of the HLF WBM are:
    - The solution application rate is 1,100 m^3/hour, which can't be met by meteoric inputs. Stream flows drop to near annual minimums during the open water season, and therefore do not provide a reliable supply of makeup water for solution application.
    - The increased makeup water demand, along with water required for camp operations and dust control, will be withdrawn from extraction wells located adjacent to the Yukon River. No site contact water is assumed to be diverted to satisfy HLF makeup demand.
    - The increased leaching rate requires water treatment for HLF drain down to be in place by Year 6. Maximum treatment rates are assumed to be 10 L/s in Years 6-8 and 20 L/s after Year 8 during the open water season. (7 L/s starting in year 6-1/1/31)
- Forte Dynamics is currently updating the HLF WBM, and the above summary is subject to change based on this revised model (changes noted above in red). Below are keys from preliminary Model Results prepared for FMEA workshop only.
- Mine plan Year -1 equates to 1/1/2025 – 12/31/2025

Table 1: Key dates from preliminary model run

Heap Leach Pad Stage	Stacking Start Date Updated Minplan	Stacking Start Year Year	Pad Phase Stage Area (m^2)	Stage Stacking Completion Date	Economic Recovery Complete	Rinsing	Cover Placement Start Date	Cover Placement End Date
1	4/1/2025	Year -1	245,124	7/1/2031	8/25/2036	12/25/2041	5/1/2042	8/1/2042
2	4/1/2026	Year 1	180,828	4/1/2032	3/14/2037	12/1/2045	5/1/2046	8/1/2046
3	10/1/2027	Year 2	268,832	7/1/2034	4/20/2038	10/7/2051	5/1/2051	8/1/2051
4	10/1/2029	Year 4	221,310	10/1/2034	12/14/2039	7/31/2056	5/1/2051	8/1/2051
5	4/1/2032	Year 7	130,331	10/1/2034	7/2/2040	6/2/2059	5/1/2051	8/1/2051

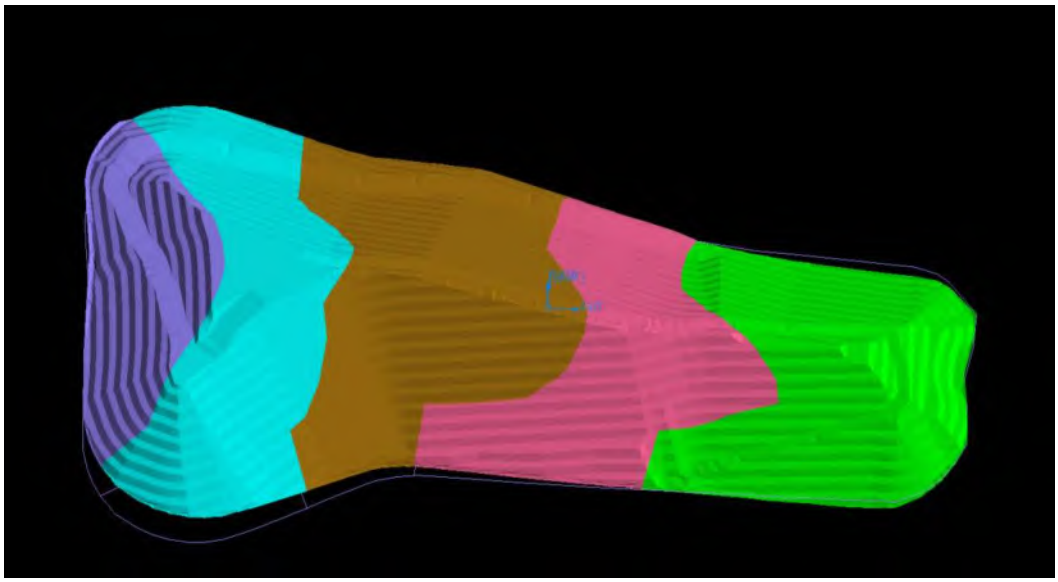


Figure 1: Heap leach pad by stage

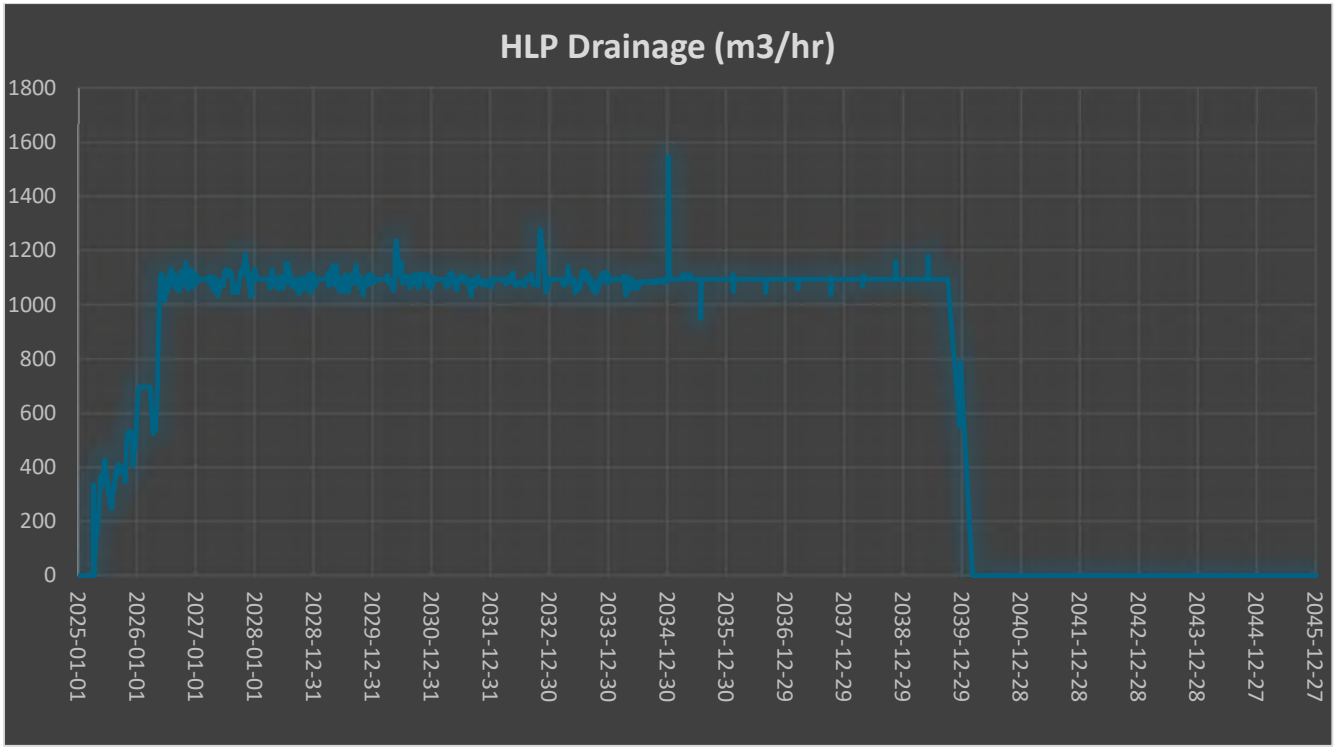


Figure 2: Heap Leach Pad Solution Drainage and drain down w/25 m3/hr

Disturbed Areas

- The process plant site, camp site and run-of-mine (ROM) stockpile are represented in the WBM with a simple runoff coefficient of 0.7.

WRSFs

- The Alpha waste rock storage facility (WRSF) and open pit backfill are represented using a modified version of the three-bucket natural catchment model.
- There is a lag between meteoric inputs to the WRSF and subsequent basal seepage flows due to wetting up, resulting in delays in release of loadings of parameters of potential concern (POPCs).
    - The WBM assumes that the WRSF was wetted up at time of placement and begins to generate seepage (and therefore loadings) immediately.
- No surface runoff is generated by the WRSFs in the WBM. All meteoric inputs are assumed to either evaporate or percolate into the WRSF.
- A long-term average infiltration (and therefore seepage) coefficient of 0.45 was targeted, noting inter-annual variability about this value from 20% to 50% of mean annual precipitation, in line with research conducted on WRSFs at other cold climate mine sites.
- The prolonged drain down of contact water from the fine fraction waste rock pore spaces is represented in the model, with elevated discharges from the WRSF persisting into the summer low-flow period in the receiving streams.

Open Pits

- There are four main pit complexes in the current mine plan (Supremo, Latte, Double Double and Kona).
- Meteoric inputs (rainfall plus snowmelt) are converted to runoff by a factor of 0.7.
- The Supremo Pit complex drains north to YT-24, and south to Latte Creek along with Double Double Pit outflows, while the Latte and Kona Pits flow to Halfway Creek via the Alpha WRSF rock drain and the Alpha Pond spillway.
- Rates of inflow to the open pit voids, and outflow seepage from pit lakes predicted by the groundwater model were encoded in the WBM. These pit lake seepage fluxes are assumed to report instantaneously to the receiving streams (i.e., no lag through the bedrock groundwater flow paths) in the WBM.
- Double Double Pit diversion is in place by the beginning of Year 2 to route non-contact flows away from this pit.
- The Kona Pit is mined beginning in Year 6, dewatered to the Alpha WRSF rock drain, and backfilled with Supremo waste rock in Year 8.

- During the Operations phase, the open pits are assumed to be dewatered instantaneously, with all runoff reporting to the pit sumps pumped out to the receiving streams in the same day.

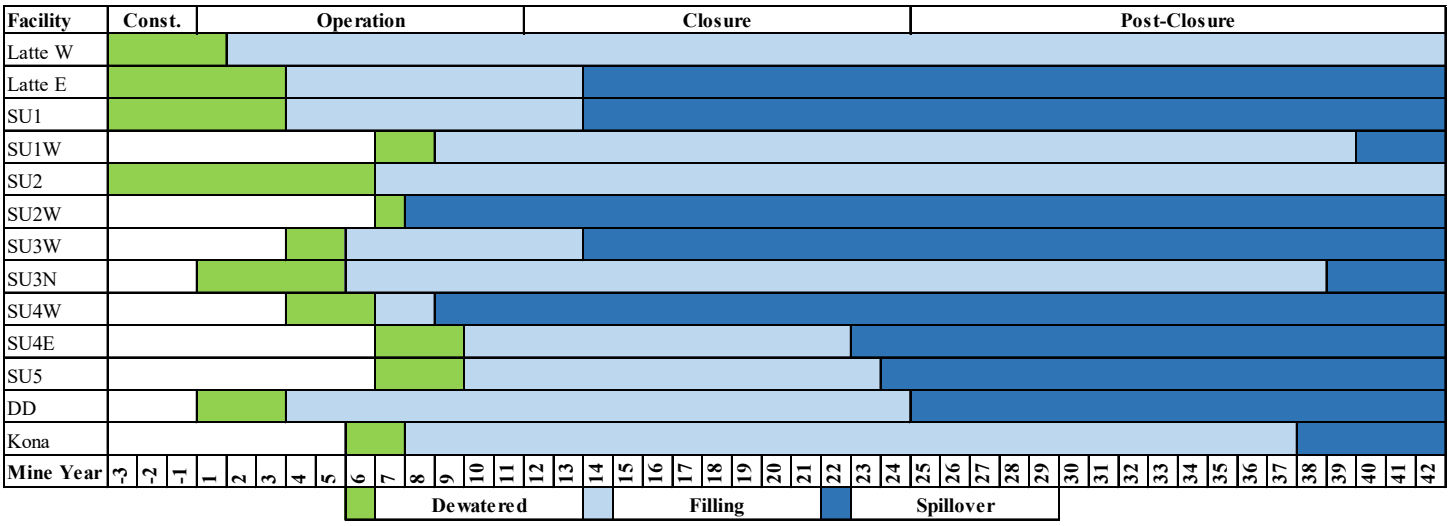
Water Management

- Two Facility Ponds are constructed in Year -1: North (spills to Alpha WRSF rock drain); and South (drains to Latte Creek).
- An initial coffer dam will be built in Year -2 further upstream in Halfway Creek to capture Alpha WRSF seepage and control sediment while the Phase I Alpha Pond dam is constructed. The Phase I Alpha Pond will operate from Year -1 to Year 3.
- The Phase II Alpha Pond and Halfway Diversion will be constructed during the winter of Year 3. Both the Phase I and Phase II Alpha Ponds discharge passively to surface waters, and also leak at rates controlled by the pond water elevation (*i.e.*, higher water levels result in increased driving head and thus higher leakage rates).

Water Balance Model Results

Open Pit Water Balances

- The mine plan schedule for open pit mining, along with the predicted timelines for pit filling and subsequent spill to the receiving environment is shown in Figure 3.



Note:
SU2 Pit not predicted to spill within modeled period (to mine year 87).
Green bars represent active mining and therefore pit dewatering, light blue represents the pit filling period, and dark blue bars indicate that the pit is spilling.

Figure 3: Predicted timelines for pit development, management, meteoric filling and spill to receiving streams.

Changes to Local Stream flows

- Project-induced changes to the baseline streamflow regime in the receiving watercourses are predicted to be minimal.
- Flow reductions are predicted to occur in Upper Latte Creek as a result of Project development, with the largest magnitude open water season changes predicted to occur during the Operation phase (mean increase of +6%, 90th percentile = 14%).
    - The magnitude of change predicted for the four indicators (Annual Runoff, Monthly Distribution, Low Flow, Peak Flow) used in this assessment ranged from low to high at LC-11.4, with ratings at downstream locations LC-0.1 and CC-4.2 generally being low and/or consistent with negligible or no change form natural/baseline condition.
    - Flow enhancements are predicted generally for the YT24-0.1, HC-6.8 and HC-1.0 model nodes due to the alteration of the existing surface and removal of vegetation due to mining operations.
- For YT-24, the relatively larger proportion of the total catchment area that will contain mine infrastructure (open pits only), the elevation of mine footprints, and increase in overall contributing area (due to water management activities), is predicted to result in moderate and high magnitude changes to the streamflow regime during the open water season (mean increase of +5%, 90th percentile = 10%). Streamflow changes are predicted to be greatest at YT24-0.1 during the Operation Phase, when pits are actively dewatered.
- Results for HC-6.8 show high magnitude change ratings for selected indicators over Project life during the open water season (mean increase of +6%, 90th percentile = 14%), with improvement (i.e., flow

enhancements diminish) in indicator ratings (e.g., Magnitude, High Flow – moderate) further downstream at HC-1.0.

Memorandum

To:	Coffee Mine HLF FMEA Participants
From:	David Flather – Lorax Environmental
Our ref:	1075-220-008
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #6 – Water Management**

Summarizing Reports

- SRK Consulting (Canada) Inc. and Lorax Environmental Services Ltd (2019). Coffee Gold Mine – YESAB Project Proposal. Appendix 31-E Water Management Plan version 3.0. August 2019.
- WesTech Engineering and Inotec (2021). Coffee Project Water Treatment from Feasibility Studies to a Conceptual System Design – Comprehensive Report. September 2021.

Background

- The majority of waste rock produced during mining will be transported to the Alpha Waste Rock Storage Facility (WRSF) located in the upper reaches of Halfway Creek.
- Low metal leaching waste rock will be used as construction material for embankments, roads and water management structures (e.g. diversion ditches, riprap in channels).
- Water for irrigation leaching will be supplied primarily from a groundwater extraction well-field, located adjacent to the Yukon River. Additional sources of process leaching water for the heap leach ore include:
    - Raincoat runoff water collected in rainwater ponds;
    - Precipitation runoff collected in open pits;
    - Runoff collected in Facility Ponds around the Plant Site area.

DRAFT

- For the purposes of water management planning three types of water are considered:
    - c*ontact water* is used to describe water that comes into contact with waste rock in the Alpha WRSF, waste rock and ore on the ROM pad, open pit walls/open pit floor and construction waste rock (e.g., roads) and only needs treatment for sedimentation control prior to release to the receiving environment.
    - *Excess HLF water* is used to describe water that contains residual heap leach solution contaminants and will require additional treatment, either using active treatment in the water treatment plant during operations and early closure or using semi-passive treatment during post closure.
    - *Non-contact water* is used to describe water that has not come into contact with any Project components or does not require any treatment prior to discharge to the environment (e.g., potentially raincoat water).

Objectives and Purpose

- The purpose of the Water Management Plan (WMP) is to describe how water will be managed at the mine site through life of mine.
- Key performance objectives for water management at Coffee are to:

1) Maintain the physical integrity and stability of the Mine Site through controlled water management;

2) Ensure that the quantity and quality of contact water and treated water discharged from the mine complies with applicable regulatory requirements;

3) Minimize any potential effects to surface water and groundwater quantity and quality in the receiving environment; and

4) Minimize alteration to the pre-development drainage network, and the volume of contact water to be managed;

Summary of Water Management

- The Coffee Project Mine Site is located near the headwaters of three watersheds:
  - Halfway Creek,
  - YT-24, and
  - Latte Creek (Figure 1).
- The water management system configuration within the Mine Site includes conveyance structures (e.g., diversion channels, diversion berms, pipelines), in-pit sumps and sedimentation ponds.
- Non-contact water will be diverted away from mine infrastructure to the extent practical to reduce infiltration into WRSFs and pit inflows, while contact water is aimed to be intercepted and conveyed by conveyance structures to sedimentation ponds and pit voids no longer being mined if necessary.

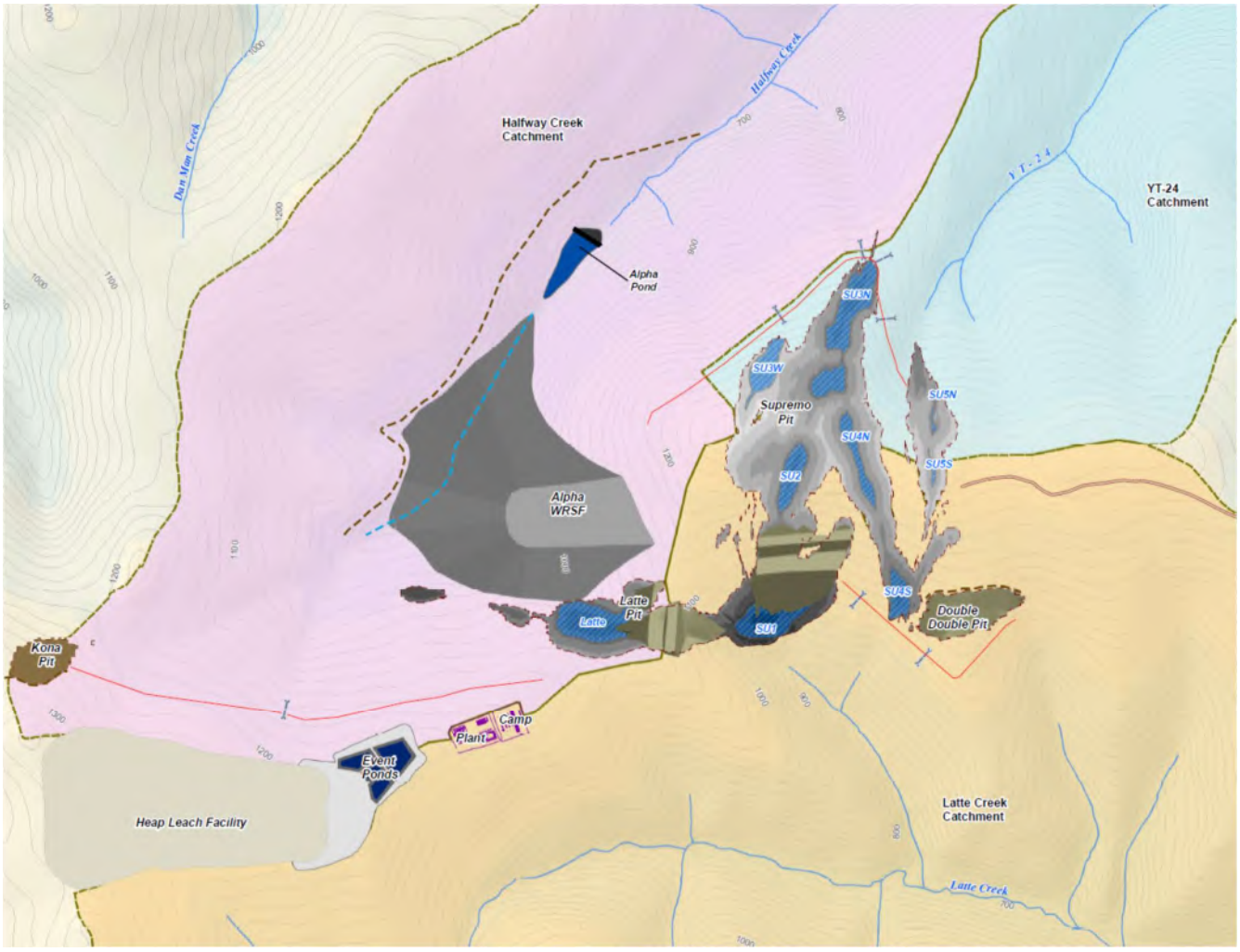


Figure 1: Early Closure Water Management Features and Receiving Environment Catchments

- Precipitation that comes into contact with the Mine Site will be collected and retained in sedimentation ponds to minimize the concentration of total suspended solids (TSS) in contact water before it is

discharged to the receiving environment. The primary sedimentation ponds will be the Alpha Ponds (Phase I and Phase II) located below the Alpha WRSF in Halfway Creek and two facility ponds: *Facility Pond North* and *Facility Pond South* will collect runoff from the plant site area.

- Precipitation and snowmelt that infiltrate the Alpha WRSF will report to the rock drain and be collected in the Alpha Pond for settling of total suspended solids (TSS).
- Contact water collected in the Alpha Pond will be discharged to Halfway Creek via a spillway and through seepage through the base of the facility.
- A diversion channel will be developed on the west slope of the Halfway catchment which will divert clean runoff away from the Alpha WRSF and into Halfway Creek, downstream of the Alpha Pond.
- In the present design, the Alpha Pond passively discharges through overflow and seepage to Halfway Creek. No treatment, other than removal or reduction in TSS is contemplated for the Alpha Pond; water quality predictions for discharge water from the Alpha Pond are such that under assumed base case conditions, water quality in Halfway Creek remains below applicable water quality objectives for the protection of aquatic life.
- Currently, development of potential mitigation strategies for Alpha Pond water quality that is worse than expected are being evaluated and include the pumping of Alpha Pond water and seepage water up to the Latte Pit (after year 3); Supremo Pits and/or pumping up to the Event Ponds for temporary storage and treatment if necessary.
- During the Construction and Operations phases, the Open Pits that are being actively mined will be dewatered. Water from pit dewatering may be discharged to the environment, transferred to other water management infrastructure or used for other mine operations needs (e.g., dust suppression, makeup water). Discharges to the environment will be intermittent, in response to accumulated water volumes in pit sumps following freshet and rainfall events.
    - TSS will be managed by providing sufficient retention time of accumulated water in the pit sumps to allow solids to settle prior to pumping and discharging in a way that will not mobilise sediment from end-of-pipe locations (i.e., using energy dissipaters like rip-rap in areas of discharge).
- Once development of an Open Pit is completed, the pit will be allowed to flood, and contact water will be stored in it, while it is flooding. Once flooded and at closure, the pits will begin to spill through engineered spillways. Some pits will be backfilled, or partially backfilled, reducing the in-pit water storage (Figure 2 and Figure 3).
- Currently, there are no water management structures in YT-24 and the small tributary catchment to Latte Creek downgradient of the SU3N pit (YT-24 catchment) or SU1 pit (Latte catchment).
    - Erosion control structures for the pit overflows will need to be designed to ensure passive overflow at closure does not result in excess erosion and TSS loadings to these receiving streams.
- The Plant Site collectively includes the process plant, camp, associated facilities and Run-of-Mine (ROM) ore stockpile. Contact water from the Plant Site will be collected for TSS settling in two ponds – Facility

Pond North and Facility Pond South. Water collected in these Facility Ponds may be used as make-up water for the HLF or discharged to Halfway Creek or Latte Creek catchment.

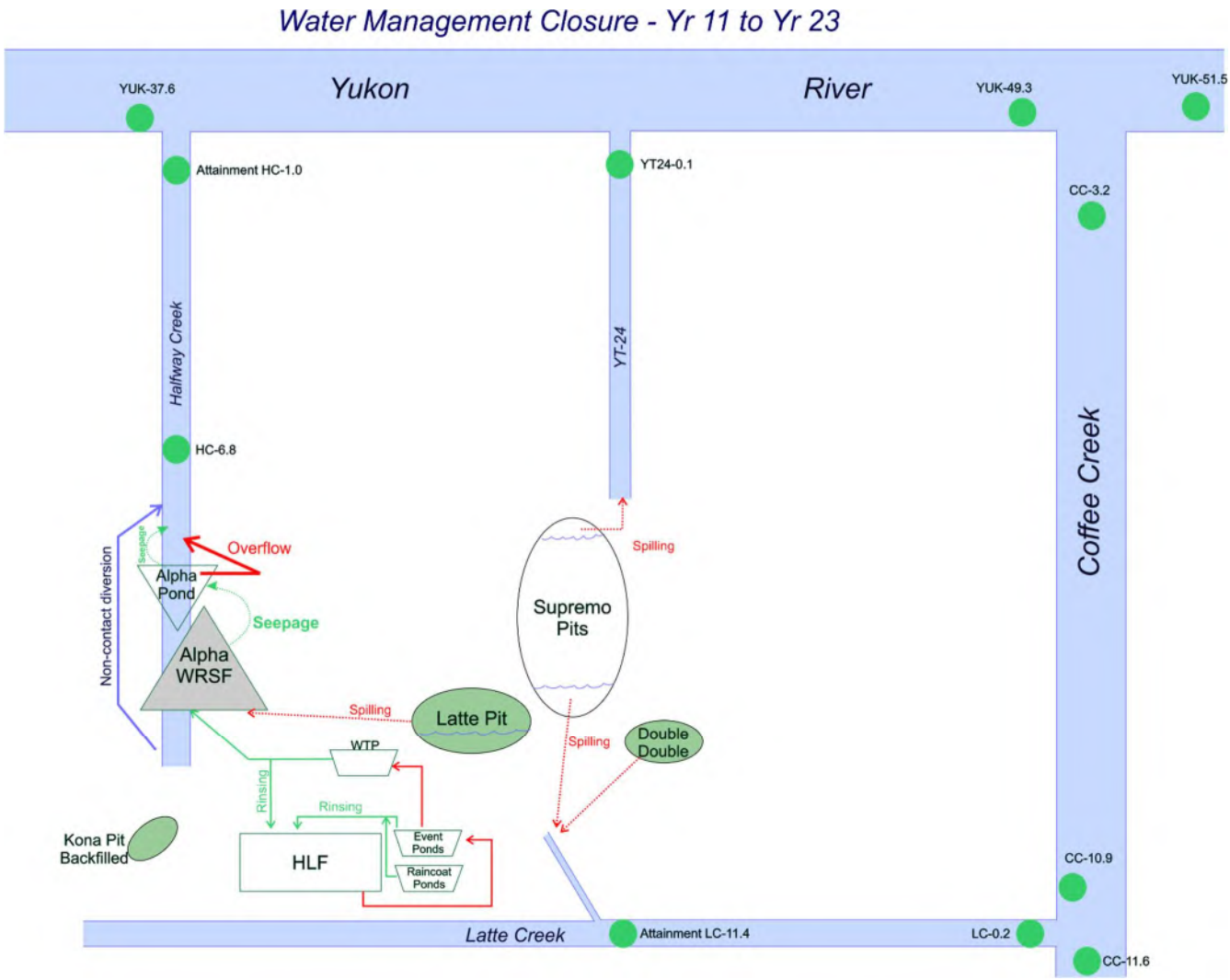


Figure 2: Schematic of Closure Water Management Components

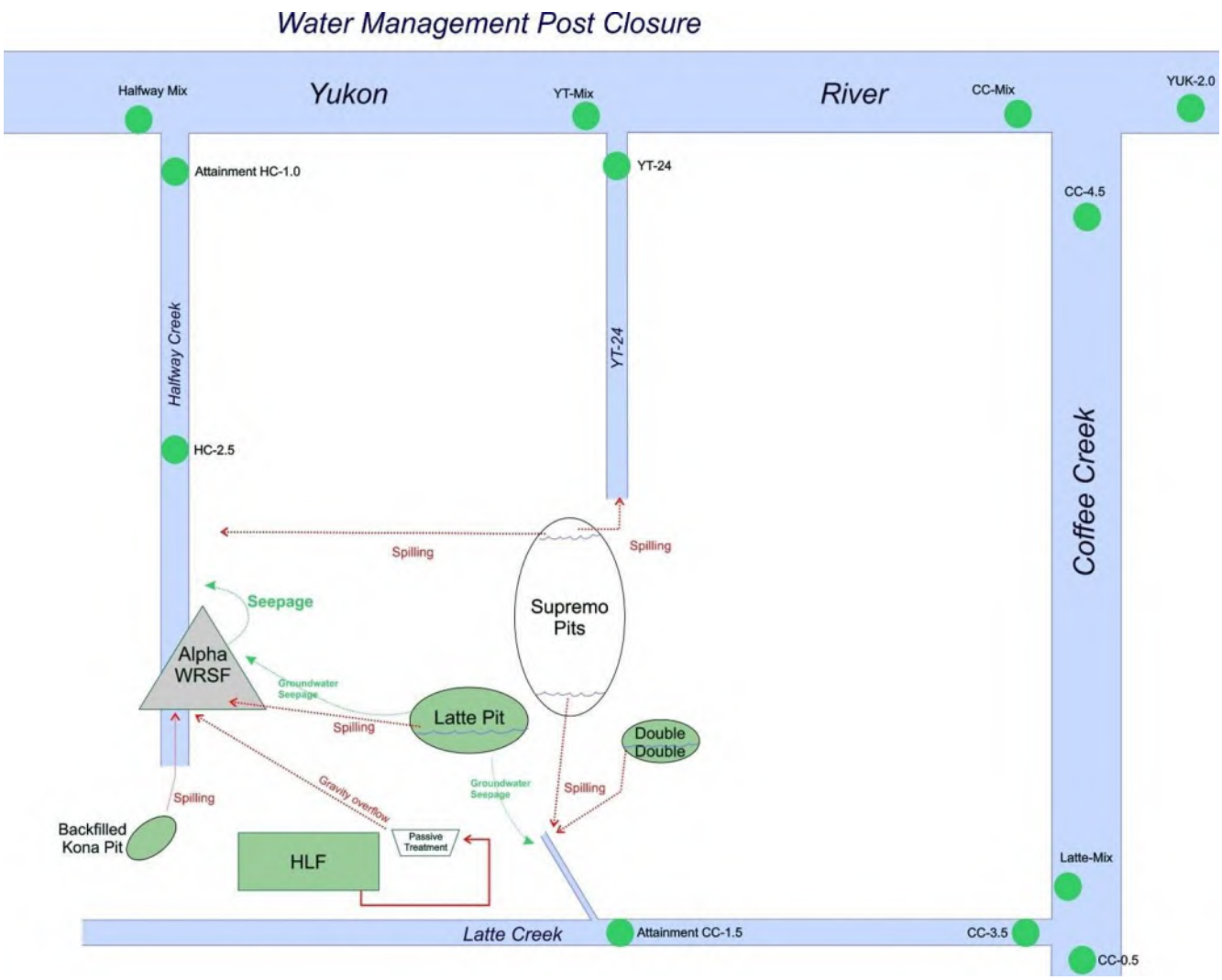


Figure 3: Water Management Schematic for Post Closure

Proposed Water Treatment Processes

Active Treatment

- During operations and early closure, excess water from the HLF will require treatment prior to discharge to the environment.
- Excess HLF solution waters are predicted to be elevated in nitrogen species (e.g., NO_3-N), sulphate, As and U.
- Two phases of water treatment test work have been completed on representative heap leach solutions water. Test work has indicated the best approach for the Coffee Mine water treatment was a multi-stage treatment train, consisting of initial treatment for cyanide (SO_2-air); arsenic and sulfate precipitation, biological Electro-biochemical Reactor (EBR) treatment for denitrification and metals polishing including

uranium, and a small aerobic post-treatment for removal of residual nutrients and reintroduction of dissolved oxygen. Treatment test work has demonstrated this configuration can meet water quality discharge targets for discharge to Halfway Creek via the Alpha Pond.

Semi-passive Treatment

- At closure, water treatment of residual heap leach seepage waters may be required. A semi-passive treatment system has been conceptually developed considering conversion of the Events ponds to passive treatment cells containing mixtures of organic carbon (to promote denitrification) and zero valent iron admixed with coarse gravels for removal of As and U.
- Bench-scale test work was completed at Yukon University for semi-passive treatment configurations and demonstrated the efficacy of zero valent iron at removing As and U from heap leach solutions. Additional work will be required to optimize hydraulic retention times for denitrification and pilot plant evaluations will be considered once actual heap leach solutions are available during operations but well before closure activities commence.

Memorandum

To:	Coffee Mine FMEA Participants
From:	Jorgelina Muscatello, Toxicologist and Aquatic Scientist – Lorax Environmental
Our ref:	1075-220-009
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #7 – Surface Water Quality Database**

Summarizing Reports (References)

- Lorax Environmental Services Ltd. (Lorax). 2022. Coffee Gold Project – Baseline Water Quality Report. Prepared for Newmont Goldcorp Inc. Prepared by Lorax Environmental Services Ltd., January 2022.
- Lorax. 2021. Coffee Gold Project – Proposed Site-Specific Water Quality Objectives for Primary Receiving Environments. Prepared for Newmont Goldcorp Inc. Prepared by Lorax Environmental Services Ltd., November 2, 2021.

Background

- Contact water related to mining and mine infrastructure is expected to drain to the Latte Creek, Halfway Creek and YT-24 catchments.
- Latte Creek (70 km^2) is a tributary to Coffee Creek (~400 km^2), which ultimately discharges to the Yukon River. YT-24 and Halfway Creeks are also tributaries to the Yukon River, comprising smaller catchment areas, and discharging to the Yukon River approximately 10 km and 11 km downstream, respectively, of the Coffee Creek confluence.
- The baseline surface water quality program in watersheds impacted by operations was initiated in October 2010 and has continued uninterrupted on a generally monthly basis to present.

- Site specific water quality objectives (SSWQOs) were derived where background concentrations naturally exceeded generic water quality guidelines (WQG) to support the environmental assessment process for the Project.
    - The Yukon government expectation for establishing water quality objectives includes two primary designations: Use Protection (UP) and Non-degradation (ND) SSWQOs.
- Use Protection SSWQOs are defined as water quality values that will not adversely affect receiving aquatic environments. Derived values and proposed attainment stations for UP SSWQOs are shown in Table 1 and Figure 1, respectively. The proposed stations where attainment of UP SSWQOs will be targeted are:
    - HC-1.0 in Halfway Creek. This station is located 1.0 km upstream of the confluence with the Yukon River and approximately 500 m upstream of the fish-bearing section of the creek;
    - LC-11.4 located in the main stem of Latte Creek and immediately downstream of the confluence with a small ephemeral drainage that will receive intermittent pit dewatering discharges during operations and pit overflow at closure; and,
    - YT24-0.1 is located in near the mouth of YT24 and freezes during winter periods. The creek will receive intermittent pit dewatering discharges during operations and pit overflow at closure.

Table 1: Summary of Proposed Site-Specific Water Quality Objectives for Halfway Creek, Latte Creek and YT-24.

	Parameter List	Units	Halfway Creek (HC-1.0)	Latte Creek (LC-11.4)	YT-24 (YT24-0.1)	Regulatory Source
General Chemistry	Sulfate (SO_4)	mg/L	218	309	218	BC MOE
	Nitrate (NO_3-N)	mg/L	8	8	8	SSWQO
	Nitrite (NO_2-N)	mg/L	0.02	0.02	0.02	BC MOE
	Ammonia (NH_3-N)	mg/L	1.5	1.3	1.8	BC MOE
	Cyanide (CN) WAD	µg/L	5	5	5	BC MOE
Metals	D-Aluminum	µg/L	366	350	272	SSWQO
	T-Antimony	µg/L	9	9	9	BC MOE (I)
	D-Arsenic	µg/L	5	5	5	SSWQO
	D-Cadmium	µg/L	0.2	0.2	0.1	BC MOE
	D-Copper	µg/L	1.3	4.7	5.3	BC MOE
	T-Iron	µg/L	1,000	1,000	1,000	BC MOE
	D-Iron	µg/L	350	350	350	BC MOE
	T-Lead	µg/L	2	3	1	CCME
	T-Mercury	µg/L	0.026	0.026	0.026	CCME
	T-Molybdenum	µg/L	73	73	73	CCME (I)
	T-Nickel	µg/L	72	96	25	CCME
	T-Selenium	µg/L	2	2	2	BC MOE
	T-Silver	µg/L	0.25	0.25	0.25	CCME

Parameter List	Units	Halfway Creek (HC-1.0)	Latte Creek (LC-11.4)	YT-24 (YT24-0.1)	Regulatory Source
D-Uranium	µg/L	86	31	15	SSWQO
D-Zinc	µg/L	24	31	26	CCME

Notes: T – Total and D – Dissolved forms; WQG – Water Quality Guidelines; I – Interim/Working Guideline; BC MOE – British Columbia Ministry of Environment; CCME - Canadian Council of Ministers of the Environment; SSWQO – Site Specific Water Quality; For nitrate, WQO includes the derivation of species sensitivity distributions; Hardness dependent WQGs calculated using 25th of background hardness data.

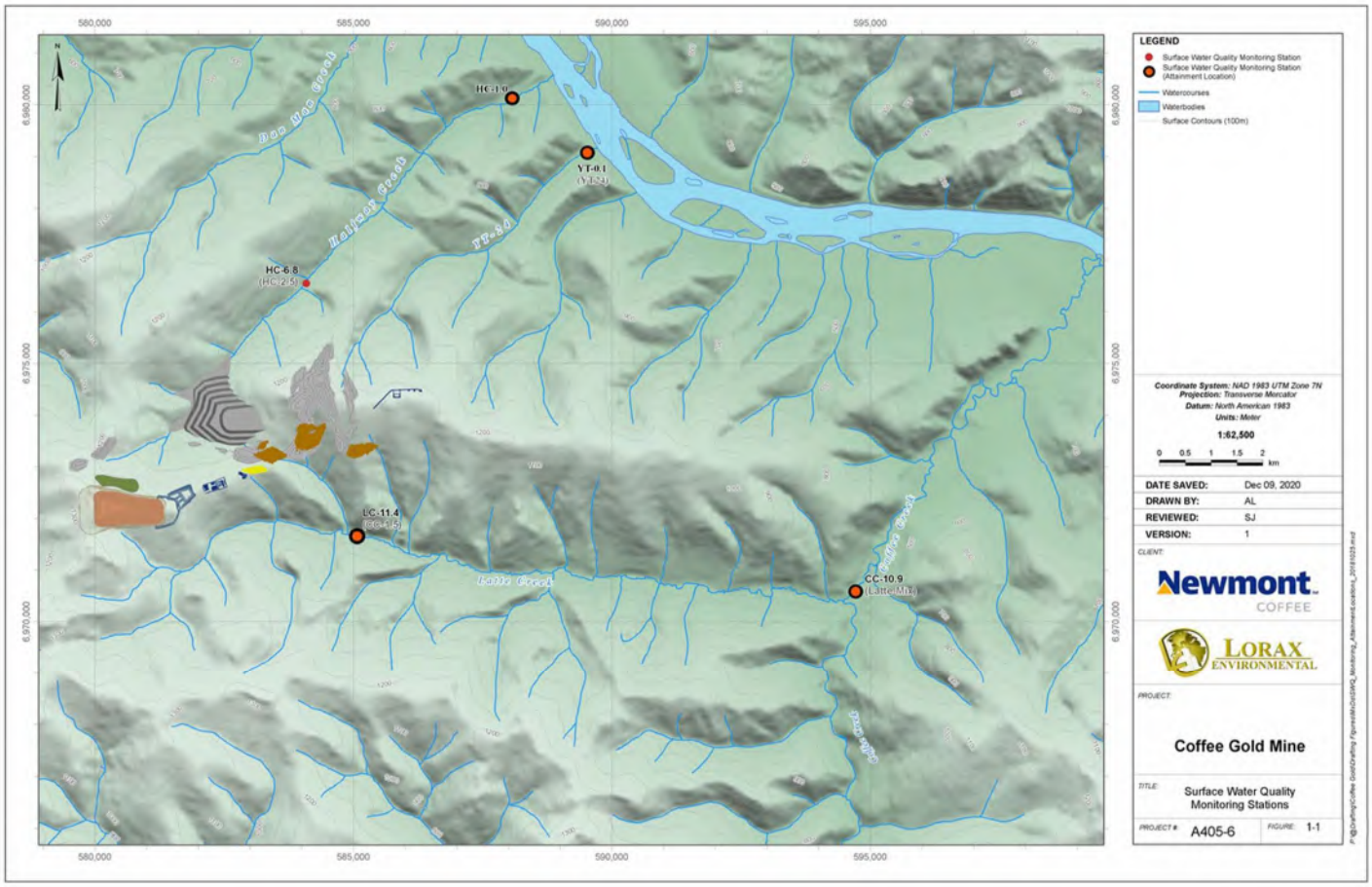


Figure 1: Location of Key Water Quality Stations for the Attainment of Water Quality Guidelines and Derived Site-Specific Water Quality Objectives.

- Non-degradation (ND) objectives are defined as water quality values that remain unchanged from pre-project conditions.
    - The proposed station for ND objectives is located in Coffee Creek, immediately downstream of the confluence with Latte Creek (CC-10.9) (Figure 1).

Baseline

Halfway Creek (HC-1)

- The surface water at HC-1 is characterized by hardness values between 66 mg/L to 175 mg/L (as $CaCO_3$), circumneutral pH, and sulphate concentrations < 76 mg/L.
- The station presents stronger seasonal signatures with pronounced seasonal fluctuations in parameters of potential concern (POPC) concentrations (e.g., arsenic, dissolved aluminum) that coincide with the peak snowmelt months (e.g., freshet).
- Nutrient concentrations (e.g., nitrogen forms and phosphorous) remain well below WQG values. Dissolved organic carbon (DOC) values ranged from < 10 mg/L during baseflow periods up to 20 mg/L during higher flow periods.
- Total and dissolved trace elements concentrations (e.g., Sb, Co, Cr, Pb, Hg, Ni, Se,) at HC-0.1 are low and generally remained below WQGs. Exceedances to WQGs are noted for:
    - Arsenic (As): Total concentrations remained well below the CCME guideline of 5.0 µg/L for the protection of aquatic life; however, sporadic exceedances occurred associated with elevated total suspended solids (TSS).
    - Dissolved Aluminum (D-Al): Exceedances well above the WQG of 100 µg/L occurred throughout Halfway Creek, with peak concentrations in the order of 300 mg/L coincident with higher flow conditions. During baseflow periods, D-Al concentrations throughout Halfway Creek are generally below 30 µg/L.
    - Total Copper (T-Cu): Concentrations of total Cu show seasonal maxima associated with peak runoff periods and higher TSS that can slightly exceed the CCME hardness-dependent Cu guideline for the protection of aquatic life.
    - Total Uranium (T-U): Low flow conditions observed at this station, specifically November to February coincided with peak total U concentrations on the order of 30 to 80 µg/L. Measured concentrations in most other months remained below the CCME guideline of 15 µg/L for the protection of aquatic life.

Latte Creek (LC-11.4)

- The station displays a strong seasonal signature, with pronounced seasonal fluctuations coinciding with freshet periods.
- This station is characterized by seasonally soft waters (approximately < 90 mg/L [as $CaCO_3$]) during freshet months (May to June) and hard to very hard waters (ranging from 110 mg/L to > 420 mg/L [as $CaCO_3$]) during lower flow periods and winter low flows.
- The pH remains relatively uniform throughout the year with values generally ranging between 7.0 and 8.0.

- Sulphate concentrations ranged between 37 to 110 mg/L, with minima occurring during high flows.
- Nutrient concentrations (e.g., nitrogen forms and phosphorous) remained well below WQGs values. The DOC concentrations range from less than 5.0 mg/L during baseflow periods, to upwards of 22 mg/L during higher flow periods reflecting carbon contributions associated with terrestrial runoff.
- Total and dissolved trace elements concentrations (e.g., Sb, Co, Cr, Pb, Hg, Ni, Se,) in LC-11.4 are low and generally remained below WQGs. Exceedances to WQGs are noted for:
    - T-As: Total As concentrations in are typically around 0.6 to 2.4 µg/L with maximum concentrations observed coincident with high flow events (~ 7 µg/L).
    - D-Al: Concentrations consistently observed to be elevated well above the WQG for the protection of aquatic life of 100 µg/L throughout Latte Creek, with peak concentrations coinciding with higher flow conditions (~ 400 µg/L). During baseflow periods, dissolved Al concentrations throughout Latte Creek are generally below 40 µg/L.
    - T-Cu: Concentrations show seasonal maxima associated with peak runoff periods that can episodically exceed the CCME hardness-dependent Cu guideline for the protection of aquatic life (maxima of 4.5 µg/L).
    - T-U: Concentrations show a distinct seasonal signature with maxima observed during winter low flow periods and coinciding with baseflow conditions. Concentrations during low flow periods can reach 30 µg/L and are often well above the CCME water quality guideline of 15 µg/L for the protection of aquatic life.

YT-24 (YT24-0.1)

- This station is characterized by soft water with hardness values ranging from 18 to 32 mg/L ($CaCO_3$).
- The pH remained circumneutral with some exceedances to WQG (6.5 to 9) recorded in May mostly due to the input of slightly acidic snowmelt water to the creek.
- Sulphate concentrations remained relatively low with values ranging from 32 to 190 mg/L. Nutrient concentrations (e.g., nitrogen forms and phosphorous) remain well below WQGs values.
- Mean monthly DOC levels at this station are relatively high, ranging between approximately 10 to 19 mg/L, with highest values observed during peak flow periods.
- Total and dissolved trace elements concentrations (e.g., Sb, Co, Cr, Pb, Hg, Ni, Se,) in LC-11.4 are low and generally remained below WQGs. Exceedances to WQGs are noted for:
    - D-Al: Concentrations episodically exceed the WQG guideline for the protection of aquatic life of 100 µg/L (up to 400 mg/L), coinciding with peak flow periods and elevated total suspended solids (TSS).

- T-Cu: Concentrations exceed the hardness-dependent WQG for the protection of aquatic life, particularly in 2016. However, these exceedances are not evident in recent years (2017, 2018, 2019).
- T-U: Unlike other stations in the Project area, T-U concentrations are generally low (< 3.0 µg/L) for most of the open water period. However, mean T-U concentrations during freshet (April and May) exceed the CCME chronic water quality guideline of 15 µg U/L.

Coffee Creek (CC-10.9)

- The surface water at this station is characterized by hardness values between 100 mg/L to 265 mg/L (as $CaCO_3$), and circumneutral pH.
- Sulphate concentrations ranged from 50 to 198 mg/L with highest values occurring during freshet months.
- The station presents stronger seasonal signatures with pronounced seasonal fluctuations in POPC concentrations (e.g., arsenic, dissolved aluminum, uranium) that coincide with the peak snowmelt months (e.g., freshet).
- Nutrient concentrations (e.g., nitrogen forms and phosphorous) remain well below WQGs values.
- Dissolved organic carbon (DOC) values ranged from < 10 mg/L during baseflow periods up to 20 mg/L during higher flow periods.
- Total and dissolved trace elements concentrations (e.g., Sb, Co, Cr, Pb, Hg, Ni, Se,) at CC-10.9 are low and generally remained below WQGs. Exceedances to WQGs are noted for:
  - D-Al: Exceedances well above the WQG of 100 µg/L occurred throughout the creek, with peak concentrations in the order of 250 mg/L coincident with higher flow conditions. During baseflow periods, D-Al concentrations throughout Coffee Creek are generally below WQG.
  - T-Cu: Concentrations of total Cu show exceedances to WQGs during summer months June, July, and August with maxima of 3 µg/L.
  - T-U: Low flow conditions observed at station CC-10.9, specifically for February, April and June coincided with peak total U concentrations on the order of 30 to 80 µg/L. Measured concentrations in most other months remained below the CCME guideline of 15 µg/L for the protection of aquatic life.

Evaluation of Water Quality Predictions – Water Quality Model

Halfway Creek (HC-1.0)

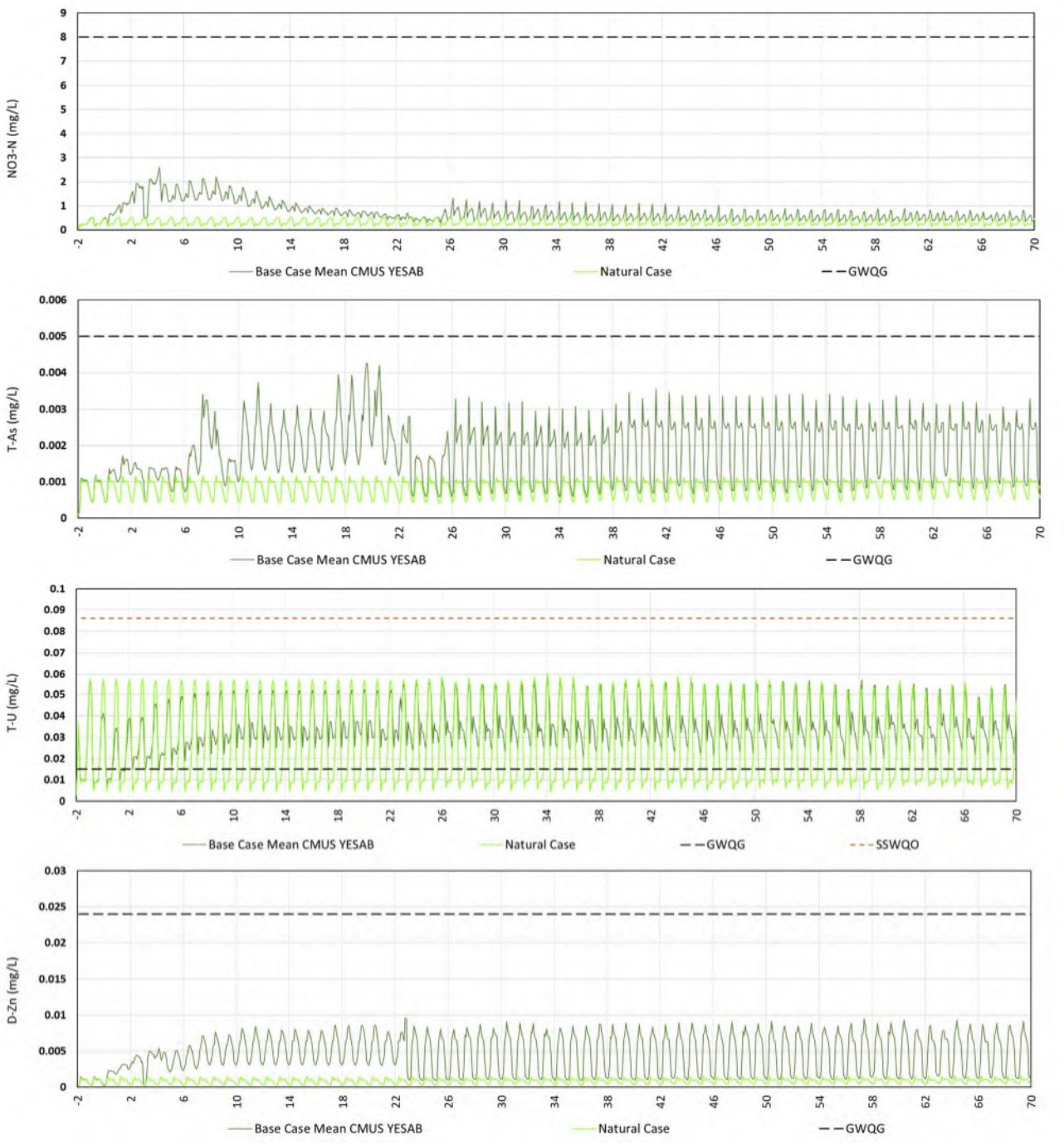


Figure 2: Predicted Base Case concentrations for nitrate (NO_3), total arsenic (T-As), total uranium (T-U) and dissolved zinc (D-Zn) compared to Natural case at HC-1. GWQG = general water quality guidelines; SSWQOs = Site Specific Water Quality Objectives.

Latte Creek (LC-11.4)

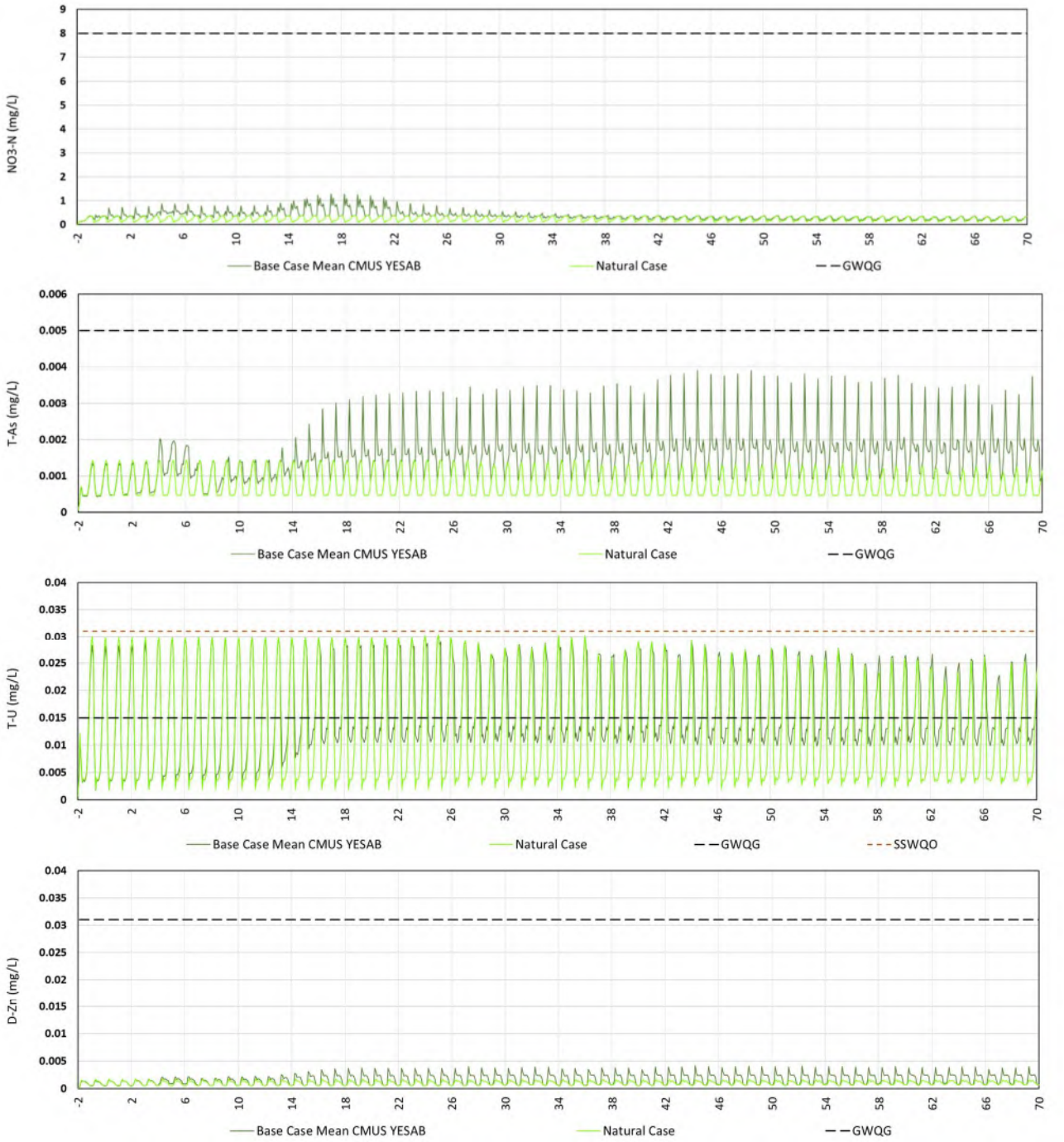


Figure 3: Predicted Base Case concentrations for nitrate (NO3), total arsenic (T-As), total uranium (T-U) and dissolved zinc (D-Zn) compared to Natural case at LC-11.4. GWQG = general water quality guidelines; SSWQOs = Site Specific Water Quality Objectives.

YT24-0.1

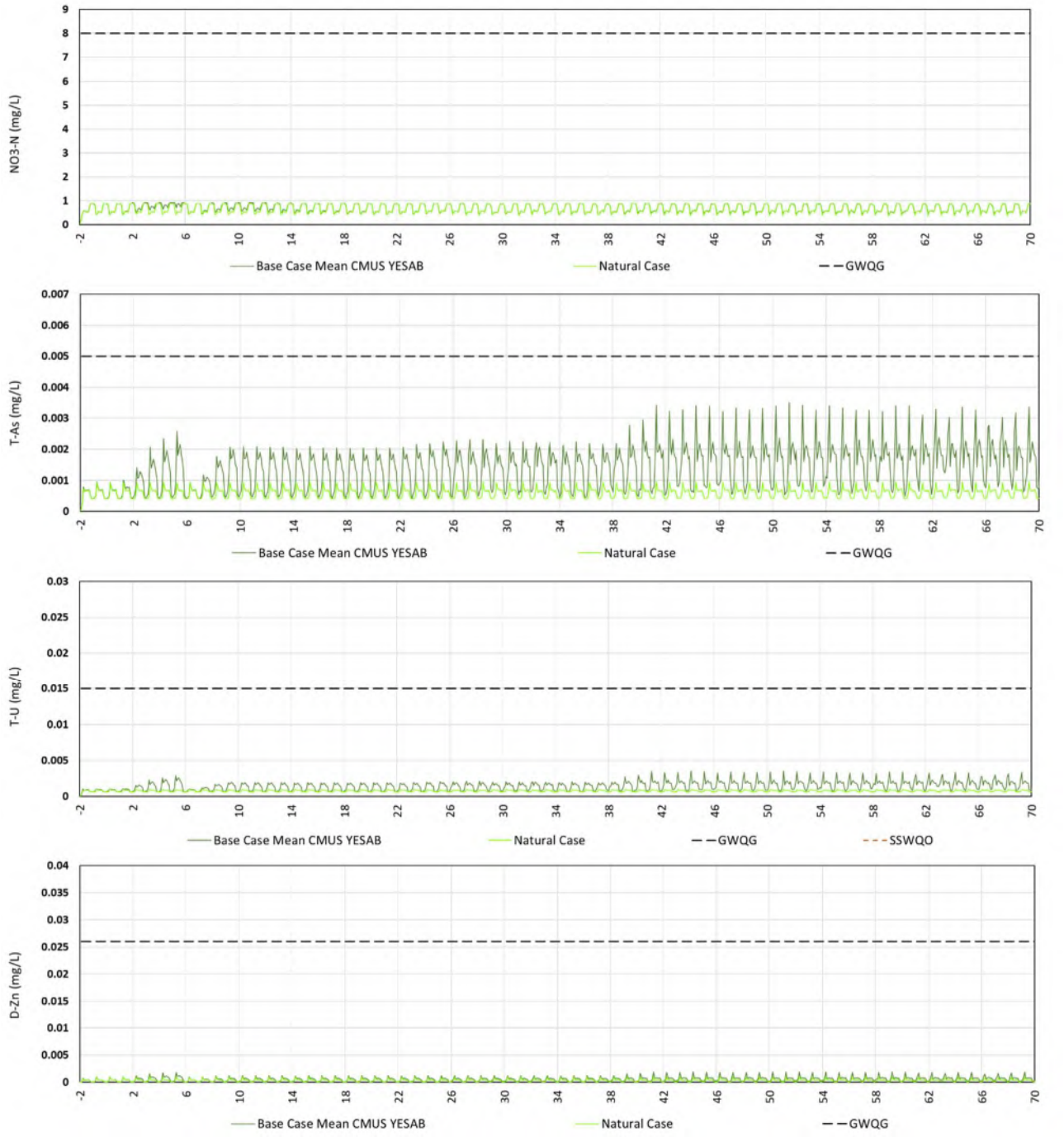


Figure 4: Predicted Base Case concentrations for nitrate (NO3), total arsenic (T-As), total uranium (T-U) and dissolved zinc (D-Zn) compared to Natural case at YT-24. GWQG = general water quality guidelines; SSWQOs = Site Specific Water Quality Objectives.

Coffee Creek (CC-10.9)

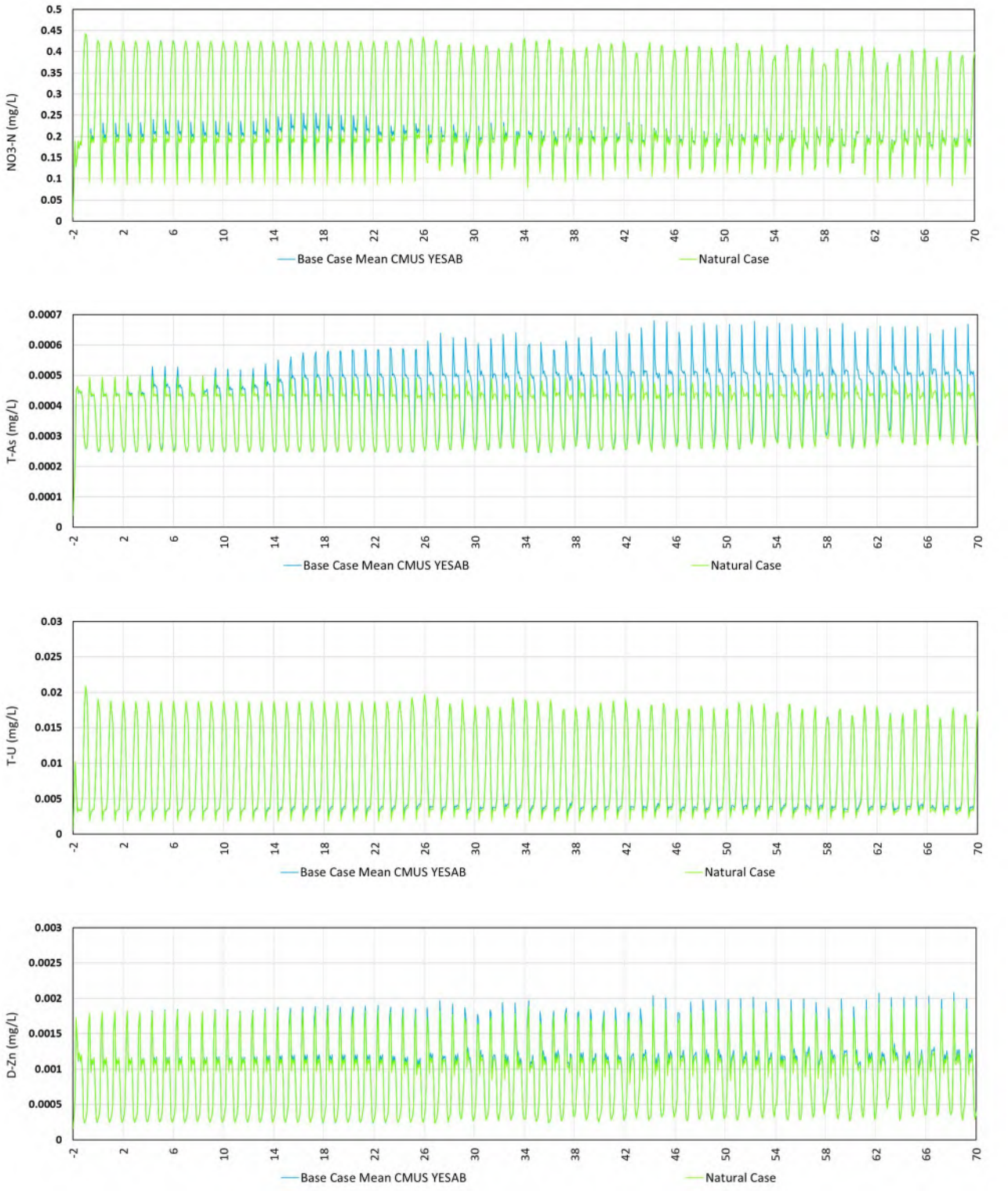


Figure 5: Predicted Base Case concentrations for nitrate (NO3), total arsenic (T-As), total uranium (T-U) and dissolved zinc (D-Zn) compared to Natural case at CC-10.9.

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-010
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #8 – Reclamation Material Balance**

Summarizing Reports (References)

- JDS Energy & Mining Ltd. (JDS). 2018. Surface Material for Reclamation.
- JDS. 2019. Material Balance Report Coffee Mine.
- Lorax Environmental (Lorax). 2019. Coffee Mine Update Study Water Balance and Water Quality Model.

Summary of Reclamation Material Volumes

- Overall estimates of available reclamation material ranges from 2.8 Mm^3 to 2.6 Mm^3 depending on the scenario of suitable material below the heap leach facility (HLF).
- Reclamation Material is comprised of 3 stratigraphic units defined by Tetratech test pitting programs – Organics, Upper Silts, and the upper 0.2 m of the Lower Gravel
- JDS (2019) was used to understand pre-production material volumes. JDS (2018) provides estimates for available material from pit development, production, and operations.
- Frozen material defined in the Coffee Mine Update Study (CMUS) was identified as material below the HLF that was not considered organics. The extent of how much of this material is frozen is not known and has been included as upper silt and lower gravel within the materials balance.

- The overall volume (including material outside the HLF foundation), and suitability of frozen material, for use as reclamation material remains an uncertainty for the project given depth of refusal for test pitting programs.
- Surface areas of components required to be reclaimed have been provided in JDS 2018. These will need to be updated as further design of these mine components is advanced in 2022.
- Cover system application scenarios have been presented for 0.3 m, 0.5 m, and 1.0 m to illustrate the impact of cover system alternatives on the overall material balance (Figure 1, and Table 1).
- In consideration of constructability and likely performance requirements, the Base Case cover system for the HLF is assumed to be a 0.5 m store and release overlying a GCL on the plateaued areas, and 0.5 m store and release cover system on sloped segments.
- The Base Case currently assumes no cover system will be placed over the Alpha WRSF.

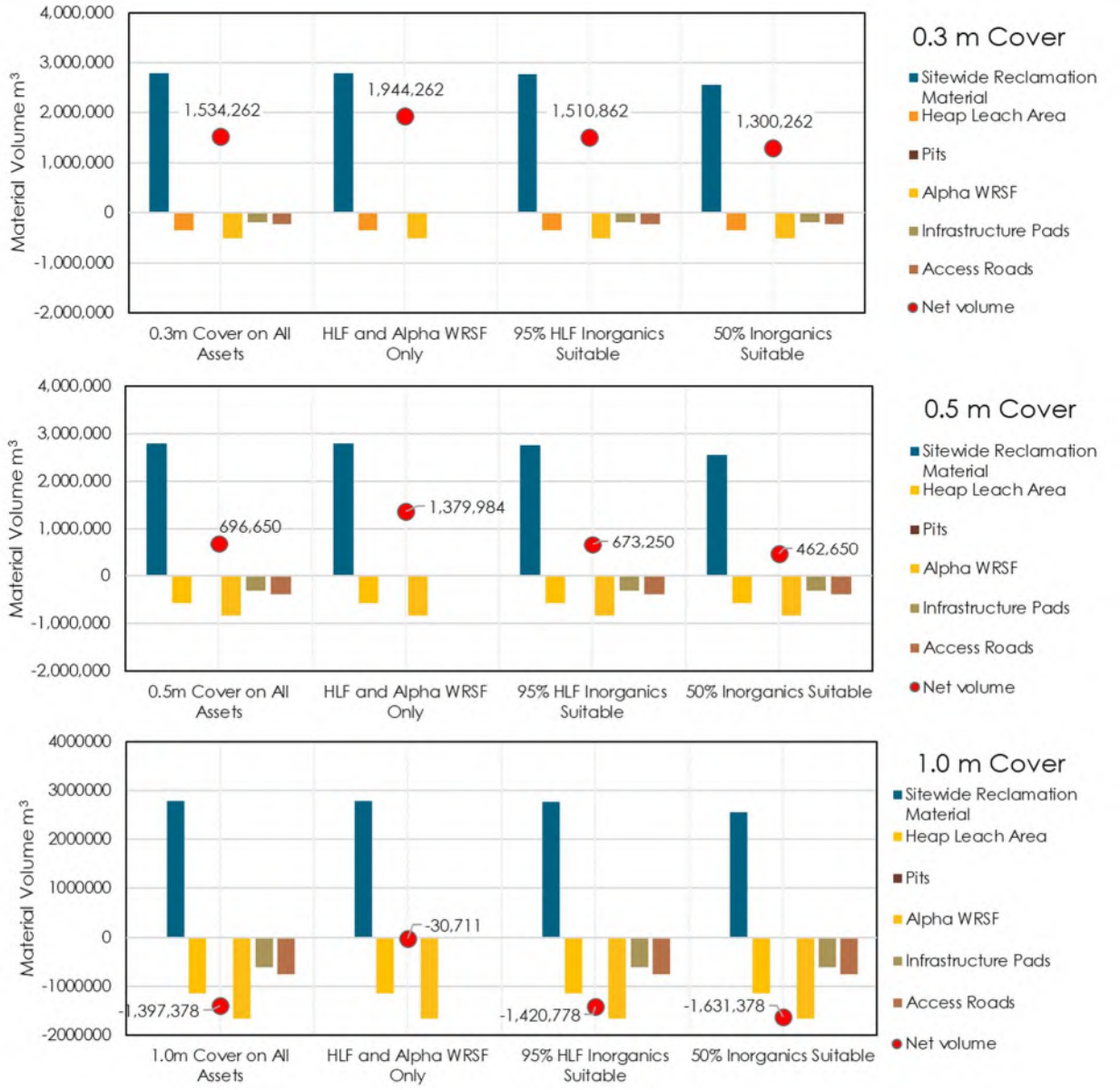


Figure 1: Material balance results for different cover thicknesses and scenarios.

Table 1: Summary of material balances for each scenario.

Average Cover Thickness	Structure	Cover on All Assets	HLF and Alpha WRSF Only	95% HLF Inorganics Suitable	50% HLF Inorganics Suitable
		m^3	m^3	m^3	m^3
0.3 m	Sitewide Reclamation Material	2,790,679	2,790,679	2,767,279	2,556,679
	Heap Leach Area	-345,000	-345,000	-345,000	-345,000
	Pits	0	0	0	0
	Alpha WRSF	-501,417	-501,417	-501,417	-501,417
	Infrastructure Pads	-182,000	0	-182,000	-182,000
	Access Roads	-228,000	0	-228,000	-228,000
	Net volume	1,534,262	1,944,262	1,510,862	1,300,262
0.5 m	Sitewide Reclamation Material	2,790,679	2,790,679	2,767,279	2,556,679
	Heap Leach Area	-575,000	-575,000	-575,000	-575,000
	Pits	0	0	0	0
	Alpha WRSF	-835,695	-835,695	-835,695	-835,695
	Infrastructure Pads	-303,333	0	-303,333	-303,333
	Access Roads	-380,000	0	-380,000	-380,000
	Net volume	696,650	1,379,984	673,250	462,650
1.0 m	Sitewide Reclamation Material	2,790,679	2,790,679	2,767,279	2,556,679
	Heap Leach Area	-1,150,000	-1,150,000	-1,150,000	-1,150,000
	Pits	0	0	0	0
	Alpha WRSF	-1,671,390	-1,671,390	-1,671,390	-1,671,390
	Infrastructure Pads	-606,667	0	-606,667	-606,667
	Access Roads	-760,000	0	-760,000	-760,000
	Net volume	-1,397,378	-30,711	-1,420,778	-1,631,378

Table 2: Reclamation Material Volume by Location and Type (JDS 2018, 2019)

Area	Material Type	Volume Available for Reclamation
Plant Area & Crusher	Organics	82,709
	Upper Silt	-
	Lower Gravel	-
	Weathered Bedrock	-
	Subtotal	**82,709**
Heap Leach Area & Event Ponds	Organics	339,030
	Upper Silt	468,000
	Lower Gravel	
	Weathered Bedrock	-
	Subtotal	**807,030**
Kona Pit	Organics	18,866
	Upper Silt	81,752
	Lower Gravel	12,577
	Weathered Bedrock	-
	Subtotal	**113,195**
Latte Pit	Organics	71,955
	Upper Silt	71,955
	Lower Gravel	71,955
	Weathered Bedrock	-
	Subtotal	**215,864**
Supremo PH 1-4 Pit	Organics	321,019
	Upper Silt	642,038
	Lower Gravel	256,815
	Weathered Bedrock	-
	Subtotal	**1,219,872**
Supremo PH5 Pit	Organics	27,177
	Upper Silt	95,118
	Lower Gravel	27,177

	Weathered Bedrock	-
	Subtotal	149,472
Double Double Pit	Organics	24,129
	Upper Silt	24,129
	Lower Gravel	-
	Weathered Bedrock	-
	Subtotal	48,258
On-Site Development	Organics	154,278
	Upper Silt	-
	Lower Gravel	-
	Weathered Bedrock	-
	Subtotal	154,278
	Total	**2,790,679**
Material Type Summary	Organics	1,039,162
	Upper Silt	914,993
	Lower Gravel	368,524
	HLF Upper Silt and Lower Gravel	468,000
	Weathered Bedrock	

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-011
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #9 – Material Properties**

Summarizing Reports (References)

- The Mines Group Inc. (MINES). 2016. Feasibility Design Report for Coffee Gold Heap Leach Facility, Yukon Territory, Canada. Prepared for Kaminak Gold Corporation. Report No. 15-78-01- Rev A. January 30, 2016.
- SRK (Steffen Robertson & Kirsten). 2016. 2015 Geotechnical Field Investigation for Kaminak Coffee Gold Project,. Denver USA.
- Tetra Tech. 2017a. Thermal Evaluation of Duration of Thaw of Permafrost Soils at Coffee Mine Site Study Area Under Long-term Climate Conditions, Yukon, Canada. Tetra Tech memo to Goldcorp Inc. January 19, 2017.
- Tetra Tech. 2017b. Fall 2017 Test Pitting Program, Coffee Mine Site Phase 1: Proposed Infrastructure Footprints, Phase 2: Proposed Open Pit Areas. Prepared for JDS Energy & Mining.
- Tetra Tech. 2019. Fall 2018 Testpitting Program Data Report Coffee Gold Project. Prepared for JDS Energy & Mining. January 9, 2019.

Summary

- Ore residue (ore material after it has been leached) is poorly graded and primarily gravel (60 to 96%)
- Corrected max dry density for ore residue ranges from 1,887 to 2,497 kg/m^3 and corrected optimum water contents range from 3 to 11%
- Hydraulic conductivity of the ore residue ranged from 3.5x10^{-4} to 6.9x10^{-3} m/s
- Overburden test pitting sites investigated can be generally summarized as poorly to well graded rock fragments with varying amounts of silts and sands.
- Test pitting results indicated that most materials were low to non-plastic
- Discontinuous lenses of permafrost occur under approximately 60% of the site, which acts as a confining layer to the groundwater below. The permafrost classification for the site is “warm” and accordingly, the ground is sensitive to disturbance.
- Frozen soils are predominately on the north- and west-facing slopes and in valleys and thickest on higher elevation north-facing slopes

Materials

Heap Leach Facility – Ore Residue Material

- Ore residue material consists of ore material after it has been leached.
- Testing was completed on leached ore residue materials from column testing completed on different pits and crush sizes by Geo-Logic Associates (GLC) of Grass Valley, California. Geotechnical testing includes specific gravity, moisture content, particle size distribution (PSD), Atterberg limits, compaction testing, direct shear, triaxial shear, and hydraulic conductivity.
- Specific gravity for the ore residues ranged from 2.69 to 2.75 in which materials were poorly graded gravel with sands, silts, and clay. Ore residues were primarily composed of gravel-sized particles ranging from 60% to 96% (Figure 1).
- Plasticity indices for these samples ranged from 6 to 16.

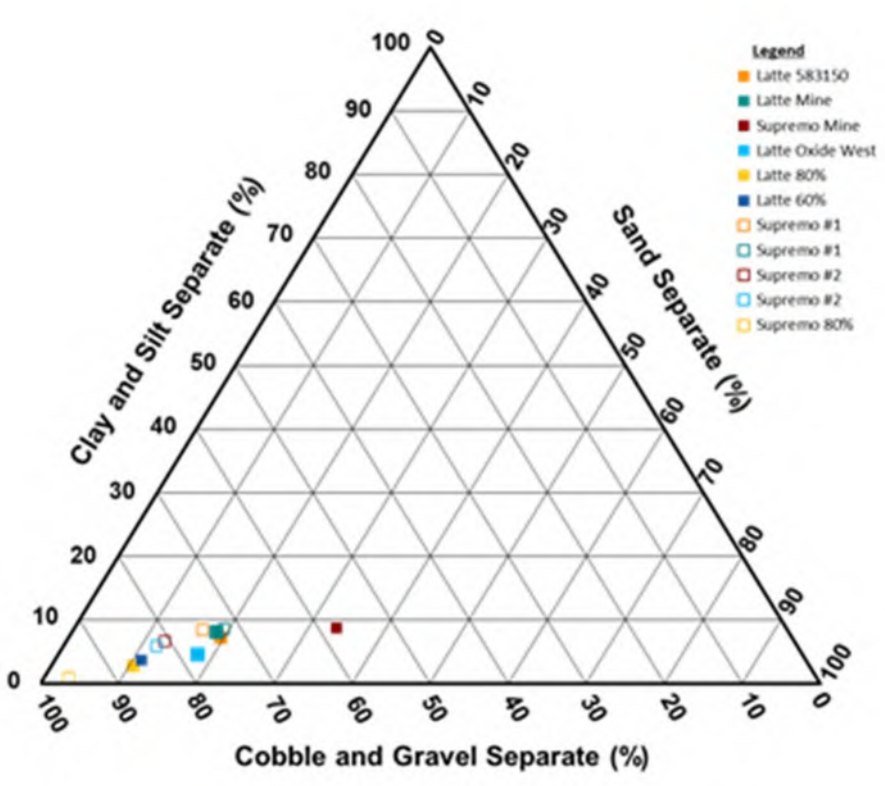


Figure 1: Texture triangle for ore residues

Data from Table 4-2 in MINES (2016)

- Compaction testing (standard proctor) was completed on nine ore residue samples. Optimum moisture contents and maximum dry density for these materials are summarized in Table 1.

Table 1: Heap leach pad sample compaction testing

Sample ID	Corrected Maximum Dry Density (kg/m^3)	Corrected Optimum Moisture Content (%)
Latte 583150	2,318	6
Latte 583350	2,372	5
Latte Mine	1,887	8
Supremo Mine	1,988	11
Latte Oxide West	2,283	4
Latte 80%	2,497	3
Latte 60%	2,332	3
Supremo #1	2,347	4
Supremo #1	2,400	4

Modification of Table 4-4 in MINES (2016)

- Triaxial shear testing was completed on three ore residue samples (Table 2) and hydraulic conductivity testing was completed on four ore residue samples (Table 3).

Table 2: Ore residue sample triaxial shear testing

Sample ID	Confining Stress (kPa)	Dev. Stress (kPa)	Pore Pressure (kPa)	Effective Stress (kPa)	Total Stress (kPa)	Final Moisture Content (%)
Latte 583150	95.8 239.2 487.5	200.6 390.2 672.2	55.2 135.1 311.6	C = 6.89 Ø = 40.2°	C = 27.6 Ø = 22.3°	11.9
Latte Oxide West	95.8 239.2 487.5	121.3 273.7 513.7	57.2 158.6 350.3	C = 0 Ø = 40.6°	C = 6.9 Ø = 20°	12.5
Supremo #1	95.8 239.2 487.5	124.1 254.4 490.2	68.9 160.6 360.6	C = 0 Ø = 40.9°	C = 13.8 Ø = 18.9°	13.7

Modification of Table 4-6 in MINES (2016)

Table 3: Ore residue sample hydraulic conductivity testing

Sample ID	Normal Stress (kPa)	Moisture Content (%)	Dry density (tonnes/m^3)	Hydraulic Conductivity (cm/s)
Latte 583150	Initial	2.1	1.56	
	241		1.58	4.8E-01
	248		1.65	4.10E-01
	965		1.53	3.6E-01
	(Drained)	7.6	1.59	
Latte Oxide West	Initial	1.9	1.52	
	241		1.52	4.9E-01
	248		1.53	4.8E-01
	965		1.53	4.5E-01
	(Drained)	6.9	1.53	
Supremo #1	Initial	0.8	1.65	
	241		1.86	7.0E-02
	248		1.94	6.2E-02
	965		2.04	3.5E-02
	(Drained)	11.9		
Supremo #2	Initial	1.9	1.53	
	241		1.69	6.5E-01
	248		1.76	6.7E-01
	965		1.82	6.9E-01
	(Drained)	9	1.82	

Modification of Table 4-7 in MINES (2016)

Disturbance Materials – Test Pit Investigation Programs

- Extensive detailed geotechnical investigations were carried out between 2015 and 2018 by Tetra Tech and SRK (SRK 2016; Tetra Tech, 2017a; 2017b; 2019).

- These investigations variably included PSD analyses, moisture content, excess ice content, specific, frozen, and bulk density, porewater salinity, Atterberg limits, compaction tests, shear tests and organics content. Investigations were carried out at all sites that may see disturbance during mining activities.

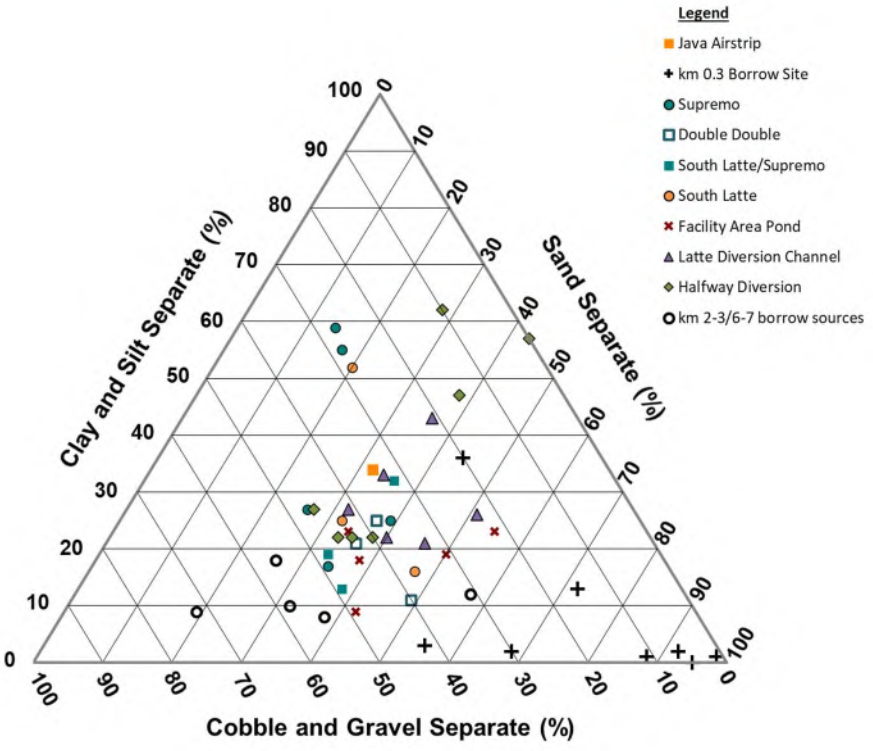


Figure 2: Texture triangle of reclamation materials sampled during 2018

(Tetra Tech, 2019)

- A summary of the 2015 test pitting investigation (Table 4) indicates variability in the material properties between locations. Each of the overburden sites investigated can be generally summarized as poorly to well graded rock fragments with varying amounts of silts and sands. Locations with a greater proportion of rock fragments and lower fines by volume included the km 2-3/km 6-7 borrow sources, the facility pond area, Double Double Pit, South Latte and South Latte/Supremo.
- Generally, the suitability of overburden for reclamation material is limited by excess fines content in some locations (i.e., Java Airstrip) and highly weathered nature of the rock fragments.
- Tetra Tech (2019) indicates that processing of the overburden to sort the rock fragments may increase the usability of overburden for various material fill applications. Screened cobbles and boulders may be used in dam applications.
- The km 0.3 borrow source is dominated by sand and sub-round gravel that is suitable for road and airstrip construction, though the lack of angularity may require blending with other materials to increase compaction.

- Localized permafrost zones may require further processing before use in construction. The km 2-3/km 6-7 borrow sources are predominantly well sorted sand and gravels.
- The presence of cobbles and boulders indicates that if processed the material can be used for applications with more stringent PSDs.

Table 4: Summary of Atterberg test results from the 2015 investigation

Original Facility Location	Hole/Test Pit ID	Sample Number	Sample Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Plasticity *	Mod. USCS Class	Natural Moisture Content (%)
North Waste Rock Dump	SRK-15S-03	17728	0.6	99	62	37	High	OH	139.9
	SRK-15S-03	17729	6.7-7	0	0	0	NP	-	12.9
	SRK-15S-04	17725	1.1	129	85	44	High	OH	317.8
	SRK-15S-04	17726	3.7	0	19	0	NP	-	16.7
West Waste Rock Dump	SRK-15S-05	17702	2.7	33	27	6	Low	ML	50.3
	SRK-15S-06	17704	0.2	0	0	0	NP	-	6.8
	SRK-15S-07	17708	3.4	0	0	0	NP	-	12.4
	SRK-15S-08	17706	0.9	0	0	0	NP	-	28.3
	SRK-15S-08	17707	3.4	20	17	3	Low	ML	13.8
	SRK-15TP-50	17592	0.4	0	0	0	NP	-	63.0
	SRK-15TP-55	17628	0.3	0	0	0	NP	-	76.5
	SRK-15TP-56	17629	0.35	0	0	0	NP	-	68.4
South Waste Rock Dump	SRK-15S-09	17709	1.8	37	30	7	Low	ML	57.2
	SRK-15S-11	17711	2.3	0	0	0	NP	-	8.8
	SRK-15S-12	17712	2.4	0	0	0	NP	-	19.5
Heap Leach Pad (HLP)	SRK-15S-13A	17718	0.9	25	19	6	Low	CL-ML	16.2
	SRK-15S-20	17722	0.9	23	17	6	Low	CL-ML	73.1
	SRK-15S-25	17723	0.6	25	22	3	Low	ML	12.6
	SRK-15TP-03	17565	0.5-1	29	23	6	Low	ML	10.5
	SRK-15TP-20	17564	0.6	0	29	0	NP	-	20.7
	SRK-15TP-43	17560	0.6	0	21	0	NP	-	12.6
ROM Stockpile & Infrastructure Sites	SRK-15S-29	17732	0.9	0	0	0	NP	-	2.9
	SRK-15S-34	17739	1.1	20	16	4	Low	ML	14.9
	SRK-15S-35	17741	1.2	0	0	0	NP	-	44.9

(SRK, 2016)

Table 5: Summary of geotechnical properties from 2018 joint (JDS and Tetra Tech) test pitting program investigation

Site Infrastructure	Sample Number	Depth		Moisture Content (%)	Fines (%)		Sand (%)	Gravel (%)	Cobble (%)	Atterberg Limits			Excess Ice Content (% by volume)	Bulk Density (kg/m³)	Proctor Result	
		From (m)	To (m)		Clay (%)	Silt (%)				LL	PL	PI			Maximum Dry Density (kg/m³)	Optimum Moisture Content (%)
Java Airstrip Alignment	TP01-01	0.30	0.50	11.9	34		32	34	0	17	14	3	-	-	2,040	10.9
	TP02-01	0.20	0.40	13.9									-	-		
	TP03-01	0.20	0.30	29.2									-	-		
	TP03A-01	0.70	1.30	9.5									-	-		
	TP04-01	0.35	0.80	-									-	-		
	TP04A-01	0.10	0.40	16.4									-	-		
km 0.3 Borrow Site	TP05-02	0.70	1.40	2.1	2		68	30	0	-	-	-	-	-	-	-
	TP06-01	0.15	1.00	8.4	36		44	20	0	-	-	-	-	-	-	-
	TP06-02	1.00	1.50	1.4	-		95	5	0	-	-	-	-	-	-	-
	TP06-03	4.00	4.00	6.1	13		72	15	0	-	-	-	-	-	-	-
	TP07-02	1.40	1.60	3.4	2		92	6	0	-	-	-	-	-	-	-
	TP08-02	0.65	1.10	1.7	3		55	42	0	-	-	-	-	-	-	-
	TP08-03	1.10	1.60	2.1	1		98	1	0	-	-	-	-	-	-	-
	TP09-02	1.20	1.50	1.6	1		88	11	0	-	-	-	-	-	-	-
Supremo	TP12-01	0.40	1.20	22.8	55		17	28	0	-	-	-	-	-	-	-
	TP14-01	0.30	0.70	24.1	59		14	27	0	-	-	-	-	-	-	-
	TP17-01	0.00	1.80	11.8	27		26	47	0	-	-	-	-	-	-	-
	TP21-01	0.30	3.50	9.7	17		34	49	0	-	-	-	-	-	-	-
	TP24-01	0.40	1.00	11.5	25		39	36	0	-	-	-	-	-	-	-
Double Double	TP25-01	0.20	1.40	11.0	21		36	43	0	-	-	-	-	-	-	-
	TP27-01	0.30	4.00	10.1	11		49	40	0	-	-	-	-	-	-	-
	TP28-01	0.20	2.20	10.7	25		37	38	0	-	-	-	-	-	-	-
	TP30-01	0.30	1.70	12.2	25		37	38	0	-	-	-	-	-	-	-
South Latte/ Supremo	TP32-01	0.15	0.70	11.1	13		38	49	0	-	-	-	-	-	-	-
	TP32-02	0.70	1.20	17.0	13	19	36	32	-	-	-	-	-	-	-	-
	TP33-01	0.20	0.90	26.4	19		33	48	0	-	-	-	-	-	-	-
South Latte	TP36-01	0.50	1.00	40.4	25		32	43	0	-	-	-	-	-	-	-
	TP36-02	1.00	1.70	17.4	7	9	47	37	-	32	0	0	-	-	-	-
	TP38-01	0.40	1.00	-	52		20	28	0	-	-	-	-	-	-	-

(Tetra Tech, 2019)

Table 5 (Con't): Summary of geotechnical properties from 2018 joint (JDS and Tetra Tech) test pitting program investigation

Site Infrastructure	Sample Number	Depth		Moisture Content (%)	Fines (%)		Sand (%)	Gravel (%)	Cobble (%)	Atterberg Limits			Excess Ice Content (% by volume)	Bulk Density (kg/m³)	Proctor Result	
		From (m)	To (m)		Clay (%)	Silt (%)				LL	PL	PI			Maximum Dry Density (kg/m³)	Optimum Moisture Content (%)
Facility Pond Area	TP40-01	0.30	1.00	8.9	9		42	49	0	-	-	-	-	-	-	-
	TP42-01	0.40	1.00	19.3	19		50	31	0	-	-	-	-	-	-	-
	TP43-01	0.20	0.80	12.5	23		34	43	0	-	-	-	-	-	-	-
	TP48-01	0.30	1.00	15.1	18		38	44	0	-	-	-	-	-	-	-
	TP49-01	0.40	1.00	11.6	8	15	55	22	-	27	0	0	-	-	-	-
Latte Diversion Channel	TP51-01	0.50	1.00	17.8	26		51	23	0	-	-	-	-	-	-	-
	TP52-01	0.45	1.00	14.4	21		46	33	0	-	-	-	-	-	-	-
	TP58-01	0.60	1.30	25.2	43		36	21	0	-	-	-	-	-	-	-
	TP59-01	0.35	1.30	11.4	8	25	34	33	-	25	0	0	-	-	-	-
	TP59-02	1.30	2.30	8.1	22		40	38	0	-	-	-	-	-	-	-
	TP62-01	0.45	1.30	11.7	27		32	41	0	-	-	-	-	-	-	-
Halfway Diversion	TP64-01	0.25	0.50	194.7	57		43	0	0	-	-	-	-	-	-	-
	TP65-01	0.20	0.50	35.1	22		35	43	0	-	-	-	-	-	-	-
	TP66-01	0.50	0.70	19.0	11	36	38	15	-	0	0	0	0.0	2,116	-	-
	TP66-02	0.70	1.10	41.9	27		27	46	0	-	-	-	29.9	-	-	-
	TP67-02	0.50	0.80	28.6	62		28	10	0	-	-	-	-	-	-	-
	TP68-02	0.45	0.90	9.5	22		33	38	7	-	-	-	-	-	-	-
	TP68-03	0.90	1.20	10.3	7	15	38	40	-	0	0	0	-	-	-	-
	TP69-01	0.90	0.95	529.0	-		-	-	-	-	-	-	41.7	1,001	-	-
	TP69-02	0.40	0.70	277.2	-		-	-	-	-	-	-	34.9	-	-	-
	TP69-03	0.80	1.20	313.7	-		-	-	-	-	-	-	34.4	-	-	-
km 2-3/km 6-7 Borrow Sources	TP70-01	1.50	1.50	5.0	8		38	41	13	-	-	-	-	-	2,150	7.0
	TP71-01	1.50	1.50	7.1	12		57	31	0	-	-	-	-	-	2,170	7.5
	TP72-01	1.50	1.50	12.6	18		26	49	7	-	-	-	-	-	2,060	8.0
	TP73-01	1.50	1.50	4.8	9		19	65	7	-	-	-	-	-	2,140	7.0
	TP74-01	1.50	1.50	9.9	10		32	54	4	-	-	-	-	-	2,160	7.5

(Tetra Tech, 2019)

Permafrost

- Lenses of discontinuous permafrost occur under approximately 60% of the site, which acts as a confining layer to the groundwater below.
- Frozen soils are predominately on the north- and west-facing slopes and in valleys and thickest on higher elevation north-facing slopes (30-165 m thick).
    - Ice-poor permafrost is common in upland settings along ridges and on moderately steep valley sides with convex or straight slopes.
    - Ice-rich permafrost is more common in areas with higher organic accumulation and silt-rich sediments in fluvial valley bottoms.
    - Approximately 34% of the project area is underlain by ice-poor permafrost, 27% by permafrost with visible excessive ice, and 1% by ice-rich permafrost.
- Permafrost-related processes active on-site include solifluction, active layer detachment, slope creep, frost heave, and thermal erosion.
- The warmest permafrost temperatures (-0.6ºC) occur at the bottom of the Halfway Creek valley. The coldest permafrost temperatures (-2.0ºC) occur at the bottom of YT-24 Creek and on the north-facing slope of the upper Halfway Creek valley.
- The permafrost classification for the site is “warm” and accordingly, the ground is sensitive to disturbance.

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-012
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #10 – Geochemistry**

Summarizing Reports (References)

- Lorax Environmental. (Lorax). 2017. Appendix 12-D Coffee Gold Project Geochemical Characterization Report. Project No. A362-2. March 2017.
- Lorax Environmental (Lorax). 2019. Coffee Mine Update Study Water Balance and Water Quality Model. Submitted to Newmont Goldcorp. August 2019.

Summary of Site Geochemistry

- All lithologies and weathering facies of waste rock were found to have little to no acid generating potential. Lack of acid generating potential is due to sulfur mineralization between 0.03 wt% and <0.01 wt%.
    - Fresh weathering facies typically show higher sulfur content; however, even in unweathered waste rock, the maximum sulfur concentration is 0.11 wt%.
- There is appreciable calcite in the waste rock (<29 wt%), indicating the presence of buffering capacity for acid-generating reactions. There are also appreciable quantities of less effective carbonate minerals.
- Acid generating potential is defined by both the sulfur content and the ratio of neutralization potential (NP) to acid generating potential (AP), or the net potential ratio (NPR). The AP for various NPR methods is provided in Figure 1.

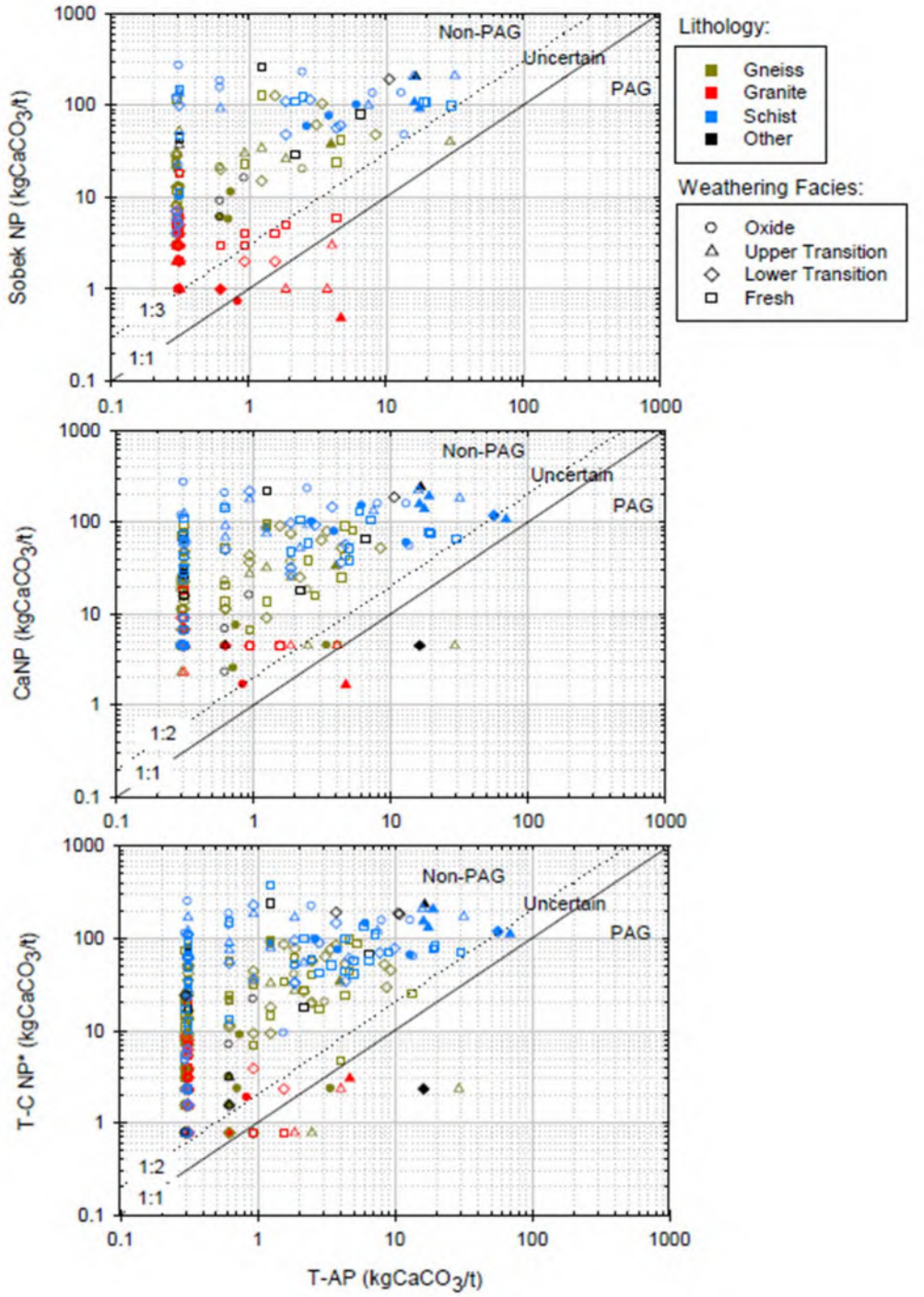


Figure 1: Sobek NP (top), Carbonate NP (middle), and Total Carbon NP vs. T-AP for Coffee Gold waste rock (hollow) and ore (filled).

Lorax, 2017

- Constituents of concern identified for the heap leach facility (HLF) are NO_3, As, and U.
- Portions of the Kona Pit wall are weakly acid generating. The pit is planned to be backfilled at closure, which could mitigate some metal leaching / acid rock drainage (ML/ARD) risk.

- As, Sb, Bi, and Se were enriched in all rock types and shake flask extraction (SFE) results indicate that these metals exceed Canadian Council of Ministers of the Environment (CCME) or the Metal and Diamond Mining Effluent Regulations (MDMER) guidelines.

Summary of Kinetic Testing Program

- Kinetic testing comprised 8 humidity cell tests (HCTs), 17 unsaturated column tests, 11 kinetic field bins (KFBs) and 10 saturated column tests.
- The HCTs were commissioned in 2014 and 2015 and terminated after approximately 20 months.
- Between 2014 and 2015, 17 unsaturated column tests were commissioned. Four were terminated in 2017. As of the Coffee Mine Update Study (CMUS), 13 columns are still running.
- The KFBs were commissioned in 2014 and 2015 and are still active as of the CMUS.
- In 2017, 10 saturated column tests were initiated terminating in 2019.
- Results were affected by rock type and test type (i.e., saturated vs. unsaturated; schist vs. granite).
- Column studies indicate that As mobility can be inhibited by the presence of Ca and SO_4 in waste rock effluent, though U mobility increases in these conditions.
- Preliminary results for the following constituents had at least one measured value exceed MDMER or 10x CCME guidelines: Al, Sb, Cr, Cu, Fe, Hg, Ni, U, NH_s-N, NO_2-N and the radioisotope ^{226}Ra.

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-013
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #11 – Regulatory Requirements**

Summarizing Reports (References)

- Goldcorp Kaminak (Goldcorp). 2019. Coffee Gold Mine YESAB Project Proposal Appendix A – Project Description Overview. December 2019.
- SRK Consulting Inc. (SRK) and Lorax Environmental Services Ltd. (Lorax). 2017. Coffee Gold Mine YESAB Project Proposal Appendix 31-C Conceptual Reclamation and Closure Plan. March 2017.
- Yukon Government Energy, Mines and Resources (EMR). 2006. Yukon Mine Site Reclamation and Closure Policy. January 2006.
- Yukon Water Board (YWB). 2012. Type A and B Quartz Mine Undertakings – Information Package for Applicants. February 2012.
- YWB and EMR. 2013a. Reclamation and Closure Planning for Quartz Mining Projects. August 2013.
- YWB and EMR. 2013b. Plan Requirement Guidance for Quartz Mining Projects. August 2013.

General Regulatory Information

- The Coffee Mine project is subject to an Executive Committee Screening under the Yukon Environmental and Socio-economic Assessment Act (YESAA), administered through the Yukon Environmental And Socio-economic Assessment Board (YESAB).

  - Screening decision is required to begin acquiring licenses and permits from federal or territorial regulators, municipal governments, or First Nations.
  - An updated Final Screening Report was issued by YESAB on February 1, 2022.
  - Decision Document is expected in mid-March.
- The Coffee Mine project requires a Type A Water Licence (WL) and a Quartz Mining Licence (QML) to construct, operate and reclaim the mine.
  - The QML is issued by the EMR, and the WL is issued by the YWB.
  - A Type A Water License is required for the mine construction, operations and closure periods.
  - A Type B Water License is required for the Northern Access Route, and construction and operation of the Java exploration camp and exploration activities.
  - The QML is required for mining operations, and must be procured prior to any construction, including pre-construction such as clearing and grubbing.
  - A QML may be issued without a Reclamation and Closure Plan (RCP) in place; however, approval to begin mining will not be granted without an RCP.
- The Type A and B Quartz Mining Undertakings Information Package for Applicants (2012) provides the information requirement for a WL application.
- Both the YWB and EMR Plan Requirement Guidance for Quartz Mining Projects (2013b) and Reclamation and Closure Planning for Quartz Mining Project Guidelines (2013a) guide provide specific details on management plan and reclamation and closure planning requirements. The required management plans and Reclamation and Closure Plan form the basis of the QML application and are a significant component of the WL application.
- QML and WL applications require preliminary designs that include construction specifications, schedules, and execution plans. These may be considered 30-60% designs.

Reclamation and Closure Planning

- EMR and YWB requires an updated RCP every two years.
  - The RCP updates should include updates of financial liability associated with the site as operations and progressive reclamation take place.
  - Liability should be broken into three categories: current liability, liability in two years, and liability at end of mine life.
- RCPs developed as part of QML and WL applications must identify suitable reclamation and closure measures with sufficient site-specific data, analysis, and design to demonstrate that the plan will achieve proposed objectives.

- RCPs must address temporary and permanent closure scenarios.
- The Yukon Government will issue a Certificate of Closure where the EMR is satisfied with the completion of all conditions of the mining license.
- Financial assurance is required to cover all third-party reclamation and closure costs, reasonable contingencies, and the net present value for future monitoring and maintenance to support reclamation and closure work.
    - Financial assurance will be held by the Yukon Government.
    - Contingency funds are specifically for high-risk components of mine features and may be based on risk assessment and / or mine conditions.
    - EMR and YWB may request separate financial liabilities.
- Progressive reclamation may be used to reduce financial security requirements.

Memorandum

To:	Coffee Mine FMEA Participants
From:	Hemmera
Our ref:	1075-330-014
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #12 – Closure Commitments**

Closure Commitments

Newmont will develop and implement a Reclamation and Closure Plan (RCP) that contains the following commitments:

- Develop a detailed closure Adaptive Management Plan (AMP) to support Project licensing.
- Consult and work with communities for subsequent versions of the reclamation and closure plan, which will include mitigation measures activities related to socio-economic aspects of closure (e.g., community contributions, partnerships).
- Salvage suitable soil material from areas that will be disturbed by the Project footprint where appropriate.
- Undertake progressive reclamation and closure. Revegetate inactive areas as soon as practical.
- Implement erosion and sedimentation mitigation associated with reclamation and closure activities.
- Ensure that reclaimed ponds and conveyance structures are graded, as required, for proper drainage. Implement a care and maintenance program during seasonal closures or temporary closure.
- During temporary closure, conduct regular inspections to confirm compliance with applicable permits and licenses.

- Maintain an egress point out of Open Pits during Reclamation and Closure and Post-closure phases, to reduce potential wildlife entrapment.
- Develop a Revegetation Reclamation Research Program where reclamation protocols will be developed and tested on-site. Apply the most successful treatments more broadly during the reclamation phase.
- Decommission and close Project facilities.
- Continue the Operation Phase monitoring programs until no longer required or have been adapted for closure.
- A Social Reclamation and Closure Plan will be developed as an effort to minimize potential negative effects to local communities and individuals.

Active Reclamation and Closure Phase

During the active Reclamation and Closure Phase, numerous personnel will be on site year-round as required, as key activities will include the following:

- Continue water treatment until Heap Leach Facility (HLF) effluent is of suitable quality for discharge.
- Continue operation of conveyance structures and sedimentation ponds until water quality in the ponds meets discharge requirements.
- Continue decommissioning of roads, pads, processing equipment, and other mine infrastructure, then decommissioning of water management infrastructure toward the end of the active Reclamation and Closure Phase.
- Reclaim remaining disturbed areas within the Mine Site footprint.
- Continue routine monthly, annual, and event-driven monitoring at conveyance structures and sedimentation ponds and their dams for stability, signs of seepage, blockage due to ice or foreign debris and significant erosion, or damage to any geosynthetic components.
- Continue monitoring of surface water quality and infrastructure in accordance with conditions of mine licences and monitoring to observe progress toward the return of the Mine Site to pre-mining conditions.
- Annual physical inspections of engineered facilities will be carried out by a qualified engineer licensed to practice in Yukon. An annual review of the monitoring program results (including inspections and instrumentation data) by a qualified engineer will be a requirement of internal protocols and expected in Project licenses.
- Certain components of the site will be buried in place at closure, this includes items that are not salvageable, (e.g., pond liners, concrete foundations, piping)

End Land Use Objectives

The Tr'ondëk Hwëch'in (TH) Proposed Conditions (March 2020) require that the RCP include:

- Description of the approach for determining End Land Use objectives that explicitly considers:
    - i. Pre-and post-mining traditional use;
    - ii. Pre-mining ecosystems and habitats in comparison with the projected post-mining landscape;
    - iii. How affected communities and First Nations will be engaged in the development of the End Land Use objectives.
- Specific closure objectives for major mine components and analysis of cover options based on the closure objectives. These specific objectives must then be incorporated into a workplan clearly illustrating how the closure objectives are considered in the development of the closure concepts and detailed closure plans proposed for each of the major mine components. These objectives should include consideration of the following:
    - i. Minimizing infiltration / contact water;
    - ii. opportunities to mitigate pathways for metal uptake in vegetation and wildlife;
    - iii. supporting target ecosystems and habitats;
    - iv. Measures to ensure arsenic concentrations within the top metre of waste rock storage locations will not exhibit an arsenic concentration greater than 60 mg/kg, on average.

Yukon Fundamental Closure Objectives

- The Yukon Fundamental Mine Reclamation and Closure Objectives defined by the Yukon Water Board (YWB) and Yukon Department of Energy, Mines and Resources (EMR) are listed in Table 1.

Table 1: Yukon Fundamental Mine Reclamation and Closure Objectives

Value	Reclamation and Closure Objectives
Physical Stability	• All mine-related structures and facilities are physically stable and performing in accordance with designs. • All mine-related structures, facilities and processes can withstand severe climatic and seismic events.
Chemical Stability	• Release of contaminants from mine-related waste materials occurs at rates that do not cause unacceptable exposure in the receiving environment.
Health and Safety	• Reclamation eliminates or minimizes existing hazards to the health and safety of the public, workers and area wildlife by achieving conditions similar to local area features. • Reclamation and closure implementation avoids or minimizes adverse health and safety effects on the public, workers and area wildlife.
Ecological Conditions and Sustainability	• Reclamation and closure activities protect the aquatic, terrestrial and atmospheric environments from mine-related degradation and restore environments that have been degraded by mine-related activities. • The mine site supports a self-sustaining biological community that achieves land use objectives.
Land Use	• Lands affected by mine-related activities (e.g., building sites, chemical and fuel storage sites, roads, sediment ponds, tailings storage facilities, waste rock storage areas, underground workings, etc.) are restored to conditions that enable and optimize productive long-term use of land. Conditions are typical of surrounding areas or provide for other land uses that meet community expectations. • Site access is consistent with community land use expectations.
Aesthetics	• Restoration outcomes are visually acceptable.
Socio-economic Expectations	• Reclamation and closure implementation avoids or minimizes adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits. • Reclamation and closure activities achieve outcomes that meet community and regulatory expectations.
Long-term Certainty	• Minimize the need for long-term operations, maintenance and monitoring after reclamation activities are complete.
Financial Considerations	• Minimize outstanding liability and risks after reclamation activities are complete.

YWB and EMR 2013

Coffee Gold Mine Closure Objectives

- The intent of the Project-specific objectives (Table 2) is to achieve the End Land Use Objectives for the Project, to respect the values and expectations of other land users, and to meet or exceed the intent of the Yukon Fundamental Mine Reclamation and Closure Objectives.

Table 2: Coffee Gold Mine Closure Objectives

Closure Value	Closure Objectives
Physical and Chemical Stability	• All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events. • Protect and maintain the land, air, and water in a condition that provides for sustainable use • Ensure water remains substantially unaltered from pre-mining conditions[1] to the extent practicable with respect to quantity, quality and rate of flow, including seasonal rate of flow.
Health and Safety	• Protect the health and safety of people and area wildlife using and accessing the site by emulating pre-mining conditions to the extent practicable.
Ecological Processes and Functions	• Protect or enhance ecological processes and functions in order to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities, with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions.
Land Use	• Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development[2]. • Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable. • Ensure the site and specific assets are available for use post-closure.
Country Food and Traditional Economy	• To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources.
Participation and Positive Relationship	• Maintain ongoing positive relationships or partnerships between Newmon and Yukon First Nations through closure. • Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation.
Culture and Heritage	• Recognize, protect and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations.
Community Health and Well-being	• Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. • Protect and promote the well-being of other Yukon residents and the interests of the public.

Closure Value	Closure Objectives
Economics	• Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic sustainability during and beyond the life of mine.
Aesthetics	• Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land
Long-term Certainty	• Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management[3]). • Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks.

Notes: 1. Pre-mining conditions refers to the state of land, air, water, and resources prior to Project-related activities and disturbances associated with both exploration and mining; 2. Sustainable Development, as defined in the Umbrella Final Agreement, means beneficial socio-economic change that does not undermine the ecological and social systems upon which communities and societies are dependent; 3. In this context, adaptive management includes a systematic and iterative process of monitoring and evaluating changing site conditions to inform adjustments to adaptation options and reduce uncertainty over time.

Source: Goldcorp Coffee Project Closure Workshops with Tr'ondëk Hwëch'in (May and August 2018) and Selkirk First Nation (September 2018); Umbrella Final Agreement (1993), Tr'ondëk Hwëch'in Final Agreement (1998), and Selkirk First Nation Final Agreement (1997) – Referred to Objectives and Provisions (common to the three agreements).

Continuous Improvement Measures

The Tr'ondëk Hwëch'in (TH) Proposed Conditions (March 2020) require that the RCP include:

Description of continuous improvement measures or research to reduce loading of contaminants into the environment through ongoing evaluation and implementation of mine planning, mine development, mitigation, and remedial options in order to meet the long-term protection goals for waterbodies downstream of the mine components, including but not limited to enhancing the level of use-protection in Halfway Creek.

- A reclamation research program that is designed to test proposed reclamation and closure activities in order to reduce uncertainty or answer specific questions in order to develop detailed reclamation and closure plans that support achieving closure objectives. This program must consider:
    - i. Specific closure objectives of major mine components;
    - ii. a detailed implementation schedule tied to life of mine milestones.

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-015
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #13 – HLF Cover Numerical Modelling**

Cover System Alternatives Evaluated

- The cover alternatives evaluated in previous alternatives assessments were primarily differentiated by variations in the coverage and application of a geosynthetic clay layer (GCL) cover system. The alternatives include:
    - GCL cover system on plateau sections only, with a store and release cover system on the slope sections; or
    - GCL cover system on both the plateau and slope sections.
- Okane completed 1D conceptual water balances for these scenarios to estimate performance with and without a GCL cover on the slopes and with a GCL on plateau segments.
- The GCL cover system was modelled as:
    - 0.5 m storage layer;
    - 0.3 m gravel drainage layer;
    - 1 cm geosynthetic clay layer; and

- 5.0 m of rinsed ore.

- The store-and-release cover system was modelled as:
  - 0.5 m storage layer; and
  - 5.0 m of rinsed ore.

Material Properties

- Material properties were estimated for each material based on available lab and field data. The saturated hydraulic conductivity for each material is shown in Table 1, while Figure 1 shows the water retention curve for each material.

Table 1: Saturated hydraulic conductivities of the materials used in the 1D numerical simulations.

Material	Storage Layer	Rinsed Ore	GCL	Gravel Drainage
Saturated Hydraulic Conductivity (m/s)	1×10^{-6}	1×10^{-4}	5×10^{-11}	1×10^{-3}

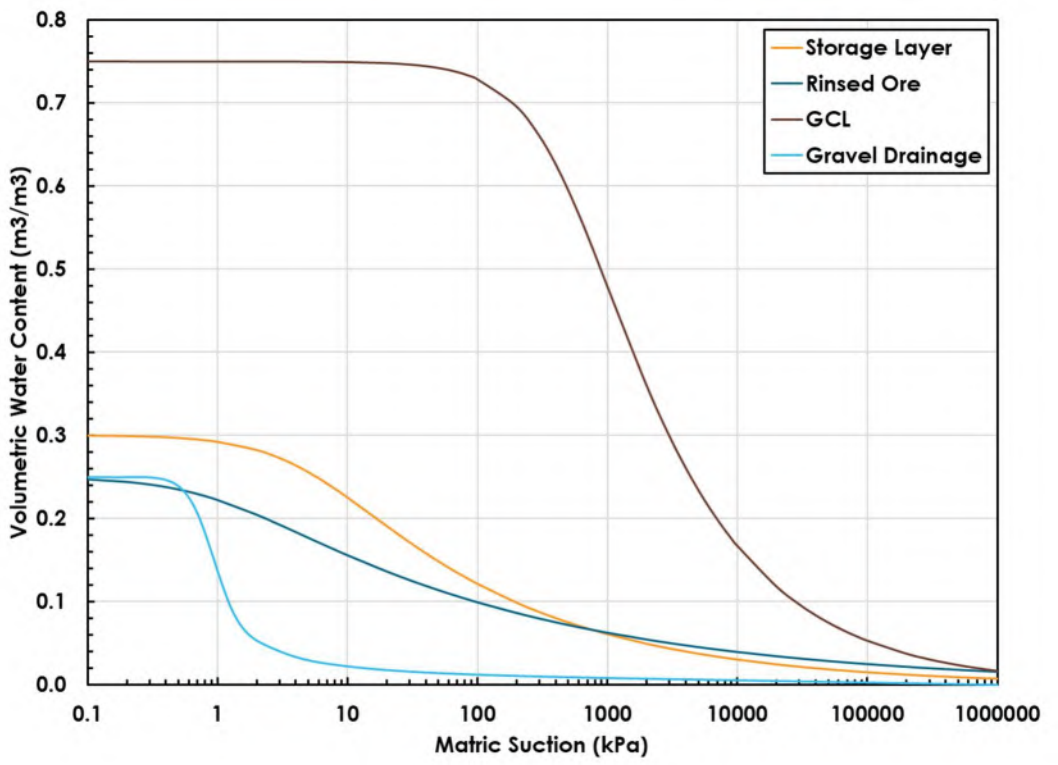


Figure 1: Water retention curves for the materials used in the 1D numerical simulations.

Numerical Water Balance Summary

- Table 2 summaries the water balance developed by Okane through 1D numerical modelling for the potential cover system scenarios of the HLF.
- The primary focus for this assessment is the amount of net percolation (NP) reaching the underlying heap material through the cover system.
- The water balance results provided in Table 2 are consistent with the conceptual range of cover system presented in terms of “very low,” “low,” “moderate,” and “high” NP from the International Network for Acid Prevention cover system guidance document.
    - high NP is classified as greater than 40% of precipitation (PPT) (% PPT),
    - moderate (Mod) is between 20% PPT and 40% PPT,
    - low is between 5% PPT and 20% PPT, and
    - very low (VL) is less than 5% PPT.
- The cover systems are estimated to perform within the following NP classifications:
    - The plateau areas of the HLF with a GCL underlying a store-and-release cover system – Very Low
    - The slopes covered with a store-and-release cover system – Moderate
    - The slope areas covered with a GCL underlying a store-and-release cover system – Very Low

Table 2: Summary of the numerical water balances for the HLF cover system scenarios.

Cover Scenario	Mean Annual Precipitation (mm)	Evapotranspiration (% MAP[1])	Runoff (% MAP)	Net Percolation (% MAP)	Sublimation (% MAP)	Interflow (% MAP)
GCL Cover System	499	53%	16%	4%	14%	13%
Store-and-Release Cover System	499	46%	16%	24%	14%	-

1 – Mean Annual Precipitation

- The net percolation varied year-to-year, as shown in Figure 2, but the GCL provided an upper limit on the net percolation into the rinsed ore of 5-6% mean annual precipitation (MAP).
- The slope store-and-release cover system showed greater net percolation, with most years having between 15% and 30% of MAP percolate into the rinsed ore (Figure 2).

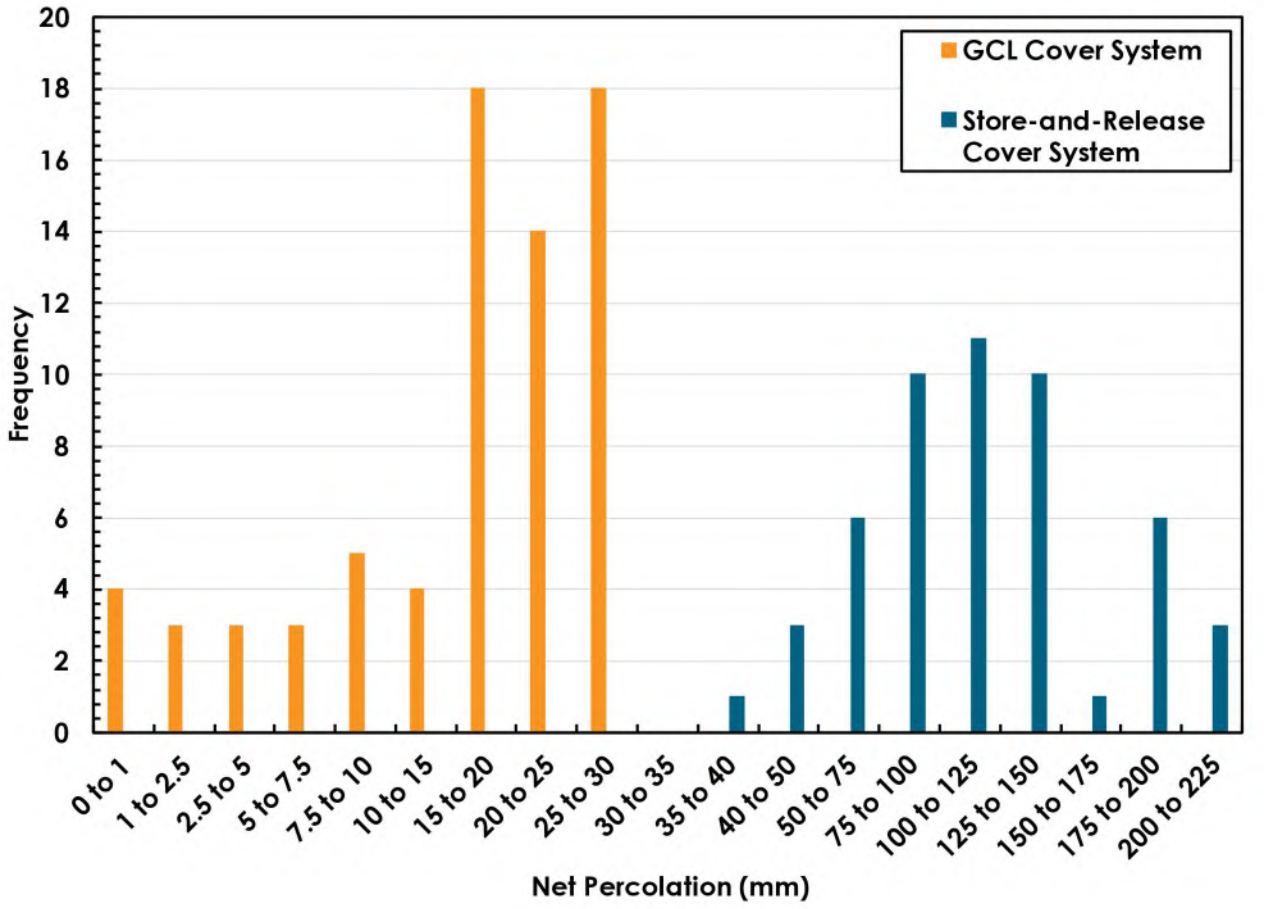


Figure 2: Distribution of net percolation for the cover system alternatives simulated.

- The distribution of runoff was more equivalent between the different scenarios than the net percolation due to the same surface material being used in the alternatives.
    - Runoff in all scenarios was mostly between 5 and 20% of MAP, as shown in Figure 3.
    - Runoff in these simulations is highly controlled by the presence of frozen soil and its ability to reduce infiltration into the soil. In simulations with the same materials and geometry but no frozen soil, only approximately 1% MAP of runoff was generated.

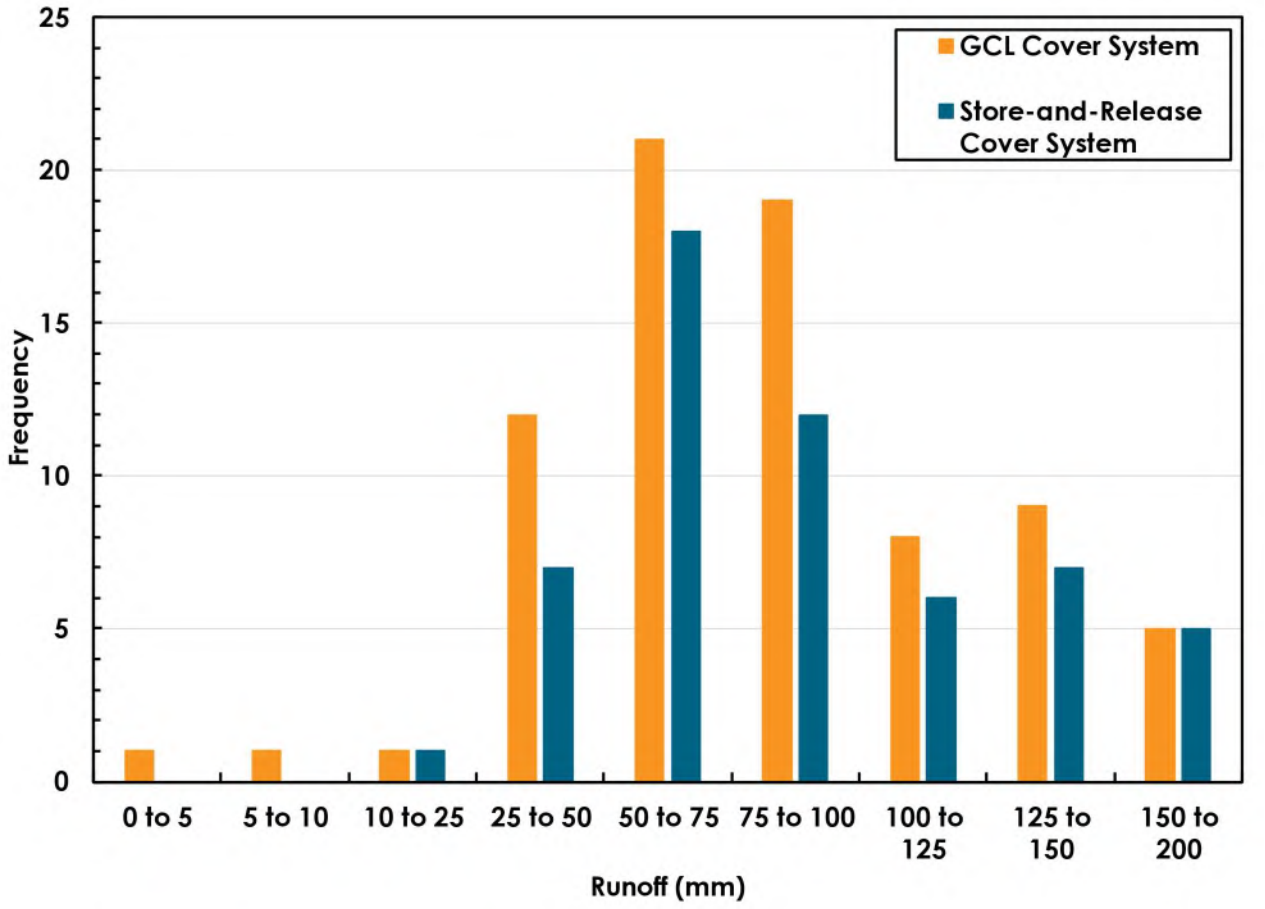


Figure 3: Distribution of runoff for the cover system alternatives simulated.

Memorandum

To:	Coffee Mine FMEA Participants
From:	Daniel Jenkins, P.Eng.
Our ref:	1075-220-016
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #14 – Temporary Closure**

Summarizing Reports and References

- Yukon Department of Energy, Mines and Resources (EMR). 2014. Yukon Mine Site Reclamation and Closure Policy. Financial Guidelines. Available at: https://yukon.ca/sites/yukon.ca/files/emr/emr-forms/emr-yukon-mine-site-reclamation-closure-policy-financial-guidelines-april2014_0.pdf. Accessed December 2021.
- Yukon Water Board (YWB) and Yukon Department of Energy, Mines and Resources (EMR). 2013. *Reclamation and Closure Planning for Quartz Mining Projects*. Available at: http://www.emr.gov.yk.ca/mining/pdf/mml_reclamation_closure_planning_quartz_mining_projects_aug2013.pdf.

Background

- Managed as part of Yukon Government commitment to ensure mining developments managed in sound and sustainable manner, greater benefits for all Yukon residents (EMR, 2014).
- Temporary closure:
    - Is closure in which mining related activities cease with the intent of resuming activities in near future (YWB & EMR, 2013).

- May be planned or unplanned and could arise from a variety of circumstances including financial challenges, design failures, extreme climatic conditions, etc. (YWB & EMR, 2013).
- Is defined as lasting more than six months but less than five years (EMR, 2014).

Objectives

- Minimize outstanding liabilities and risks while the site is in state of temporary closure.
- Primary objectives include:
  - Confirming all mine-related landforms, infrastructure, and facilities are physically and chemically stable and performing in accordance with designs.
  - Confirming all mine-related landforms, infrastructure, and processes can withstand severe climatic and seismic events.
  - Eliminating or minimizing health and safety hazards to site personnel, the public, and area wildlife by preventing access to areas that pose a risk.
  - Confirming mine-related disturbances (e.g., building sites, hazardous materials storage sites, roads, etc.) are not going to adversely affect aquatic and terrestrial environments to prevent future long-term uses or a self-sustaining ecosystem.

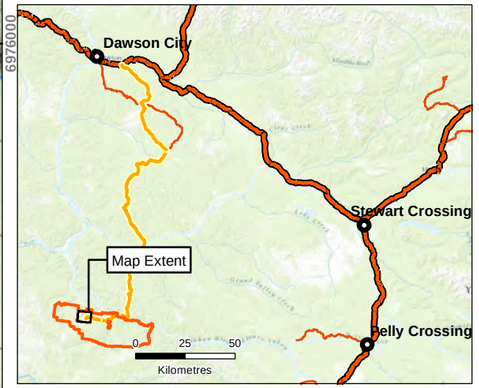
Scenario Description

- Temporary suspension of operating activities (through change in market conditions or mine-related factors), either planned or unplanned.
  - As the Reclamation and Closure Plan (RCP) is anticipated to be updated every two years, subsequent plans will describe a temporary closure period mid-way through or towards end of Operation Phase.
  - It is unlikely that a temporary closure would occur due to market conditions or another unplanned event during the Construction Phase.
- For the purpose of this RCP, temporary closure is assumed to occur at the end of Year 1 in Operation Phase due to unfavorable market conditions
- Suspension of full operations assumed to occur continuously for two-year period
- Mine infrastructure and facilities within the Mine Site area at the end of Year 1 are shown in Figure 1, and include the following:
  - Partially developed Latte, Supremo, and Double Double open pits;
  - Stage 1 of HLF pad, event ponds EP-1N and EP-1S, EP2, and a rainwater pond;
  - Partially developed Alpha WRSF, including the frozen soil storage area;
  - Partially developed soil stockpile;

- ROM stockpile area;
- Crusher system and crushed ore stockpile area;
- Camp and Plant sites, and waste management areas;
- Mine site and haul roads;
- Emulsion Plant;
- Water management infrastructure including the facility ponds and alpha pond, diversion berms, and rock drains;
- Airstrip; and
- NAR and Mine Site Access Route.

COFFEE GOLD MINE

Proposed Layout - Year 1



Legend

- Municipalities
- Waterbody
- Watercourse
- Pit
- WRSF/Backfill
- MineRoad

N

1:20,000

0 400 800 1,200

Meters

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 2-18	Date: Aug 2, 2019	Drawn by: AL	Reviewed: SJ/DF

NEWMONT GOLDCORP.

Figure 1: Proposed Layout – Year 1

HLF and ROM Stockpile

- Assuming temporary closure occurs at the end of Year 1, approximately 10.5 million tonnes (Mt) of ore will be present on the heap leach pad with an additional ~0.7 Mt on the ore stockpile. Sources of ore during this period come primarily from Latte (9.53 Mt), Supremo (1.69 Mt), and lesser quantities from Double Double (0.04 Mt). Due to the geochemistry of these pits, little to no acid generation potential exists for the HLP.
- The geochemical characteristics and cyanide leaching conditions (e.g., elevated CN and pH) result in significant metal leaching potential if ore is left completely exposed. This potential extends to run of mine (ROM) ore on the ROM stockpile as well.
    - To ensure that seepage drainage from the ROM stockpile does not result in poor drainage water quality entering the Facility Ponds, stockpiled ore remaining on the ROM stockpile pad will be transferred and stacked onto the heap leach pad during temporary closure.
- The primary physical stability concern for the HLP is to ensure that it does not freeze and maintains thermal integrity throughout the temporary closure period. Two primary strategies will be used to minimize the potential for freezing:
    - Continuous circulation of heap leach solutions (in addition, maintains the HLF as a zero-discharge facility).
    - Deployment of raincoats (geomembrane covers) to fully cover the HLF.
- A small operations crew will continue to irrigate the heap with barren solution, collect and store pregnant solution, operate gold recovery facilities, and maintain the facility as a zero-discharge facility. Maintenance of HLF infrastructure (e.g., process equipment) will be completed as required during temporary closure.
- To avoid freezing of the heap leach and to facilitate year-round HLF operation during temporary closure, operating requirements will be similar to those currently proposed during January through March of each year for routine operations.
    - Pregnant, barren, and wash water will be stored in tanks at the plant (rather than ponds, which will only being used in upset conditions).
    - Monitoring of leak detection systems will continue.
    - An annual water balance will be performed to ensure solutions are not accumulating in the HLF.
    - As a contingency, if solutions are demonstrated to be accumulating in the HLF, excess water could be released to EP1 and stored until operations resume.
    - The recirculation of process solutions and recovery of gold will continue until operations resume or a decision is made to cease recirculation. The latter may occur if all economically recoverable gold has been processed or the mine progresses towards permanent closure.

Alpha WRSF

- At the end of Year 1, waste rock will have been generated from Latte, Double Double, and Supremo pits:
    - Latte: 24.7 Mt.
    - Double Double: 1.5 Mt.
    - Supremo: 18.3 Mt.
- Waste rock from these three open pits is non-acid generating but exhibits metal leaching potential. Water balance and water quality modeling has indicated that seepage from the Alpha WRSF can report to the Alpha Pond and be discharged directly to Halfway Creek.

Open Pits

- Exposed open pit walls in the Latte, Double Double, and Supremo pits are predicted to be non-acid generating; however, metal leaching from contact with meteoric water will accumulate in pit voids.
- Water quality modeling has indicated that water accumulating in pit voids can be directly discharged (dewatered on a regular basis, from the Supremo (SU1) at a minimum) to the receiving environment without adversely affecting aquatic life.

Water Management Infrastructure, Facility and Alpha Ponds

- Water management infrastructure will be operated, maintained, and monitored in accordance with license requirements and the Water Management Plan.
- During temporary closure, monitoring of discharge water quality and downstream water quality will be conducted in accordance with Operation Phase requirements outlined in the Water Management Plan and the Environmental Monitoring & Adaptive Management Plan (EMAMP).
- In the Facility Ponds, pumping systems will remain in place to allow for control of water volumes in the ponds. Water that meets discharge water quality standards will be periodically released to either the Latte catchment or pumped to Halfway Creek and the Alpha Pond.
- In Alpha Pond, pumping systems will be maintained to avoid the potential for overtopping of this facility during temporary closure.

Scenario Discussion

- Temporary closure occurring at the end of Year 1 may not be the ‘highest risk’ time for a temporary closure to occur. Depending on future mine and operations planning, the ‘highest risk’ scenario is anticipated to occur just before the active water treatment plant is commissioned, when the HLF is at its largest footprint with no additional water treatment capacity on site.

- The 'highest risk' scenario may change whether economics or water quality are viewed as the primary consequence. The time-period with maximum surface disturbance does not necessarily equate to maximum risk for a closure scenario to occur. Given the context of the current state of the project, and a hesitance to overlook a scenario that could play out in the early stages of mine operation, Newmont has chosen to continue to consider a temporary closure occurring at the end of Year 1.
- A temporary closure scenario beyond Year 1, but still before the active water treatment plant is commissioned will be described in a future RCP, likely once construction is complete, and operations have commenced.

Newmont Commitments

- In event of temporary closure, a full review of the RCP liability estimate and security may be undertaken by regulators.
- Newmont will submit to the appropriate authorities an updated RCP early in the temporary closure period.
- Within three months of the temporary closure event, Newmont will provide regulators with:
    - Short term HLF water balance for solution recirculation, contingency volume, and time available, as well as volume and quality of water required for HLF rinsing (per the Final Screening Report Recommendations).
    - Implementation plan for the Water Treatment Plant (if not operational), including execution of the start of a pilot plant program within those three months (per the TH Technical Action tracker).
- An annual water balance will be performed to ensure solutions are not accumulating in the HLF.
- At the onset of a temporary closure period, Newmont will submit a notice of closure within a specified period to the appropriate regulators, Project partners, and stakeholders (as dictated by licenses). The notice of closure will describe the following:
    - Reasons for and anticipated duration of the suspension of operations.
    - Actions that will be taken to maintain compliance with mine licenses and permits, and
    - Any events which would reasonably be anticipated to result in the resumption of mining or the permanent closure of the mine.
- If the decision is made to enter permanent closure, Newmont will provide regulators with an updated RCP (per the Final Screening Report Recommendations).
- During temporary closure, regular inspections will be conducted to confirm compliance with applicable permits and licenses. Infrastructure such as the Alpha WRSF, HLF and process facilities, open pits, water management infrastructure, fuel and storage tanks, and all roads (including the NAR) will be inspected to confirm physical stability and integrity.

- Climate, surface water quality, hydrology, groundwater, and biological components will be monitored at designated stations in accordance with the license conditions, generally as per the monitoring program outlined for the Operation Phase in the EMAMP.

Appendix B

FMEA Worksheet

Failure Mode ID	Failure Mode Description	Discipline	Timeframe	Likelihood	Consequence Category								Highest Risk Ranking	Mitigations / Comments
					Environmental		Stakeholder Consultation and Permitting (SCP)		Life of Project Cost		Legal and Other			
1	Proposed base case cover system design is unacceptable to regulatory bodies and Stakeholders, resulting in redesign prior to issuance of water license and QML.	Closure Design	**Near-term**	U	I	L	Mi	L	Ma	H	I	L	H	C:Base case design was included within the YESAB project review; however, licencing body and stakeholders have not yet approved. C: Regulatory bodies would only not accept the base case design only if there is an effect of water quality C: If water board does not approve of the base case they would likely want a redesign and additional financial assurance. Likelihood is unlikely as permitting delays are not expected from the water board. Project history in the region has shown that a condition would only be placed on the permit. C: SCP consequences are minor due to the possibility of requiring a redesign resulting in permitting delays of 1-3 months for redesign work. C: The redesign would result in a change in the cover system design that further reduces NP (GCL). Major financial consequences due to the additional financial assurance. M: Circulate base design with Stakeholders and regulators to understand their acceptance
2	Actual draindown of HLF material is longer than predicted, leading to extended active water treatment and monitoring / maintenance of HLF discharge.	Hydrology	**Short-term**	U	I	L	Mi	L	Mo	Mo	I	L	Mo	C: ERB treatment systems have not been extensively used in the Yukon. C: To date, there is some uncertainty in the water balance. Likelihood is unlikely C: Moderate financial consequences due to requiring longer active treatment (low end of moderate) M: Revisiting source terms during operations. M: Material characterization to better understand hydraulic properties M: Monitoring wetting-up of the facility
3	Characterization of ML/ARD potential of heap material is not consistent with field conditions, leading to water quality exceeding guidelines	Geochemistry	**Short-term**	U	Mi	L	Mi	L	Mo	Mo	Mi	L	Mo	C: Moderate financial consequences due to requiring to treat water longer or more aggressively. M: Additional material characterization of ore during operations
4	Borrow material quality is inappropriate for use as a cover material on a 2.5H:1V slope, resulting in excessive erosion or physical instability.	Closure Design	**Short-term**	P	Mi	Mo	Mi	Mo	Mi	Mo	Mi	Mo	Mo	C: Consideration of analog sites and past project experience in similar regions characterize the borrow material as a gravely till which could become heavily erodible on a 2.5:1 slope. C: Possibility for ore to become exposed - however, routine monitoring and maintenance in the short-term would identify maintenance work prior to this occurring. M: Ensure a geomorphic landform design to reduce erosion potential on slopes and proper surface water management infrastructure.
5	There is insufficient borrow material to cover the HLF, leading to constructing a thinner cover system with higher net percolation rates.	Closure Design	**Short-term**	R	Mi	L	Mi	L	Mo	Mo	Mi	L	Mo	C: Likelihood is rare as material balance shows a surplus under the base case design. C: Minor environmental risks as seepage reports to treatment systems and Latte pit C: Moderate financial consequences due to additional material sourcing M: Proper documentation of stripping volumes and material available for reclamation
6	HLF seepage quality is poorer than anticipated resulting in the passive treatment system requiring additional maintenance and replacement of reactive medium to sufficiently treat seepage.	Geochemistry	**Short-term**	U	Mi	L	I	L	Mi	L	I	L	L	C: Concentrations observed in test work are within predicted concentrations. Unlikely likelihood given the expected variability in the geochemistry. C: Quality of the seepage will not have environmental consequences but would result in additional Op ex to replace reactive material. C: This Failure mode is thought to already be ALARP
7	Cover system design tolerances do not meet actual material volumes (including the various types), resulting in the need to source additional reclamation material.	Closure Design	**Near-term**	R	Mi	L	Mi	L	Mo	Mo	I	L	Mo	C: Base case design includes only cover system on the HLF. Material balance indicates sufficient material volume C: Construction specifications for store and release cover systems typically have a large material envelope for suitable material C: Potential need for additional borrow areas, or processing materials to meet specifications M: Material stockpile management plan, borrow material characterization program, design criteria for store and release cover systems
8	HFL runoff and interflow management features fail, resulting in excessive erosion or slope failure and loss of cover system functionality	Closure Design	**Short-term**	L	Mi	H	I	Mo	Mi	H	I	Mo	H	G: No surface water management design C: Possible to occur until a surface water management design is in place C: Minor environmental impacts as the impact is within the project boundary. C: Still on site in the short-term M: Develop surface water management design that can effectively transport water off the HLF landform
9	Base case cover system design does not match First Nations expectations resulting in Newmont not meeting returning land use/closure performance	Permitting	**Near-term**	U	I	L	I	L	Ma	H	I	L	H	C: Non-acceptance is in the perspective of the FN. If they do not accept it, they will raise issue with the water board and result in permitting delays. C: If water board does not approve of the base case they would likely want a redesign and additional financial assurance. Likelihood is unlikely as permitting delays are not expected from the water board. Project history in the region has shown that a condition would only be placed on the permit. C: The redesign would result in a change in the cover system design that further reduces NP (GCL). Major financial consequences due to the additional financial assurance for soil amendment or design changes M: Demonstration of why/how the base case works.
10	Progressive reclamation of the HLF interferes with operations resulting in delays to progressive reclamation	Operations	**Near-term**	U	I	L	Mi	L	Mi	L	I	L	L	C: No sequencing of progressive reclamation is included in the mine plan but there is commitments to progressive rec starting in Year 8 M: Resources required for progressive reclamation activities included in resource management plan C: Minor SCP due to redesign of mine plan C: Minor financial consequences if progressive reclamation interferes with haul distances M: Include progressive reclamation plans into mine plan
11	Net percolation through the HLF is in excess of passive treatment system capacity leading to an inability to sufficiently treat water and meeting discharge criteria	Closure Design	**Short-term**	P	Mi	Mo	Mo	H	Ma	S	Mo	H	S	C: Under the base case design NP through the slopes is expected to be ~30% C: Likelihood is possible under the current capacity of the passive treatment system. The system is expected to have capacity under most circumstances but it is possible to occur during higher PPT months/years C: If passive treatment system is over capacity, there is minor environmental impacts as contamination levels to downstream receptors would be limited. Additionally, there is built in capacity in the system to hold water on-site prior to discharge. C: Moderate SCP consequences due to the importance placed on water quality at closure. C: Major financial consequences due to requiring to reconstruct an alternate cover system that further limits NP (GCL ~$15/m2). M: Surge pond to capture excesses seepage prior to moving through the passive system.
12	Climate change results in excess water through the system resulting in an inability to manage surface water during storm events.	Closure Design	**Long-term**	U	Mi	L	I	L	Mo	Mo	I	L	Mo	C: All models include RCP 6 climate change scenario C: Ensure design a robust surface water management system that incorporates climate change and increased PMP C: Currently ALARP
13	PRB system is not effective in passively treating water in the long-term resulting in exceedance of water quality objectives in Halfway Creek	Hydrology	**Long-term**	P	Mi	Mo	Mo	H	Ma	S	Mo	H	S	C: PRB systems are not currently a proven/accepted technology. Coffee Project climate also creates problems with PRB systems. C: Likelihood is possible given the Yukon climate and PRB systems are not a proven / accepted technology C: Seepage from HLF is directed into Latte pit where it will be mixed with clean water. Therefore minor environmental consequences C: Moderate SCP consequences due to regulators and Stakeholders not accepting an unproven technology for water treatment. C: Major financial consequences due to requiring long-term water treatment. M: In the near-term conduct field trials on a PRB system to understand if this system can work for long-term treatment. M: Monitoring transition between active and passive treatment

14	Unsuitable veneer stability of the HLF cover system leading to inability to meet performance criteria.	Geotechnical	**Short-term**	P	I	L	I	L	Mi	Mo	Mi	Mo	Mo	C: Performance criteria includes all closure aspects (e.g., visual, runoff quality, NP, vegetation) C: Base case design has 2.5:1 slopes. Likelihood of having unsuitable veneer stability is possible (has been seen in other local operations). Race between establishing vegetation and the time erosion to occur. C: This likelihood would increase if a GCL would be installed on the slope. C: During the short-term, there is active monitoring and maintenance can easily be completed. Insignificant environmental consequences. C: There is budget in the short-term to perform some cover system maintenance. Only minor financial consequences. C: Minor legal consequences due to inspections required M: Ensure vegetation will establish prior to erosion occurring. M: Erosion modelling as part of on-going reclamation research programs
15	HLF global instability results in a release of constituents off lease boundary	Geotechnical	**Long-term**	R	Ma	Mo	Ma	Mo	Ma	Mo	Ma	Mo	Mo	C: Likelihood is rare assuming that standards are being met and designed to best practices C: FM is ALARP, therefor no mitigations required

Failure Mode ID	Failure Mode Description	Discipline	Timeframe	Likelihood	Consequence Category								Highest Risk Ranking	Mitigations / Comments
					Environmental		Stakeholder Consultation and Permitting (SCP)		Life of Project Cost		Legal and Other			
16	Lack of defined performance criteria for the Alpha WRSF leads to stakeholders and First Nations not accepting the closure measures for the Alpha WRSF	Closure Design	**Near-term**	P	Mi	Mo	Mo	H	Mo	H	Mi	Mo	H	C: There has not been detailed work around specific closure criteria (i.e., returning flora and fauna, returning traditional land use, aesthetics) to define what successful closure of the Alpha WRSF is for all stakeholders and First Nations C: Because the criteria has not been developed, the likelihood is "possible" because the goal post has not been defined G: What are the performance criteria for the WRSF? C: SCP consequences are moderate due to the possibility of major re-work around the closure design of the Alpha WRSF (i.e., cover application, resloping) M: ongoing stakeholder and First Nations consultation M: Development of end land use objectives and performance criteria
17	Use of the Alpha WRSF as a flow-through rock drain results in increased metals loading in the Alpha Pond, leading to exceedances of water quality guidelines.	Hydrology	**Short-term**	U	Mi	L	Mo	Mo	Mi	L	Mo	Mo	Mo	C: Rock drain acts as a pathway to convert non-contact water into contact water. C: Surface area of rock drain structure is unlikely to convert to high metals leaching. M: Implement a geochemistry characterization plan in the near-term as the waste rock is placed to better understand the likelihood of the failure mode G: Effluent quality standards post-closure.
18	Absence of cover system on the Alpha WRSF in the base case is unacceptable to regulatory bodies and stakeholders, resulting in a permit not being issued.	Closure Design	**Near-term**	U	I	L	I	L	Mo	Mo	I	L	Mo	C: Base case design was included within the YESAB project review; however, licencing body and stakeholders have not yet approved. C: Regulatory bodies would only not accept the base case design only if there is an effect of water quality C: If water board does not approve of the base case they would likely want a redesign and additional financial assurance. Likelihood is unlikely as permitting delays are not expected from the water board. Project history in the region has shown that a condition would only be placed on the permit. C: SCP consequences are moderate due to the possibility of requiring a redesign C: The redesign would result in a change in the cover system design that is acceptable to stakeholders for the ability to meet post-closure end land use. C: ALARP failure mode
19	Characterization of ML/ARD potential of waste rock in the short-term is not consistent with field conditions, leading to exceedances of water quality guidelines.	Geochemistry	**Short-term**	U	Mi	L	Mo	Mo	Mo	Mo	Mo	Mo	Mo	C: Currently have a good understanding of waste rock geology and geochemistry. It is unlikely that conditions are worse than expected. C: In the short-term seepage from the WRSF will report to the Alpha pond prior to Halfway Creek. C: Sensitivity analysis completed on the base case mine plan showed minor disturbances to water quality criteria but is not a toxicity issue. G: Effluent quality standards post-closure. C: Moderate SCP and legal consequences due to not meeting water quality criteria. C: In the short-term, Newmont would have to pump water to Latte pit M: Implement a geochemistry characterization plan in the near-term as the waste rock is placed to better understand the likelihood of the failure mode M: Reduce NP through the WRSF with a cover system C: Possible mitigation measures for other COCs (changing blasting practices to lower nitrate) C: Moderate financial consequences due to requiring a cover system
20	Current Alpha WRSF closure configuration does not support target ecosystems and habitats resulting in Newmont being unable to meet closure commitments.	Closure Design	**Short-term**	P	Mi	Mo	Mo	H	Mo	H	Mi	Mo	H	C: There has not been detailed work around specific closure criteria (i.e., returning flora and fauna, returning traditional land use, aesthetics) to define what successful closure of the Alpha WRSF is for all stakeholders and First Nations C: Regulatory body has NOT accepted the base case design C: Because the criteria has not been developed, the likelihood is "possible" because the goal post has not been defined G: Definition of target ecosystems and habitats. M: Revegetation research program. To date, everything has looked at covered surface and not bare waste rock. C: Regulatory bodies would only not accept the base case design only if there is an effect of water quality C: If water board does not approve of the base case they would likely want a redesign and additional financial assurance. Likelihood is unlikely as permitting delays are not expected from the water board. Project history in the region has shown that a condition would only be placed on the permit. **C: SCP consequences are moderate due to the possibility of requiring a redesign** C: The redesign would result in a change in the cover system design. M: Circulate base design with stakeholders, First Nations, and regulators to understand their acceptance
21	Alpha Pond water quality is lower quality than predicted, resulting in exceedances of water quality guidelines	Geochemistry	**Short-term**	U	Mi	L	Mo	Mo	Ma	H	Mo	Mo	H	M: pump Alpha Dam water back up to open pits for treatment C: Summation of water quality streams that report to the Alpha Dam, and not necessarily associated with the Alpha WRSF. C: Water treatment plant / dam structure changes are expected to push cost over $5M
22	Water quality within the Alpha Dam does not meet water quality criteria, resulting in inability to proceed with the reclamation plan for the Alpha Dam (i.e., breach and decommissioning)	Geochemistry	**Long-term**	U	Mi	L	Mo	Mo	Ma	H	Mo	Mo	H	C: Because can't breach Alpha Dam, a licensed dam structure remains on-site, requiring long-term water treatment / management M: Add better source control to HLF and WRSF. Pump water back to pits in interim M: pump Alpha Dam water back up to open pits for treatment C: not moving towards passive closure because the Alpha Dam requires ongoing treatment outside of active closure period
			Near-term											M: Monitoring and QA/QC as the WRSF is constructed M: Alteration to the dumping plan during operations

23	Global stability of Alpha WRSF results in a release of material into Halfway Creek	Geotechnical	**Short-term**	U	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	C: Monitoring during operations would decrease likelihood in the short and long-term C: Moderate environmental consequences due to immediate remediation required. C: Moderate legal consequences due to water quality
24	Plugging of the underdrain results in WRSF instability	Geotechnical	Near-term **Short-term**	U	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	#N/A Mo	C: natural low area to limit ponding of water in the WRSF C: Potential for erosion of lower benches if underdrain is plugged C: Unlikely but need to revisit the design to confirm. C: Same consequences as FM9 C: ALARP
25	Plugging of the underdrain results in increased saturated conditions in the lower benches		**Short-term**	U									#N/A	C: Work has been completed to look at this FM
26	Alpha Dam capacity is exceeded due to a storm event greater than 1:10 year return (design storm), leading to decreased hydraulic residence time and increased downstream TSS loading.	Hydrology	**Near-term**	P	Mi	Mo	Mi	Mo	Mi	Mo	I	L	Mo	C: there is a spillway allowing for emergency release M: Evaluate need to Increase the design storm for the Alpha Dam to accommodate a greater range of predicted storm events.

Failure Mode ID	Failure Mode Description	Discipline	Timeframe	Likelihood	Consequence Category								Highest Risk Ranking	Mitigations / Comments
					Environmental		Stakeholder Consultation and Permitting (SCP)		Life of Project Cost		Legal and Other			
27	Pit water quality spilling into the Latte Creek watershed is of poor quality, resulting in impacts to receiving environments	Geochemistry	**Short-term**	U	Mi	L	Ma	H	Mo	Mo	Mo	Mo	H	C: Sensitivity analysis has been conducted on long-term loadings. Same material and characterization that is going into the Alpha WRSF G: Effluent water quality criteria post-closure C: Latte Creek watershed is known fish habitat and is a more sensitive ecosystem than Halfway Creek. C: Minor environmental consequences but Major SCP due to effecting downstream ecosystems. M: Following monitoring and devleopment of pit water quality, In pit water treatment (either active or passive) M: Additional backfill in pit
28	Pit water quality spilling into the Halfway Creek watershed is of poor quality, resulting in impacts to receiving environments	Geochemistry	**Short-term**	U	Mi	L	Mo	Mo	Mo	Mo	Mo	Mo	Mo	C: Lower SCP consequences as there is no fish ecosystem in Halfway creek
29	Instability of pit backfill when acting as a dam results in a large discharge of material to downstream environments	Geotechnical	**Long-term**	R	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	C: Likelihood is rare if roadway reclamation is done properly. C: Failure mode evaluated as the downstream effects on Coffee Creek C: Environmental effects would be reversible and short-term, therefor moderate M: Regrading on other roadways C: Roadways will be reclaimed (in some way) at closure. M: Install conveyance structures through mid-pit roadways to reduce likelihood of classification as a dam.
30	Water quality in Alpha Dam requires relocation and temporary storage of water prior to the availability of Latte pit	Operations	**Near-term**	U	I	L	Mi	L	Mo	Mo	Mi	L	Mo	C: Base case has Latte pit available end of Year 3 for contingency on-site water storage. C: Potential for Latte pit LOM to be extended and not available by year 3. C: There is potential to store water in an event pond but only short-term (30 days) C: Assumed that Newmont would not release poor quality water M: Sumps constructed in an alternate open pit for temporary water storage C: Financial consequences due to interrupting operations and delaying mining G: Understanding the volume available for water storage in each operating year
31	Subsidence of fully backfilled pits results in exposure of the high wall(s), leading to spillage of poor-quality water to Halfway Creek.	Hydrology	**Long-term**	U	Mi	L	I	L	Mo	Mo	Mi	L	Mo	C: pits will be backfilled with the lowest risk (highest neutralization potential) material C: Failure mode only applies to water filling and subsequently spilling from a depression associated with subsidence. M: address subsidence by increasing material volume and strategically backfill (i.e., compactive effort) C: Life of project cost associated with return to site and sourcing new / additional material outside of the material balance

Failure Mode ID	Failure Mode Description	Discipline	Timeframe	Likelihood	Consequence Category								Highest Risk Ranking	Mitigations / Comments
					Environmental		Stakeholder Consultation and Permitting (SCP)		Life of Project Cost		Legal and Other			
32	Haul roads are composed of metal leaching or potentially acid generating material resulting in seepage water that does not meet water quality criteria.	Closure Design	**Short-term**	U	Mi	L	Mi	L	Mo	Mo	Mi	L	Mo	C: FM considers Latte Creek specifically, because the majority of the haul roads are located in this catchment, and other catchments are more impacted by the HLF and Alpha facilities. M: Additional reclamation required for haul roads, including application of cover system or relocation to pits, if necessary
33	Reclamation material stockpiles are not managed correctly, resulting in loss of reclamation materials or additional effort to sort and segregate for use.	Closure Design	**Near-term**	U	Mi	L	Mi	L	Mi	L	Mi	L	L	C: material balance for the base case shows an excess of material, making it unlikely that there is not sufficient material
34	Seepage from the ROM stockpile is of poor quality, resulting in inability to meet surface water quality criteria	Geochemistry	**Short-term**	R	Mi	L	Mi	L	Mi	L	Mi	L	L	C: ROM stockpile pad is impacted by storage of material. C: Base case is all ROM material is removed and reclamation takes place in parallel with plant area - including cover system application.
35	Insufficient suitable stockpile material to construct closure cover systems resulting in additional sourcing or segregating of borrow material	Closure Design	**Near-term**	U	I	L	Mi	L	Mo	Mo	Mi	L	Mo	C: As the Alpha WRSF does not require a cover there is sufficient material on site for coving the HLF. **C: Any changes in cover system design must be looked at holistically from a material balance perspective.** C: Reclamation and cover material specifications need to consider what is available onsite. M: Additional material characterization for its physical properties and in support of specifications development.
36	HLF Freezes during temporary closure leading to issues with water management during temporary closure and resuming production	Closure Design	**Near-term**	R	I	L	I	L	Mo	Mo	I	L	Mo	C: If the HLF freezes there is the potential for the frozen material to impact flow of water within (lateral flow), and also uncertainties surrounding re-starting leaching operations C: Potential issues surrounding recovery C: Risk around system failure not addressed in timely fashion, or plan not being followed M: continuous circulation of solution in closure M: Built into permit and RCP - Newmont submits updated water balance. M: barren solution will be heated Nov-March G: Monitoring program details C: Cost to life of project is in consideration of costs to eventually re-start production, not NPV.
37	HLF cannot be maintained as a zero-discharge facility during temporary closure resulting in poor water quality discharged to the receiving environment	Closure Design	**Near-term**	R	Mo	Mo	I	L	Mo	Mo	Mo	Mo	Mo	C: Within 3 months of temporary closure Newmont will provide regulators with an implementation plan for the WTP (if not operational) C: WTP would need to come in ASAP. If can't be implemented in time, there could be environmental impacts. C/M: Water balance submitted during temporary closure provides the basis for additional storage and or treatment, and timeframes. M: Initiate WTP as soon as practicable M: Deploy raincoats as required. C: Considering the potential toxicity of solution during temporary closure, and reduced options (in comparison to closure) to manage. C: costs assume that WTP costs are included in baseline plan

Failure Mode ID	Failure Mode Description	Discipline	Timeframe	Previous Risk Ranking	Likelihood	Consequence Category								Residual Risk	Mitigations / Comments
						Environmental		Stakeholder Consultation and Permitting (SCP)		Life of Project Cost		Legal and Other			
1	Proposed base case cover system design is unacceptable to regulatory bodies and stakeholders, resulting in redesign prior to issuance of water license and QML.	Closure Design	**Near-term**	**H**	R	I	L	Mi	L	Ma	Mo	I	L	Mo	M: Circulate base design with stakeholders and regulators to understand their acceptance *Once circulated with stakeholders and regulators the likelihood of the base case design being unacceptable decreases from unlikely to rare.
8	HFL runoff and interflow management features fail, resulting in excessive erosion or slope failure and loss of cover system functionality	Closure Design	**Short-term**	**H**	U	Mi	L	I	L	Mi	L	I	L	L	M: Develop surface water management design that can effectively transport water off the HLF landform * Once a surface water management plan is developed the likelihood decreases from likely to unlikely. The surface water management plan should be robust and constructed to future climate conditions
9	Base case cover system design does not match First Nations expectations resulting in Newmont not meeting returning land use/closure performance criteria	Permitting	**Near-term**	**H**	R	I	L	I	L	Ma	Mo	I	L	Mo	M: Demonstration of why/how the base case works. * Demonstration of base case performance in the near-term (such as vegetation studies, field trials, constructability tests) would give confidence in Newmont achieving FN expectations and would decrease the likelihood from unlikely to rare. It is assumed that the demonstrations would result in a positive outcome and would not reassure/increase the likelihood of the failure mode.
11	Net percolation through the HLF is in excess of passive treatment system capacity leading to an inability to sufficiently treat water and meet discharge criteria	Closure Design	**Short-term**	**S**	U	Mi	L	Mo	Mo	Ma	H	Mo	Mo	H	M: Surge pond to capture excesses seepage prior to moving through the passive system. * Construction of a surge pond would decrease the likelihood of exceeding the capacity of the passive system from possible to unlikely. * This risk is carried by Newmont and is a financial risk that is thought to be acceptable at this time.
13	PRB system is not effective in passively treating water in the long-term resulting in exceedance of water quality objectives in Halfway Creek	Hydrology	**Long-term**	**S**	R	I	L	Mi	L	Ma	Mo	Mi	L	Mo	M: In the near-term conduct field trials on a PRB system to understand if this system can work for long-term treatment. M: Monitoring transition between active and passive treatment * Demonstrating the functionality of a PRB system in the near-term would give confidence in the designs ability to treat water, therefore decreasing the likelihood from possible to rare. * Continuous monitoring the transition between active and passive treatment systems would also mitigate any environmental, SCP, or legal consequences
16	Lack of defined performance criteria for the Alpha WRSF leads to stakeholders and First Nations not accepting the closure measures for the Alpha WRSF	Closure Design	**Near-term**	**H**	U	Mi	L	Mo	Mo	Mo	Mo	Mi	L	Mo	M: Ongoing stakeholder and First Nations consultation M: Development of end land use objectives and performance criteria * Once end land use objectives and performance criteria are developed in collaboration with Stakeholders and First Nations, the likelihood decreases from possible to unlikely.
20	Current Alpha WRSF closure configuration does not support target ecosystems and habitats resulting in Newmont being unable to meet closure commitments.	Closure Design	**Short-term**	**H**	U	Mi	L	Mo	Mo	Mo	Mo	Mi	L	Mo	M: Revegetation research program. To date, everything has looked at covered surface and not bare waste rock. M: Circulate base design with stakeholders, First Nations, and regulators to understand their acceptance * Revegetation research programs and circulation of the base case would give confidence in the base case design to support target ecosystems, therefore decreasing the likelihood from possible to unlikely.
21	Alpha Pond water quality is lower quality than predicted, resulting in exceedances of water quality guidelines	Geochemistry	**Short-term**	**H**	U	I	L	Mi	L	Ma	H	Mi	L	H	M: Pump Alpha Dam water back up to open pits for treatment * Pumping Alpha Dam water back up to the open pits would mitigate any environmental, SCP, or legal consequences. * This is a financial risk to Newmont and is considered acceptable at this time with the plan mitigations
22	Water quality within the Alpha Dam does not meet water quality criteria, resulting in inability to proceed with the reclamation plan for the Alpha Dam (i.e., breach and decommissioning)	Geochemistry	**Long-term**	**H**	U	Mi	L	Mi	L	Ma	H	Mi	L	H	M: Add better source control to HLF and WRSF. Pump water back to pits in interim. M: Pump Alpha Dam water back up to open pits for treatment * Pumping Alpha Dam water back up to the open pits and adding better source control would mitigate any environmental, SCP, or legal consequences. * This is a financial risk to Newmont and is considered acceptable at this time with the plan mitigations
27	Pit water quality spilling into the Latte Creek watershed is of poor quality, resulting in impacts to receiving environments	Geochemistry	**Short-term**	**H**	U	Mi	L	Mo	Mo	Mo	Mo	Mo	Mo	Mo	M: Water treatment (either active or passive) M: Additional backfill in pit M: Monitoring of pit water quality while during pit filling * Monitoring would indicate any issue with pit water quality and allow for active water treatment (e.g., in-pit lime treatment)

Appendix C

Identified Risk Mitigations

IDENTIFIED RISK MITIGATIONS

Table C.1: Summary of HLF risk mitigations

Failure Mode ID	Failure Mode	Identified Mitigation	Timeframe	Risk Ranking Addressed
1	Proposed Base Case cover system design is unacceptable to regulatory bodies and Stakeholders, resulting in redesign prior to water license and QML.	Early collaboration and circulate base case design with Stakeholders and regulatory to understand their acceptance prior to permit submission	Near-term	High
2	Actual draindown of HLF material is longer than predicted, leading to extended active water treatment and monitoring / maintenance of HLF discharge.	Revisit HLF source terms during operations	Short-term	Moderate
		Material characterization program during operations to better understand hydraulic properties		
		Monitor wetting-up and draindown of the HLF		
3	Characterization of ML/ARD potential of heap material is not consistent with field conditions, leading to water quality exceeding guidelines.	Additional material characterization of ore during operations	Short-term	Moderate
4	Borrow material quality is inappropriate for use as a cover material on a 2.5H:1V slope, resulting in excessive erosion or physical instability.	Ensure geomorphic landform design to reduce erosion potential on slopes and proper surface water management infrastructure	Short-term	Moderate
5	There is insufficient borrow material to cover the HLF, leading to constructing a thinner cover system with higher net percolation rates.	Proper documentation of stripping volumes and material available for reclamation	Short-term	Moderate
7	Cover system design tolerances do not meet actual material volumes, resulting in the need to source additional reclamation material.	Develop material stockpile management plan, borrow material characterization program, and design criteria for store and release cover systems	Near-term	Moderate
8	HLF runoff and interflow management features fail, resulting in excessive erosion or slope failure and loss of cover system functionality.	Develop surface water management design that can effectively transport water off the HLF landform	Short-term	High

Failure Mode ID	Failure Mode	Identified Mitigation	Timeframe	Risk Ranking Addressed
9	Base case cover system design does not match First Nations expectations, resulting in Newmont not meeting returning land use/closure performance criteria.	Field-scale demonstrations of base case cover system performance (e.g., revegetation, net percolation, veneer stability)	Near-term	High
10	Progressive reclamation of the HLF interferes with operations, resulting in delays to progressive reclamation.	Include progressive reclamation resource requirements in resource management plan	Near-term	Low
		Include progressive reclamation activities into the mine plan		
11	Net percolation through the HLF is in excess of passive treatment system capacity, leading to an inability to sufficiently treat water and meet discharge criteria.	Construct surge pond to capture excess seepage prior to moving through the passive system	Short-term	Severe
13	PRB system is not effective in passively treating water in the long-term, resulting in exceedance of water quality objectives in Halfway Creek.	In the near-term, conduct field trials on a PRB system to understand if this system can function for long-term treatment	Long-term	Severe
		Monitor water quality when transitioning between active and passive treatment		
14	Unsuitable veneer stability of the HLF cover system leading to inability to meet performance criteria	Ensure vegetation will establish prior to erosion occurring	Short-term	Moderate
		Erosion modelling as part of on-going reclamation research programs		
16	Lack of defined performance criteria for the Alpha WRSF leads to Stakeholders and First Nations not accepting the closure measures for the Alpha WRSF.	Ongoing Stakeholder and First Nations consultation	Near-term	High
		Develop closure vision / objectives suitable to define performance criteria		
17	Use of the Alpha WRSF as a flow-through rock drain results in increased metals loading in the Alpha Pond, leading to exceedances of water quality guidelines	Geochemistry characterization program in the near-term	Short-term	Moderate
19	Characterization of ML/ARD potential of waste rock in the short-term is not consistent with field conditions, leading to exceedances of water quality guidelines	Geochemistry characterization program in the near-term	Short-term	Moderate

Failure Mode ID	Failure Mode	Identified Mitigation	Timeframe	Risk Ranking Addressed
20	Current Alpha WRSF closure configuration does not support target ecosystems and habitats, resulting in Newmont being unable to meet closure commitments	Revegetation research program on bare waste rock	Short-term	High
		Circulate base case design with Stakeholders, First Nations, and regulators to understand their acceptance of the current closure configuration		
21	Alpha Pond water quality is lower than predicted, resulting in exceedances of water quality guidelines.	Pump water back up to open pits for treatment	Short-term	High
		Set-up water treatment train downgradient of the Alpha Dam		
		Update/expand dam structure to promote additional treatment opportunities		
22	Water quality within the Alpha Pond does not meet water quality criteria, resulting in inability to proceed with reclamation plans for the Alpha Dam.	Set-up water treatment train downgradient of the Alpha Dam	Long-term	High
		Update/expand dam structure to promote additional treatment opportunities		
26	Alpha Dam capacity is exceeded due to a storm event greater than 1:10 year return period, leading to decreased hydraulic residence time and increase downstream TSS loading.	Increase the design storm event for the Alpha Dam to accommodate a greater range of predicated storm events	Near-term	Moderate
27	Pit water quality spilling into the Latte Creek watershed is of poor quality, resulting in impacts to receiving environments.	Investigate active or passive water treatment options	Short-term	High
		Investigate the effects of additional backfill in Latte Pit to reduce ML/ARD potential		
29	Instability of pit backfill when acting as a dam, results in a large discharge of material to downstream environments.	Install conveyance structures through mid-pit roadways to reduce likelihood of holding back flowable material	Long-term	Moderate
30	Water quality in Alpha Dam required relocation and temporary storage of water prior to the availability of Latte Pit (end of Year 3).	Sumps constructed in an alternate open pit for temporary water storage	Near-term	Moderate
31	Subsidence of fully backfilled pits results in exposure of the high wall(s), leading to	Address subsidence by increasing material volumes placed in backfilled pits.	Long-term	Moderate

Failure Mode ID	Failure Mode	Identified Mitigation	Timeframe	Risk Ranking Addressed
	spillage of poor-quality water to Halfway Creek.			
32	Haul roads are composed of ML/ARD material, resulting in seepage water that does not meet water quality criteria.	Additional reclamation required for haul roads including application of cover system or relocation to pits, if necessary	Short-term	Moderate
33	Reclamation material stockpiles are not managed correctly, resulting in loss of reclamation material or additional effort to sort and segregate for use.	Robust material salvage and stockpiling plan to protect available quantities or reclamation material	Near-term	Low
34	Metal leaching occurring from the run of mine stockpile, results in inability to meet surface water quality criteria.	Remove impacted material and store in open pit with neutral rock	Short-term	Low
36	HLF freezes during temporary closure leading to issues with water management during temporary closure and resuming production.	Continuous circulation of solution during temporary closure. Heat solution during winter months.	Near-term	Moderate
37	HLF cannot be maintained as a zero discharge facility during temporary closure, resulting in poor water quality discharged to receiving environment.	Submit water balanced under temporary closure to provide the basis for additional storage and or treatment. Initiate water treatment plant as soon as practicable	Near-term	Moderate

APPENDIX 3-A
Component Specific Objectives Table

Mine Components	Open Pits	Alpha WRSF	HLF	Water Management Infrastructure	Northern Access Route	Infrastructure
Component details	Latte; Double Double; Supremo; Kona	n/a	Heap leach pad; event and rainwater ponds; associated piping	Alpha and Facility sedimentation ponds; conveyance structures	n/a	Crusher system; plant site; camp complex; bulk explosives storage area
Closure Principles	• Physical Stability • Chemical Stability • Health and Safety • Long-term Certainty • Financial Considerations	• Physical Stability • Chemical Stability • Health and Safety • Long-term Certainty • Financial Considerations	• Physical Stability • Chemical Stability • Ecological Conditions and Sustainability • Land Use • Aesthetics • Socio-economic Expectations • Long-term Certainty • Financial Considerations	• Physical Stability • Chemical Stability • Ecological Conditions and Sustainability • Land Use • Aesthetics • Socio-economic Expectations • Long-term Certainty • Financial Considerations	• Health and Safety • Ecological Conditions and Sustainability • Land Use • Aesthetics • Socio-economic Expectations	• Physical Stability • Health and Safety • Ecological Conditions and Sustainability • Land Use • Aesthetics • Socio-economic Expectations
Project-specific Closure Objectives	• All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events. • Protect and maintain the land, air, and water in a condition that provides for sustainable use. • Ensure water remains substantially unaltered from pre-mining conditions to the extent practicable with respect to quantity, quality and rate of flow, including seasonal rate of flow. • Maintain ongoing positive relationships or partnerships between Newmont and Yukon First Nations through closure. • Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation • Recognize, protect and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations. • Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. • Protect and promote the well-being of other Yukon residents and the interests of the public. • Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic sustainability during and beyond the life of mine • Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management). • Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks.	• All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events. • Protect and maintain the land, air, and water in a condition that provides for sustainable use. • Ensure water remains substantially unaltered from pre-mining conditions to the extent practicable with respect to quantity, quality and rate of flow, including seasonal rate of flow. • Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development. • Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable. • Ensure the site and specific assets are available for use post-closure. • Maintain ongoing positive relationships or partnerships between Newmont and Yukon First Nations through closure. • Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation • Recognize, protect and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations. • Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. • Protect and promote the well-being of other Yukon residents and the interests of the public. • Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic sustainability during and beyond the life of mine • Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management). • Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks.	• All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events. • Protect and maintain the land, air, and water in a condition that provides for sustainable use. • Ensure water remains substantially unaltered from pre-mining conditions to the extent practicable with respect to quantity, quality and rate of flow, including seasonal rate of flow. • Protect or enhance ecological processes and functions in order to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities, with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions. • Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development. • Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable. • Ensure the site and specific assets are available for use post-closure. • To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources. • Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land. • Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management). • Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks. • Maintain ongoing positive relationships or partnerships between Newmont and Yukon First Nations through closure. • Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation • Recognize, protect and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations. • Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. • Protect and promote the well-being of other Yukon residents and the interests of the public. • Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic sustainability during and beyond the life of mine	• All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events. • Protect and maintain the land, air, and water in a condition that provides for sustainable use. • Ensure water remains substantially unaltered from pre-mining conditions to the extent practicable with respect to quantity, quality and rate of flow, including seasonal rate of flow. • Protect or enhance ecological processes and functions in order to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities, with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions. • Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development. • Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable. • Ensure the site and specific assets are available for use post-closure. • To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources. • Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land. • Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management). • Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks. • Maintain ongoing positive relationships or partnerships between Newmont and Yukon First Nations through closure. • Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation • Recognize, protect and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations. • Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. • Protect and promote the well-being of other Yukon residents and the interests of the public. • Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic sustainability during and beyond the life of mine	• Protect the health and safety of people and area wildlife using and accessing the site by emulating pre-mining conditions to the extent practicable. • Protect or enhance ecological processes and functions in order to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities, with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions. • Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development. • Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable. • Ensure the site and specific assets are available for use post-closure. • To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources. • Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land. • Maintain ongoing positive relationships or partnerships between Newmont and Yukon First Nations through closure. • Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation • Recognize, protect and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations. • Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. • Protect and promote the well-being of other Yukon residents and the interests of the public. • Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic sustainability during and beyond the life of mine. • Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management). • Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks.	• All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer term risks such as for severe climatic and seismic events. • Protect and maintain the land, air, and water in a condition that provides for sustainable use. • Ensure water remains substantially unaltered from pre-mining conditions to the extent practicable with respect to quantity, quality and rate of flow, including seasonal rate of flow. • Protect the health and safety of people and area wildlife using and accessing the site by emulating pre-mining conditions to the extent practicable. • Protect or enhance ecological processes and functions in order to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities, with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions. • Protect and maintain environmental quality (a combination physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Developmen. • Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable. • Ensure the site and specific assets are available for use post-closure. • To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources. • Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land. • Maintain ongoing positive relationships or partnerships between Newmont and Yukon First Nations through closure. • Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation • Recognize, protect and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations. • Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. • Protect and promote the well-being of other Yukon residents and the interests of the public. • Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic sustainability during and beyond the life of mine. • Increase certainty and decrease risk regarding Post-closure conditions and outcomes (through, as examples, contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management). • Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing
Component-specific Closure Objectives	• Minimizing infiltration/contact water (Kona and Double Double)	• Minimizing infiltration/contact water • Opportunities to mitigate pathways for metal uptake in vegetation and wildlife • Measures to ensure arsenic concentrations within the top metre of waste rock storage locations will not exhibit an arsenic concentration greater than 60 mg/kg, on average.	• Minimizing infiltration/contact water • Opportunities to mitigate pathways for metal uptake in vegetation and wildlife	• Supporting target ecosystems and habitats	• Supporting target ecosystems and habitats	• Supporting target ecosystems and habitats

Mine Components	Open Pits	Alpha WRSF	HLF	Water Management Infrastructure	Northern Access Route	Infrastructure
Component details	Latte; Double Double; Supremo; Kona	n/a	Heap leach pad; event and rainwater ponds; associated piping	Alpha and Facility sedimentation ponds; conveyance structures	n/a	Crusher system; plant site; camp complex; bulk explosives storage area
Closure Measures	• Evaluations will be ongoing and the workplans for each major mine component will be advanced as the level of engineering for the closure measures is advanced. • Pits backfilled with waste rock. • Spillway channels constructed to prevent erosion and downstream sedimentation. • Disturbed areas around pit perimeters and spill points revegetated. • Kona and Double Double Pit backfill will be capped with at least one meter of low arsenic material (at or below 60 mg/kg). • The reclamation research program will evaluate metals uptake in various growth media, including bare waste rock with a range of arsenic concentrations. Site-specific reclamation efforts will be advanced based on outcomes of research.	• May receive cover based on operations material balance. • West Diversion maintained during the Post-mining Closure Phase. • Minor re-sloping in closure to construct appropriate water conveyance. • Natural revegetation of WRSF. • Revegetation strategy may be updated based on outcomes of reclamation research program and/or End Land Use Planning. • The Alpha WRSF will be progressively capped with at least one meter of low arsenic material (at or below 60 mg/kg). • The reclamation research program will evaluate metals uptake in various growth media, including bare waste rock with a range of arsenic concentrations. Site-specific reclamation efforts will be advanced based on outcomes of research.	• Heap surface compacted, engineered cover installed on flat areas. Store and release cover system on slopes. • Surface drainage system established during cover construction. • Active water treatment will remain in effect until passive water treatment system (if needed) commissioned, or until water quality objectives met. • HLF and HLF ponds revegetated. • The reclamation research program will evaluate metals uptake in various growth media, including bare waste rock with a range of arsenic concentrations. Site-specific reclamation efforts will be advanced based on outcomes of research.	• The base of sedimentation ponds will be revegetated. Alpha Pond base reshaped to natural streambed. • Strategic breach locations to protect permafrost. • Conveyance structures regraded to pre-mining drainage patterns. • Disturbed areas revegetated. • The reclamation research program will evaluate metals uptake in various growth media, including bare waste rock with a range of arsenic concentrations. Site-specific reclamation efforts will be advanced based on outcomes of research.	• New sections of NAR reclaimed. o Culverts, bridges removed, pre-construction surface drainage patterns established. o Scarifying and re-contouring surfaces. o Disturbed areas revegetated. • The reclamation research program will evaluate metals uptake in various growth media, including bare waste rock with a range of arsenic concentrations. Site-specific reclamation efforts will be advanced based on outcomes of research.	•Equipment and infrastructure removed. •Hazardous waste removed from site. Other waste transported offsite or landfilled on-site if on approved landfill item list. •Concrete pads broken up. Disturbed areas covered and revegetated. • The reclamation research program will evaluate metals uptake in various growth media, including bare waste rock with a range of arsenic concentrations. Site-specific reclamation efforts will be advanced based on outcomes of research.

APPENDIX 4-A

2015 Climate Change Projections for Coffee Creek Region Yukon



Coffee Gold Project

Climate Change Projections for Coffee Creek Region, Yukon

September 2015

Prepared for:

KAMINAK GOLD CORPORATION

Prepared by:

Lorax Environmental Services
2289 Burrard St, Vancouver BC

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Gold Project

Climate Change Projections for Coffee Creek Region, Yukon

September 2015

LORAX ENVIRONMENTAL

Table of Contents

TABLE OF CONTENTS I
1. INTRODUCTION 1-1
2. BACKGROUND TO CLIMATE CHANGE PROJECTIONS 2-1
3. METHODS AND DATA SOURCES 3-1
4. TEMPERATURE PROJECTIONS 4-1
5. PRECIPITATION PROJECTIONS 5-1
6. FREEZE AND THAW DATES AND GROWING-SEASON LENGTH PROJECTIONS 6-1
7. SUMMARY AND CONCLUSIONS 7-1
REFERENCES R-1

APPENDIX A SNAP SCENARIO URLS

LIST OF FIGURES

FIGURE 2-1: ADAPTED FROM MOSS ET AL. (2008), AND HTTPS://EN.WIKIPEDIA.ORG/WIKI/REPRESENTATIVE_CONCENTRATION_PATHWAYS#/MEDIA/FILE:ALL_FORCING_AGENTS_CO2_EQUIVALENT_CONCENTRATION.PNG. THE RED STAR ILLUSTRATES THE APPROXIMATE CONCENTRATION OF ALL GREENHOUSE GASES AT PRESENT, SCALED AS CO2-EQUIVALENT, EQUAL TO ABOUT 480 PPM OF CARBON DIOXIDE IN THE ATMOSPHERE. THE FOUR IPCC REPRESENTATIVE CONCENTRATION PATHWAYS ARE SHOWN TO THE YEAR 2100 BY THE FOUR COLOURED LINES, EACH OF WHICH WAS CALCULATED BASED ON SETS OF SOCIOECONOMIC AND POPULATION GROWTH ASSUMPTIONS..... 2-2

FIGURE 2-2: PROJECTED GLOBAL AVERAGE TEMPERATURE CHANGES TO THE END OF THE TWENTY-FIRST CENTURY RELATIVE TO THE LATE 19TH CENTURY, AS A FUNCTION OF CO_2 EMISSIONS AND TIME. CHANGE IN GLOBAL TEMPERATURE FROM 1870 TO 2010 AS A FUNCTION OF ESTIMATE EMISSIONS IS SHOWN BY THE BLACK LINE. DOTS FOR EACH PATHWAY MARK DECADE ENDPOINTS. IF HUMANITY FOLLOWS THE RCP 8.5 PATHWAY, AVERAGE GLOBAL TEMPERATURE AT THE END OF THIS CENTURY WILL BE ~4.5 ± 1.5 °C HIGHER THAN IN THE 1861-1880 PERIOD. THE FIGURE HAS BEEN MODIFIED FROM FIGURE 10 OF: WWW.IPCC.CH/PDF/PRESENTATIONS/AR5/WG1/PC270913_APPR_SPM_STOCKER.PDF.... 2-3

FIGURE 4-1: TEMPERATURE AVERAGES MODELED USING SNAP (SEE TEXT) ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES (2030-2039 – END OF OPERATIONS/CLOSURE; 2060-2069 – POST-CLOSURE; AND 2090-2099 – END OF PROJECTIONS). THE DASHED RECTANGLE MARKS THE PROJECT SITE. THE YUKON RIVER (LABELLED) RUNS ACROSS THE NORTHEAST CORNER OF EACH PANEL. THE 1961-1990 AVERAGE IS SCALED USING PRISM TECHNOLOGY (SEE TEXT) FROM DATA COLLECTED AT MULTIPLE YUKON WEATHER STATIONS, AND THE CONSTRUCTIONS FOR THREE FUTURE DECADES ARE BASED ON THE SRES A2 SCENARIO (SEE TEXT). SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM, AS ILLUSTRATED BY THE SQUARE GRID CELLS (2 KM PER SIDE). 4-2

FIGURE 4-2: TEMPERATURE AVERAGES FOR SPRING ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP. SEE FIGURE 4-1 CAPTION FOR ADDITIONAL DETAILS. 4-3

FIGURE 4-3: TEMPERATURE AVERAGES FOR SUMMER ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP. SEE FIGURE 4-1 CAPTION FOR ADDITIONAL DETAILS. 4-4

FIGURE 4-4: TEMPERATURE AVERAGES FOR FALL ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP. SEE FIGURE 4-1 CAPTION FOR ADDITIONAL DETAILS. 4-5

FIGURE 4-5: TEMPERATURE AVERAGES FOR WINTER ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP. 4-6

FIGURE 5-1: ANNUAL PRECIPITATION AVERAGES IN MILLIMETERS OF WATER EQUIVALENT MODELED USING SNAP (SEE TEXT) ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP. SEE FIGURE 4-1 CAPTION FOR ADDITIONAL DETAILS. 5-2

FIGURE 5-2: PRECIPITATION AVERAGES FOR SPRING IN MILLIMETERS OF WATER EQUIVALENT ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP..... 5-3

FIGURE 5-3: PRECIPITATION AVERAGES FOR SUMMER IN MILLIMETERS OF WATER EQUIVALENT ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP..... 5-4

FIGURE 5-4: PRECIPITATION AVERAGES FOR FALL IN MILLIMETERS OF WATER EQUIVALENT ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. MODELED USING SNAP. 5-5

FIGURE 5-5: PRECIPITATION AVERAGES FOR WINTER IN MILLIMETRES OF WATER EQUIVALENT ACROSS THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP..... 5-6

FIGURE 6-1: ESTIMATED DAY OF FREEZE FOR THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP. 6-2

FIGURE 6-2: ESTIMATED DAY OF THAW FOR THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE DASHED RECTANGLE MARKS THE PROJECT SITE. SPATIAL RESOLUTION OF THE MODEL OUTPUT IS 2 KM. DATA SHOWN ARE FROM SNAP. 6-3

FIGURE 6-3: ESTIMATED LENGTH OF THE GROWING SEASON FOR THE COFFEE CREEK REGION FOR BOTH THE PAST (1961-1990) AND THREE FUTURE DECADES. THE GROWING SEASON LENGTH IS DEFINED AS THE NUMBER OF DAYS WHERE THE AVERAGE TEMPERATURE EXCEEDS 0°C, AND IS EQUAL TO THE NUMBER OF DAYS BETWEEN THE DAY OF THAW AND THE DAY OF FREEZE, SHOWN RESPECTIVELY IN FIGURES 6-1 AND 6-2. 6-4

1. Introduction

Kaminak Gold Corporation (Kaminak) is in the process of developing and permitting the Coffee Gold Project (Project), a proposed heap leach operation located in west-central Yukon, approximately 180 km south of Dawson City. The Project is located within the traditional territory of the Tr´ondëk Hwëch´in and the asserted traditional territory of the White River First Nation. A portion of Kaminak's claim block is located in Selkirk First Nation's traditional territory. Currently the Project is undergoing a detailed Feasibility Study with project engineering and design progressing with full consideration of environmental conditions within the project area.

Climate, meteorological conditions and attendant hydrological systems at the Coffee Gold Project influence engineering design parameters, in particular the heap leach design, heap leach water balance, site wide water balance and ultimately comprehensive site wide water management systems. Existing climate conditions at the Coffee Gold Project are unlikely to remain static and consideration of potential climate change scenarios are being incorporated into project planning. Kaminak commissioned Lorax Environmental Services Ltd. (Lorax) to conduct a climate change analysis for the Coffee Gold Project. The analysis, the subject of the following report, was prepared by Dr. Thomas Pedersen, Director, Lorax and current Director, Pacific Institute for Climate Solutions, University of Victoria; Dr. Pedersen also serves as Chair, Canadian Climate Forum.

Within a few to several decades global warming is projected to have a profound impact at high latitudes in both hemispheres. Impacts are already being widely felt: in the polar and sub-polar regions of northern Canada, average annual temperatures are rising—dramatically in some areas; regional snow cover is declining; glaciers are retreating; permafrost is thawing, particularly at lower elevations; and the areal coverage and frequency of wildfires are both on the rise. Such phenomena are summarized in the 2014 Yukon State of the Environment Report (http://www.env.gov.yk.ca/publications-maps/documents/SOE_2014_Web.pdf).

Climate-model projections suggest that the character of seasonal climate will also change significantly over the course of this century: winters on the whole will be warmer and wetter in the North while summers will be hotter and drier. Weather extremes, including heat waves and intense rainfall events are projected to become more frequent. There will also be, and already are, associated biological and ecological changes. Biomes are moving north, while optimal habitats for some plant and animal species are moving upward to higher-elevation (thus, cooler) areas. Each of these physical and biological impacts will

have effects across the Coffee Creek region that need to be considered in planning over the longer term.

As discussed in the following sections, if human society continues to follow the greenhouse-gas emissions pathway that is currently in place, within several decades the climate of the North, including the south-central Yukon, will be notably different. By the year 2100, average temperatures at the Coffee Creek Project site can reasonably be expected to be 3°C to 5°C warmer relative to the waning decades of the last century. Average annual precipitation at Coffee Creek may not change so notably. However, summer and winter can be expected to be slightly wetter in the future, with spring and fall seasons projected to see little net change in precipitation abundance.

Overall, warming is anticipated to be particularly pronounced in the summer at Coffee Creek and this will lead to a later freeze-up in fall and an earlier thaw in spring, according to the model results. In tandem, this yields a growing season that is as much as one month longer by the end of the century and implies a significantly lengthened duration for above-zero temperatures and consequent negative implications for permafrost integrity in the region.

2. Background to Climate Change Projections

Global climate models (GCMs) use a physical representation of the ocean-land-atmosphere system under various climate-forcing scenarios to project future mean climatic states. Over the last two decades, the international modeling community has established two sets of potential emissions pathways, the first published in 2000 by the Intergovernmental Panel on Climate Change (IPCC), as a Special Report on Emissions Scenarios (SRES). Four 'scenario families' (A1, A2, B1, B2) were outlined in that report that spanned possible 21st Century (and beyond) emissions pathways resulting from different global population and economic growth trajectories, varying emphases on energy sources (renewables versus fossil fuels) and materials energy intensities, and variable emphasis on local to global solutions (IPCC SRES, 2000). The A2 scenarios encompassed continuously increasing population and regional economic development in a world of independent, self-reliant nations. These defined the most rapid increases in emissions trajectories over the next 100 years.

A more recent set of scenarios, 'Representative Concentration Pathways' (RCPs) was produced for the Fifth Assessment Report of the IPCC released in 2014. RCPs describe four potential emissions trajectories (RCP2.6, RCP4.5, RCP6.0 and RCP8.5, Figure 2-1) that, like SRES pathways, could be possible depending on future international climate mitigation policies and primary socioeconomic influences including economic and population growth, fossil-fuel-derived energy intensity per unit of GDP, and technological advances.

The number associated with each RCP refers to an assumed change in radiative forcing by the year 2100 in Watts/m^2, relative to pre-industrial time. RCP 8.5 (*i.e.,* 8.5 W/m^2 of additional forcing by 2100) represents the "worst-case" scenario, and includes all greenhouse gas contributions, not just that from carbon dioxide. Two key points emerge when all four RCP scenarios are considered. First, regardless of which pathway is chosen, there is little difference in impact on global average surface temperature prior to mid-century, but after that point, the divergence is progressive and striking. By the year 2100, for example, should we follow the RCP 8.5 scenario, global average surface temperature increases relative to pre-industrial time will be on the order of 4-5°C (Figure 2-2). This outcome is very similar to that projected by the SRES A2 scenario. In contrast, temperature change can be held to <2°C by 2100 (Figure 2-2) if global society instead follows the RCP 2.6 pathway (the green curve in Figure 2-1, and the royal blue curve in Figure 2-2). Second, current emissions rates define a trajectory that is actually slightly *worse* than the RCP 8.5

pathway (note the labelled star in Figure 2-1). Given that, and considering the need to be conservative in forecasting potential future climatic changes, we adopt the worst-case scenario here. The SRES A2 pathway is very similar to the more recent RCP 8.5 trajectory, and is used in the future-climate projections that follow.

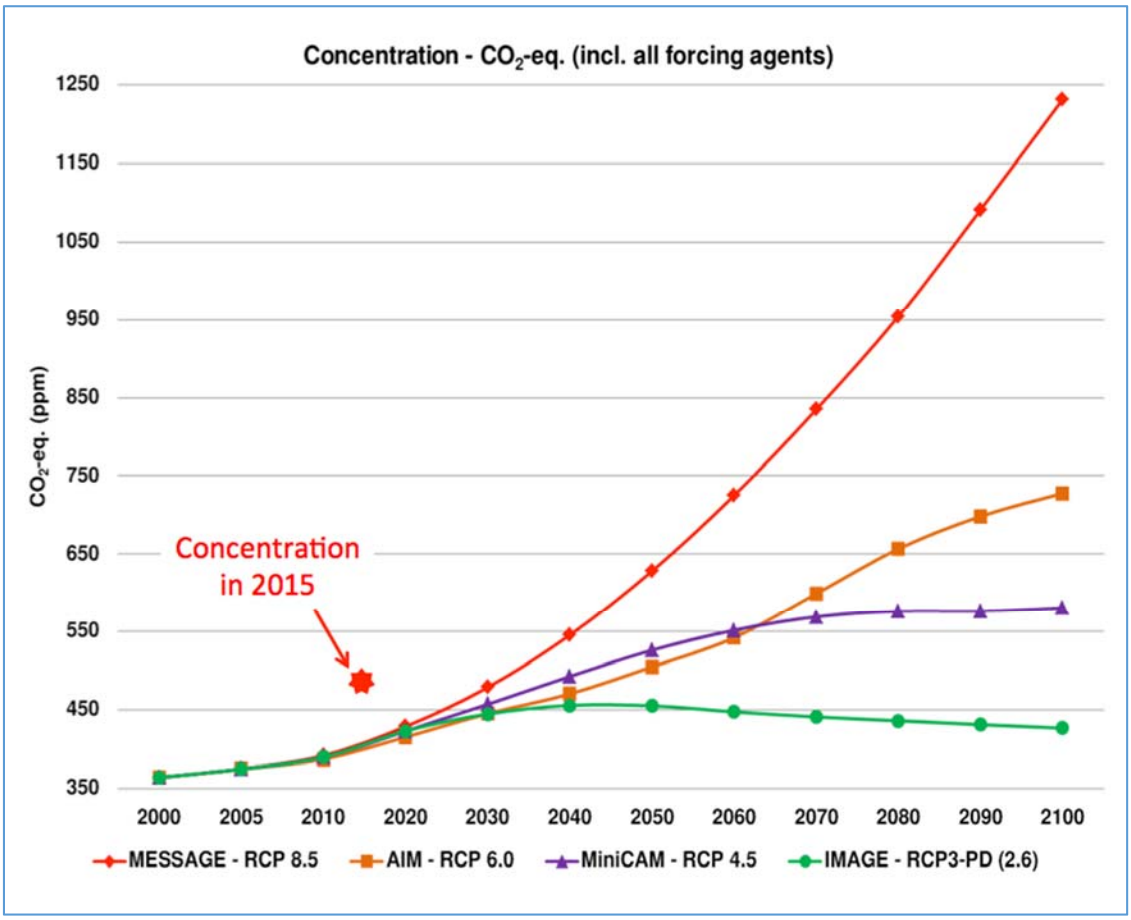


Figure 2-1: **Adapted from Moss et al. (2008), and https://en.wikipedia.org/wiki/Representative_Concentration_Pathways#/media/File:All_forcing_agents_CO2_equivalent_concentration.png. The red star illustrates the approximate concentration of all greenhouse gases at present, scaled as CO2-equivalent, equal to about 480 ppm of carbon dioxide in the atmosphere. The four IPCC Representative Concentration Pathways are shown to the year 2100 by the four coloured lines, each of which was calculated based on sets of socioeconomic and population growth assumptions**

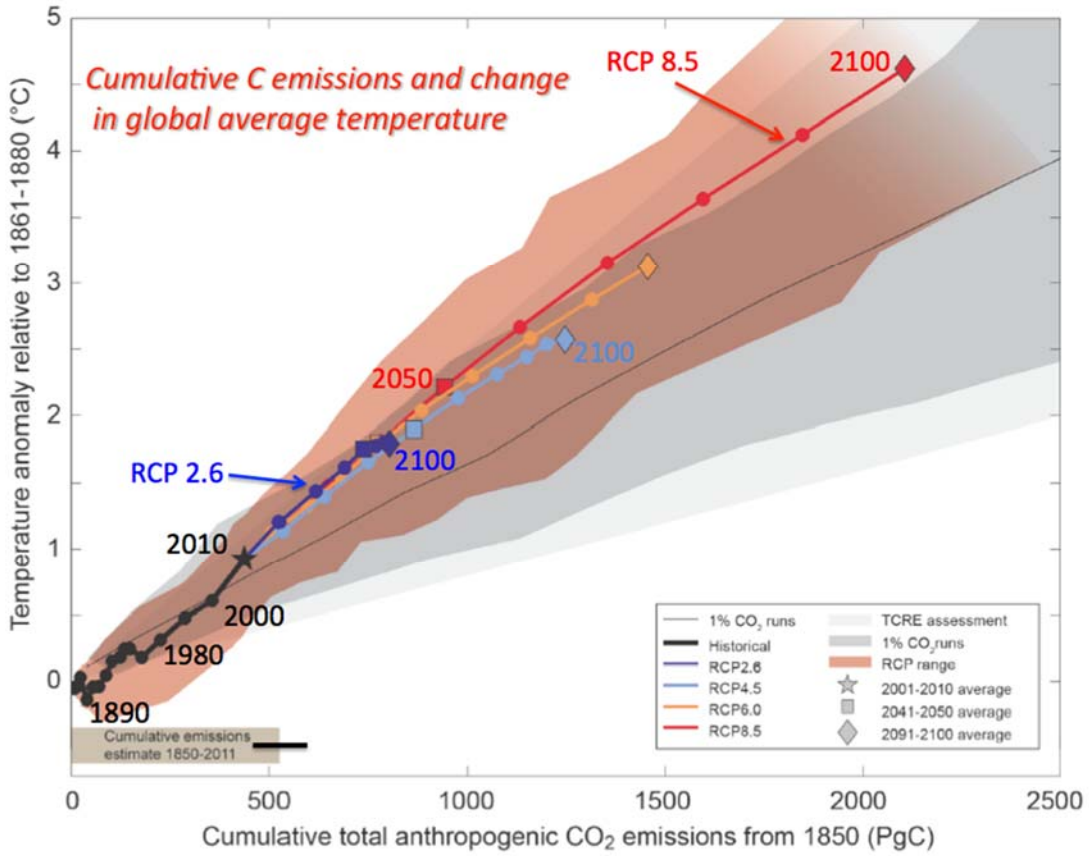


Figure 2-2: Projected global average temperature changes to the end of the Twenty-first Century relative to the late 19th Century, as a function of CO_2 emissions and time. Change in global temperature from 1870 to 2010 as a function of estimate emissions is shown by the black line. Dots for each pathway mark decade endpoints. If humanity follows the RCP 8.5 pathway, average global temperature at the end of this century will be ~4.5 ± 1.5 °C higher than in the 1861-1880 period. The figure has been modified from Figure 10 of: www.ipcc.ch/pdf/presentations/ar5/wg1/pc270913_appr_spm_stocker.pdf.

3. Methods and Data Sources

The two principal climate variables, temperature and precipitation, are discussed here for the region approximately bounded by longitudes 138.6 and 139.8°W and 62.7 and 63.0°N. The Coffee Creek heap leach site sits near the centre of this ~2300 km^2 quadrant. Projected dates of spring thaw and fall freeze are also included in the following discussion.

Modeled historical climate averages and future projections were obtained from the Scenarios Network for Alaska and Arctic Planning (SNAP) at the University of Alaska, Fairbanks, which produces climate information for Alaska and the Yukon region. All parameters specified for the projections that follow (Figure 4-1 through Figure 6-3). The following periods have been selected from the SNAP data to represent key phases of the proposed Coffee Gold Project:

- Historical (1961-1990)
- End of operations/closure (2030-2039)
- Post-closure (2060-2069)
- End of projections (2090-2099)

SNAP uses a statistical downscaling approach to apply baseline climate states projected by general circulation models (GCMs) onto high-resolution topography. The approach used––"the delta method", descriptions of which can be found at https://www.snap.uaf.edu/methods/downscaling and http://www.ccafs-climate.org/statistical_downscaling_delta/ - draws on a suite of five top-ranked climate models of both past and future climate. Outputs discussed here are based on downscaled five-model averages.

Data sources, described at https://www.snap.uaf.edu/methods/data, yield a 2 km spatial resolution for the Yukon region that relies on PRISM (Parameter-Elevation Relationships on Independent Slopes Model) data and technology developed originally by Daly *et al.* (2008) at Oregon State University. PRISM technology is considered by regional climate modelers internationally to be state of the art. As noted above, the projections below are based on the IPCC SRES (2000) A2 scenario, which can be considered to be the 'worst case' future emissions trajectory. It must be emphasized, however, that global emissions today and over the previous decade *exceed* the pathway assigned by the constructed A2 scenario. "Worst case" may, therefore, prove to be an understatement.

4. Temperature Projections

Average annual temperatures are projected to rise significantly in the Coffee Creek region over the course of this century. The current annual average, about -3°C at the Coffee Gold Project site (Lorax, 2015), is forecast to rise by 3 to 5 degrees C by the end of the century, to on the order of +1 ± 1°C (Figure 4-1).

Average seasonal temperatures are projected to increase by a similar amount in spring, fall and winter, but will likely rise more dramatically in summer (compare Figure 4-2, Figure 4-4 and Figure 4-5 with Figure 4-3). Lorax (2015) estimated that June-July-August temperature for the project site at present is +11.3°C. By the end of the century, that 'summer average' temperature is projected to be between 14.9 and 16.5°C using the A2 scenario (Figure 4-3), an increase of some 3 to 5°C relative to average conditions today. Note that this projection is scenario dependent and therefore uncertain. Should greenhouse gas emissions increase at a rate less than that proscribed by SRES A2, end-of-century temperature increases in all seasons across the North would likely be lower. However, current global practices, as described above, do not support grounds for optimism: it is certain to warm at Coffee Creek over the course of this century, with a high probability that the increase will be several degrees across all seasons, with summer showing the largest change.

There is one caveat that applies at the seasonal level: episodic temperature inversions are common in Yukon valleys in winter, particularly January, as noted by Lorax (2015). Anecdotally, these can lower temperatures by as much as 15°C on a valley floor relative to nearby elevations upslope (personal communications, S. Mooney, Yukon Research Centre, Whitehorse, and Prof. David Atkinson, University of Victoria). PRISM-based reconstructions take into account such abrupt climatic shifts with elevation across Alaska and the Yukon by assigning two layers to the atmosphere: the boundary layer and the free atmosphere above it (Simpson *et al.*, 2005). Inversions are determined in the PRISM database by comparing surface station data with the Global Gridded Upper Air Statistics data set, as noted by Simpson *et al* (2005), and are taken into account in the SNAP projections (personal communication, Dr. Faron Anslow, Pacific Climate Impacts Consortium, University of Victoria). Thus, winter average temperatures along the Yukon River projected by SNAP for the Coffee Creek region incorporate the statistical likelihood that inversions will continue to occur episodically.

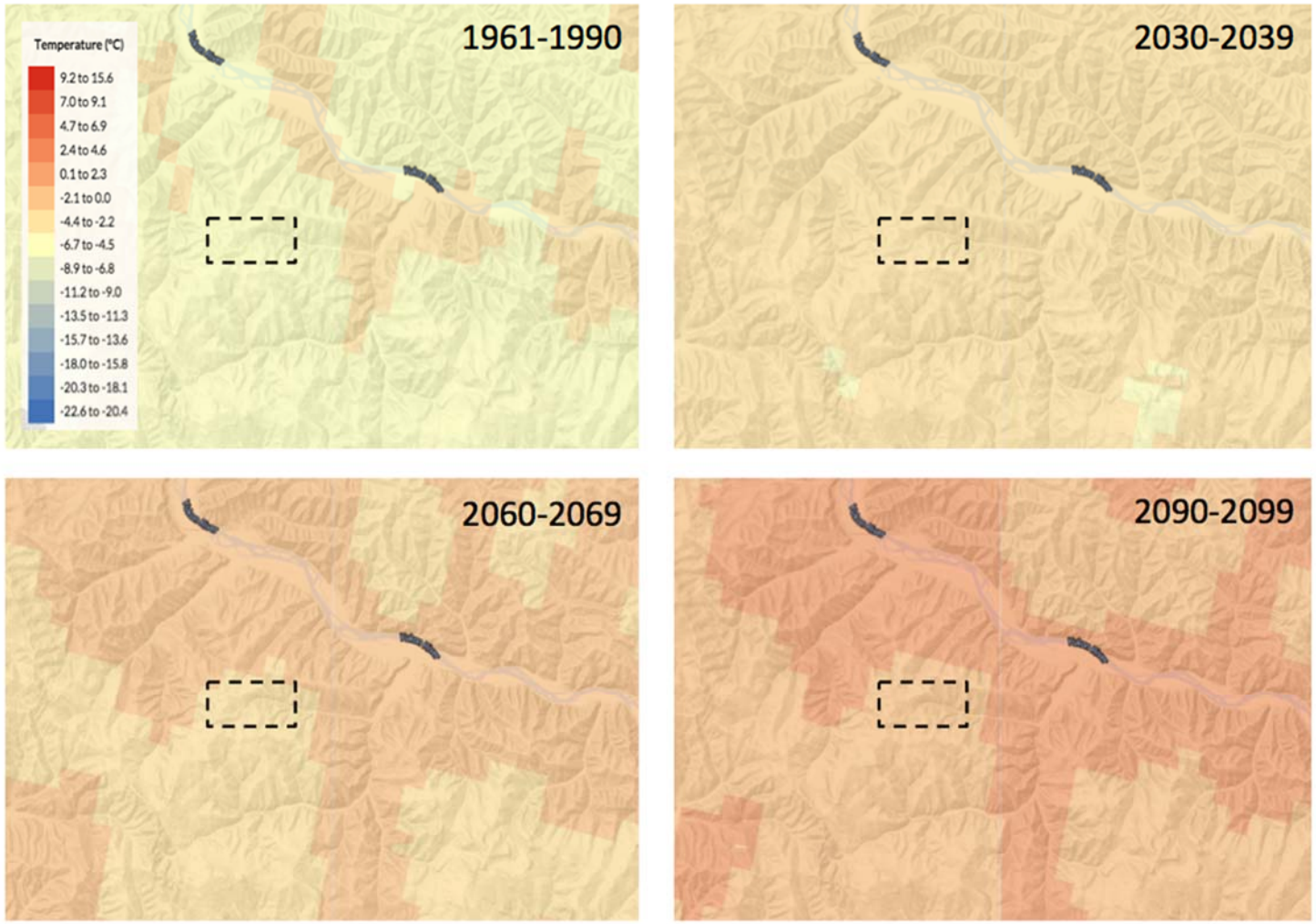


Figure 4-1: Temperature averages modeled using SNAP (see text) across the Coffee Creek region for both the past (1961-1990) and three future decades (2030-2039 – End of operations/Closure; 2060-2069 – Post-closure; and 2090-2099 – End of projections). The dashed rectangle marks the project site. The Yukon River (labelled) runs across the northeast corner of each panel. The 1961-1990 average is scaled using PRISM technology (see text) from data collected at multiple Yukon weather stations, and the constructions for three future decades are based on the SRES A2 scenario (see text). Spatial resolution of the model output is 2 km, as illustrated by the square grid cells (2 km per side).

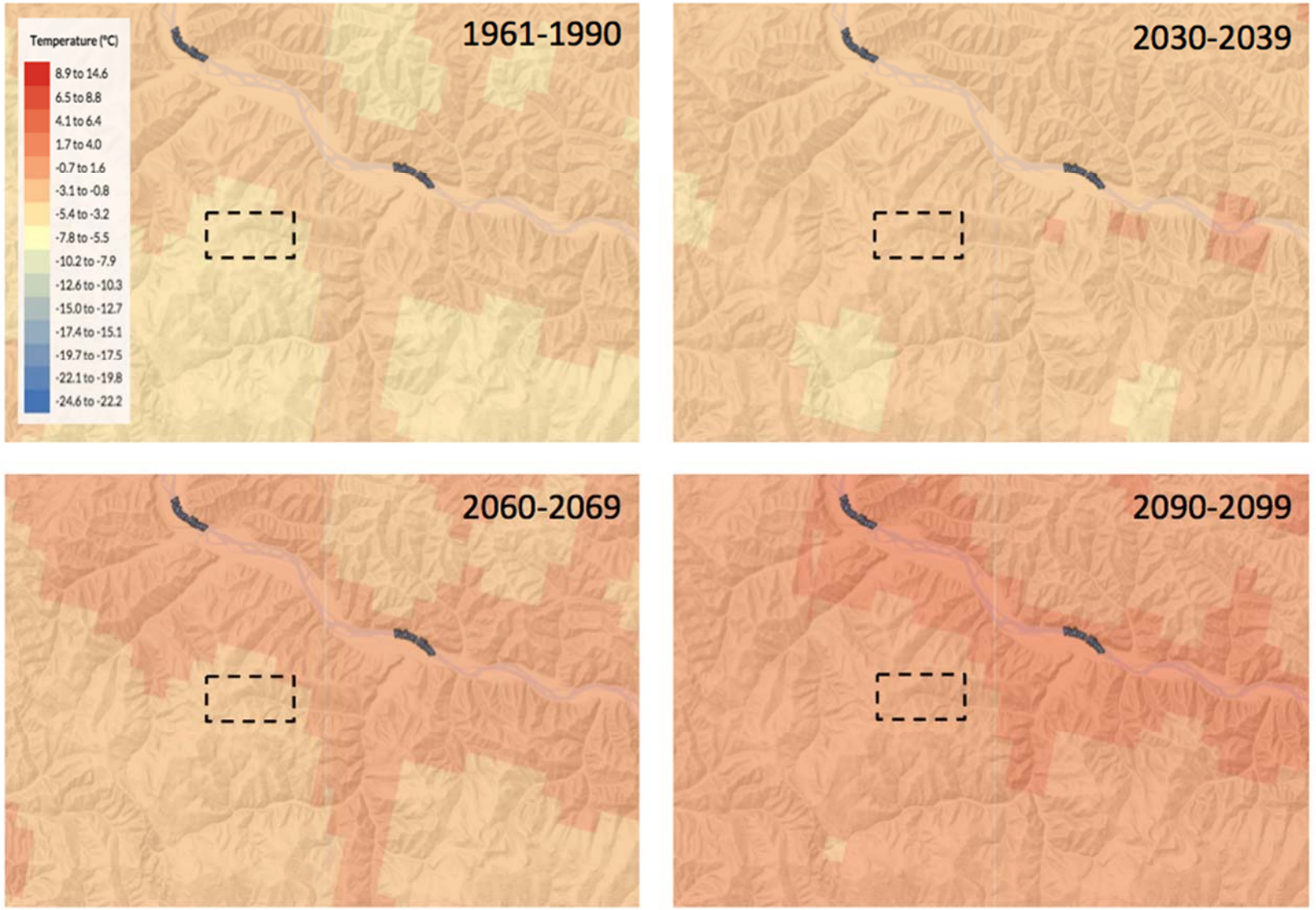


Figure 4-2: Temperature averages for Spring across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP. See Figure 4-1 caption for additional details.

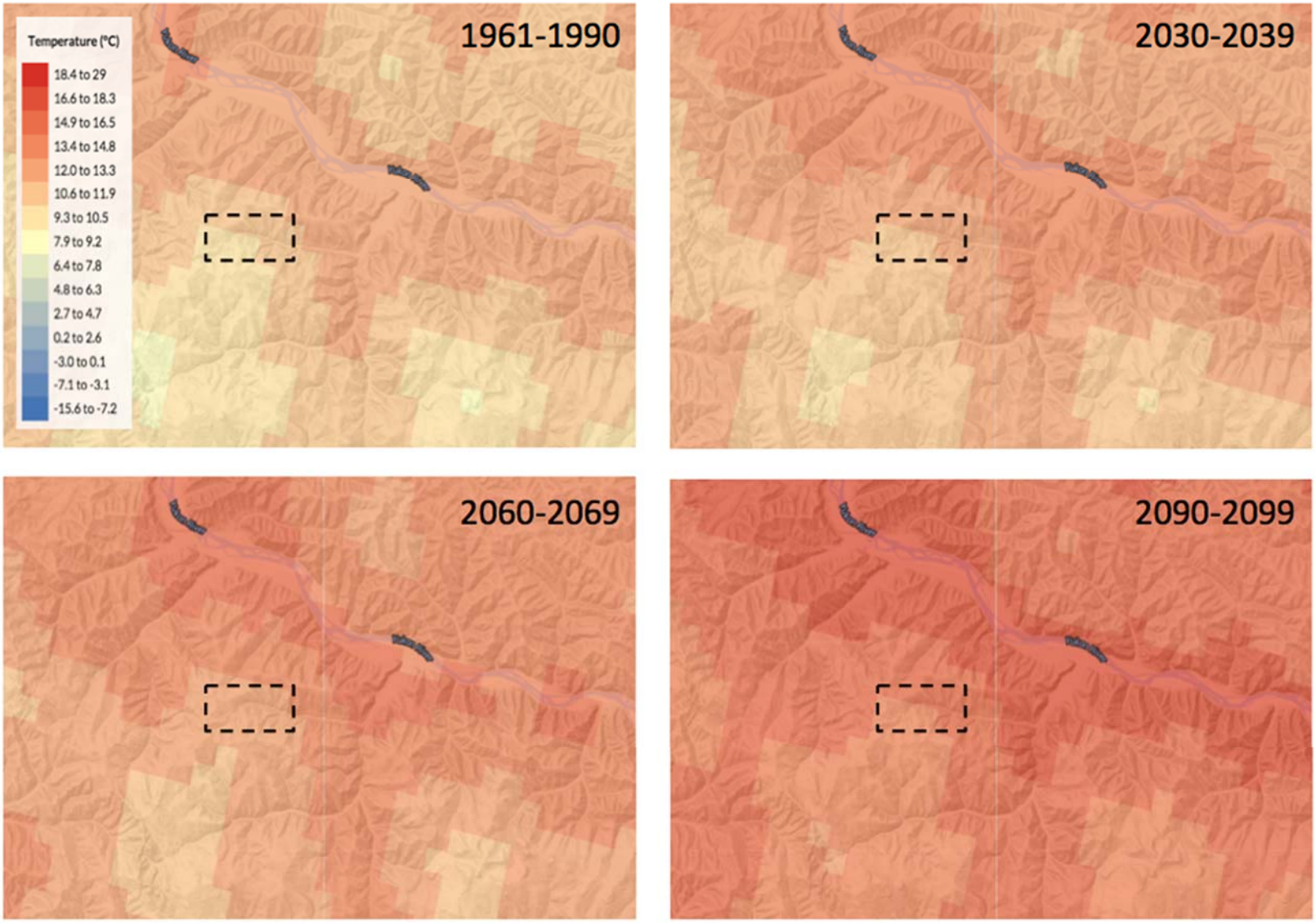


Figure 4-3: Temperature averages for Summer across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP. See Figure 4-1 caption for additional details.

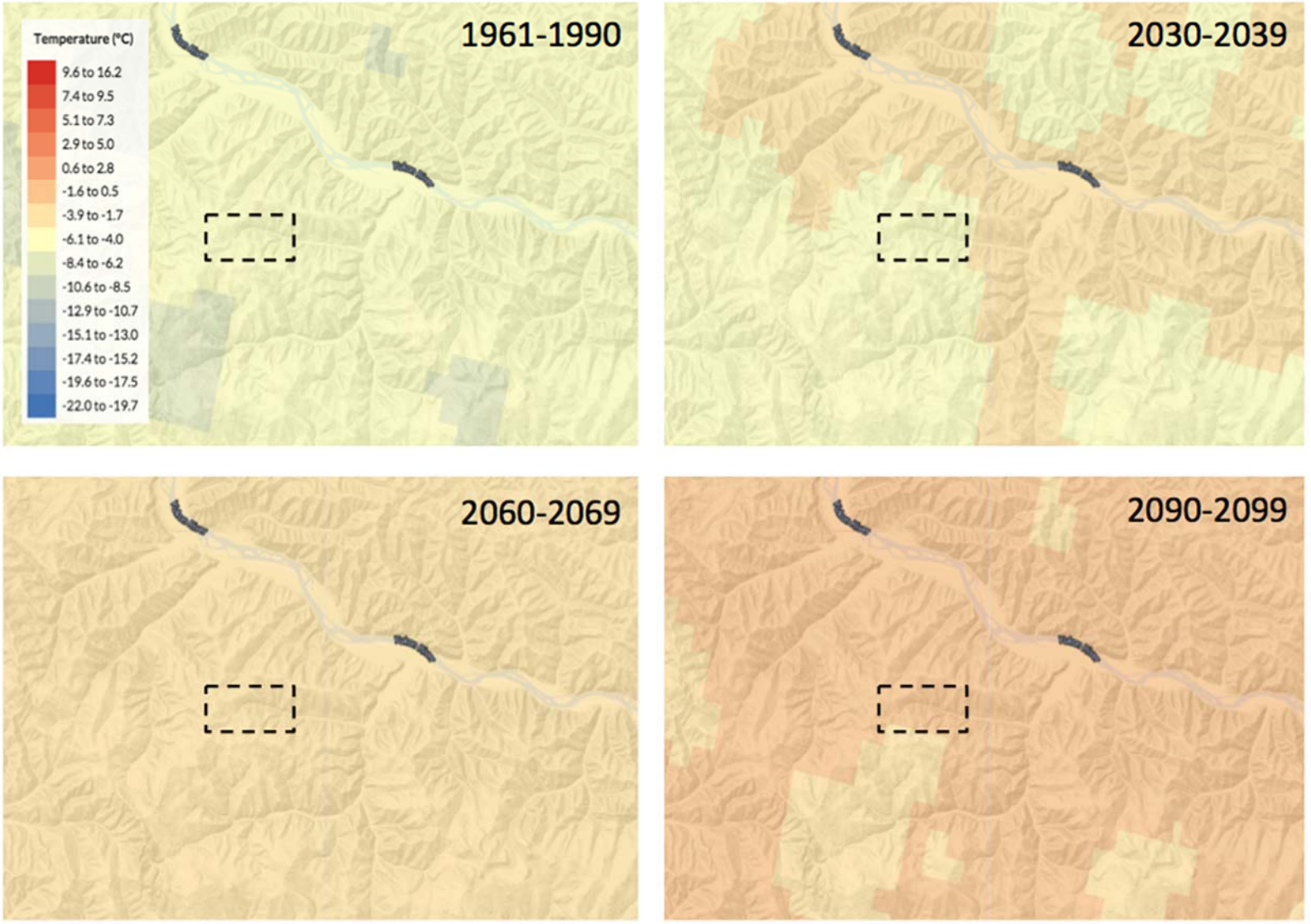


Figure 4-4: Temperature averages for Fall across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP. See Figure 4-1 caption for additional details.

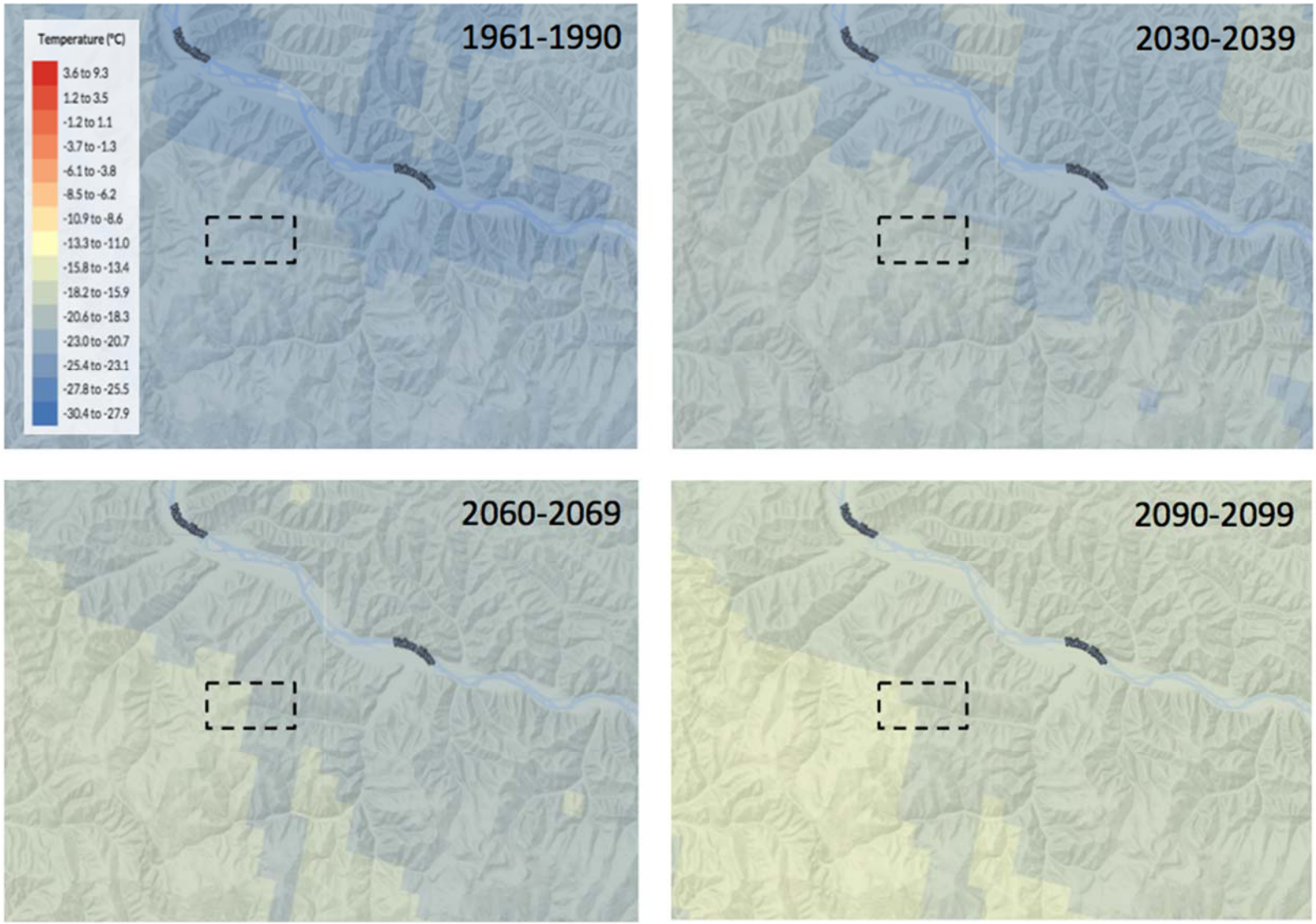


Figure 4-5: Temperature averages for Winter across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

Colder valley-bottom temperatures in winter notwithstanding, implications of the projected temperature increases for permafrost integrity in the region are obvious. The active layer can be expected to grow in thickness in the warmer months of coming decades, while the depth to intersection with permanently frozen ground will slowly increase. But how fast such changes will be witnessed remains a question largely dependent on the rate of change in radiative forcing with time.

5. Precipitation Projections

As for mean temperature, net precipitation in the Coffee Creek region overall is projected to increase over the course of this century (Figure 5-1). Lorax (2015) computed an average precipitation rate of 485 mm yr^{-1} for the project site at present, slightly higher than the 428-476 mm yr^{-1} modeled at the valley floor as the average over the 1961-1990 interval (Figure 5-1). At that same valley-floor elevation, average annual precipitation by the end of this century is projected to increase marginally to 477-525 mm yr^{-1}, while across much of the broader region, an increase of some 20% to some 574-670 mm yr^{-1} can be anticipated by the year 2100 (compare the lower right and upper left panels of Figure 5-1), given the emissions pathway specified by the SRES A2 scenario.

At present, the bulk of annual precipitation at Coffee Creek falls between May and September, with March and April, being particularly dry months (Lorax, 2015, Table 3-1). This contrasting pattern is projected to persist over the course of the century, albeit with Summer and Winter receiving greater precipitation than historically at the project site (compare Figure 5-2 through Figure 5-5; note that legend scales differ for each season), and little change being witnessed in Spring or Fall.

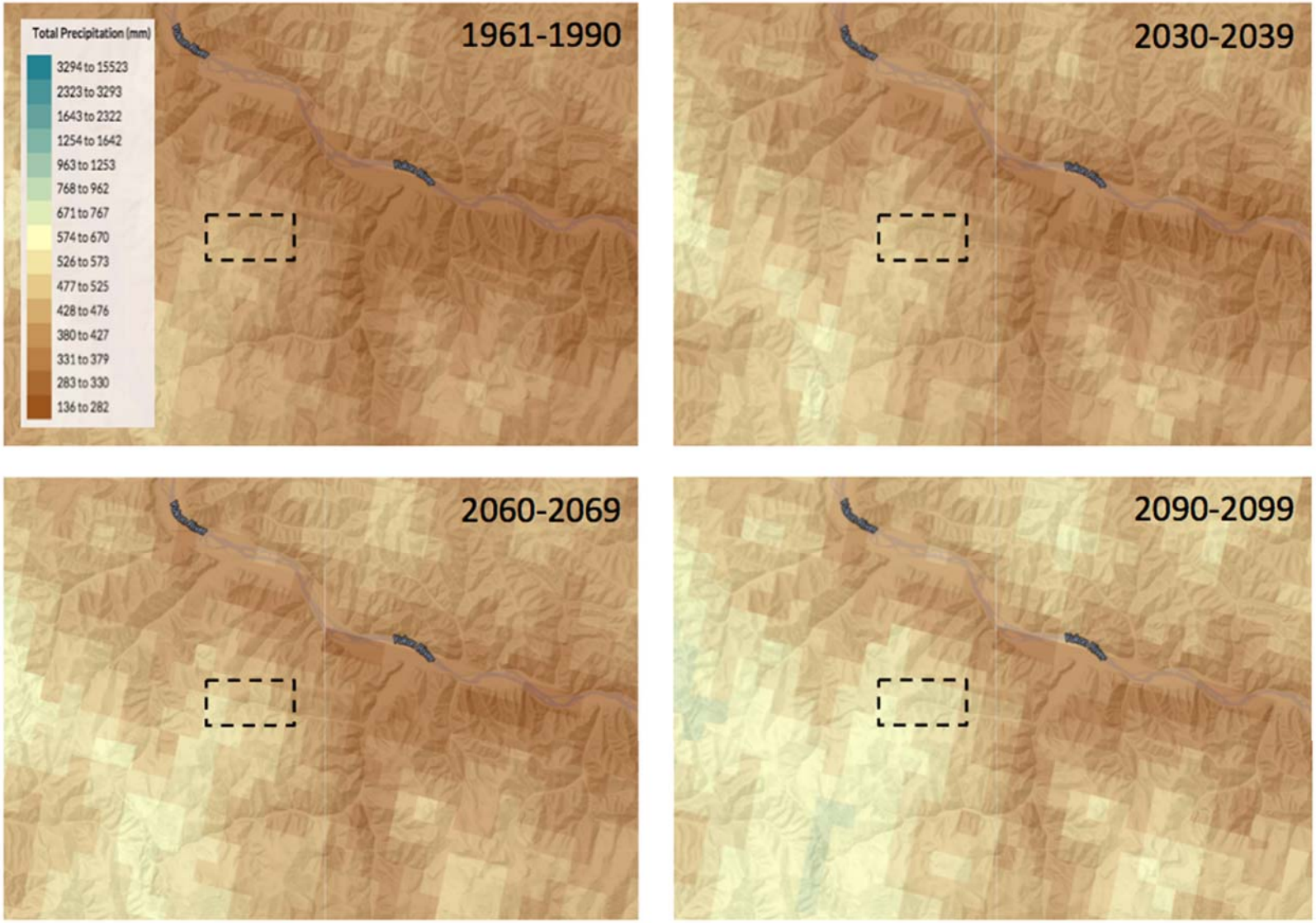


Figure 5-1: Annual precipitation averages in millimeters of water equivalent modeled using SNAP (see text) across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP. See Figure 4-1 caption for additional details.

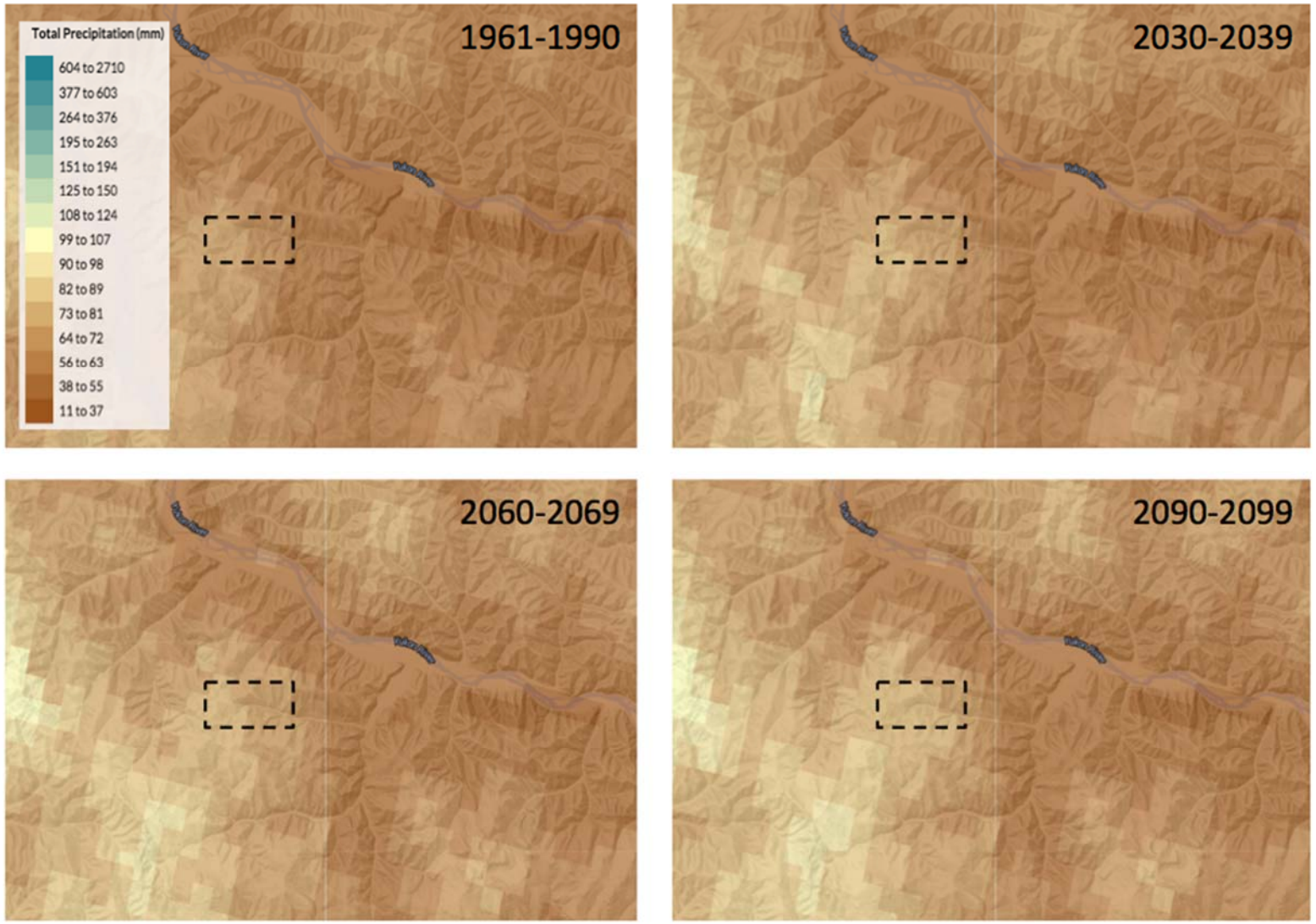


Figure 5-2: Precipitation averages for Spring in millimeters of water equivalent across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

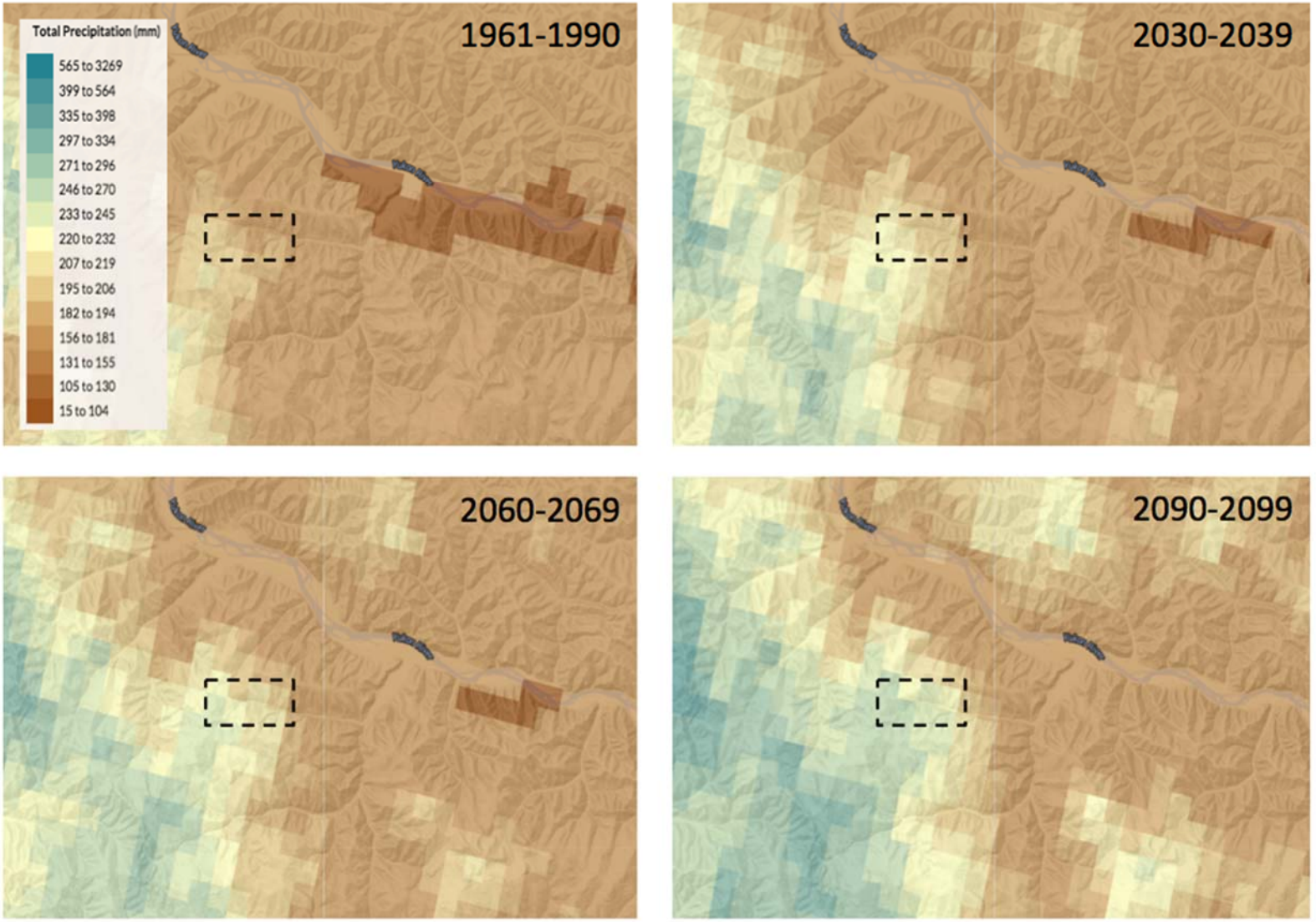


Figure 5-3: Precipitation averages for Summer in millimeters of water equivalent across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

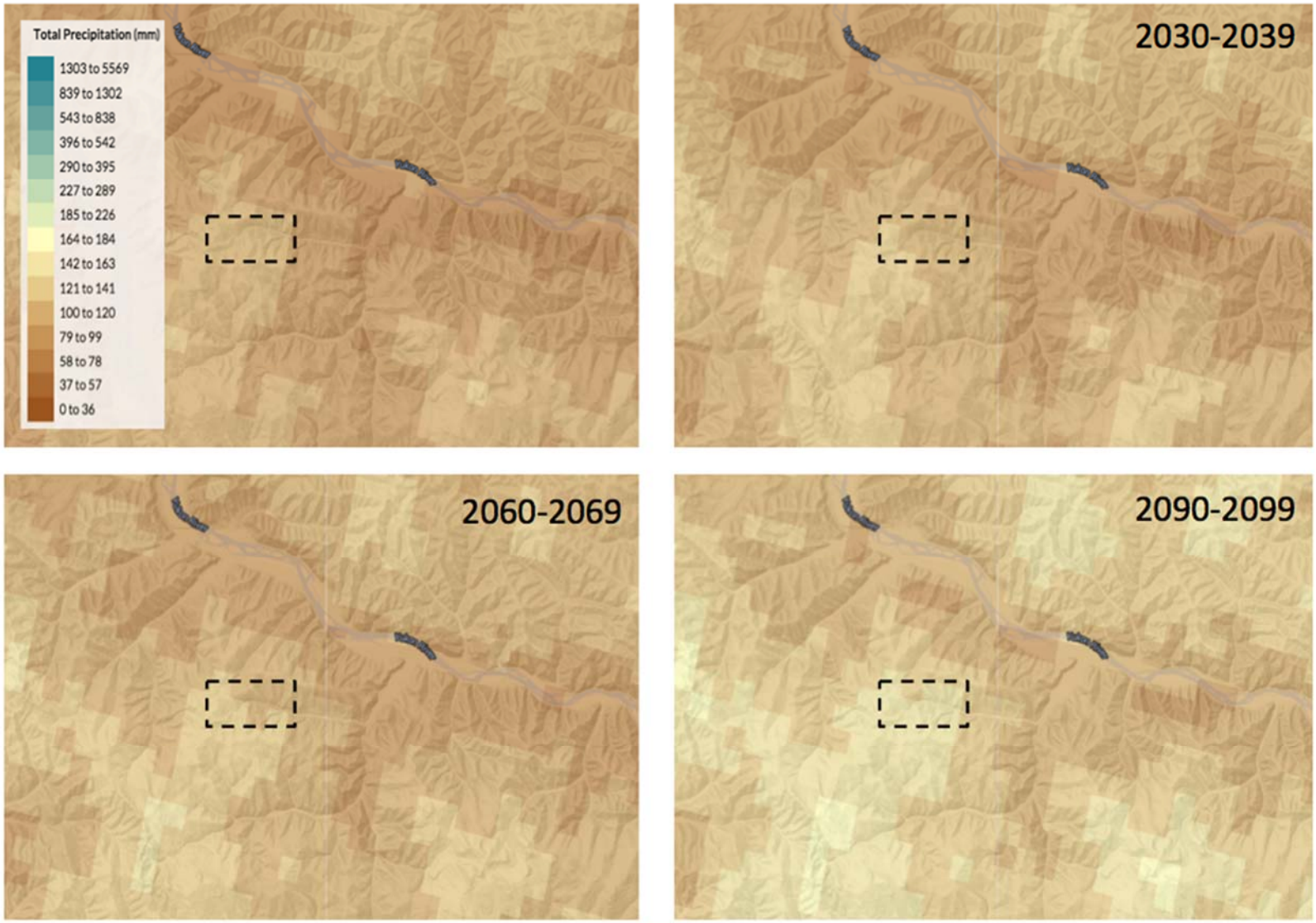


Figure 5-4: Precipitation averages for Fall in millimeters of water equivalent across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Modeled using SNAP.

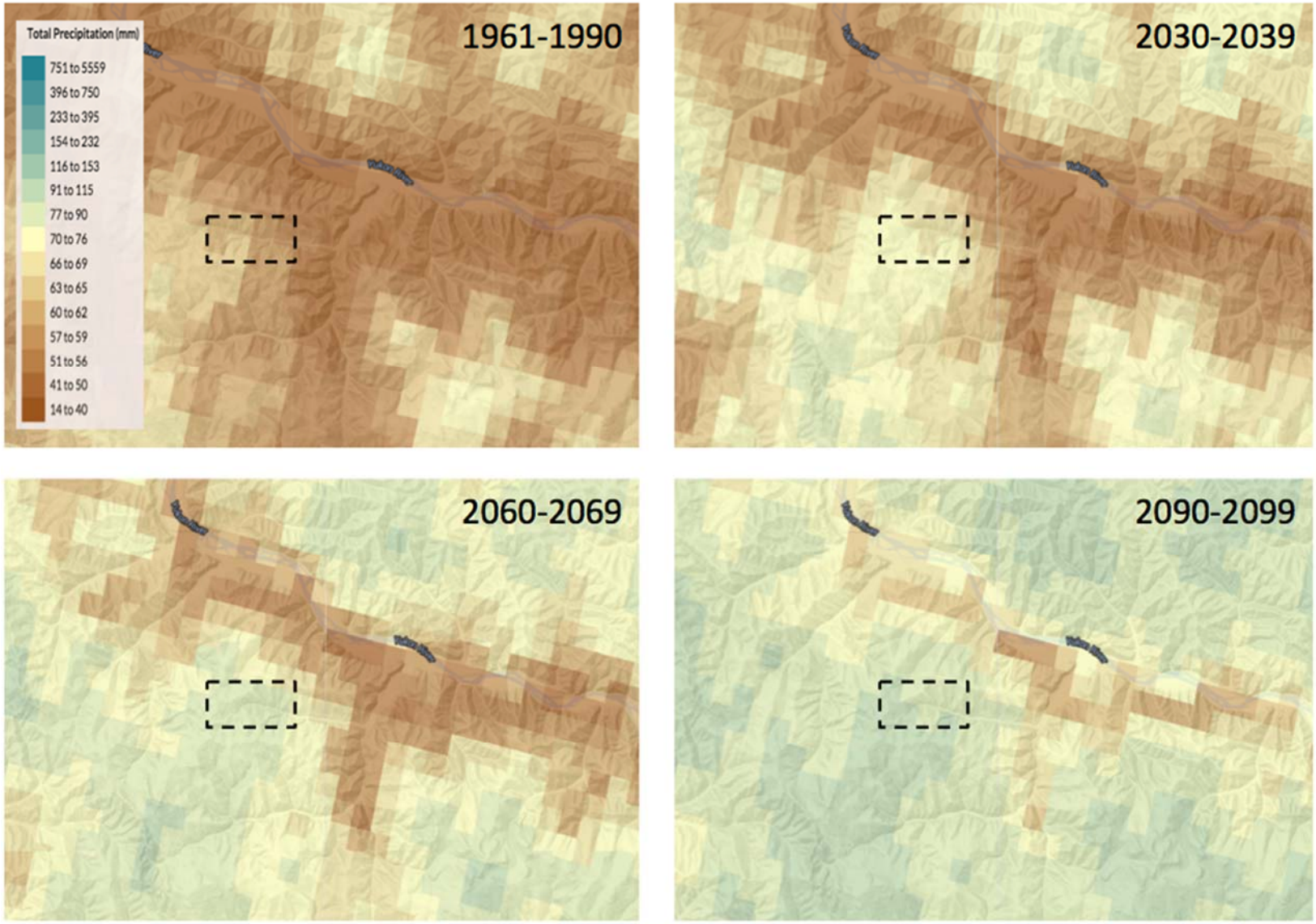


Figure 5-5: Precipitation averages for Winter in millimetres of water equivalent across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

6. Freeze and Thaw Dates and Growing-Season Length Projections

SNAP defines the Day of Freeze (Day of Thaw) as "the day when consecutive monthly mid-point temperatures transition from positive to negative (negative to positive)." As average annual and seasonal temperatures rise as the century progresses, the projections under SRES A2 indicate that the historical Day of Freeze at the elevation of the Yukon River will shift from about the first to the third week of October by the 2030s (Figure 6-1). Similarly, as mean conditions warm, by the year 2100 the Day of Thaw is projected to shift about a fortnight earlier to near the beginning of April (Figure 6-2). These changes—later freeze-up and earlier thaw—increase the length of the growing season (*i.e.*, the number of days between the Day of Thaw and Day of Freeze) in the Coffee Creek region by nearly a month by the end of this century (Figure 6-3).

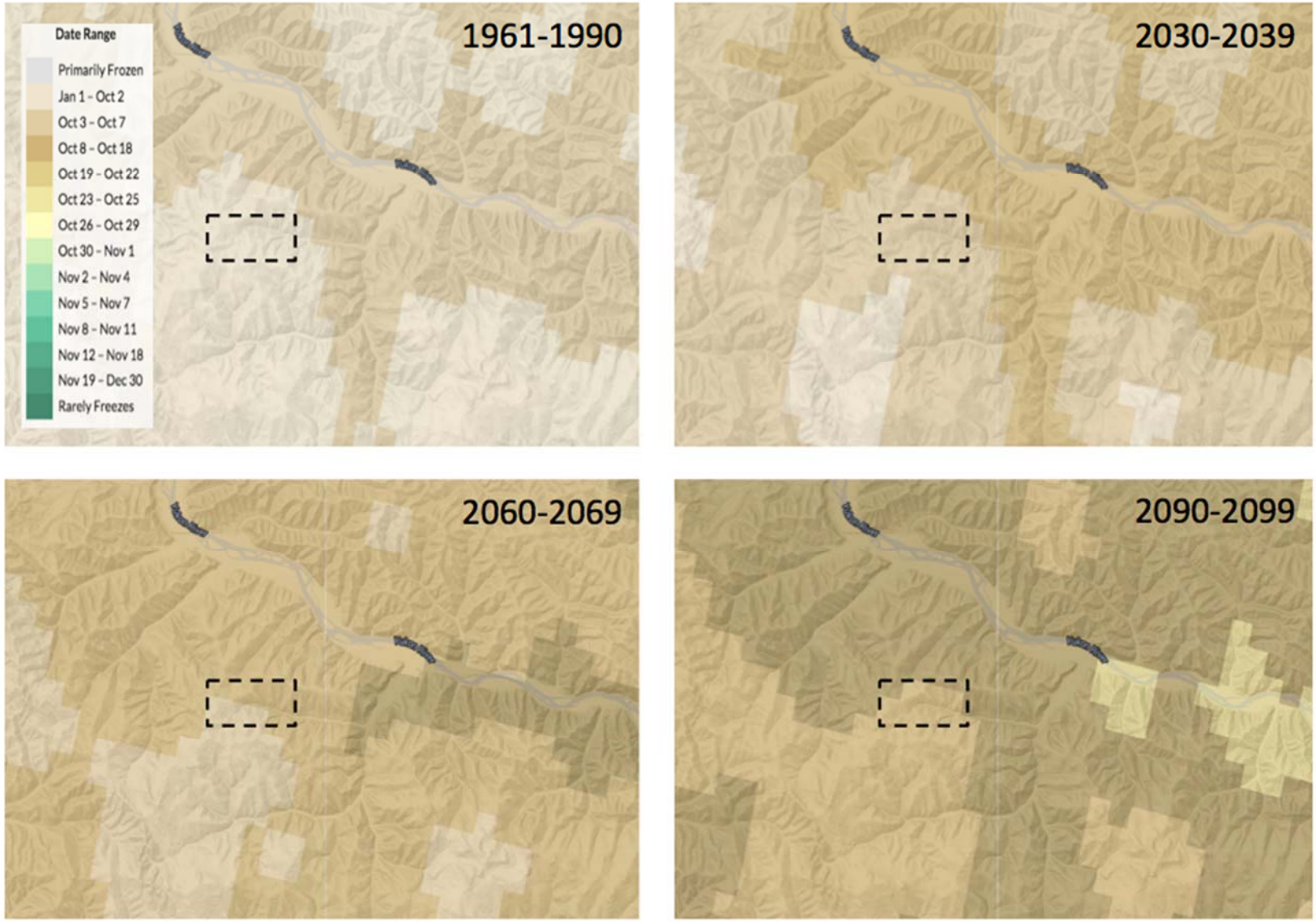


Figure 6-1: Estimated Day of Freeze for the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

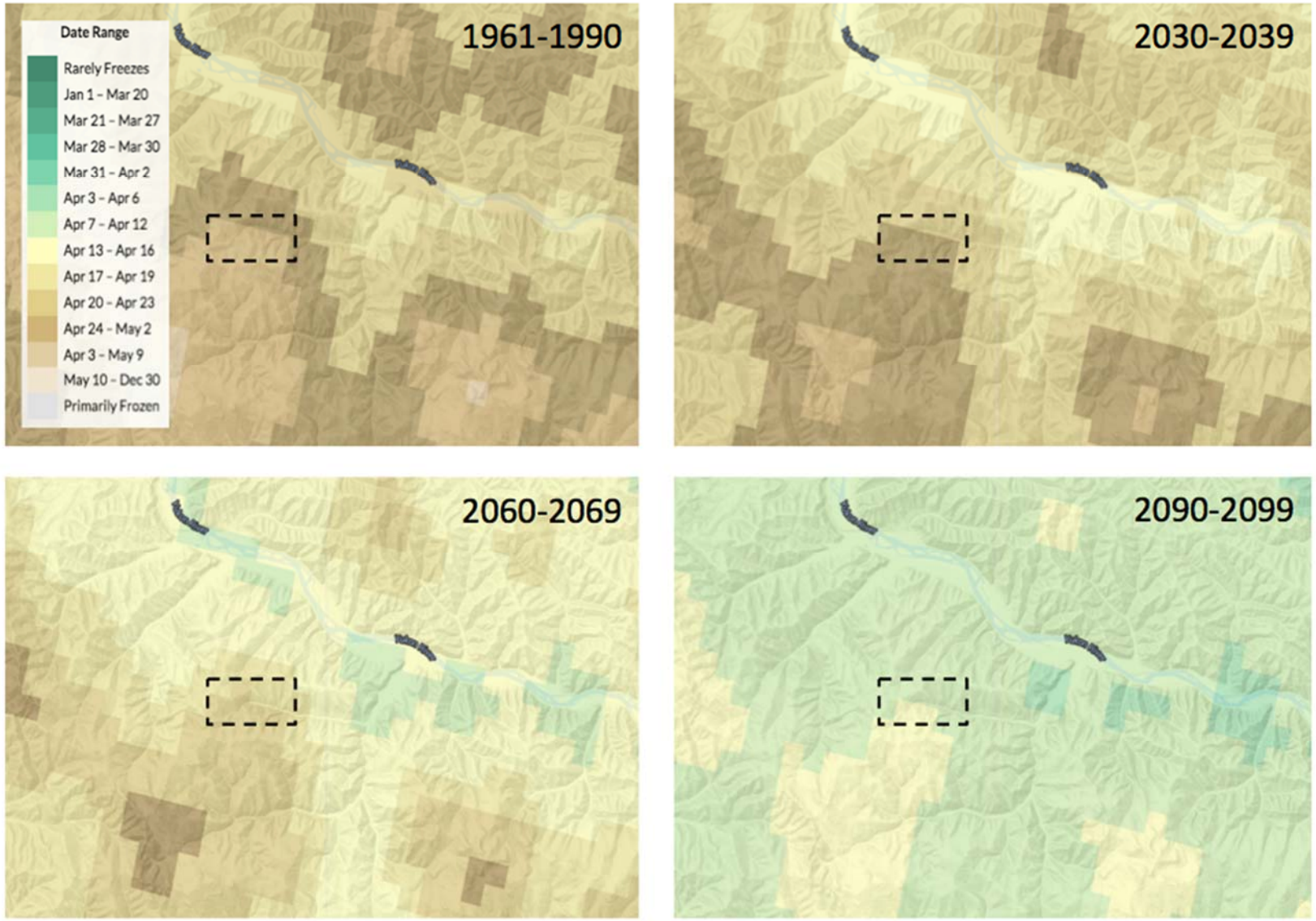


Figure 6-2: Estimated Day of Thaw for the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

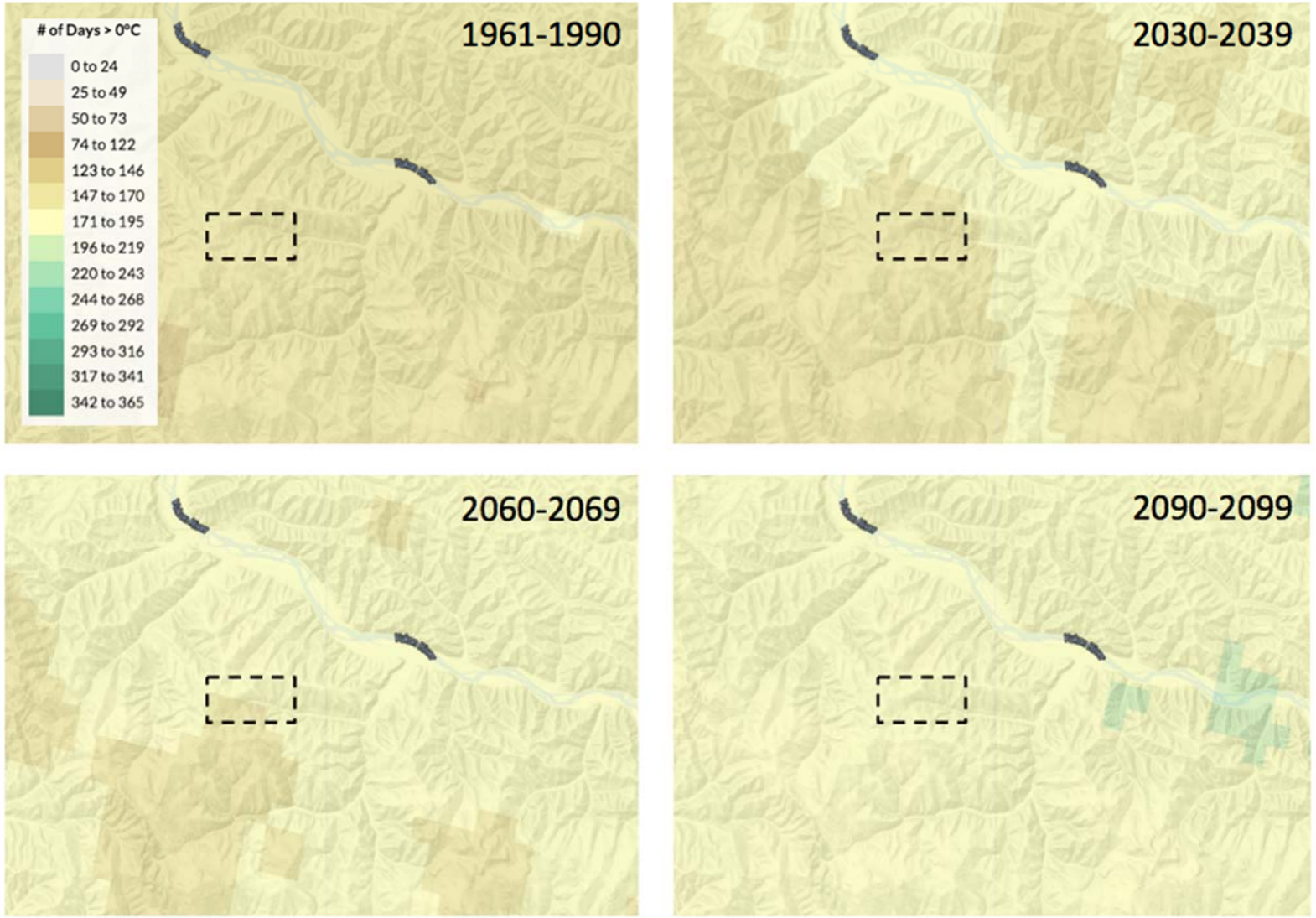


Figure 6-3: Estimated length of the growing season for the Coffee Creek region for both the past (1961-1990) and three future decades. The growing season length is defined as the number of days where the average temperature exceeds 0°C, and is equal to the number of days between the Day of Thaw and the Day of Freeze, shown respectively in Figures 6-1 and 6-2.

7. Summary and Conclusions

The pace at which climate is changing in the high latitudes of the Northern Hemisphere North is already amongst the highest in the world. There is every reason to believe that this trend will continue. Without exception, the best global climate models project ongoing warming and a progressively wetter climate at these latitudes. Seasonality will also be enhanced with, on average, drier summers and wetter conditions in the colder half of the year.

By the year 2100, average temperatures at the Coffee Creek Project site can reasonably be expected to be 3 to 5°C warmer relative to the waning decades of the last century. The warming is anticipated to be particularly pronounced in the summer. In contrast, average annual precipitation at Coffee Creek may not change dramatically. Summer and Winter can be expected to be slightly wetter, but the Spring and Fall seasons are projected to see little net change in precipitation abundance.

The warming will lead to a later freeze-up in fall and an earlier thaw in spring, according to the model results. In tandem, this will yield a growing season that is as much as one month longer by the end of the century. This implies a significantly lengthened duration for above-zero temperatures, with consequent negative implications for permafrost integrity in the region.

References

Daly, C., M. Halbleib *et al.* (2008) Physiographically sensitive mapping of climatological temperature and precipitation across the conterminous United States. Int. J. Climatol. (2008) Published online in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/joc.1688.

IPCC SRES (2000), Nakićenović, N., and Swart, R., ed., Special Report on Emissions Scenarios: A special report of Working Group III of the Intergovernmental Panel on Climate Change, Cambridge University Press, ISBN 0-521-80081-1, 978-052180081-5 (pb: 0-521-80493-0, 978-052180493-6).

Lorax (2015). Synthetic Daily Climate Records for the Coffee Gold Project. Lorax memo to Kaminak Gold Corp., April 2, 2015.

Moss, R., M. Babiker *et al.* (2008). Towards New Scenarios for Analysis of Emissions, Climate Change, Impacts, and Response Strategies. Intergovernmental Panel on Climate Change, Geneva, 132 pp.

Simpson, J.J., G. L. Hufford *et al.* (2005). Comparing Maps of Mean Monthly Surface Temperature and Precipitation for Alaska and Adjacent Areas of Canada Produced by Two Different Methods, Arctic 58, 137– 161.

Appendix A: SNAP Scenario URLs

All climate projections and historical climate maps used in this document were obtained from:

Scenarios Network for Alaska and Arctic Planning (SNAP), University of Alaska. [2015]. Retrieved on August 21, 25, 25 and September 2, 3, and 8, 2015.

Average Temperature, Historical, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedTemperature&zoom=10

Average Temperature, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=temperature&zoom=10

Average Temperature, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=temperature&zoom=10

Average Temperature, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=temperature&zoom=10

Average Precipitation, Historical Annual, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Annual, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Annual, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Annual, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Historical Spring, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=spring&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Spring, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=spring&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Spring, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=spring&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Spring, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=spring&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Historical Summer, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=summer&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Summer, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=summer&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Summer, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=summer&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Summer, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=summer&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Historical Fall, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=fall&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Fall, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=fall&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Fall, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=fall&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Fall, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=fall&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Historical Winter, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=winter&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Winter, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=winter&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Winter, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=winter&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Winter, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=winter&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Day of Freeze, Historical, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedDayOfFreeze&zoom=10

Day of Freeze, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=dayOfFreeze&zoom=10

Day of Freeze, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=dayOfFreeze&zoom=10

Day of Freeze, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=dayOfFreeze&zoom=10

Day of Thaw, Historical, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedDayOfThaw&zoom=10

Day of Thaw, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=dayOfThaw&zoom=10

Day of Thaw, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=dayOfThaw&zoom=10

Day of Thaw, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=dayOfThaw&zoom=10

Length of Growing Season, Historical:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedLengthOfGrowingSeason&zoom=10

Length of Growing Season, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=lengthOfGrowingSeason&zoom=10

Length of Growing Season, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=lengthOfGrowingSeason&zoom=10

Length of Growing Season, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=lengthOfGrowingSeason&zoom=10

APPENDIX 4-B

Ground Temperature Monitoring Update, Coffee Mine Project, YT

TETRA TECH

TECHNICAL MEMO

ISSUED FOR USE

To:	Christian Roldan, Study Manager, Newmont Canada	**Date:**	March 21, 2025
c:	Nigel Goldup, P.Eng.; Fai Ndofor, P.Geo.	**Memo No.:**	001
From:	Vladislav E. Roujanski, P.Geol. Ernest Palczewski, P.Geo.	**File:**	ENG.EARC03259-01
Subject:	Ground Temperature Monitoring Update, Coffee Mine Project, YT, Revision 1		

1.0 INTRODUCTION

As per communication via e-mail between Tetra Tech Canada Inc. (Tetra Tech) and Newmont Canada (Newmont) on November 29, 2022, Tetra Tech reviewed recent ground temperature data from the Coffee Mine Project Area (Project Area, Figure 1) and updated ground temperature monitoring profiles, covering the period from 2016 to November 2022.

The original map of spatial distribution of permafrost with variable ground ice content within the Project Area initially compiled by Tetra Tech in 2016 (Tetra Tech EBA 2016) and last time updated in 2019 (Tetra Tech Canada 2019b) was also updated to include the latest ground temperature data received from Newmont on November 10, 2022.

The objective of this memo is to present up to date ground temperature monitoring profiles, summarize ground temperature trends, and provide data review findings.

2.0 METHODOLOGY

As permafrost is defined based on temperature, the key method of its monitoring is a regular collection of ground temperatures. It is especially important for the zone of discontinuous permafrost (<90% of land area underlain by permafrost), such as the Project Area with 61% of it underlain by permafrost. The collected ground temperature data allows for delineating perennially frozen and permafrost-free areas. Although various techniques and equipment are available for collecting ground temperature data, thermistors are the most widely used, reliable, and accurate sensors.

Tetra Tech reviewed and interpreted ground temperature data collected from the continued monitoring of the Project Area ground thermal regime with multi-bead GTCs installed by Tetra Tech (Tetra Tech EBA 2016; Tetra Tech 2017a; Tetra Tech 2017b; and Tetra Tech 2019a), Lorax Environmental Services Ltd. (Lorax 2016), and SRK (SRK 2016). The instrumentation borehole locations are shown on Figure 2.

Tetra Tech Canada Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

3.0 SUMMARY AND TRENDS OF 2022 DATA REVIEW

A key component for monitoring permafrost is having adequate instrumentation installed to establish baseline ground temperatures and for future monitoring use. To date, 20 multi-bead GTCs and numerous SBTSs were installed in completed boreholes within the Project Area. Figure 2 shows the existing GTC monitoring network in the Project Area. It is important that these GTCs are continually read to monitor changes in the ground thermal regime.

The latest GTC readings were taken in mid-September 2022, providing an opportunity to determine changes in the permafrost temperatures and thickness of the permafrost interval across the Project Area.

Table 3-1 presents a summary of permafrost conditions in the Project Area, including the latest data review findings, such as permafrost temperatures, permafrost thickness, as well as provides comments on recently observed ground temperature trends.

Table 3-1: Summary of Ground Temperature Cable (GTC) Monitoring and Permafrost Conditions

Year GTC Installed	Proposed Site Infrastructure (at the time of installation)	Borehole No.	Number of Beads	Depth of 1st Bead (m)	Depth of Bottom Bead (m)	Cable Serial Number	Installation Date	Installed By	UTM ZONE 7		Elevation (m)	2019 Ground Temperatures (°C)	2022 Ground Temperatures (°C)	Comments
									Northing (m)	Easting (m)				
2016	North Waste Rock Storage Facility	GT-14	16	0.25	19.75	TS4135	30-Aug-16	Tetra Tech	6,975,088	585,456	1,082.20	-1.1	-1.0	Approximately 0.1°C increase in permafrost temperature (PT) since 2019. 2019-09 is the warmest ground temperature trend recorded to date.
	Heap Leach Facility	GT-63	16	-0.22(1)	18.78	TS4134	24-Sep-16	Tetra Tech	6,973,171	581,284	1,028.67	-1.4	-1.3	Approximately 0.1°C increase in PT since 2019. Warming ground temperature trend.
2017	Alpha Pond WRSF	GT17-26T	16	8.5	20.35	TS4544	8-Aug-17	Tetra Tech	6,974,350	581,984	844	0	0	No change in ground temperature since 2019. Generally, follows historical ground temperature trend.
		GT17-28T	16	0.5	20	TS4339	6-Aug-17	Tetra Tech	6,973,675	581,994	972	-1.7	-1.5	Approximately 0.2°C increase in PT since 2019. Generally, warmer ground temperature trend to 13 m depth, but colder temperatures at Beads #14 and #15 (possible failure of these beads?)
	Alpha Pond	GT17-34T	16	0.5	20	TS4538	6-Aug-17	Tetra Tech	6,975,589	582837,	801	-0.6	-0.6	Slight cooling ground temperature trend.
		GT17-36T	16	0.5	20	TS4542	6-Aug-17	Tetra Tech	6,975,480	582,974	817	-2.1	-2.1	Generally, follows historical ground temperature trend with slight cooling.
		GT17-37T	16	0.5	20	TS4540	6-Aug-17	Tetra Tech	6,975,610	582,995	776	-0.2	-0.2	Generally, no change in PT since 2019
	Alpha Underdrain	GT17-39T	16	0.1	19.6	TS4541	6-Aug-17	Tetra Tech	6,974,617	582,310	849	0	1.7	Significant warming ground temperature trend (~1.7°C increase since 2019), especially at 12 m to 13 m depth.
	Heap Leach Facility	GT17-10T	16	0.75	20.25	TS4543	10-Aug-17	Tetra Tech	6,972,475	580,528	1,264	-0.5	-0.4	Approximately 0.1°C increase in PT since 2019.
	Kona Pit	GT17-01T (MW17-01T)	13	0.5	181	TS4545	10-Aug-17	Lorax	6,973,195	579,736	1,245.80	-0.5	N/A	No new data collected since 2018-09-15.

Table 3-1: Summary of Ground Temperature Cable (GTC) Monitoring and Permafrost Conditions

Year GTC Installed	Proposed Site Infrastructure (at the time of installation)	Borehole No.	Number of Beads	Depth of 1st Bead (m)	Depth of Bottom Bead (m)	Cable Serial Number	Installation Date	Installed By	UTM ZONE 7		Elevation (m)	2019 Ground Temperatures (°C)	2022 Ground Temperatures (°C)	Comments
									Northing (m)	Easting (m)				
2018	Halfway Diversion	TT18-01	1	8.5	8.5	SBTS #16	24-Apr-18	Tetra Tech	6,975,902	582,886	849	Undetermined	Undetermined	SBTS not monitored.
		TT18-02	1	8.1	8.1	SBTS #7	25-Apr-18	Tetra Tech	6,975,682	582,673	868	Undetermined	Undetermined	SBTS not monitored.
		TT18-03	16	0.5	20	TS4681	24-May-18	Tetra Tech	6,975,298	582,404	890	-0.4	-0.4	No change in ground temperature since 2019.
		TT18-04	1	8.5	8.5	SBTS #9	27-Apr-18	Tetra Tech	6,974,978	582,253	932	Undetermined	Undetermined	SBTS not monitored.
		TT18-05	16	0.5	20	TS4687	30-May-18	Tetra Tech	6,974,552	581,912	943	-0.4	-0.4	Very slight warming ground temperature trend.
	Alpha Pond	SRK-AP-18-01	16	-2.8(1)	16.7	TS4686	3-Jun-18	Tetra Tech	6,975,306	582,731	790.4	0.3 (permafrost free)	1-1.9 (permafrost free)	Up to 1.6°C increase in ground temperature since 2019.
		SRK-AP-18-05	16	1.2	20.7	TS4683	24-May-18	Tetra Tech/SRK	6,975,362	582,819	784	-1.1	-1.0	Approximately 0.1°C increase in PT since 2019. Generally, follows historical ground temperature trend.
		SRK-AP-18-06	16	0.2	19.7	TS4684	3-Jun-18	Tetra Tech	6,975,380	582,765	791.8	-0.3	-0.3	Warming ground temperature trend between approximately 16 m and 20 m depth. Permafrost base is at a depth of approximately 17.8 m.
		SRK-AP-18-07	16	0.2	19.7	TS4682	18-May-18	SRK	6,975,406	582,739	803.5	-0.1	-0.1	Generally, cooling ground temperature trend between permafrost table and permafrost base, with warming ground temperatures between 18 m and 20 m depth, at the bottom of GTC installation. Permafrost base is at a depth of approximately 18.8 m.
		SRK-AP-18-08	16	0.2	19.7	TS4678	May 28,2018	Tetra Tech	6,975,424	582,711	817.2	-0.1	-0.1	Thermistor beads #8, #10, and #13 could be failing. Permafrost base is at a depth of approximately 18.3 m.
		SRK-AP-18-11	16	-1.5(1)	18	TS4679	19-Sep-18	Tetra Tech	6,975,426	582,823	776	-0.6	-0.6	Generally, follows historical ground temperature trend. No change in PT
	Kona Pond	SRK-KP-18-03	16	0.53	20	TS4680	17-Sep-18	Tetra Tech	6,973,228	580,747	1,109.00	-1.2	-1.2	Generally, follows historical ground temperature trend. No change in ground temperatures.
	Facility Pond	SRK-FP-18-05	2 SBTS	2.9	5.7	SBTS#8/SBTS#9	20-Sep-18	Tetra Tech	6,972,570	583,242	1,004.40	Undetermined	Undetermined	SBTS not monitored.
		SRK-FP-18-03	16	0.58(1)	18.92	TS4685	17-Sep-18	Tetra Tech	6,972,620	583,343	1,029.00	0.4 (permafrost free)	0.4 (permafrost free)	Generally, follows historical ground temperature trend. No change in ground temperatures.

(1) First bead located above the ground surface
PT = Permafrost Temperature (measured at the depth of zero annual amplitude)

- Cooler ground temperature trend or decrease in PT
- Unchanged ground temperature trend since 2019
- Slight warming ground temperature trend
- Significant warming ground temperature trend
- No new ground temperature data collected / not monitored

4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Newmont Canada and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Newmont Canada, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

5.0 CLOSURE

We trust this technical memo meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully Submitted,
Tetra Tech Canada Inc.

FILE: ENG.EARC03259-01

Prepared by:
Ernest Palczewski, B.Sc., P.Geo. (NT/NU/AB)
Geologist, Arctic Region
Direct Line: 587.460.3595
Ernest.Palczewski@tetratech.com

Reviewed by:
Vladislav Roujanski, Ph.D., P.Geol. (NT/NU/AB)
Principal Specialist, Geologist – Geocryologist, Arctic Region
Direct Line: 587.460.3610
Vladislav.Roujanski@tetratech.com

/kla

REFERENCES

Lorax Environmental Services Ltd. 2016. Coffee Gold Feasibility Study: Appendix J2: Hydrogeology. Report prepared for Kaminak Gold Corporation, dated February 1, 2016.

SRK Consulting (U.S.), Inc. 2016. 2015 Geotechnical Field Investigation, Coffee Gold Project, Yukon Territory, Canada. Report prepared for Kaminak Gold Corporation, dated January 4, 2016.

Tetra Tech EBA Inc. 2016. Technical Memorandum No.: 2 (Issued for Use – Revision 2): Permafrost and Related Geohazard Mapping within the Coffee Mine Site Study Area. Submitted to Kaminak Gold Corporation, dated May 3, 2016.

Tetra Tech Canada Inc. and SRK Consulting (Canada) Inc. 2017a. Fall 2016 Geotechnical Investigation Data Report (Issued for Use), Coffee Mine Site, Coffee Gold Project. Submitted to Goldcorp Inc., dated March 20, 2017.

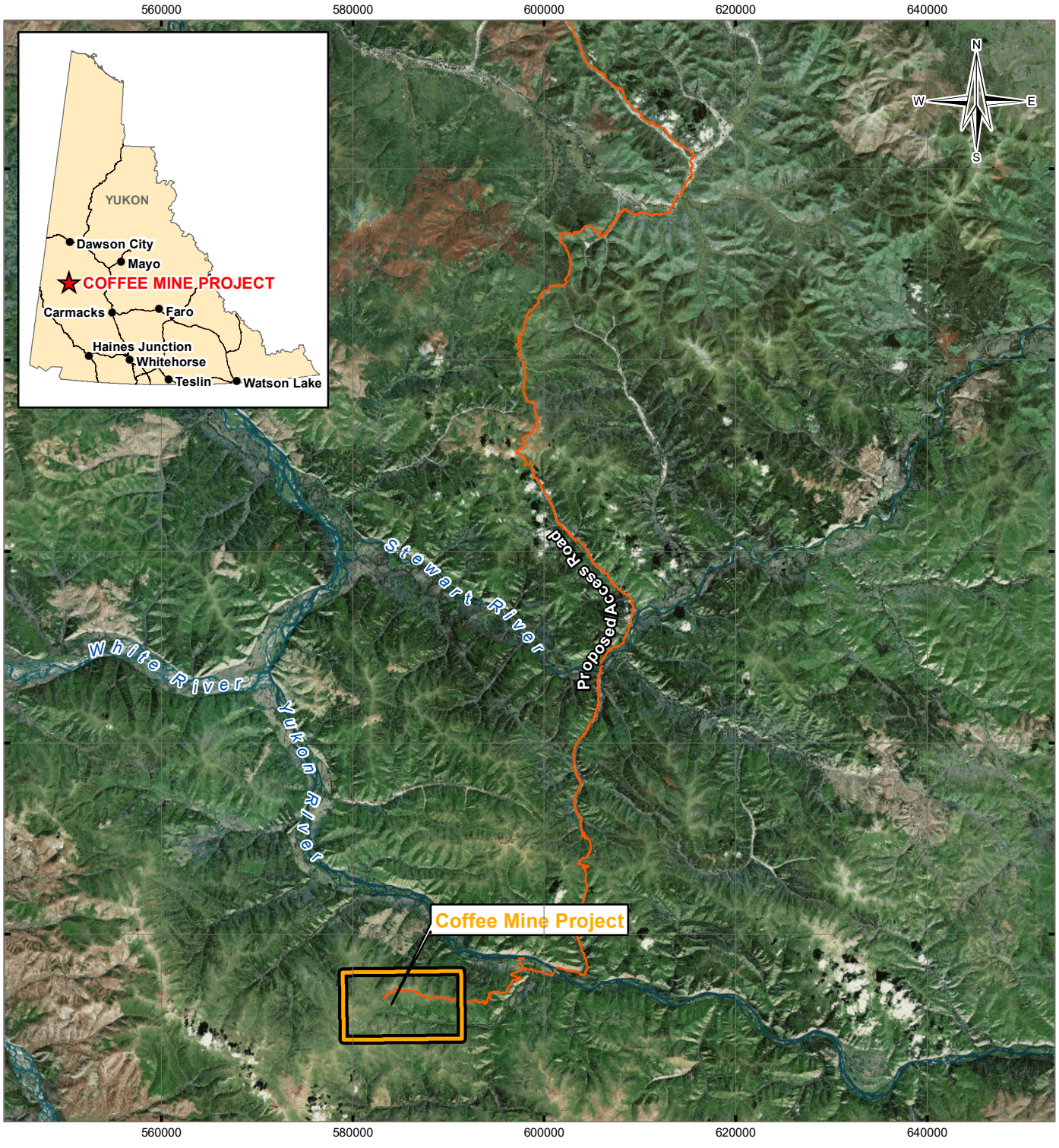
Tetra Tech Canada Inc. 2017b. Summer 2017 Geotechnical Investigation Data Report, Coffee Mine Site, Coffee Gold Project. Report prepared for JDS Energy & Mining Inc., November 2017.

Tetra Tech Canada Inc. and SRK Consulting (Canada) Inc. 2019a. 2018 Geotechnical Investigation Data Report (Issued for Review), Coffee Gold Project. Submitted to JDS Energy & Mining Inc., dated February 1, 2019.

Tetra Tech Canada Inc. 2019b. Permafrost Distribution Mapping Update, Coffee Mine Site Development Area, Coffee Gold Project. Submitted to JDS Energy & Mining Inc., April 9, 2019.

FIGURES

Figure 1 Project Location
Figure 2 Historical As-Drilled Borehole/Testpit Locations and General Arrangement
Figure 3a Permafrost Distribution, Thickness and Ground Temperatures
Figure 3b Permafrost Distribution, Thickness and Ground Temperatures



LEGEND

- Coffee Mine Project Area
- Proposed Access Road

NOTES
Base data source:
Imagery provided by ESRI;
Earthstar Geographics (1999)
Road data from Kaminak (February 2016)

STATUS
ISSUED FOR USE

COFFEE MINE PROJECT
GROUND TEMPERATURE CABLE MONITORING UPDATE

Project Location

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	Newmont CANADA

Scale: 1:600,000
10 5 0 10
Kilometres

TETRA TECH

FILE NO. EARC03259-01_Figure01_PrjLocation.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-EDM	MRB	SL	VER	0

DATE December 14, 2022
PROJECT NO. ENG.EARC03259-01

Figure 1

Q:\Edmonton\GIS\ENGINEERING\EARC\EARC03259-01\Maps\MAPPING_UPDATE\EARC03259-01_Figure01_PrjLocation.mxd modified 2022-12-14 by megan.verburg

LEGEND

- Testpit (TT, 2018)
- Borehole (T - Thermistor Installed) (TT/SRK, 2018)
- Borehole (T - Thermistor and VWP Installed) (TT/SRK, 2018)
- Borehole (VWP Installed) (TT/SRK, 2018)
- Borehole (T - Thermistor Installed) (TT, Summer 2017)
- Testpit (TT, Fall 2017)
- Testpit (TT, Summer 2017)
- Testpit (TT/SRK, 2016)
- Borehole (T - Thermistor Installed) (TT/SRK, 2016)
- Borehole (T - Thermistor Installed) (SRK, 2015)
- Borehole (T - Thermistor and VWP Installed) (SRK, 2015)
- Borehole (Lorax, 2015)
- Borehole (SRK, 2015)
- Borehole (T - Thermistor Installed) (Knight Piesold, 2014)
- Borehole (VWP Installed) (TT EBA, 2013)
- Fi — Perennially frozen ground – predominantly very ice-rich with ground ice content locally exceeding 50% by volume of visible ice
- Fv — Perennially frozen ground – predominantly ice-rich with ground ice content generally ranging between 10% and 50% by volume of visible ice. May include patches of ice-poor permafrost (Fn) and/or unfrozen ground (UF)
- Fn — Perennially frozen ground – predominantly ice-poor with either non-visible ground ice or visible ice (ice content generally less than 10% by volume). May include patches of ice-rich permafrost (Fv) and/or unfrozen ground (UF)
- UF — Predominantly permafrost-free terrain; may include patches of permafrost (Fv, Fn)
- Boundary of Permafrost Distribution
- Frozen Soil Stockpile
- Heap Leach Facility (HLF)
- KONA WRSF (Temporary)
- Organics Stockpile
- Pit
- ROM Stockpile
- Waste Rock Storage Facility (WRSF)
- Mine Site Development Area
- Haul Road Alignment
- Diversion Channel Alignment
- Underdrain Alignment
- Site Access Road
- Contour (10 m)
- Watercourse
- Pond

NOTES
1. Base Data Source: Project Footprint provided by Hatch (February 2019). Updates by JDS (April 2019). CanVec 1:50,000.
2. Permafrost boundaries as of September 28, 2022.
3. Imagery provided by Kaminak (2011).

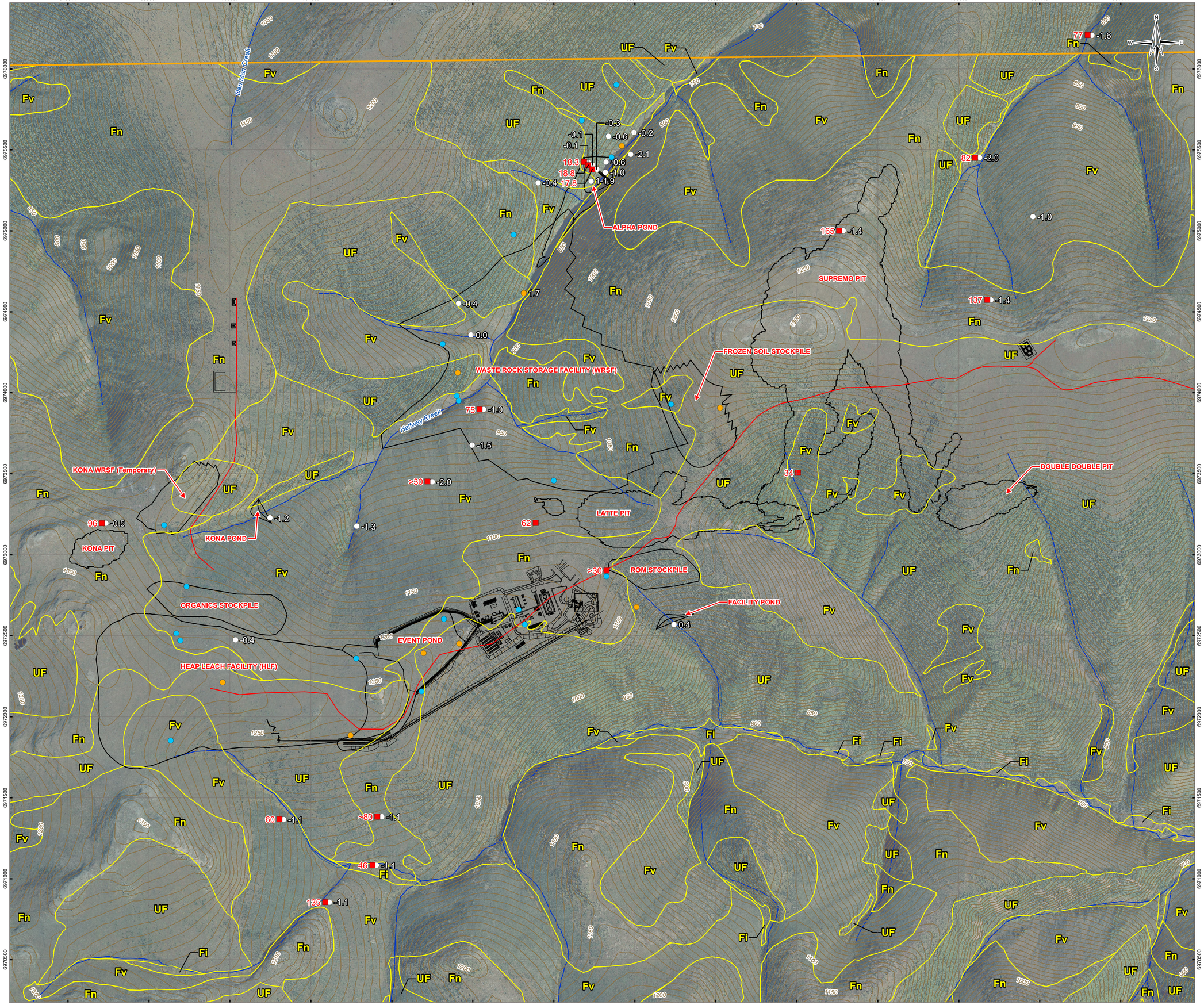
STATUS
ISSUED FOR REVIEW

COFFEE MINE PROJECT
GROUND TEMPERATURE CABLE MONITORING AND PERMAFROST DISTRIBUTION MAPPING UPDATE

Historical As-Drilled Borehole/Testpit Locations and General Arrangement

PROJECTION: UTM Zone 7	DATUM: NAD83	CLIENT: Newmont CANADA		
Scale: 1:15,000 (300 150 0 300 Metres)		TETRA TECH		
FILE NO.: EARC03282-01_Figure02_BoreholeRecord.mxd				
OFFICE: TI-EDM	DWN: MRB	CKD: SL	APVD: VER	REV: 0
DATE: March 19, 2025	PROJECT NO.: ENG.EARC03282-01			Figure 2

G:\ENGINEERING\EARC\EARC03282-01\GIS\Maps\Mapping_Update\EARC03282-01_Figure02_BoreholeRecord.mxd modified 3/19/2025 by MEGAN BURNS



LEGEND

- Ground Temperature (°C) Measured with GTC
- Permafrost Thickness (m)
- Location of Single-bead Thermistor Indicating Permafrost Condition
- Location of Single-bead Thermistor Indicating Unfrozen Condition
- Fi — Perennially frozen ground – predominantly very ice-rich with ground ice content locally exceeding 50% by volume of visible ice
- Fv — Perennially frozen ground – predominantly ice-rich with ground ice content generally ranging between 10% and 50% by volume of visible ice. May include patches of ice-poor permafrost (Fn) and/or unfrozen ground (UF)
- Fn — Perennially frozen ground – predominantly ice-poor with either non-visible ground ice or visible ice (ice content generally less than 10% by volume). May include patches of ice-rich permafrost (Fv) and/or unfrozen ground (UF)
- UF — Predominantly permafrost-free terrain; may include patches of permafrost (Fv, Fn)
- Boundary of Permafrost Distribution
- Mine Site Development Area
- Site Access Road
- Contour (10 m)
- Watercourse

NOTES
1. Base Data Source: Project Footprint provided by Hatch (February 2019). Updates by JDS (April 2019). CanVec 1:50,000.
2. Permafrost boundaries as of September 28, 2022.
3. Imagery provided by Kaminak (2011).

STATUS
ISSUED FOR USE

COFFEE MINE PROJECT
GROUND TEMPERATURE CABLE MONITORING UPDATE

Permafrost Distribution, Thickness and Ground Temperatures

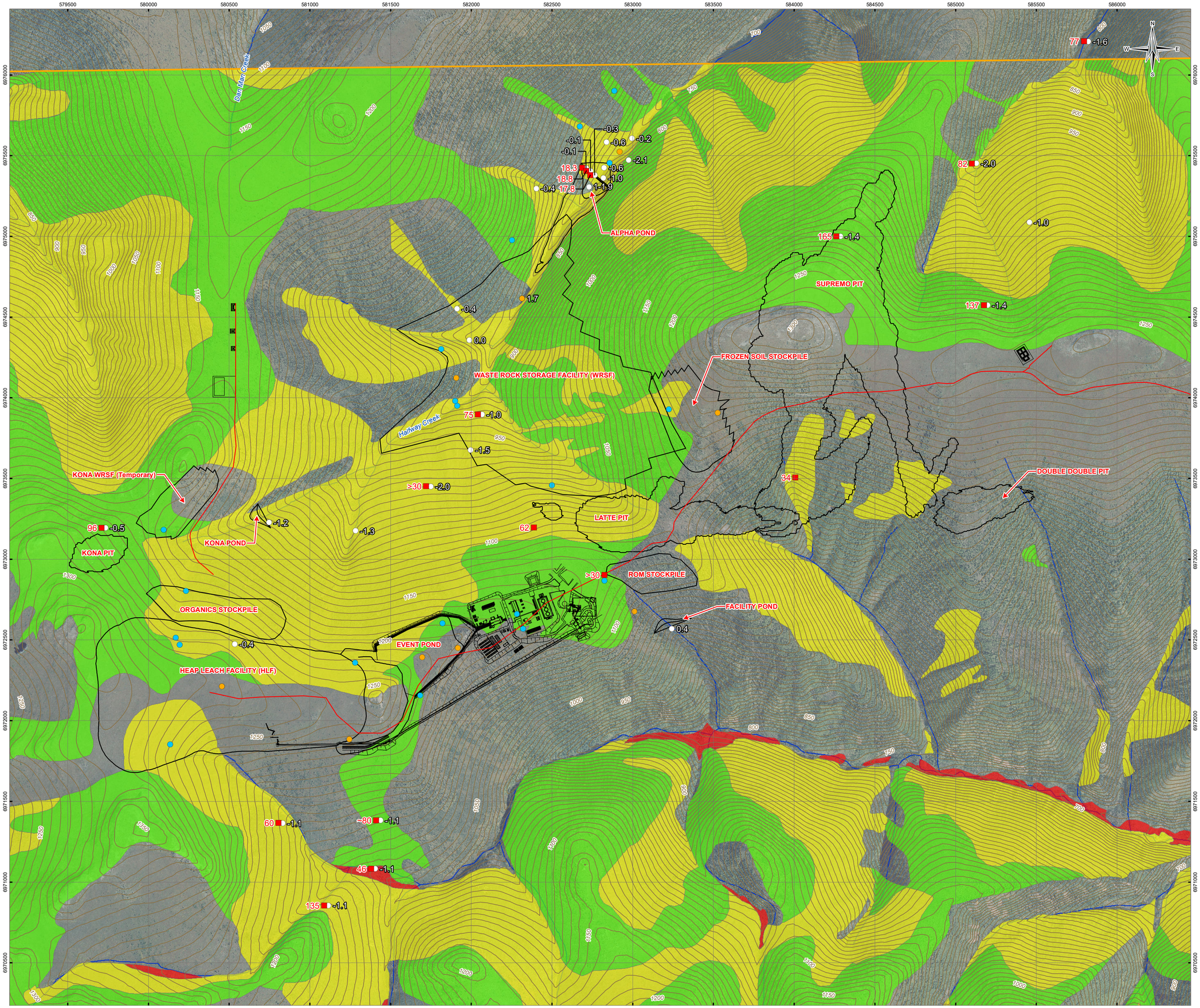
PROJECTION: UTM Zone 7			DATUM: NAD83		
Scale: 1:15,000 (300 150 0 300 Metres)					
FILE NO.: EARC03259-01_Figure03a_ThicknessTemp.mxd					
OFFICE: TI-EDM	DWN: MRB	CKD: SL	APVD: VER	REV: 0	
DATE: December 14, 2022	PROJECT NO.: ENG.EARC03259-01				

CLIENT: Newmont CANADA

TETRA TECH

Figure 3a

Q:\Edmonton\GIS\ENGINEERING\EARC\EARC03259-01\Maps\MAPPING_UPDATE\EARC03259-01_Figure03a_ThicknessTemp.mxd modified 2022-12-14 by megan.verburg



LEGEND

- Ground Temperature (°C) Measured with GTC
- Permafrost Thickness (m)
- Location of Single-bead Thermistor Indicating Permafrost Condition
- Location of Single-bead Thermistor Indicating Unfrozen Condition
- Fi — Perennially frozen ground – predominantly very ice-rich with ground ice content locally exceeding 50% by volume of visible ice
- Fv — Perennially frozen ground – predominantly ice-rich with ground ice content generally ranging between 10% and 50% by volume of visible ice. May include patches of ice-poor permafrost (Fn) and/or unfrozen ground (UF)
- Fn — Perennially frozen ground – predominantly ice-poor with either non-visible ground ice or visible ice (ice content generally less than 10% by volume). May include patches of ice-rich permafrost (Fv) and/or unfrozen ground (UF)
- UF — Predominantly permafrost-free terrain; may include patches of permafrost (Fv, Fn)
- Mine Site Development Area
- Site Access Road
- Contour (10 m)
- Watercourse

NOTES
1. Base Data Source: Project Footprint provided by Hatch (February 2019). Updates by JDS (April 2019). CanVec 1:50,000.
2. Permafrost boundaries as of September 28, 2022.
3. Imagery provided by Kaminak (2011).

STATUS
ISSUED FOR USE

COFFEE MINE PROJECT
GROUND TEMPERATURE CABLE MONITORING UPDATE

Permafrost Distribution, Thickness and Ground Temperatures

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	Newmont CANADA

Scale: 1:15,000
300 150 0 300
Metres

TETRA TECH

FILE NO.: EARC03259-01_Figure03b_ThicknessTemp.mxd

OFFICE	DWN	CKD	APVD	REV
TI-EDM	MRB	SL	VER	0

DATE: December 14, 2022
PROJECT NO.: ENG.EARC03259-01

Figure 3b

Q:\Edmonton\GIS\ENGINEERING\EARC\EARC03259-01\Maps\MAPPING_UPDATE\EARC03259-01_Figure03b_ThicknessTemp.mxd modified 2022-12-14 by megan.verburg

APPENDIX A

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 BEARING CAPACITY

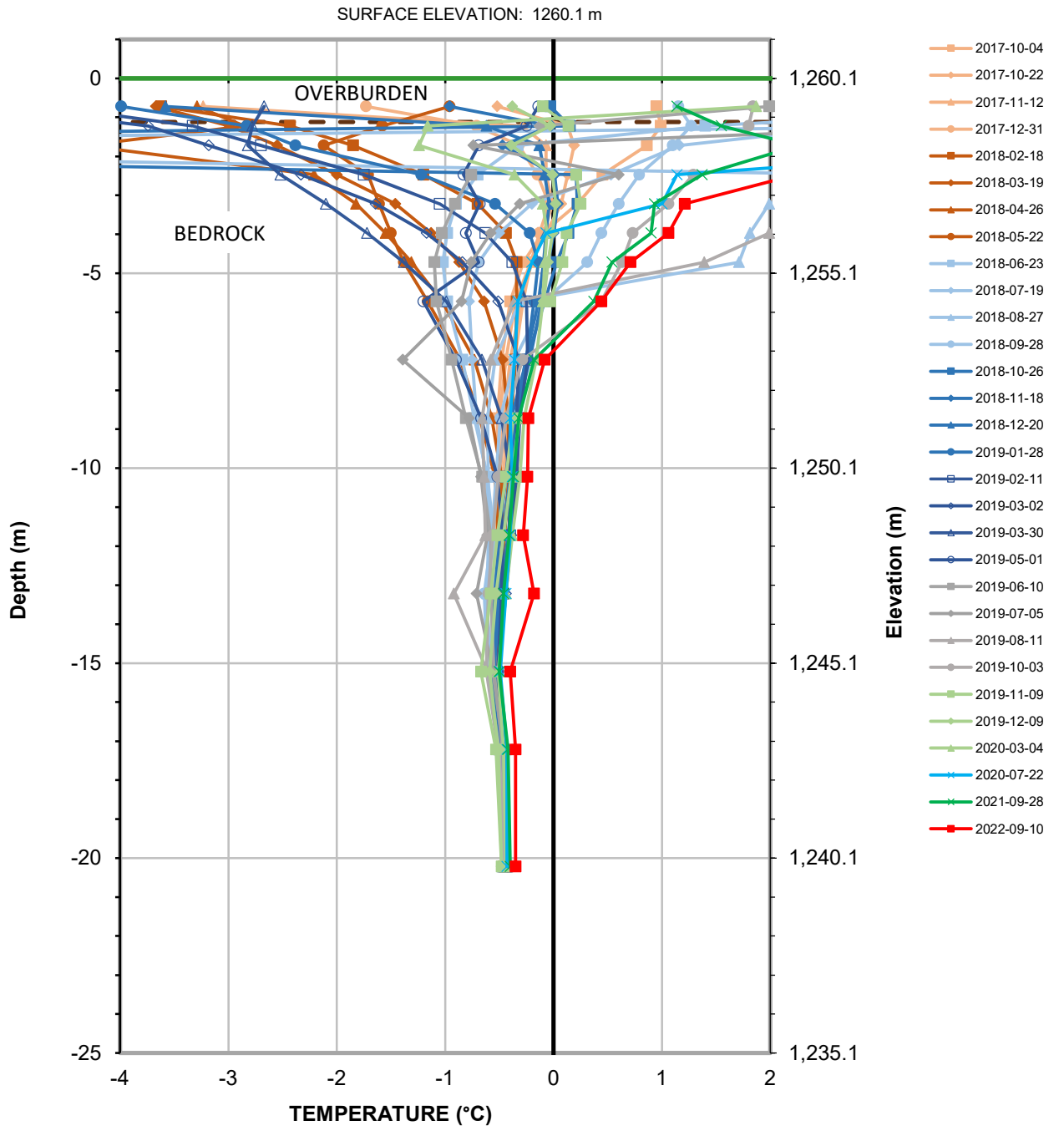
Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

APPENDIX B

GROUND TEMPERATURE PROFILES

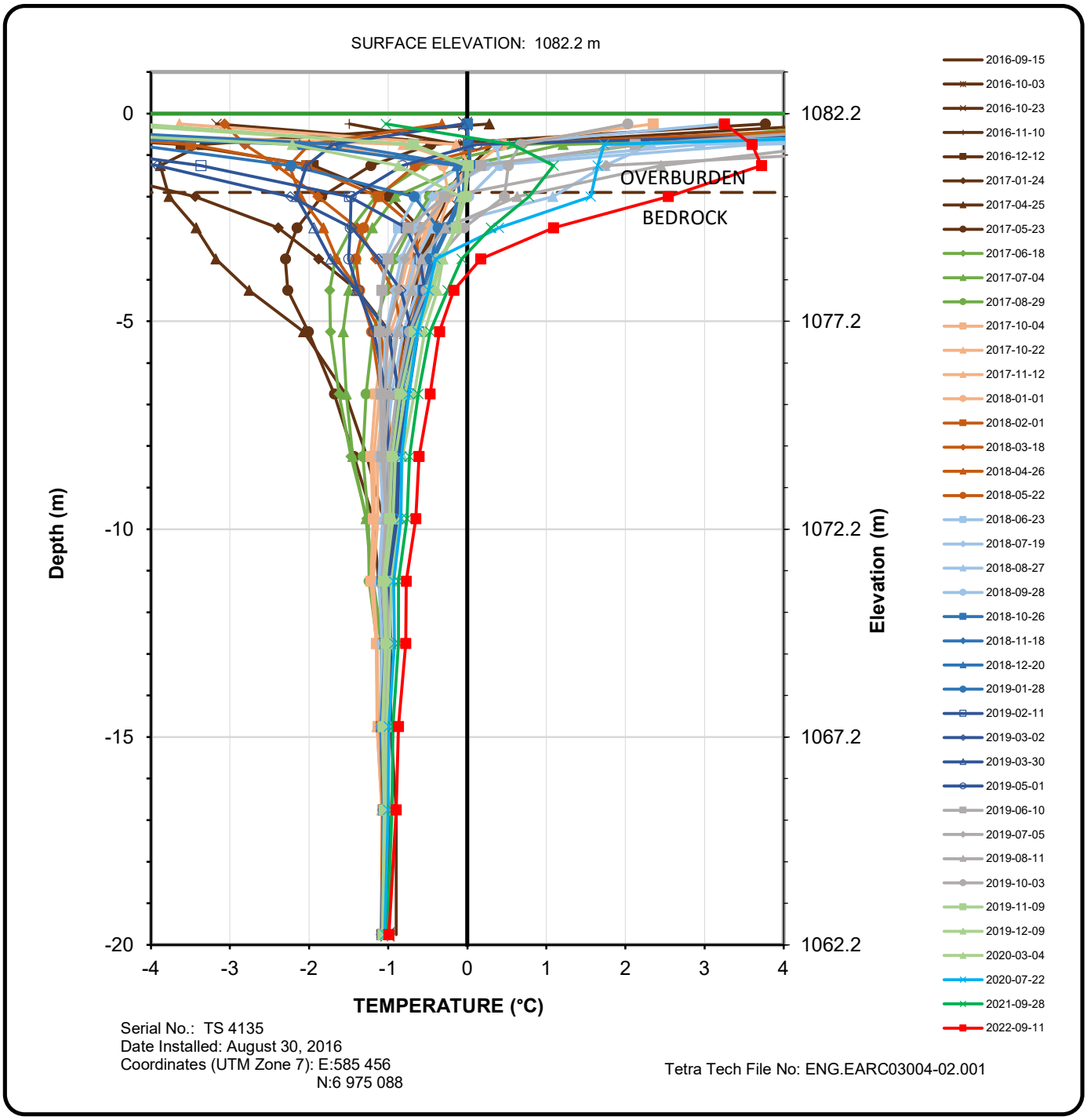


Serial No.: TS 4543
Date Installed: August 10, 2017
Coordinates (UTM Zone 7): E: 580 535
N: 6 972 476

Tetra Tech File No.: ENG.EARC03094-01

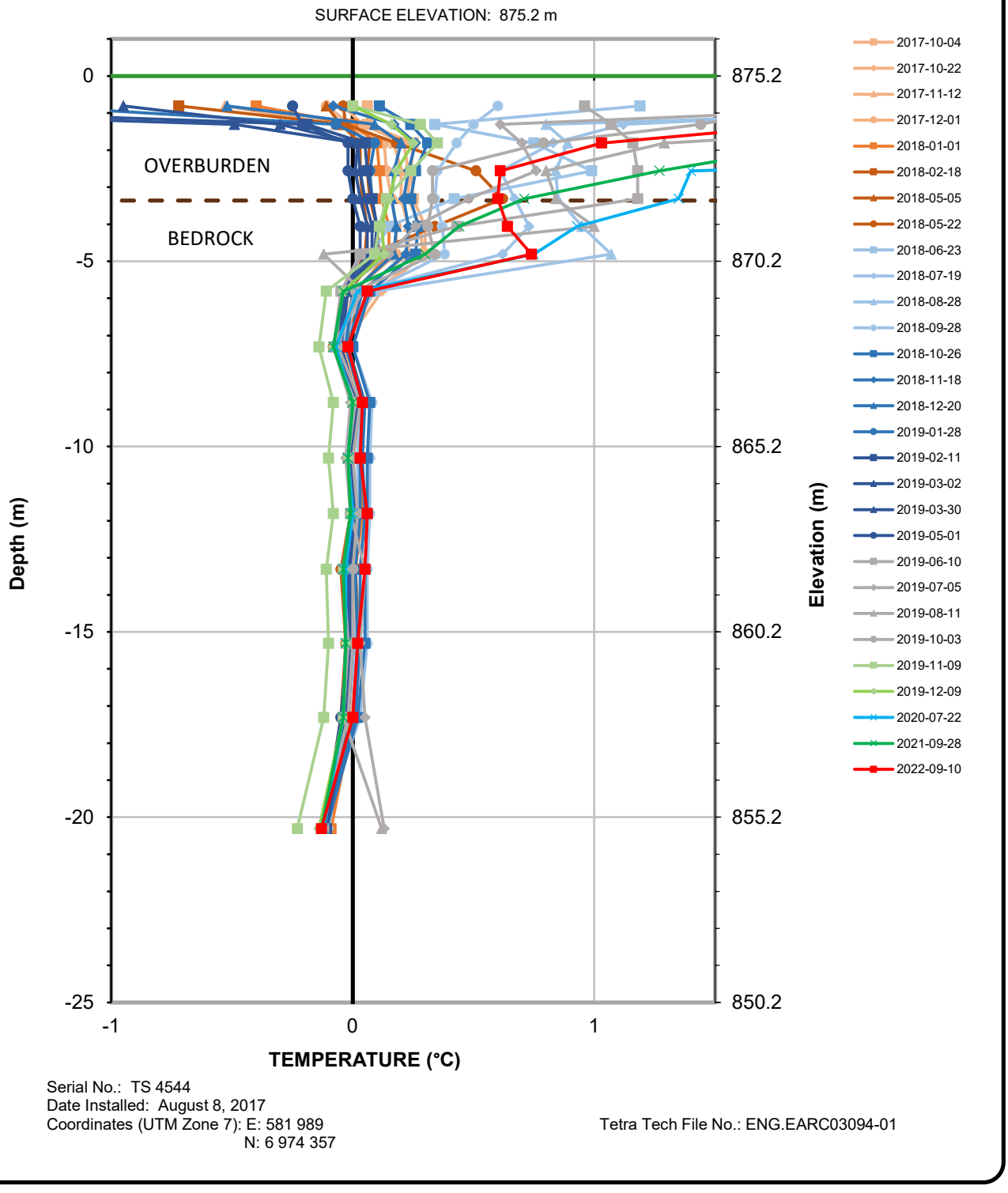
Ground Temperature Profile
HLF, Borehole GT17-10T
Elevation: 1260.1 m

TETRA TECH



Ground Temperature Profile
North WRSA, Borehole GT-14
Elevation: 1082.2 m

TETRA TECH

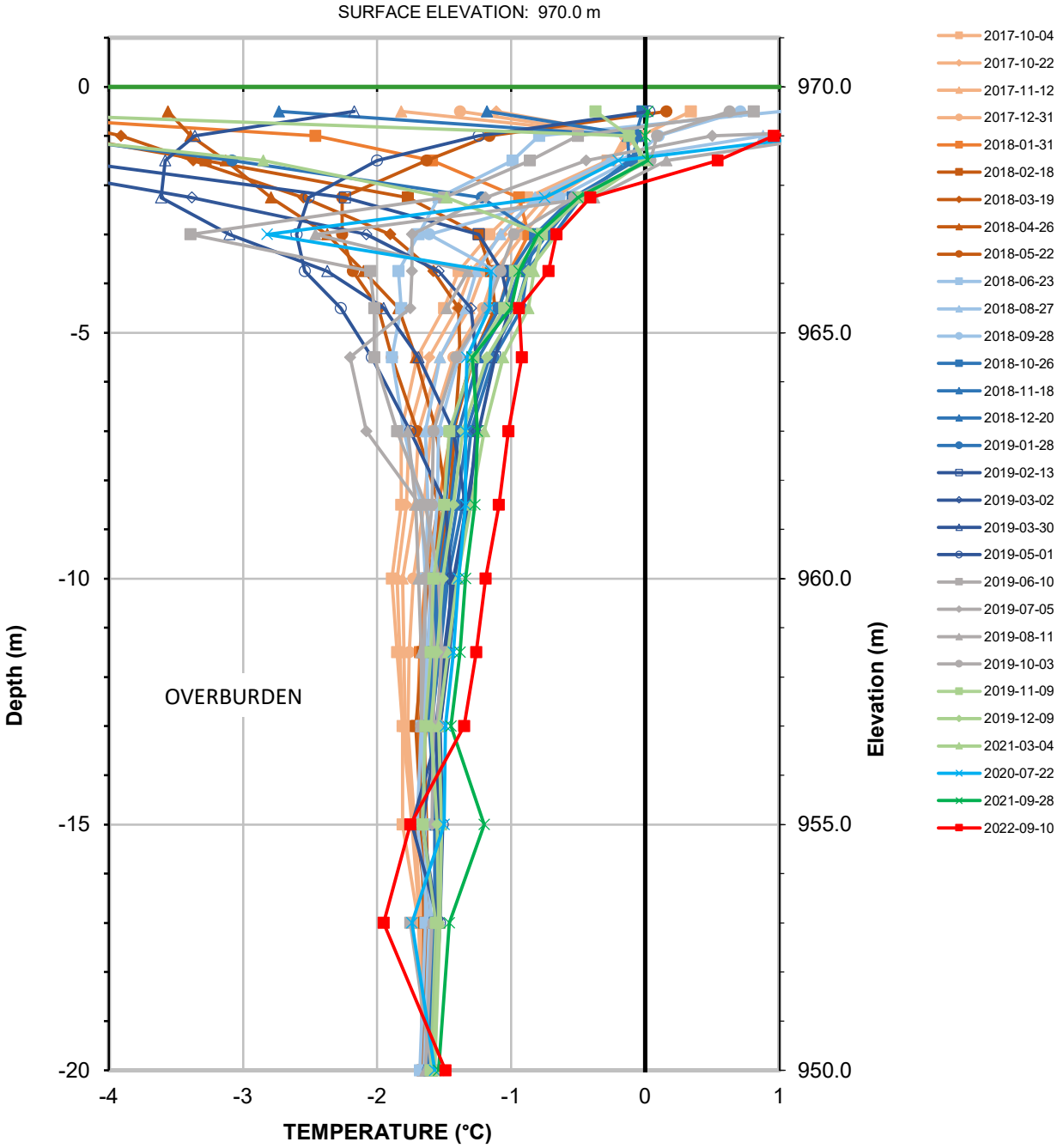


Serial No.: TS 4544
Date Installed: August 8, 2017
Coordinates (UTM Zone 7): E: 581 989
N: 6 974 357

Tetra Tech File No.: ENG.EARC03094-01

Ground Temperature Profile
Alpha WRSF, Borehole GT17-26T
Elevation: 875.2 m

TETRA TECH

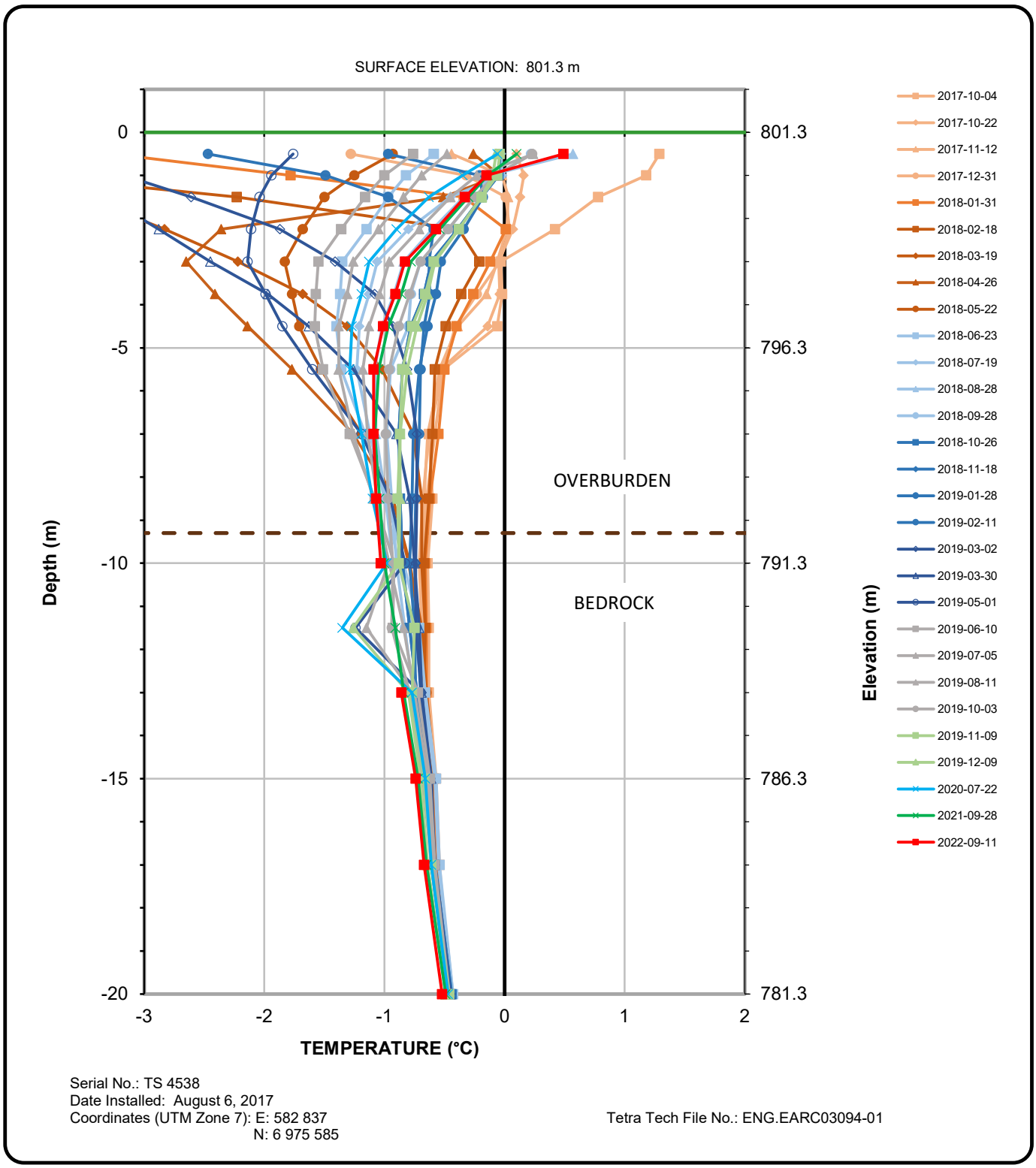


Serial No.: TS 4539
Date Installed: August 6, 2017
Coordinates (UTM Zone 7): E: 581 997
N: 6 973 678

Tetra Tech File No.: ENG.EARC03094-01

Ground Temperature Profile
Alpha WRSF, Borehole GT17-28T
Elevation: 970.0 m

TETRA TECH

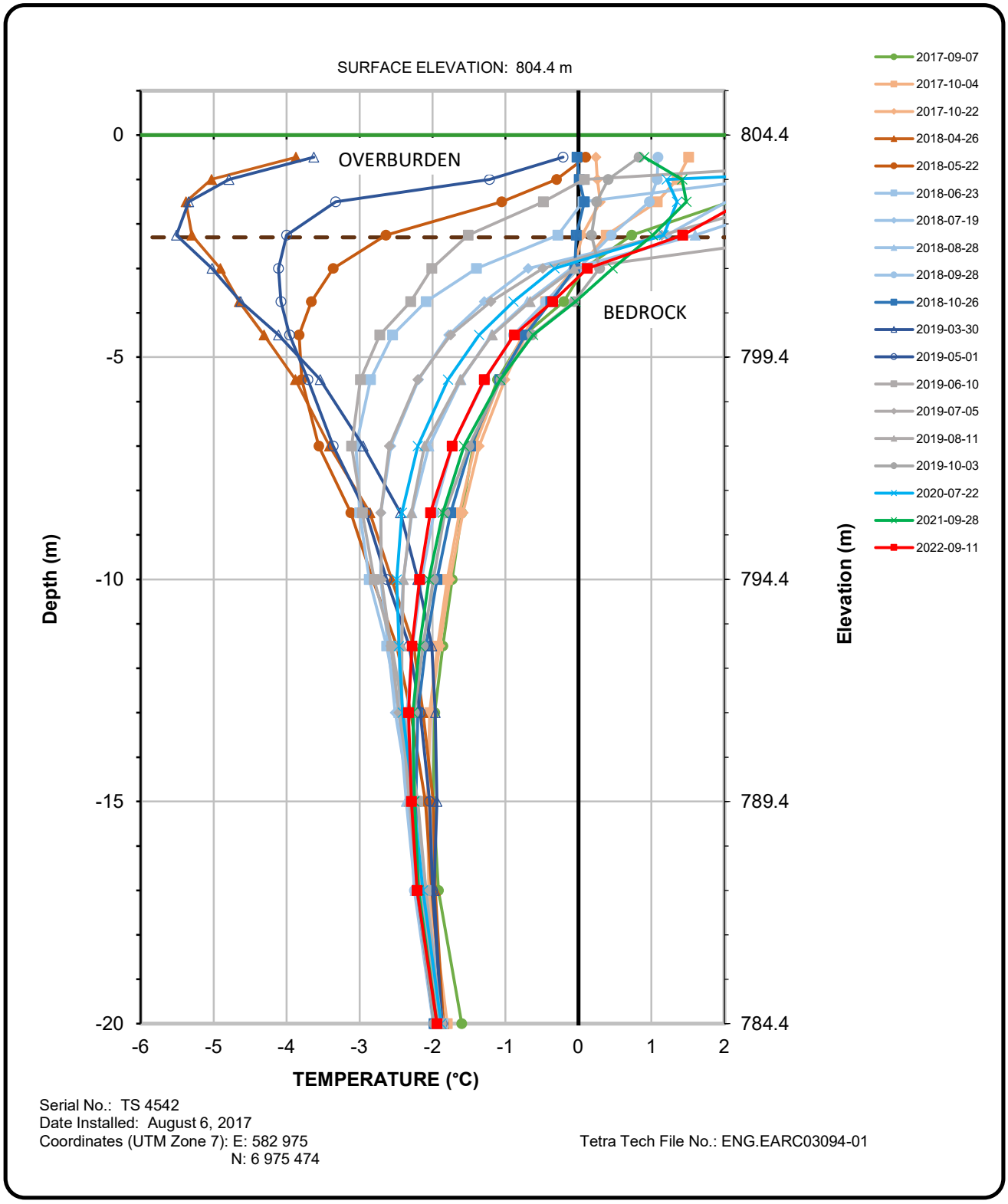


Serial No.: TS 4538
Date Installed: August 6, 2017
Coordinates (UTM Zone 7): E: 582 837
N: 6 975 585

Tetra Tech File No.: ENG.EARC03094-01

Ground Temperature Profile
Alpha Pond, Borehole GT17-34T
Elevation: 801.3 m

TETRA TECH

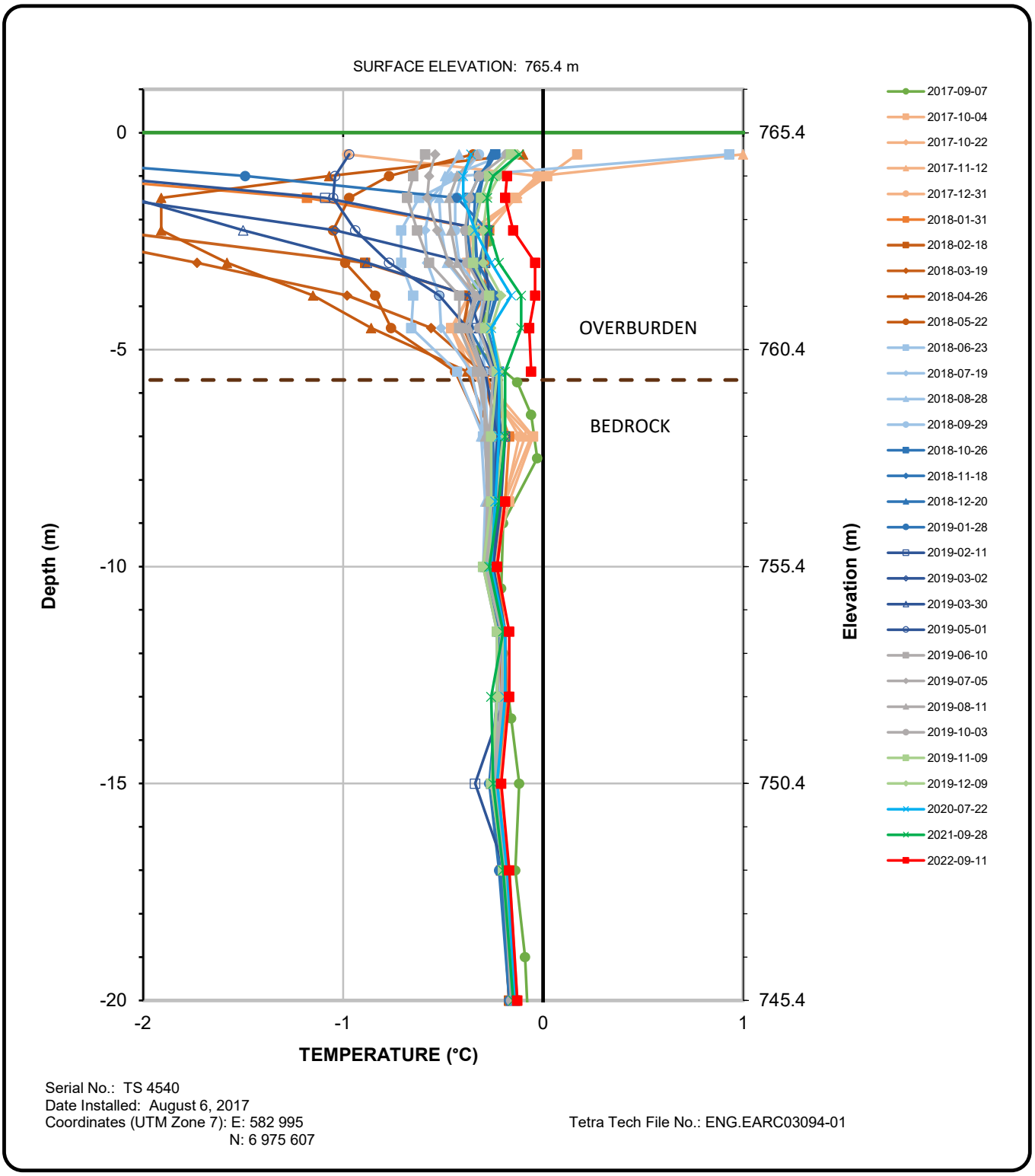


Serial No.: TS 4542
Date Installed: August 6, 2017
Coordinates (UTM Zone 7): E: 582 975
N: 6 975 474

Tetra Tech File No.: ENG.EARC03094-01

Ground Temperature Profile
Alpha Pond, Borehole GT17-36T
Elevation: 804.4 m

TETRA TECH

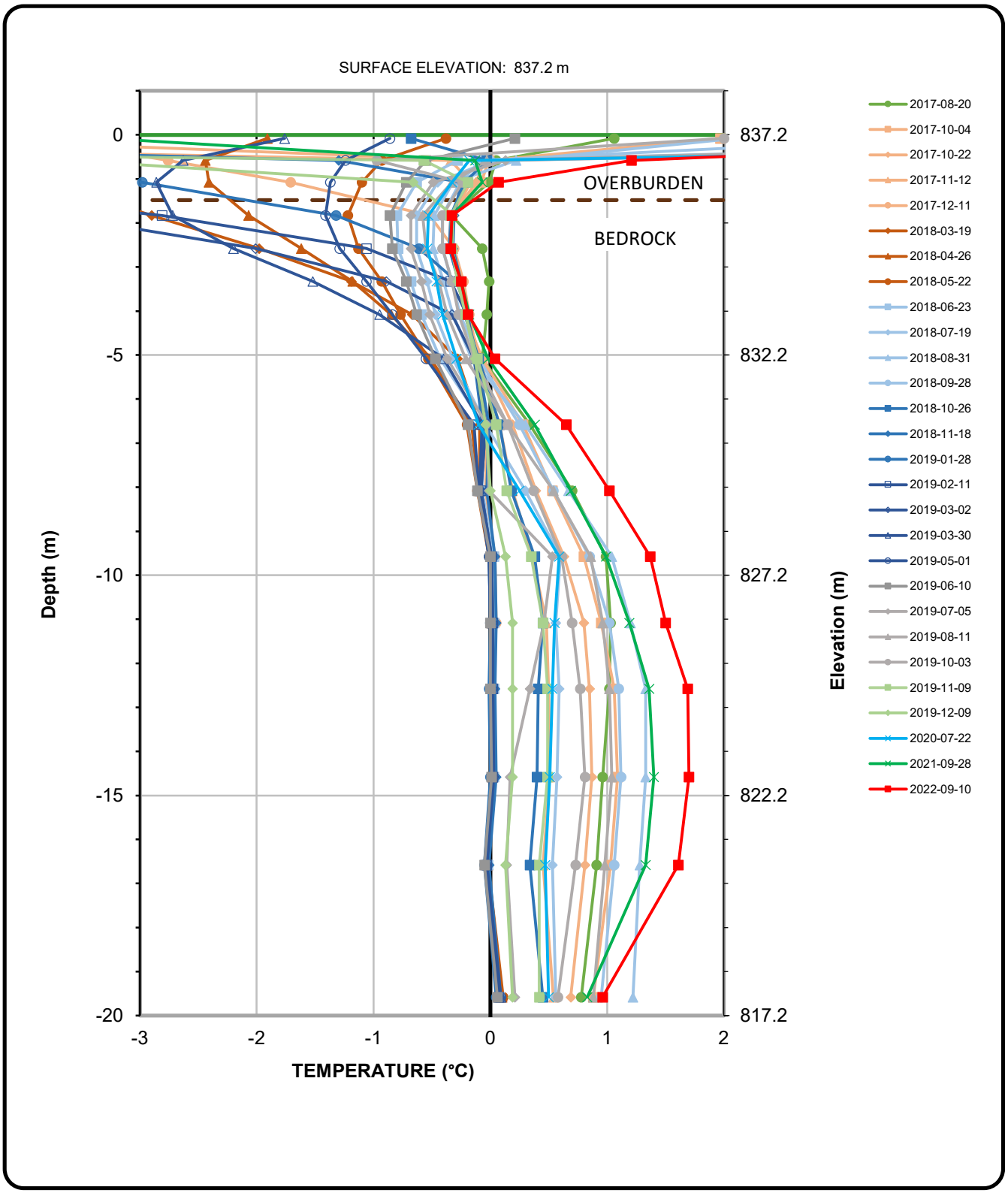


Serial No.: TS 4540
Date Installed: August 6, 2017
Coordinates (UTM Zone 7): E: 582 995
N: 6 975 607

Tetra Tech File No.: ENG.EARC03094-01

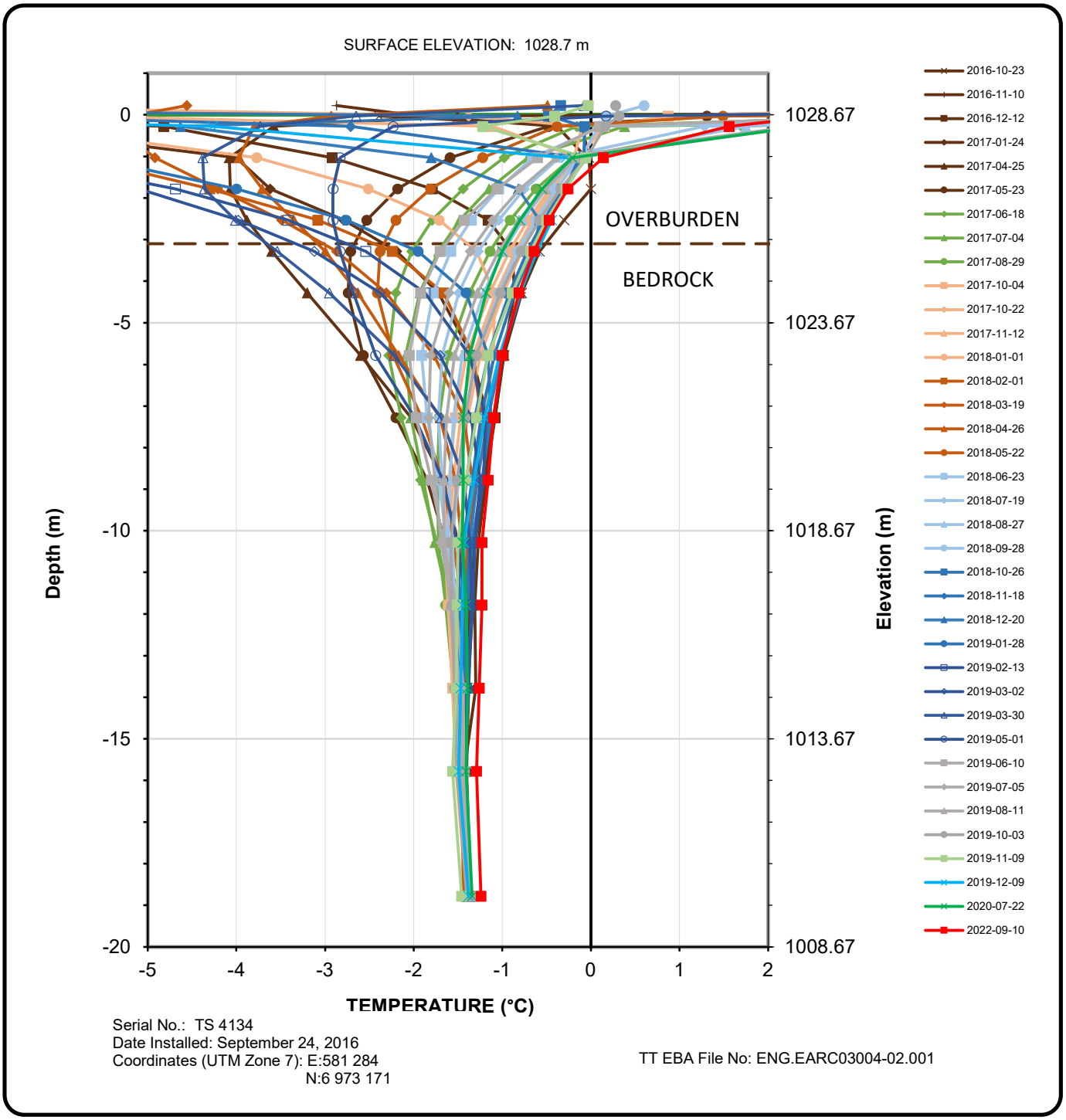
Ground Temperature Profile
Alpha Pond, Borehole GT17-37T
Elevation: 765.4 m

TETRA TECH



Ground Temperature Profile
Alpha Underdrain, Borehole GT17-39T
Elevation: 837.2 m

TETRA TECH

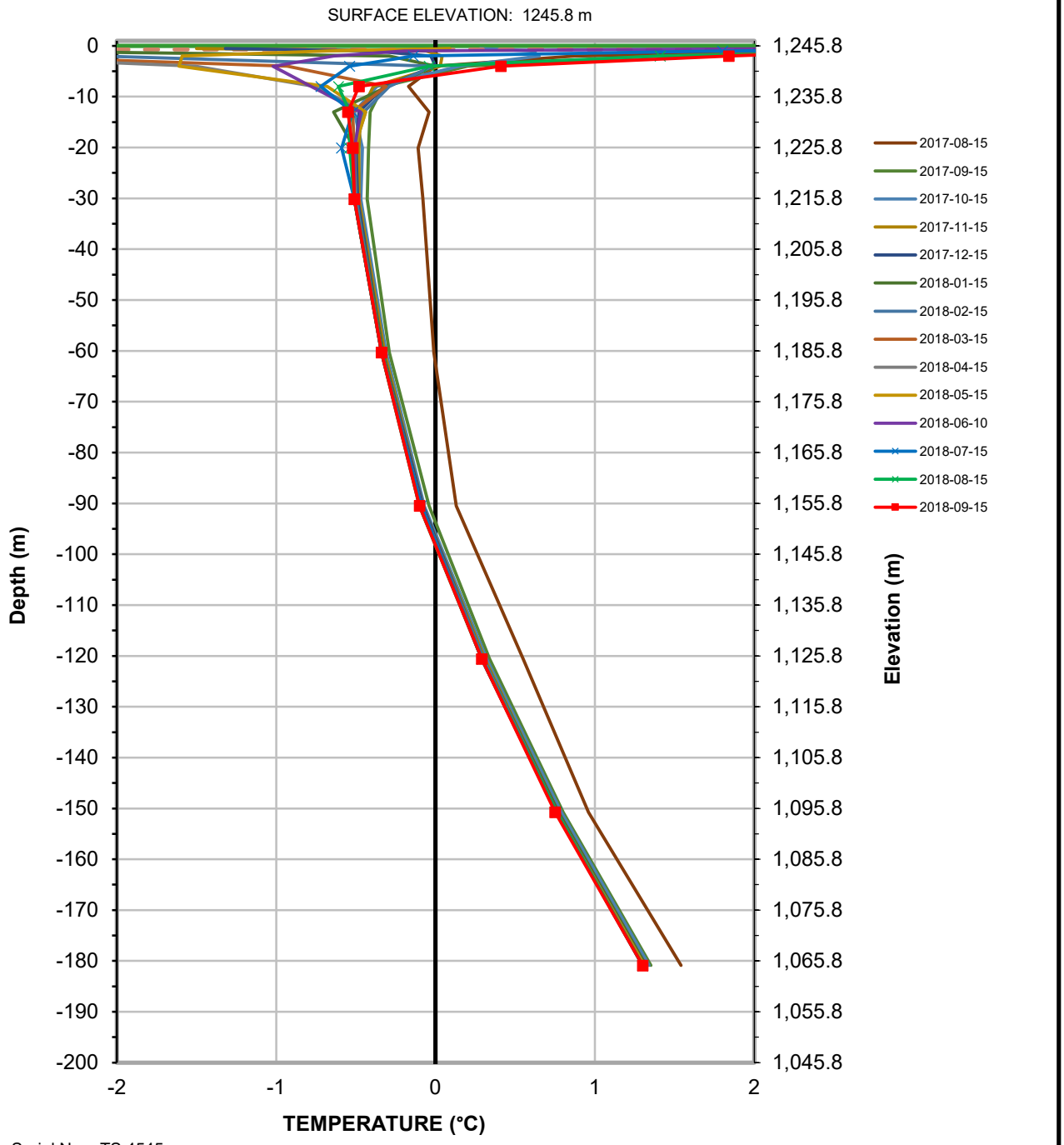


Serial No.: TS 4134
Date Installed: September 24, 2016
Coordinates (UTM Zone 7): E:581 284
N:6 973 171

TT EBA File No: ENG.EARC03004-02.001

Ground Temperature Profile
Borehole GT-63, Halfway Pond
Elevation: 1028.7 m

TETRA TECH

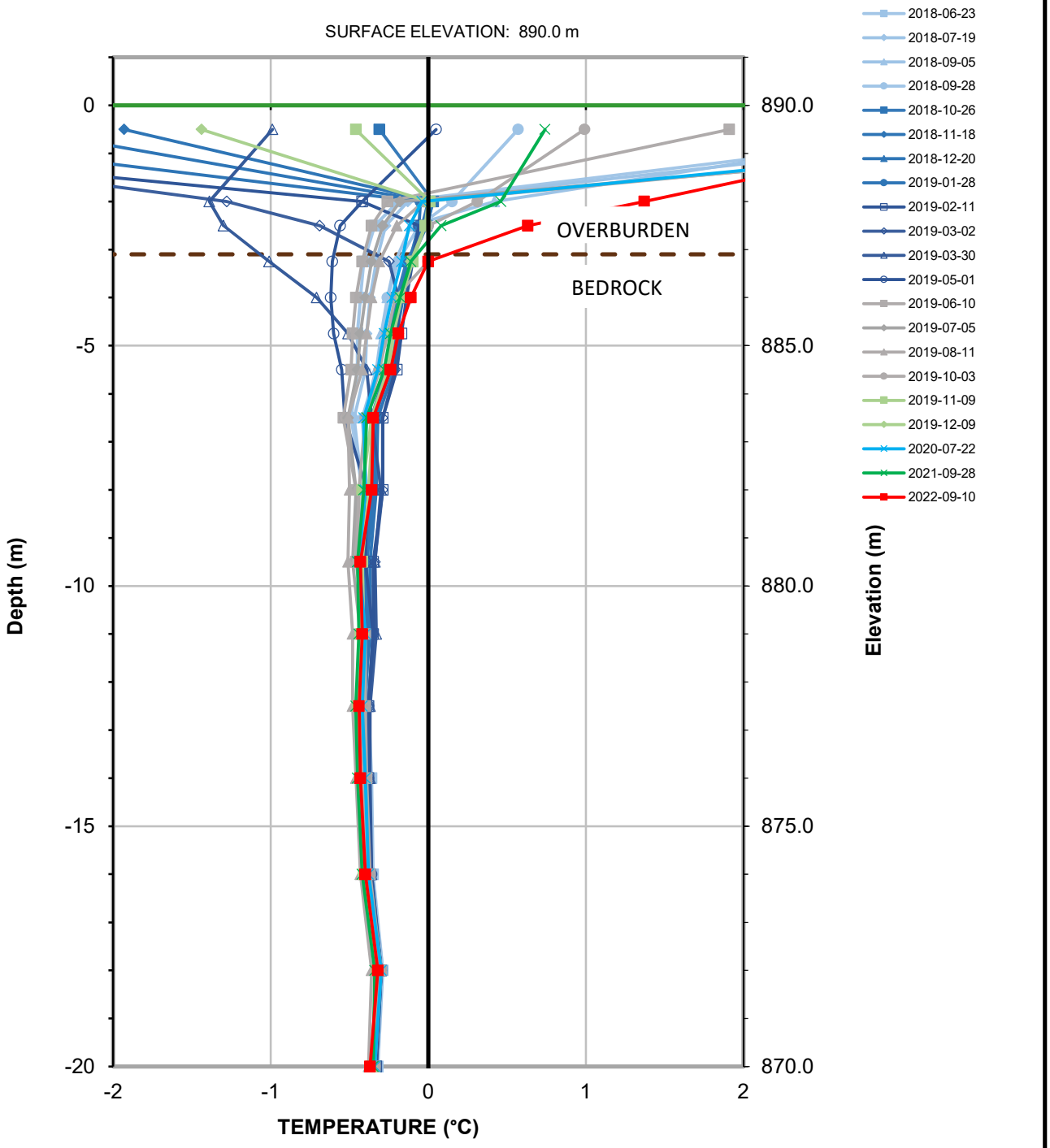


Serial No.: TS 4545
Data Logger: Model: DT2040; Serial #02236
Date Installed: August 10, 2017
Coordinates (UTM Zone 7): E: 579 736
N: 6 973 195

Tetra Tech File No.: ENG.EARC03094-01

Ground Temperature Profile
Kona Pit Area, Borehole GT17-01T/MW17-01
Elevation: 1245.8 m

NOTE: Interpreted Lorax Environmental Data

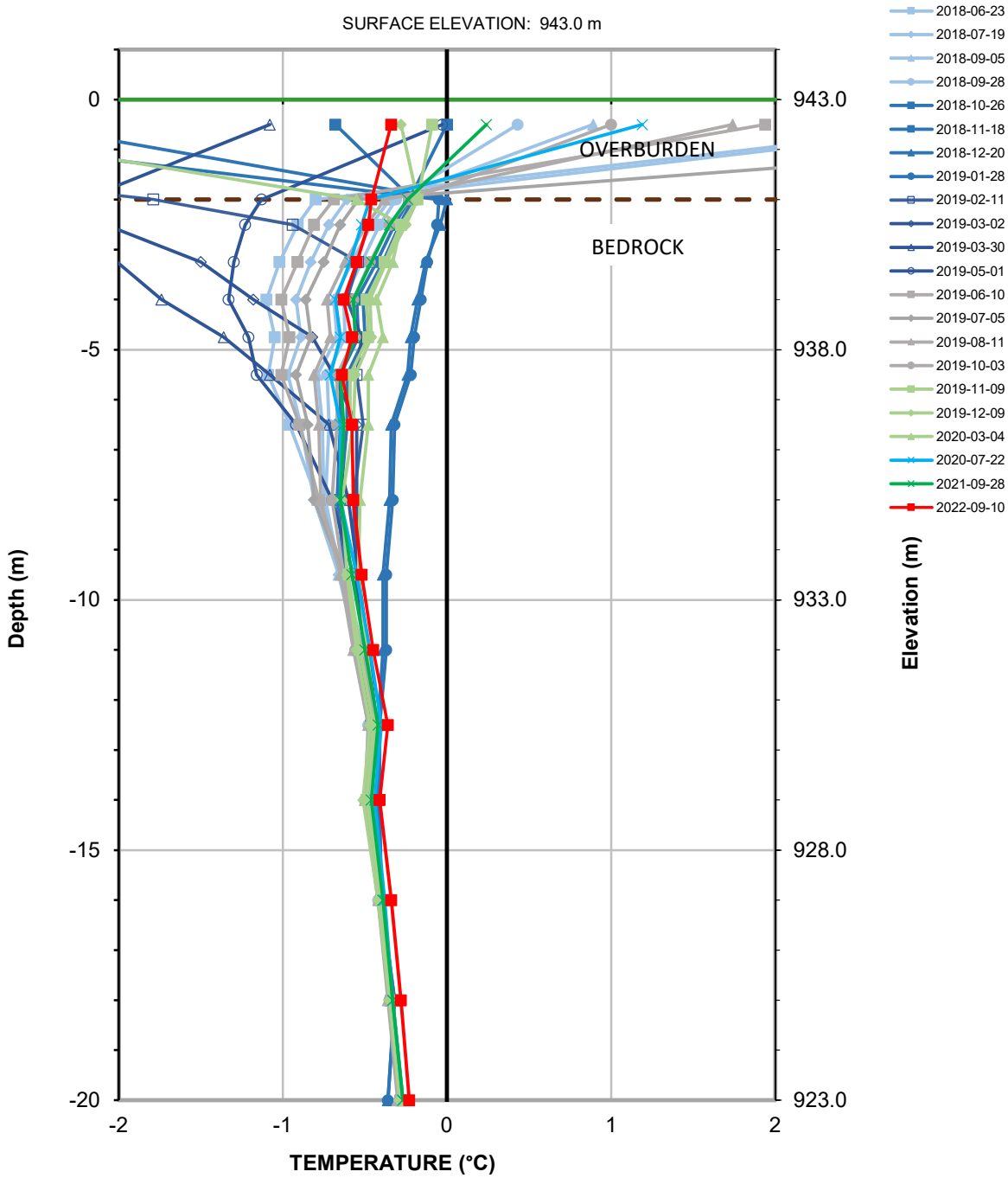


Serial No.: TS 4681
Date Installed: May 25, 2018
Coordinates (UTM Zone 7): E: 582 404
N: 6 975 298

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Halfway Diversion, Borehole TT18-03
Elevation: 890.0 m

TETRA TECH

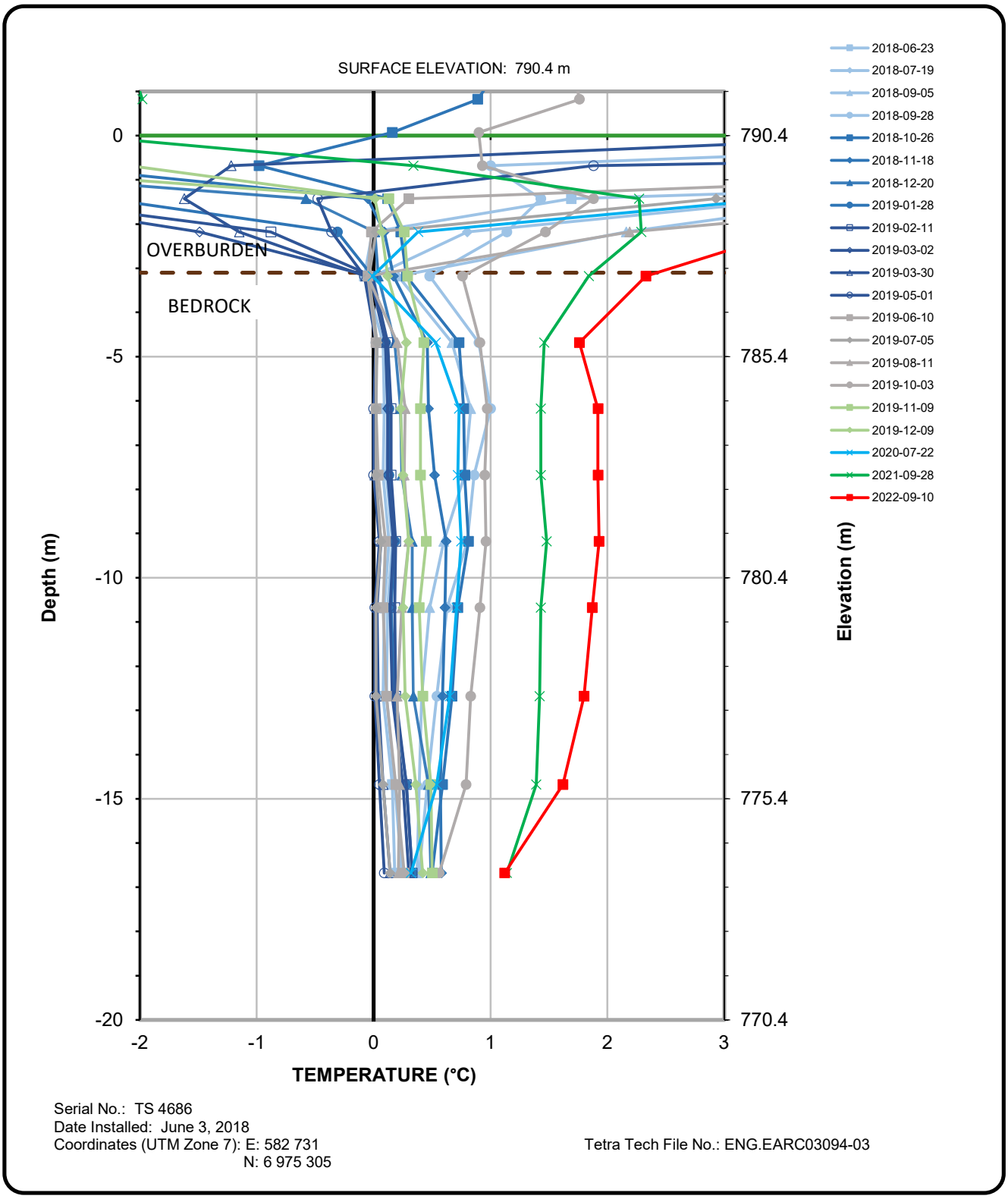


Serial No.: TS 4687
Date Installed: May 30, 2018
Coordinates (UTM Zone 7): E: 581 912
N: 6 974 552

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Halfway Diversion, Borehole TT18-05
Elevation: 943.0 m

TETRA TECH

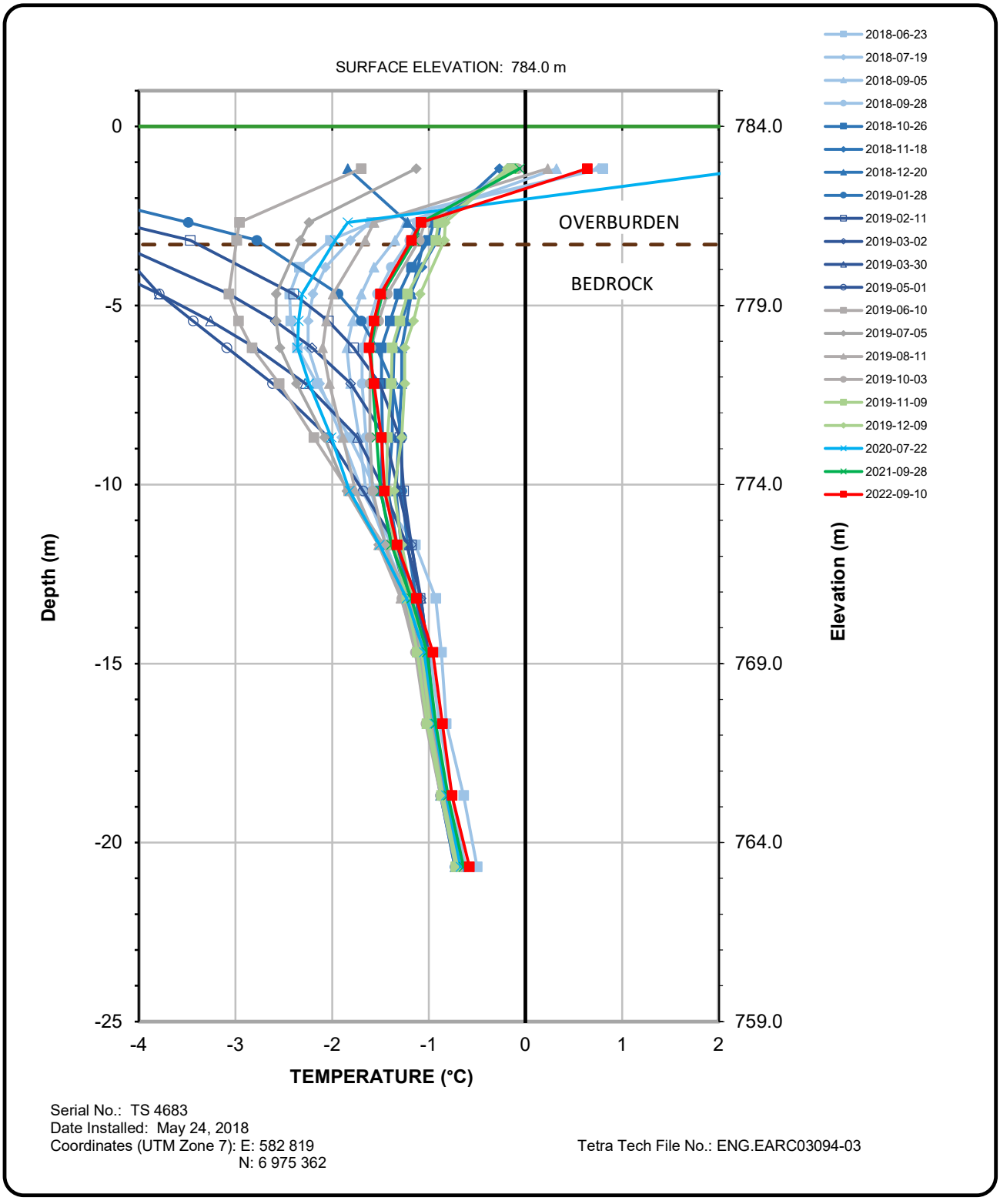


Serial No.: TS 4686
Date Installed: June 3, 2018
Coordinates (UTM Zone 7): E: 582 731
N: 6 975 305

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Alpha Pond, Borehole SRK-AP-18-01
Elevation: 790.4 m

TETRA TECH

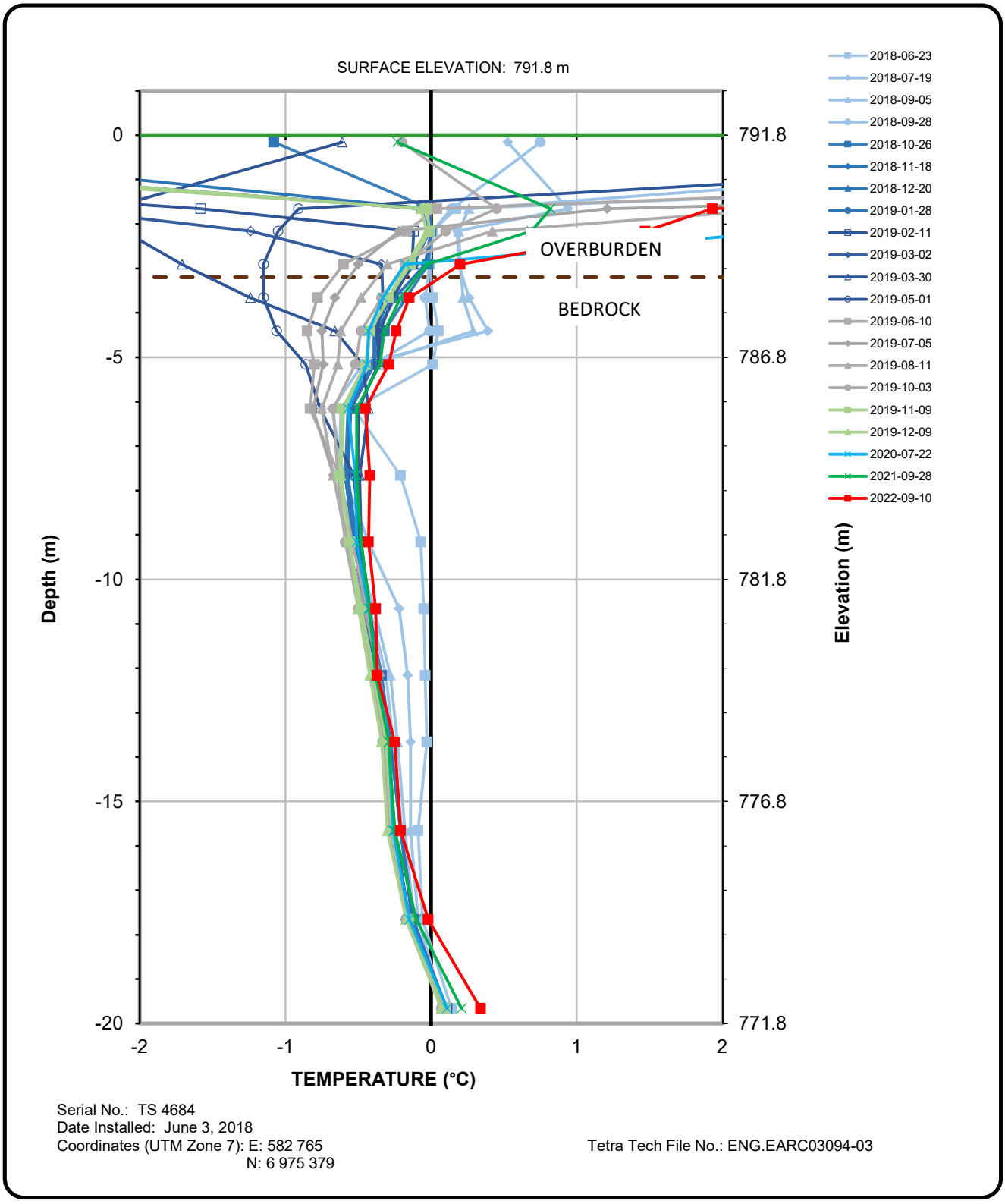


Serial No.: TS 4683
Date Installed: May 24, 2018
Coordinates (UTM Zone 7): E: 582 819
N: 6 975 362

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Alpha Pond, Borehole SRK-AP-18-05
Elevation: 784.0 m

TETRA TECH

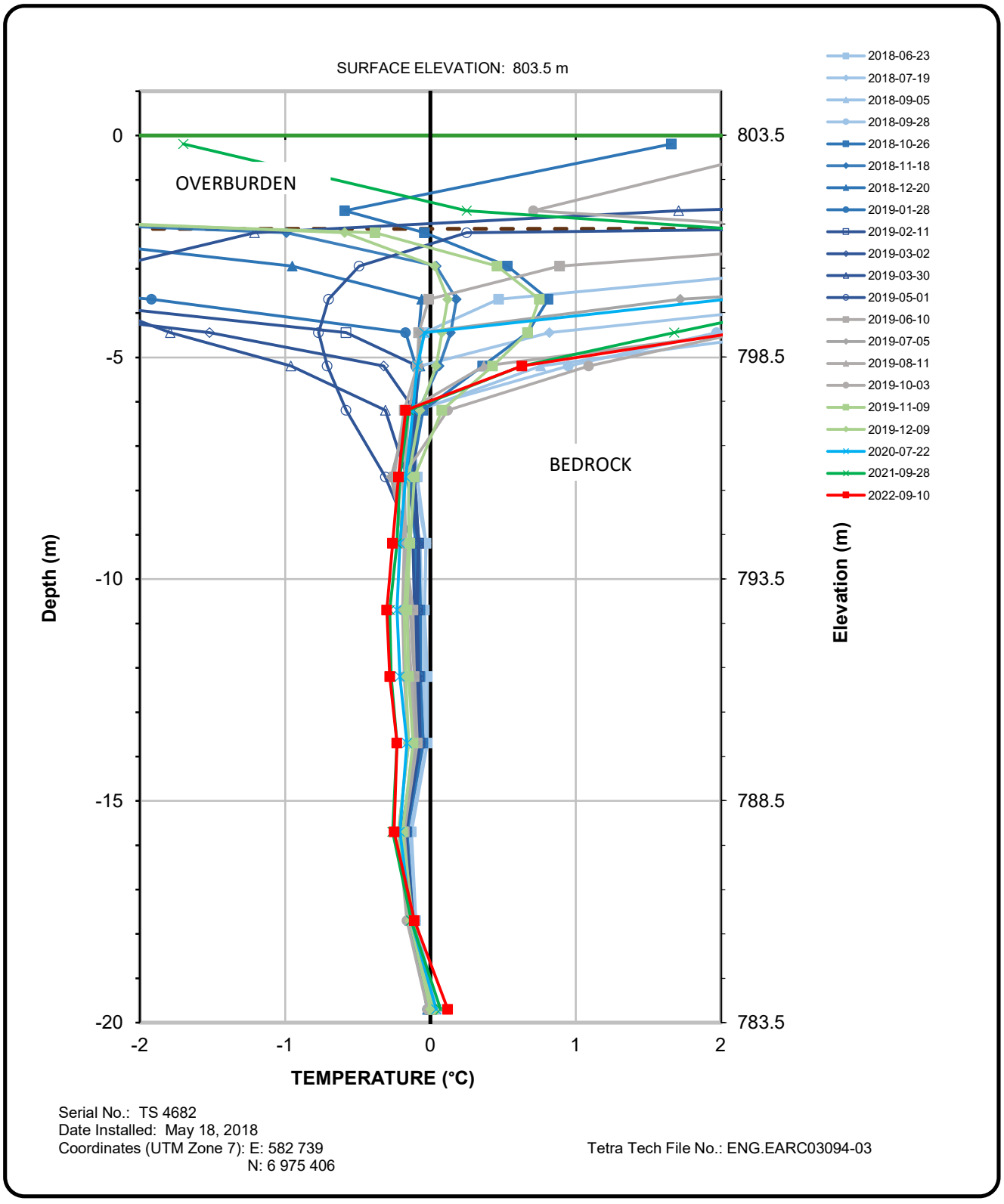


Serial No.: TS 4684
Date Installed: June 3, 2018
Coordinates (UTM Zone 7): E: 582 765
N: 6 975 379

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Alpha Pond, Borehole SRK-AP-18-06
Elevation: 791.8 m

TETRA TECH

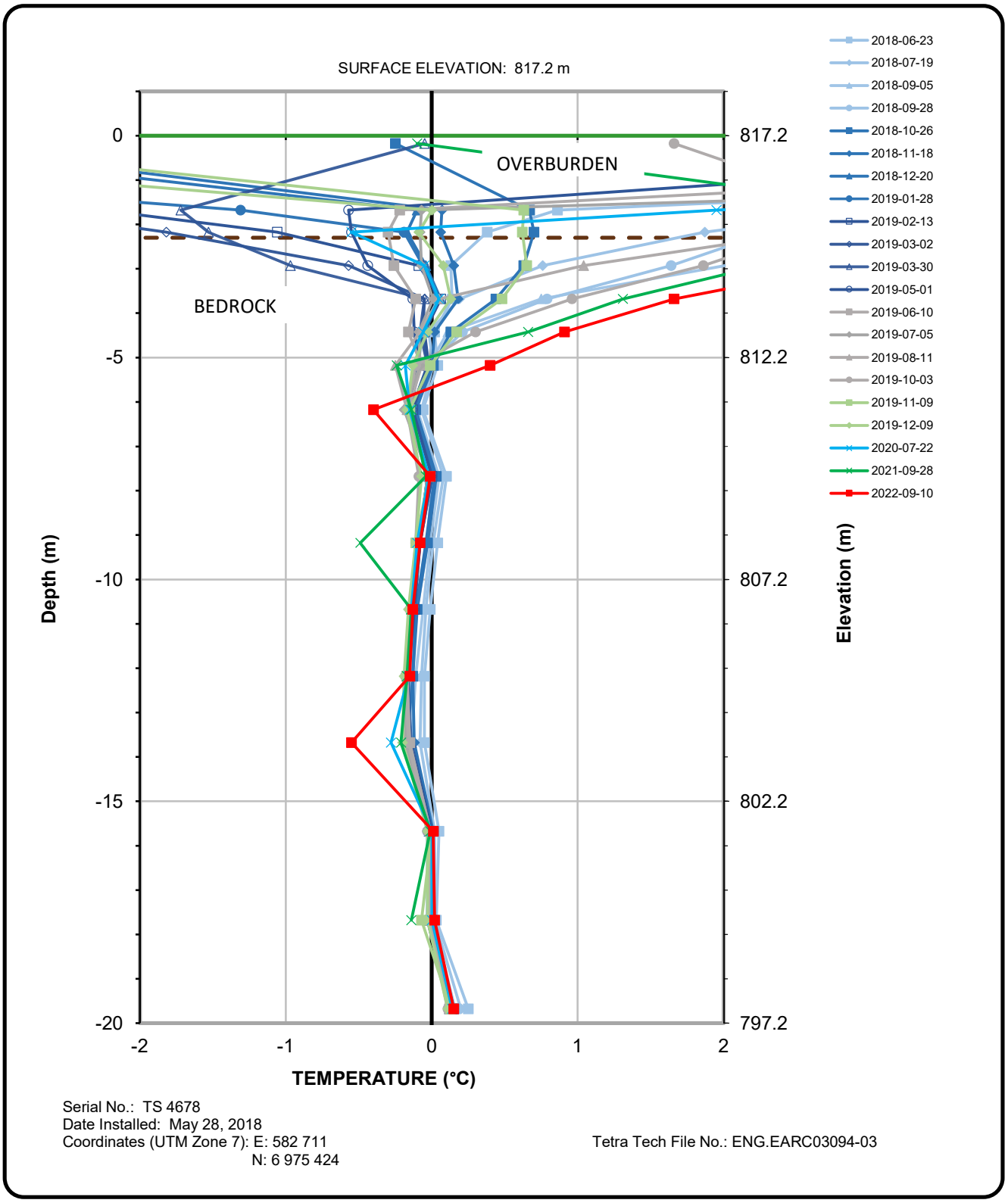


Serial No.: TS 4682
Date Installed: May 18, 2018
Coordinates (UTM Zone 7): E: 582 739
N: 6 975 406

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Alpha Pond, Borehole SRK-AP-18-07
Elevation: 803.5 m

TETRA TECH

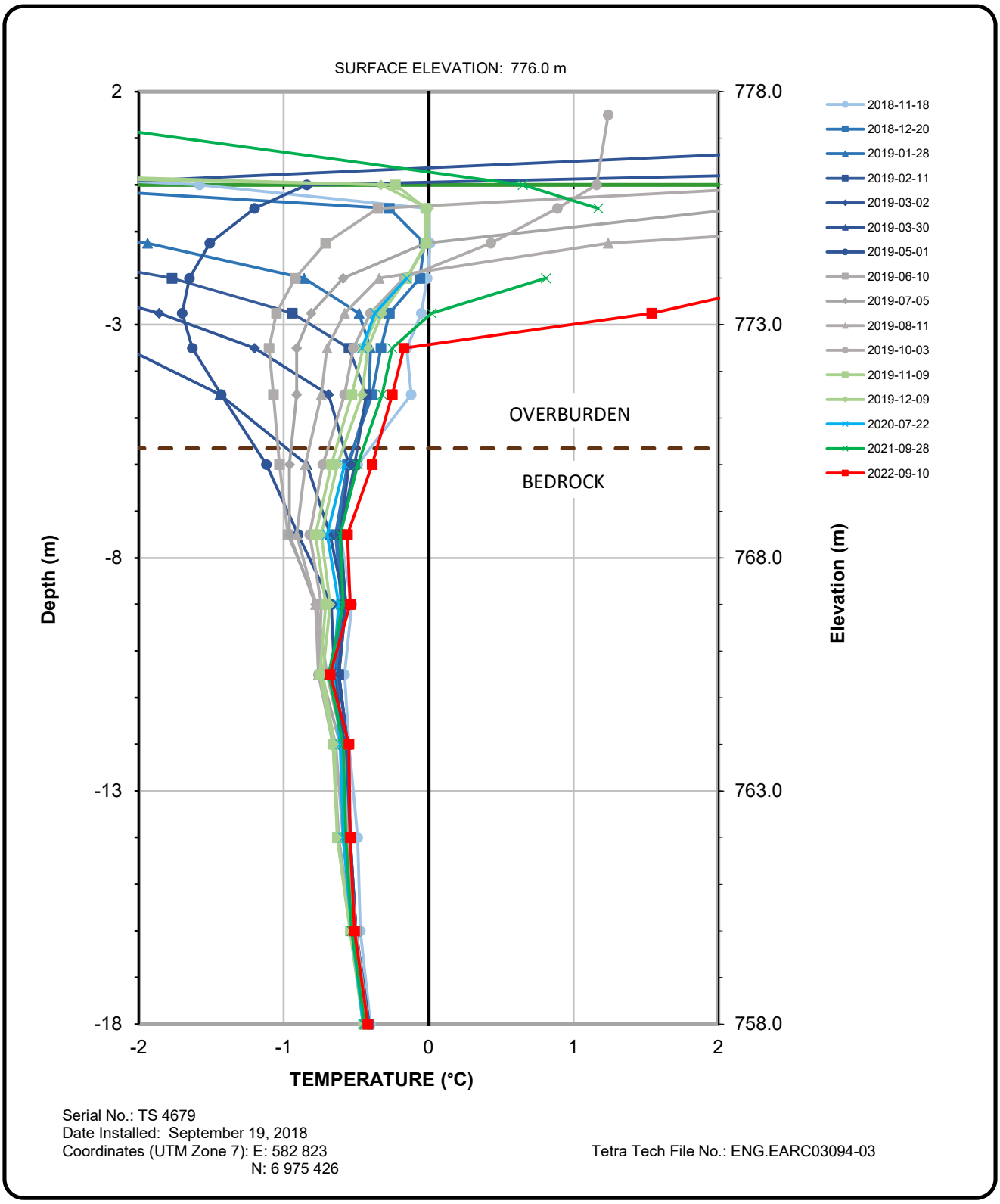


Serial No.: TS 4678
Date Installed: May 28, 2018
Coordinates (UTM Zone 7): E: 582 711
N: 6 975 424

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Alpha Pond, Borehole SRK-AP-18-08
Elevation: 817.2 m

TETRA TECH

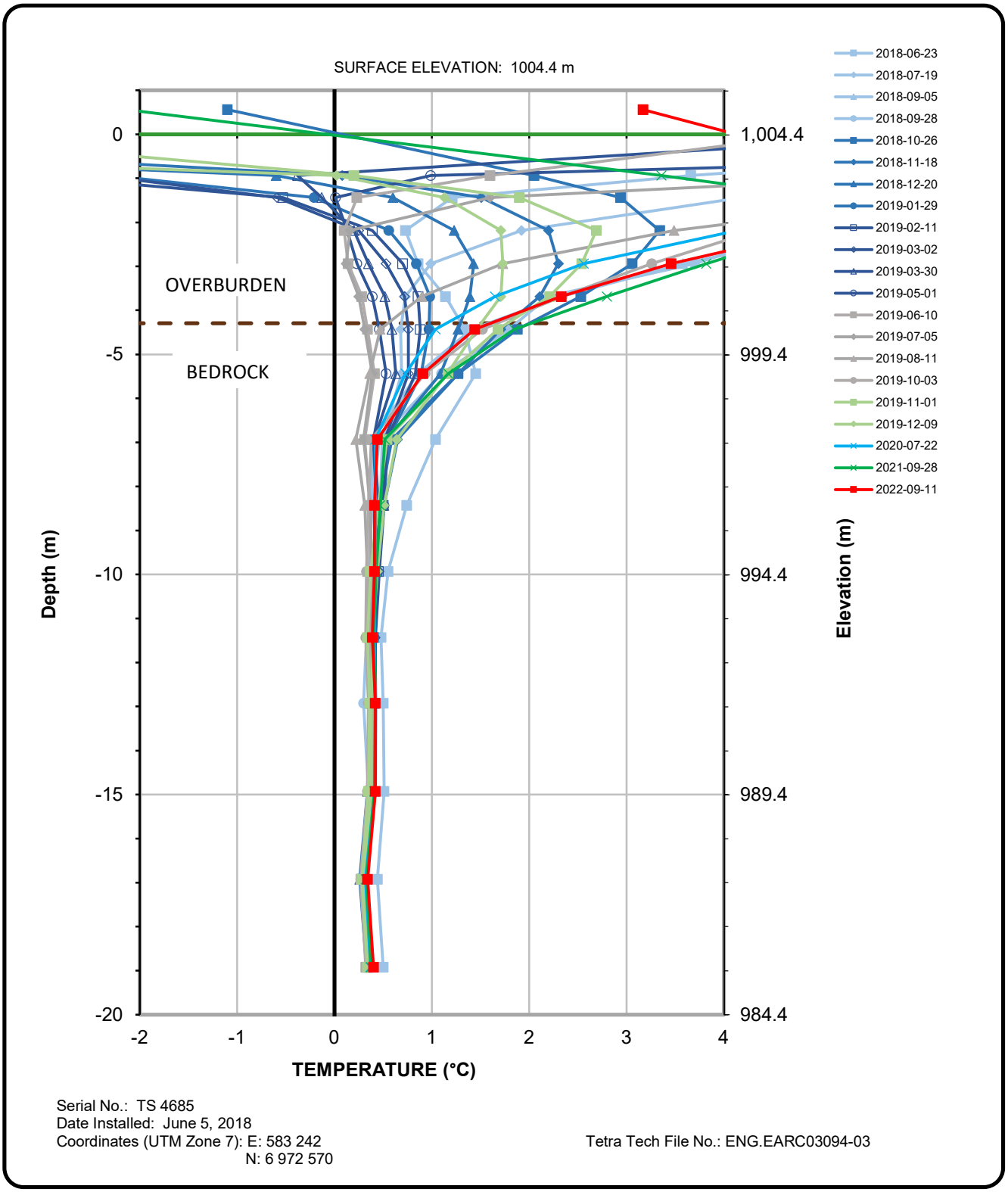


Serial No.: TS 4679
Date Installed: September 19, 2018
Coordinates (UTM Zone 7): E: 582 823
N: 6 975 426

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Alpha Pond, Borehole SRK-AP-18-11
Elevation: 776.0 m

TETRA TECH

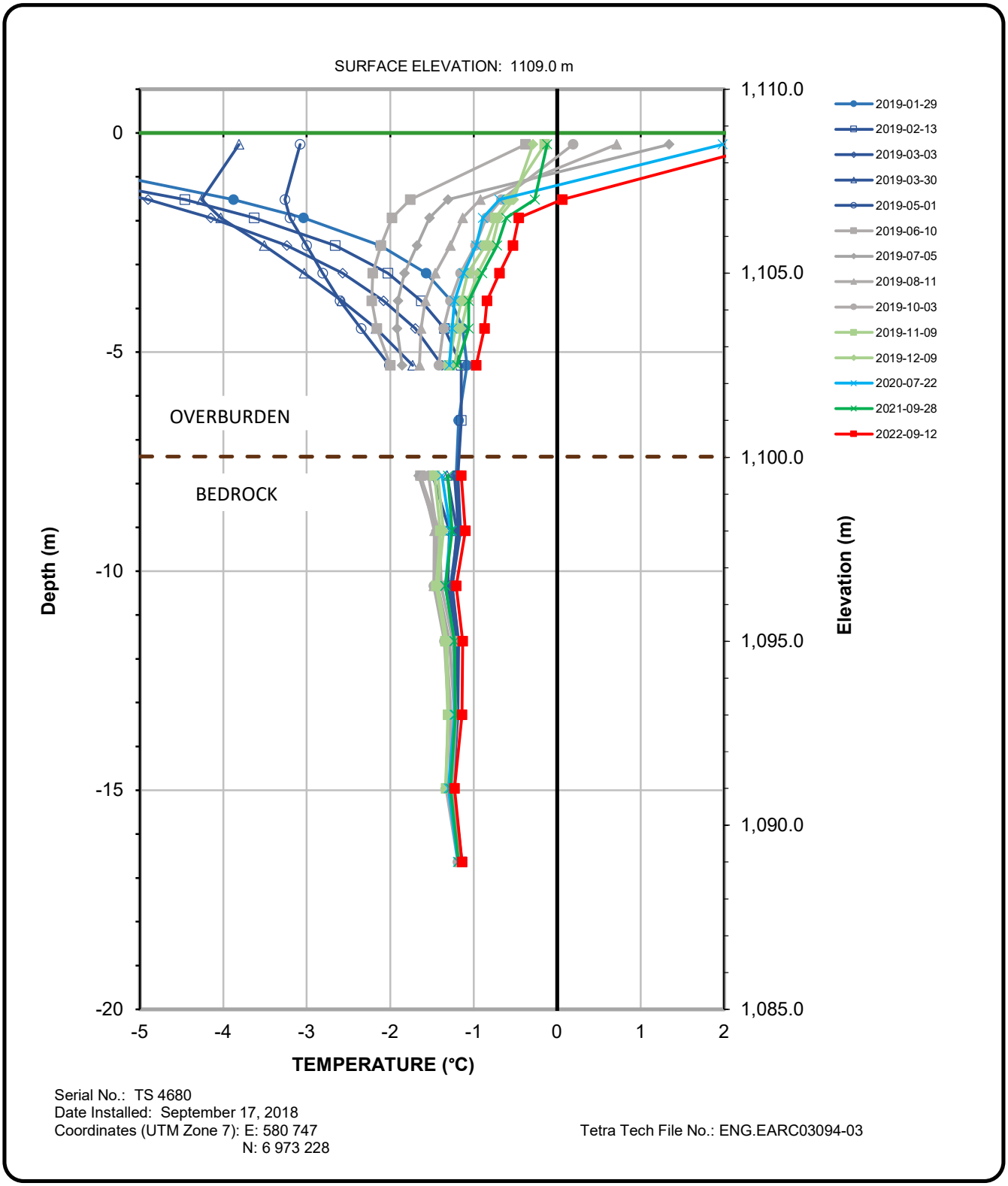


Serial No.: TS 4685
Date Installed: June 5, 2018
Coordinates (UTM Zone 7): E: 583 242
N: 6 972 570

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Facility Pond, Borehole SRK-FP-18-03
Elevation: 1004.4 m

TETRA TECH



Serial No.: TS 4680
Date Installed: September 17, 2018
Coordinates (UTM Zone 7): E: 580 747
N: 6 973 228

Tetra Tech File No.: ENG.EARC03094-03

Ground Temperature Profile
Kona Pond, Borehole SRK-KP-18-03
Elevation: 1109 m

TETRA TECH

APPENDIX 5-A

2023 Feasibility Pit Slope Stability Update

NEWMONT COPORATION
COFFEE GOLD PROJECT

FEASIBILITY PIT SLOPE STABILITY UPDATE

REPORT DATE: AUGUST 9, 2023



PREPARED FOR

NEWMONT COPORATION
Suite 3400, 666 Burrard St.,
Vancouver, BC V6C 2W2

PREPARED BY

JDS ENERGY & MINING INC.
Suite 900, 999 West Hastings St.,
Vancouver, BC V6C 2W2

Table of Contents

1 Introduction and Scope of Work 1-1
1.1 Project Background 1-1
1.2 Scope of Work 1-1
2 Geological Setting 2-1
2.1 Property Geology 2-1
2.2 Site Structural Geology 2-3
2.2.1 Metamorphic Foliation 2-4
2.2.2 Jurassic Shearing 2-4
2.2.3 Brittle Fracturing and Faulting 2-4
3 Field Data Collection Program 3-1
3.1 Geotechnical Core Logging 3-2
3.2 Point Load Testing 3-4
3.3 Orientation of Discontinuities 3-5
3.4 Test Pitting Program 3-6
4 Laboratory Testing Program 4-1
4.1 Unconfined Compressive Strength and Elastic Properties 4-1
4.2 Triaxial Compressive Strength 4-2
4.3 Indirect Tensile Strength Testing 4-3
4.4 Direct Shear Strength Testing 4-3
4.5 Unit Weight 4-4
5 Rock Mass Characterization 5-1
5.1 Rock Mass Domains 5-1
5.2 Intact Rock Strength 5-1
5.3 Rock Mass Classification 5-3
5.4 Rock Mass Shear Strength 5-5
5.5 Groundwater 5-7
6 Geologic Discontinuities 6-1
6.1 Structural Domains 6-1
6.2 Kinematic Assessment 6-6
7 Bench Design Considerations 7-1
7.1 Description of Methodology 7-2
7.2 Bench Design Conclusions 7-4

8 Interramp / Overall Slope Stability Analyses 8-1
8.1 Slope Stability Sections 8-2
8.2 Methodology 8-2
8.3 Geomechanical Parameters 8-3
8.4 Results of Interramp/Overall Stability Analysis 8-4
9 Pit Slope Design Recommendations 9-1
10 Assessment of Future Geomechanical Work 10-1
11 Closure 11-1
12 References 12-1

List of Tables

Table 2-1: Main Rock Units in the Coffee Gold Project Area 2-3
Table 2-2: Tectonic Events at Coffee 2-3
Table 3-1: Summary of Geomechanical Drillholes 3-1
Table 3-2: Summary of PLT Is(50) Results 3-4
Table 4-1: Average Intact Rock Properties Derived from Laboratory Test Results 4-2
Table 4-2: Direct Shear Test Results 4-4
Table 5-1: Summary of UCS Values Correlated from PLTs 5-3
Table 5-2: Summary of Rock Mass Classification Data 5-4
Table 5-3: Design Rock Mass Parameters 5-7
Table 6-1: Supremo East and West Domain Discontinuity Sets 6-3
Table 6-2: Latte and Double Double Domain Discontinuity Sets 6-5
Table 6-3: Kona Domain Discontinuity Sets 6-6
Table 8-1: Results of Overall / Interramp Slope Stability Modeling 8-4
Table 9-1: Recommended Pit Slope Design Parameters 9-2
Table 10-1: Recommended Additional Geotechnical Drillholes 10-1

List of Figures

Figure 2-1: Geology in the Supremo, Latte, Double Double, and Kona Areas 2-2
Figure 3-1: Location of 2015 and 2018 Geotechnical Drillholes 3-2
Figure 5-1: Correlation of Laboratory UCS and Field Point Load Index Test Results 5-2
Figure 6-1: Supremo Pit Domain and Discontinuity Pole Plots 6-2
Figure 6-2: Latte and Double Double Pit Domain and Discontinuity Pole Plots 6-4
Figure 6-3: Kona Pit Domain and Discontinuity Pole Plot 6-4
Figure 7-1: Explanation of Bench Design Terminology 7-2
Figure 8-1: Pit Slope Design Components 8-1
Figure 8-2: Location of Critical Slope Stability Cross Sections 8-2
Figure 9-1: Pit Slope Design Recommendations 9-1

List of Appendices

Appendix A: Geotechnical Core Logs
Appendix B: Laboratory Test Results
Appendix C: Interramp/Overall Stability Analyses

1 INTRODUCTION AND SCOPE OF WORK

Newmont Corporation. (Newmont) requested that JDS Energy & Mining, Inc. (JDS) carry out a supplemental pit slope stability evaluation update for the Coffee Gold Project located in west-central Yukon Territory, Canada. This supplemental pit slope evaluation was carried out to investigate the possibility of increasing pit slope angles in order to reduce waste stripping. The original pit slope evaluation and geotechnical design criteria was carried out by SRK (2016) as part of the project Feasibility Study (JDS 2016).

This report and supplemental pit slope stability evaluation update is primarily based on a Geotechnical Investigations (GI) conducted in 2018 by JDS. A minor supplemental test pitting program was completed across the open pits in 2018 (after the 2018 GI) to provide better estimates of the amount of organics and overburden soils that will be encountered. Relevant details regarding the 2018 test pitting program are summarized in Section 3.4.

Newmont has indicated that, although some updated pit shells have been run more recently, the pit designs assessed in 2018 still remain current.

1.1 Project Background

The Coffee Gold Project is located in the White Gold district, approximately 130 km south of Dawson City and 85 km east of the Alaskan border near the confluence of White and Yukon Rivers. The area consists of low mountainous terrain with steep valleys and rounded ridges, typical of central Yukon. The elevation of the mine site is approximately 1,300 m above sea level.

The Project is currently comprised of four separate open pits (Supremo, Latte, Double Double and Kona), a permanent waste rock storage facility and heap leach pad and supporting infrastructure facilities and roadways. The development is primarily located on a central ridge line between Halfway Creek and Latte Creek, with limited impacts beyond the slope of the ridgeline.

Based on the previous Feasibility Study (JDS, 2016), a nominal ore mining rate of 5 million tonnes per annum would be mined using conventional truck and shovel methods for approximately ten years. A total of 312 Mt of material would be mined to produce 46.4 Mt of ore (5.7:1 strip ratio).

Open pit mining operations will currently use a fleet comprising industry-standard hydraulic shovels, front-end loaders, excavators, and haul trucks. This fleet will be supplemented by appropriately sized drills, graders, and dozers. The fleet selected results in a design ramp width of 27 m.

1.2 Scope of Work

The scope of work for the pit slope stability update included the following:

- Recommendation of the number, location and orientation of core holes believed to be appropriate to update or refine the original SRK (2016) geotechnical design;

- Geotechnical core logging, point load testing and orientation of discontinuities intersecting core recovered from the drillholes in order to characterize pit wall geotechnical conditions;

- Selection of representative drill core samples and management of the laboratory strength testing program;

- Analyses and interpretation of the geotechnical field data and laboratory test results to develop a comprehensive geotechnical model to serve as the basis for slope stability modeling;

- Geotechnical modeling of bench, interramp and overall slopes for the four proposed open pits;

- Assess impact on geotechnical design recommendations of the 2018 test pitting program that was conducted to provide better estimates of the amount of organics and overburden soils; and

- Provide geotechnical design recommendations based on the analyses and compilation of a feasibility-level Pit Slope Stability Evaluation Update report.

2 GEOLOGICAL SETTING

The following summary has been reproduced from Section 7 of the JDS (2016) NI 43-101 Feasibility Study Technical Report for the Coffee Gold Project.

2.1 Property Geology

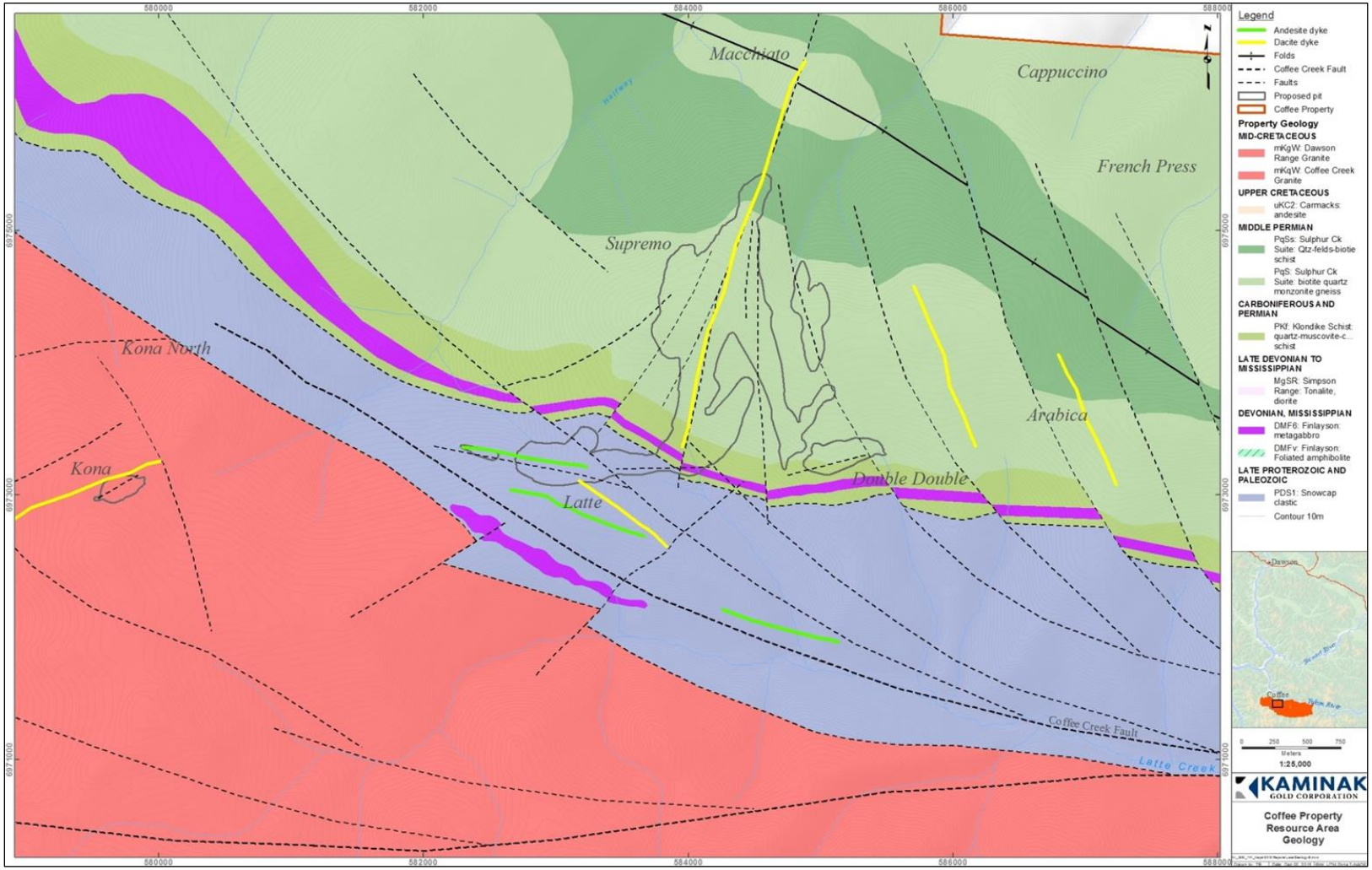
The Coffee Project area is underlain by a package of metamorphosed Paleozoic rocks of the Yukon–Tanana Terrane (YTT) that was intruded by a large granitic body in the Late Cretaceous. The Paleozoic rock package consists of a mafic schistose to gneissic panel which overlies the Sulphur Creek orthogneiss. Both packages form the southwestern limb of a northwest-trending antiformal fold with limbs dipping shallowly to the northeast and southwest.

The schistose and gneissic mafic rock package comprises a thick panel of biotite (+ feldspar + quartz + muscovite ± carbonate) schist with rare lenses of amphibolite which overlies a panel of amphibolite and metagabbro with arc-derived geochemical signatures. Within the schistose panel, slices of 20 m thick serpentinized ultramafic are in tectonic contact with the surrounding rocks. This rock sequence overlies the augen orthogneiss. These rocks are in contact to the southwest with the 98.2 ± 1.3 Ma Coffee Creek granite. Both the Paleozoic metamorphic rocks and Cretaceous granite are cut by intermediate to felsic dykes of andesitic to dacitic composition.

Due to only rare outcrop exposure on the property (<5%), the geological map (Figure 2-1) has been compiled from a combination of geological traverses, bedrock mapping, borehole data, soil geochemistry, and geophysics (magnetic and radiometric).

The magnesium number from soil samples (Mg# = Mg/Mg+Fe) was used to discern mafic from felsic units with the granite being the most felsic, followed by the felsic gneiss. The mafic schist unit was further subdivided into felsic-intermediate schist, biotite schist, amphibolite, and ultramafic rocks (Table 2-1).

Figure 2-1: Geology in the Supremo, Latte, Double Double, and Kona Areas



Source: Grodzicki, K. R., Allan, M. M., Hart, C.J.R., and Smith, T. 2015. Geologic Map of the Coffee Gold deposit area, western Dawson Range, Yukon (MDRU Map M-9)

Table 2-1: Main Rock Units in the Coffee Gold Project Area

Rock Unit	Description
Felsic Gneiss	Variable quartz + feldspar augen + biotite + muscovite. Typical Mg# 2-28. Low in potassium. Host to gold mineralized zones at Supremo.
Biotite Schist	Biotite+/-feldspar+/-quartz+/-muscovite+/- amphibole. Commonly carbonate-rich. High in potassium. Typical Mg# 20 - 40. Locally mylonitic. Host to gold mineralized zones at Latte.
Muscovite Schist	Mainly quartz + muscovite. Typical Mg# 10 - 20. Locally mylonitic.
Biotite Amphibolite	Amphibole + feldspar + biotite. Typical Mg# 20 -40. Biotite and amphibole both Fe-rich. Contains up to 20% biotite.
Amphibolite	Found within the lower mafic footwall. Amphibole + feldspar ± biotite. Typical Mg# 30-50, biotite and amphibole more Mg rich than biotite amphibolite. Contains up to 15% biotite.
Metagabbro/Amphibolite	Interleaved metagabbro with coarse magnesiohornblende + feldspar, and fine-grained, massive amphibolite with >95% magnesiohornblende. Moderate to strong retrogression to actinolite. High Mg content of biotite, amphibole.
Ultramafics	Serpentinite, pyroxenite or listwaenite. Typical Mg# 50 - 73, higher than all amphibolites and metagabbro. Very high in chromium and nickel.
Granite	Coffee Creek granite and Dawson Range batholith. Both are phases of the Whitehorse Plutonic suite and are uranium-rich. Dawson Range batholith higher in Thorium. Both are identifiable using airborne radiometrics.
Dacite Dykes	Quartz + feldspar phenocryst porphyry. Generally, strongly silicified and sericitized. Strong spatial association with mineralized gold zones.
Andesite Dykes	Feldspar phenocrystic. Aphanitic in gold-bearing structures where all original textures are destroyed by intense silicification and sericitization. Strong spatial association with mineralized gold zones.

Source: JDS (2016)

2.2 Site Structural Geology

Rocks at the Coffee Project were deformed by a series of three YTT-wide tectonic events (Table 2-2). Gold mineralization at Coffee occurred during the Cretaceous event.

Table 2-2: Tectonic Events at Coffee

Event	Age	Structures	Mineralization
Extension	Cretaceous	Brittle Fractures	Main Coffee Gold mineralization
		Dextral normal faults	

Event	Age	Structures	Mineralization
YTT-Laurentia Collision	Jurassic	East-west shears and thrust faults	Quartz veining, sericite alteration
		Slices of ultramafic rocks	
Klondike Orogeny	Pre- to late-Permian	Metamorphic gneissosity and schistosity	

Source: JDS (2016)

2.2.1 Metamorphic Foliation

Gneissose and schistose metasedimentary rocks at Coffee contain a shallowly-to-moderately southwest dipping penetrative cleavage (S2 foliation of Berman et al. (2007). The foliation becomes steeper-dipping to the south. Structural data collected from oriented drill core show the following average orientations:

- Supremo: 20° to 40° dip to the south-southwest (190° to 230°);
- Latte: 35° to 55° dip to the south-southwest (180° to 210°); and
- Double Double: 35° to 65° dip to the south-southwest (170° to 200°).

2.2.2 Jurassic Shearing

As the YTT-Laurentia collision continued and the Slide Mountain Ocean was completely closed, the rocks in the Coffee area developed roughly east-west brittle-ductile shears and younger rocks were thrust north over older rocks. This deformation corresponds to the D3 deformation of Berman et al., 2007. This deformation is best seen in the more mafic rocks of the southern schistose panel where intervals of mylonitic rocks are traceable between multiple sections.

2.2.3 Brittle Fracturing and Faulting

Following post-collision uplift and erosion in the YTT, steep-to-vertical brittle fractures and normal faulting affected all lithologies at Coffee. These brittle structures are the hosts to gold mineralization at Coffee. This deformation corresponds to the D5 deformation of Berman et al. (2007). The faults and fractures are splays of the regional Big Creek fault to the southeast of the property. The faults may have locally followed pre-existing Jurassic shear zones. The faults both deflect along the northern edge of the Coffee Creek granite and cut the granite and therefore are syn-to-post granite emplacement (~98 Ma). Younger dacite and andesite dykes intruded into these brittle fractures.

Gold mineralized structures comprise strike-extensive planar zones exhibiting a continuum of deformation intensity from crackle breccia/stockwork fracture systems through to polyphaser

high-energy matrix-supported breccias with intensely altered and reworked clasts. Individual mineralized structures exhibit localized flexures, anastomosing patterns and pinch and swell geometries over scales of tens to hundreds of meters. Overall however, gold mineralization, accompanied by elevated arsenic and antimony, wallrock alteration, deformation intensity, the presence of sub-parallel pre-mineralization dykes, and post-mineral oxidation in the upper 0 to 300 m below surface, display continuity over hundreds of meters in strike and dip, and over 2 km along strike at Supremo T3 and Latte.

Structural measurements of vein orientations and deformation fabrics from oriented drill core provide hard evidence on the structural geometries but are often not available in the mineralized zones due to the disaggregated nature of fractured and often clay-altered core. Where intact core is able to be measured, various structural fabrics from within mineralized zones are used to measure local orientation of mineralization and guide 3D geometric interpretation of mineralization on section and from section to section. Fabrics measured include the dominant fracture orientation, internal fracture or shear fabric, breccia margin, and vein or dyke margin orientation.

The planar gold mineralized zones at Coffee exhibit a number of strike orientations, dominated by east-west, north-south and east-northeast–west-southwest strike directions. Structures typically have sub-vertical dip, with the exception of western Latte which dips 60° to 70° south.

3 FIELD DATA COLLECTION PROGRAM

The 2018 Geotechnical Investigation (GI) was designed with the primary objective of rock mass characterization and discontinuity orientation to augment the previous Geomechanical Model. The 2018 GI was designed very similar to the 2015 GI to allow integration of the two data sets. Both Programs consisted of geotechnical core logging and discontinuity orientation, point load testing and laboratory rock strength testing. The 2018 GI also included downhole surveying of discontinuities with a televiewer. This section focuses on details of the 2018 Geotechnical Investigation. Additional details regarding the 2015 Geotechnical Investigation are contained in SRK, 2016.

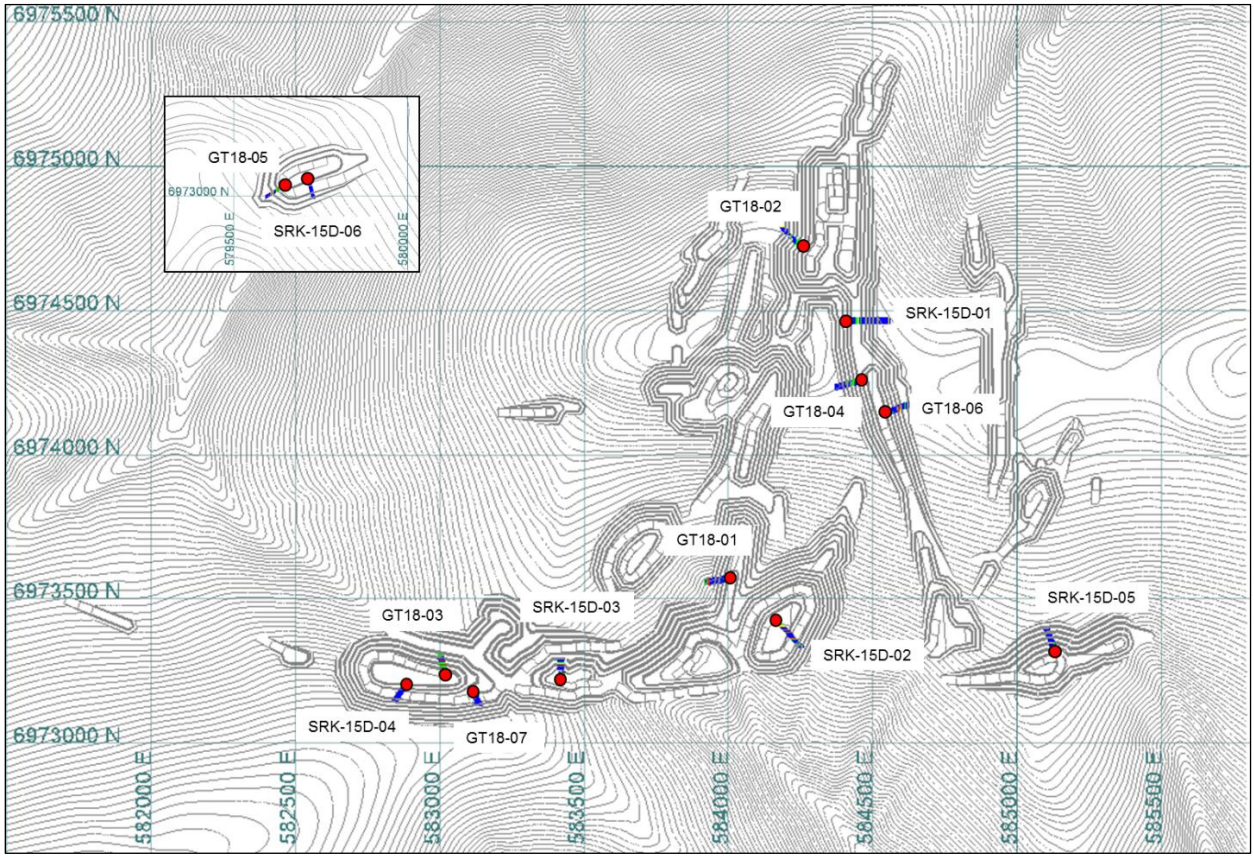
A total of 13 HQ3 diameter core holes were logged and tested between the two programs totaling 2,105 m in length. Drillhole inclinations of approximately 60º below horizontal were targeted since they were judged to be more likely, than would vertical holes, to intersect geologic structures such as joints and faults which would most adversely influence pit slope stability. Collar locations and drillhole orientations of the combined 13 geotechnical specific drillholes from the 2015 and 2018 Programs are summarized in Table 3-1 and shown on Figure 3-1. The geotechnical drillholes targeted the final pit walls. Due to the narrow width of the mineralization and pits, very few, if any, phased pit walls will exist.

Table 3-1: Summary of Geomechanical Drillholes

Program	Hole ID	Deposit	Easting (UTM)	Northing (UTM)	Elevation (masl)	Depth (m)	Azi. (º)	Inc. (º)
2015	SRK-15D-01	Supremo	584,411	6,974,465	1,256	245	090	-51
	SRK-15D-02	Supremo	584,168	6,973,424	1,031	215	137	-52
	SRK-15D-03	Latte	583,421	6,973,227	1,098	110	359	-50
	SRK-15D-04	Latte	582,881	6,973,203	1,099	152	264	-60
	SRK-15D-05	Double Double	585,127	6,973,328	1,106	134	340	-55
	SRK-15D-06	Kona	579,716	6,976,046	1,262	100	340	-55
2018	GT18-01	Supremo	584,000	6,973,570	1,053	175	263	-61
	GT18-02	Supremo	584,243	6,974,730	1,251	192	316	-62
	GT18-03	Latte	583,016	6,973,249	1,094	155	346	-65
	GT18-04	Supremo	584,459	6,974,257	1,252	196	256	-61
	GT18-05	Kona	579,628	6,973,019	1,276	105	239	-65
	GT18-06	Supremo	584,552	6,974,146	1,237	180	069	-61
	GT18-07	Latte	583,122	6,973,169	1,117	145	161	-72

Source: JDS (2019)

Figure 3-1: Location of 2015 and 2018 Geotechnical Drillholes



Source: JDS (2019)

3.1 Geotechnical Core Logging

Geotechnical logging, field point load testing and orientation of discontinuities intersected by core recovered from a total of seven drillholes were conducted to support this update. Drilling was carried out using 1.5 m long, HQ3 diameter triple tube core barrels to preserve the in situ condition of the rock to the largest extent possible. To minimize disturbance, core retrieved from the seven holes was logged on a 24-hour per day basis, at the rig, in the liners prior to boxing and transporting.

The geotechnical core logging program was designed to provide information pertinent to pit slope stability evaluation, such as geologic contacts, profiles of rock strength, and characterization and frequency of discontinuities. Specific parameters that were logged included:

- General lithology and structures;

- Total core recovery;
- Rock Quality Designation (RQD);
- Rock weathering/alteration and intact strength indices;
- Frequency of discontinuities;
- Discontinuity characteristics (type, roughness, infillings and wall condition);
- Micro-defect intensity and strength; and
- Discontinuity orientation (when possible).

Core retrieved from the geotechnical drillholes was logged at the rig by trained geologists or geotechnical engineers before transportation to the core logging facility. Geotechnical markings on the core were made using a standardized system. Care was taken to exclude fractures that were caused during drilling and handling as the inclusion of such would unnecessarily lower rock quality classifications. Geotechnical core logs are presented in Appendix A.

Information regarding major geologic structures, such as faults and shear zones, was also obtained during the logging program. Major structures, as observed in core, often include heavily fractured or broken zones, sheared zones and/or sections of gouge. These large-scale structures are weakening features that are captured separately from the basic logging parameters. They are commonly widely spaced and can serve as a reference to define geotechnical zones or domains. The following information was recorded for each major structure:

- Depth of the feature;
- A quality descriptor of the feature (jointed, broken, sheared or gouged);
- The number of joints or fractures attributed to the feature; and
- The orientation or angle of the structure with respect to the core axis (when possible).

During core logging, representative core samples were selected from each drillhole to provide specimens for laboratory strength testing. Samples were collected at approximately 15 m intervals, or when significant rock type or strength changes were apparent. Each sample was sealed and safely stored at the time of collection. Upon completion of the drilling, test samples were shipped to the Queen's University Rock Mechanics Laboratory in Kingston, Ontario for testing. Details of the laboratory testing program are contained in Section 4.

Following the completion of geomechanical logging and sampling, each of the geotechnical drillholes was logged for lithology and alteration by Goldcorp (previously Kaminak) geologists to assure the best possible correlation of the geotechnical data with the current Goldcorp Geologic Model.

3.2 Point Load Testing

Point load testing provides a quick, inexpensive method of relative strength testing of rock core that can be conducted in the field allowing a large number of tests to be carried out. Although not a precise measurement of rock strength, this method typically provides a more accurate estimation of variability compared to laboratory testing as smaller and weaker samples can be immediately tested at their natural moisture content and without potential disturbance that can occur during shipping.

Point load tests (PLT) were routinely conducted during the 2018 core logging program at a frequency of approximately one test per 1 m using a Matest A125N test machine, thereby providing detailed and nearly continuous profiles of relative rock hardness. In addition to the routine tests, approximately three additional tests were also conducted on core immediately adjacent above and below each uniaxial compressive strength (UCS) sample obtained for laboratory testing. The pairing of PLT results and UCS samples was undertaken to permit estimation of a correlation factor for conversion of the field PLT tests to laboratory UCS values as discussed in Section 5.2. PLTs were conducted according to International Society for Rock Mechanics (ISRM) procedures (ISRM, 1985).

A total of 1,242 point load tests were conducted on core from the seven, 2018 geotechnical drillholes; of those, 853 (69%) met test criteria for valid test results. Point load indices (Is(50)) were calculated from the field PLT data using the ISRM (1985) suggested method. The combined 2015 and 2018 PLT results are summarized in Table 3-2 for each primary rock type and oxidation group. Only tests considered valid per ISRM standards, i.e., those tests in which the core did not break along pre-existing weakness, were utilized for the analysis. Invalid or failing tests that broke along a pre-existing defect such as a healed joint or foliation plane were considered separately and used as an indicator of the potential strength anisotropy of the rock types.

Table 3-2: Summary of PLT Is(50) Results

Pit	Lithology	Oxide Zone	No. of Tests	$Is_{(50)}$ (MPa)[1]			
				Average	Std. Dev.	Min.	Max.
Supremo	Gneiss (MXF/MxM/FG)	Oxide	16	3.7	1.9	0.5	7.4
		Upper Trans	12	5.4	2.3	0.6	9.2
		Middle Trans	54	5.5	2.3	0.8	11.9
		Lower Trans	94	6.2	2.3	0.5	10.1
		Fresh	260	6.6	2.2	0.2	12.5
Double Double	Gneiss (MxF/MxM)	Oxide	-	-	-	-	-
		Upper Trans	-	-	-	-	-
		Middle Trans	3	2.2	0.4	1.7	2.5
		Lower Trans	11	2.7	1.2	1.3	4.5
		Fresh	14	4.1	2.4	0.5	7.9
	Schist (BtS)	Fresh	20	4.3	2	1.6	8.1

Pit	Lithology	Oxide Zone	No. of Tests	$Is_{(50)}$ (MPa)[1]			
				Average	Std. Dev.	Min.	Max.
Latte	Schist (BtS/Bts_carb)	Oxide	1	3.8	-	3.8	3.8
		Upper Trans	10	3.7	1.7	1.1	7.6
		Middle Trans	21	3.4	1.2	1.7	5.9
		Lower Trans	48	3.3	1.8	0.3	7.8
		Fresh	49	2.7	1.7	0.3	9.4
Kona	Granite (GG)	Oxide	-	-	-	-	-
		Upper Trans	3	4	0.5	3.6	4.4
		Middle Trans	5	3.7	1.2	2.3	4.9
		Lower Trans	8	5	0.9	3.9	6.2
		Fresh	26	5.6	1.7	1.9	8.8

Source: JDS (2019)

3.3 Orientation of Discontinuities

An ACTIII Core Orientation System manufactured by Reflex Instruments was used to attempt to orient the discontinuities in each run for both the 2015 and 2018 Programs. The depth, alpha angle, and beta angle were measured for each discontinuity on all core runs that were successfully oriented. The beta angle, i.e., the angle from the lowest part of the ellipse formed by the intersection of each discontinuity with the core, was measured from the bottom of the core in a clockwise direction when looking down hole. The alpha angle was also measured and is defined as the maximum angle made by the discontinuity with respect to the core axis.

It was possible to orient a total of 1,924 discontinuities out of the total 3,479 (55%) discontinuities logged for the seven, 2018 geotechnical holes, excluding “added” joints where a frequency of 4 joints per 10 cm was added to account for intensely fractured or rubbelized zones where counting of discrete joints was not possible. For the 2015 Program it was possible to orient a total of 1,581 discontinuities out of the total 2,158 (73%) discontinuities logged for the six geotechnical drillholes, excluding “added” joints.

Discontinuity orientations and conditions for the 2018 Program were also characterized using downhole optical (OTV) and acoustical (ATV) televiewing. DGI Geoscience Inc., of Toronto, ON completed the surveys which collected the depth, in situ orientation, width (mm) and an inferred type of discontinuity. A total of 5,811 discontinuities were identified by the televiewer between the seven 2018 drillholes (although only 1,190 (20%) had open apertures). Although similar, the ATV data set appears more consistent and reliable than the oriented core data sets and was therefore relied upon mostly for analyses of the 2018 data.

In addition to discontinuity orientations obtained from the 13 geotechnical specific drillholes listed above, a significant percentage of the diamond resource drillholes were also oriented by the previous owner, Kaminak Gold Corporation using the ACT orientation tool. These drillholes were

used to augment the geotechnical specific drillhole data set where possible. Additional details regarding the resource drillhole orientation database are contained in SRK, 2013 SRK, 2016.

3.4 Test Pitting Program

A supplemental test pitting program was completed across the open pits in 2018 (after the 2018 GI) to provide better estimates of the amount of organics and overburden soils that will be encountered. A total of 28 test pits were excavated to bedrock across the Supremo, Latte and Double-Double open pits. Results indicate that the depth of organics typically ranges from 0.2 to 0.7 m with up to approximately 2.5 m of overburden soils beneath. The materials were mostly unfrozen or ice-poor but materials with visible ice were encountered locally. Additional details regarding the test pitting program are summarized in the Tetra Tech (2019) report.

JDS has reviewed the results of this 2018 test pitting program, and given the limited organic and overburden depths encountered, that the results and recommendations of the 2018 analyses are not impacted.

4 LABORATORY TESTING PROGRAM

A total of 73 laboratory tests were performed on core samples selected to represent the range of the rock conditions observed in core from the 2018 Geotechnical Investigation. The overall laboratory testing consisted of uniaxial compressive, triaxial compressive, indirect tensile (Brazilian) and natural joint direct shear strength tests, as well as measurements of unit weight and elastic properties. The 2018 laboratory testing was carried out by the Queen's University Rock Mechanics Laboratory located in Kingston, Ontario. Raw laboratory test data are included in Appendix B. An additional 59 tests were carried out by Agapito Associates Inc. located in Grand Junction, Colorado and the University of Arizona Rock Mechanics Laboratory in Tucson, Arizona as part of the 2013 and 2015 test programs.

After completion of the laboratory testing program, before and after photographs of the test samples were forensically reviewed to confirm validity of test results. The type and quality of break were assessed through the sample photographs. Test samples that broke through a pre-existing structure or fabric and not through intact rock were discounted from the analyses, where possible. Due to the relatively high number of schist samples that broke along the schistose fabric or foliation, most of the strength values summarized below are influenced to some extent by the fabric/foliation.

4.1 Unconfined Compressive Strength and Elastic Properties

The uniaxial compressive strength (UCS) test is the most commonly used measure of intact rock strength and is one of the primary inputs to basic rock mechanics classifications and strength criteria such as rock mass rating systems and the Hoek-Brown (Hoek, et al., 2002) shear strength criteria, both of which are discussed in detail in Section 5.

UCS testing involves the application of a steadily increasing axial load upon a core sample with a length-to-diameter (L/D) ratio of, ideally, between 2.0 and 2.5. The uniaxial compressive strength of the sample is the applied load that produces failure divided by the cross-sectional area of the core.

For selected UCS tests, strain gauges were applied to the samples to monitor longitudinal and lateral strains produced by the axial loading. The elastic properties are derived from the strain gauge output; specifically, Young's Modulus (E) is the ratio of the vertical stress to the longitudinal strain, while Poisson's Ratio (ν) describes the relationship between the lateral strain and the longitudinal strain.

UCS testing was conducted on a total of 65 samples between the 2013, 2015 and 2018 testing programs according to ASTM Method D7012. Elastic properties (Young's Modulus and Poisson's Ratio) were measured for 20 of the 65 UCS samples. Young's moduli were also calculated for an additional 15 triaxial compressive strength tests as discussed below. The average laboratory UCS results for the combined 2015 and 2018 programs are summarized in Table 4-1 by primary rock type and oxidation zone, along with other laboratory test results.

Table 4-1: Average Intact Rock Properties Derived from Laboratory Test Results

Lithology	Oxide	γ (kN/m^3) [1]	BTS [1] (MPa)	UCS [1,2] (MPa)	E_i (GPa) [1]	ν [1]	m_i	σ_{ci} [2] (MPa)
Gneiss	All	25.4 (56)	11.9 (19)	81 (31)	26 (22)	0.25 (11)	18	89
	Oxide	24.7 (2)	-	67 (2)	-	-		
	Transition	25.4 (19)	8.4 (5)	77 (12)	30 (7)	0.26 (5)		
	Fresh	25.5 (35)	13.2 (14)	82 (18)	24 (15)	0.25 (6)		
Schist	All	25.4 (31)	7.7 (8)	69 (13)	16 (10)	0.24 (6)	19	54
	Oxide	26.1 (3)	-	58 (2)	12 (1)	0.11 (1)		
	Transition	24.6 (15)	4.6 (5)	66 (6)	16 (7)	0.26 (5)		
	Fresh (valid tests)	26.3 (31)	12.7 (3)	76 (5)	19 (2)	-		
	Fresh (all tests)	26.3 (31)	12.7 (3)	51 (9)[3]	19 (2)	-		
Granite	All	24.6 (8)	7.1 (3)	70 (6)	29 (3)	0.19 (3)	-	-
	Oxide	-	-	-	-	-		
	Transition	23.9 (4)	2.6 (1)	41 (4)	15 (2)	0.14 (2)		
	Fresh	25.2 (4)	9.4 (2)	130 (2)	55 (1)	0.30 (1)		

Source: JDS (2019)

Notes:

[1] Numbers in parentheses indicate the number of test results available to calculate the average intact rock parameters.

[2] 'UCS' indicates lab UCS test results while 'σ_{ci}' represents the intercept of the triaxial strength envelope with the σ_3 axis.

[3] Excludes breaks where the sample broke along a pre-existing weakness such as healed joints or foliation.

4.2 Triaxial Compressive Strength

Triaxial compressive strength (TCS) tests were conducted to calculate the Hoek-Brown (Hoek, et al, 2002) material coefficient mi as discussed in Section 5.4. The TCS test involves encasing a core sample in an impervious membrane and subjecting the sample to a selected confining pressure (σ_3) while the sample is loaded axially (σ_1) until failure occurs. The applied load that results in failure divided by the cross-sectional area of the core is the triaxial compressive strength, referenced to the appropriate confining pressure.

Multi-stage TCS tests were conducted on 15 samples (46 individual test points) from the 2018 GI using ASTM Method D7012. Young's moduli were also calculated from each TCS. The samples were tested at confining pressures ranging between 0.5 and 20 MPa. The maximum confining pressure was selected to be approximately of one-half of the UCS values, as recommended by Hoek and Brown (1997). The raw TCS testing data are contained in Appendix B.

Regression analyses were conducted on the triaxial test data set for each rock type using RocData software (Rocscience 2017) to estimate mi values. Values of 18 and 19 were estimated for the Gneiss and Schist rock types respectively. Insufficient data was available to develop a

triaxial curve for the Kona Granite due to the shallow pit depth and limited number of samples obtained from the geotechnical drillholes.

4.3 Indirect Tensile Strength Testing

The indirect (Brazilian) tensile strength (BTS) test measures the tensile strength of the intact rock by applying pressure to opposite sides of a relatively thin disc sample, similar to a diametral field point load test, but in a controlled laboratory environment. The BTS test results provide some level of verification of field point load testing values and, in conjunction with UCS data, the determination of the Hoek-Brown (Hoek, et al., 2002) mi value as discussed in Sections 5.4.

A total of 37 BTS tests were conducted according to ASTM Method D3967 between the 2013, 2015 and 2018 Geotechnical Investigations. The average laboratory BTS test value are shown by rock type and oxidation group in Table 4-1 along with the other laboratory test results.

4.4 Direct Shear Strength Testing

Direct shear testing is commonly used for estimating the expected shear strength along natural rock discontinuities such as joints, bedding or foliation planes and faults. Since the stress levels developed within open pits are usually much lower than the rock substance or intact strength, displacement frequently occurs along pre-existing geologic discontinuities, making the determination of discontinuity shear strength a necessity.

The direct shear test involves the application of a load perpendicular (normal) to a discontinuity separating two intact blocks of rock, with the simultaneous application of a shear load parallel to the discontinuity of sufficient magnitude to induce displacement of the blocks relative to each other. To define the overall shear strength envelope, tests are conducted at three or more normal stresses, with continuous displacement/shear stress data being obtained at each of the normal loads. For each normal load, the peak (maximum) and residual (steady state relative to displacement) shear stresses are recorded, thereby defining the peak and residual shear strengths given a normal stress. The relationship between an applied normal stress and the resulting shear strength defines a point on the shear strength envelope. Peak and residual shear strength envelopes can then be determined from the shear strength/normal stress points using statistical regression methods.

A total of 20 core samples were selected between the 2013, 2015 and 2018 drillholes for four-point, small scale direct shear (SSDS) tests in accordance with ASTM Method D5607. Natural fractures preserved in the field were used for all of the direct shear tests. The range of normal stresses applied during testing, approximately 170 to 4,880 kPa, was selected to approximate the in situ stresses that are expected to develop within the slopes.

In order to fit a shear strength envelope to the laboratory data points, a linear or curvilinear regression analysis is typically conducted. For a linear fit, the envelope is presented according to the Mohr-Coulomb, or linear, criterion, i.e., in the form of an angle of internal friction (Φ), which corresponds to the inverse tangent of the slope of the least-squares regression line, and an apparent cohesion (c), which corresponds to the shear strength intercept at zero normal stress. Discontinuity shear strengths derived from the direct shear tests are summarized by rock type

and fracture type in Table 4-2 for the combined 2015 and 2018 testing programs. Raw test data is contained in Appendix B. Cohesion values listed in Table 4-2 were obtained directly from linear regression analysis of the raw laboratory test data and, in some cases, are considered unrealistically high. Joint and foliation strength cohesions were typically reduced to 10 kPa for the subsequent stability analyses as discussed in Section 5.4.

Table 4-2: Direct Shear Test Results

Fracture Type	No.	ϕ (°)	Cohesion (kPa)
Schist Foliation	7	29	28
Gneiss Foliation	4	31	47
Gneiss Joint	6	29	40
Schist Joint	1	29	53
Granite Joint	1	38	53

Source: JDS (2019)

4.5 Unit Weight

The unit weight or density of each material type is required for slope stability modeling as both the resisting and driving forces of potential instabilities are functions of weight (or stress). Prior to actual testing of rock core samples, sample dimensions and weights were measured and used to calculate total unit weights for each sample. The combined data set includes 96 measurements between the 2015 and 2018 programs and ranges from 22.6 to 29.5 kN/m^3 with a mean value of 25.9 kN/m^3, for all samples. The average unit weights for each rock type and oxidation zone are summarized in Table 4-1 along with the previously discussed intact rock properties.

5 ROCK MASS CHARACTERIZATION

Rock mass models are developed to provide a framework for interramp / overall slope stability modeling by mathematically simulating site geotechnical conditions. The term “rock mass” refers to the entire body of rock, including discontinuities. In contrast, “intact rock” or “substance strength” refers to the rock between discontinuities in a rock mass. A typical rock mass model is heavily influenced by site geologic information such as lithologic, alteration and/or structural models.

5.1 Rock Mass Domains

Geotechnical models consist of individual domains, or volumes of rock, each of which comprises materials exhibiting similar geotechnical properties, such as rock mass strength, porewater pressures and orientation of geologic structures. Pertinent geotechnical parameters are assigned to each domain, based on engineering properties that are determined during field and laboratory data collection programs.

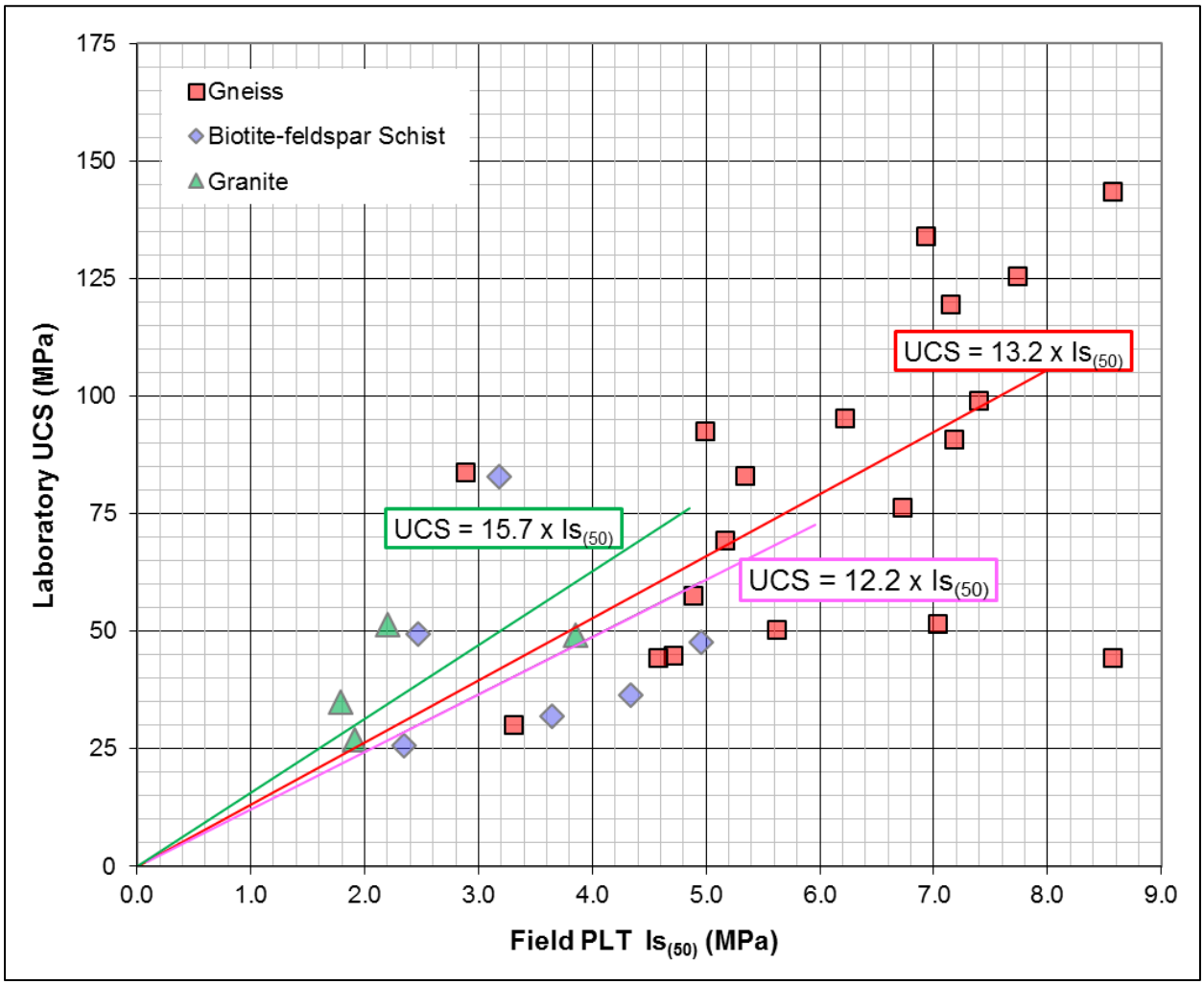
Following the completion of the 2018 GI the data was compiled with the previous 2015 GI data to form a complete database for analysis. The geotechnical properties were first analyzed by primary rock type and then oxidation group for each drillhole and then geotechnically similar rock types were combined to form geotechnical or rock mass domains. It was concluded from the analyses that the, while the three primary lithologies (i.e. schist, gneiss or granite) were generally similar in their characteristics, rock mass quality may be best delineated by the various oxide zones within each lithology. Additional information regarding geologic structure and structural domains is contained in Section 6.

5.2 Intact Rock Strength

The term “intact rock” or “substance strength” refers to the rock between discontinuities in a rock mass; in contrast, “rock mass” refers to the entire body of rock, including discontinuities. Intact rock strengths were assessed in the field by logging the ISRM (1978) qualitative ‘hardness’ index for each core run and by conducting field PLTs according to the ISRM (1985) recommended procedure, as discussed in Section 3.2. Samples of rock core were also selected for subsequent laboratory UCS, TCS and BTS tests described in Section 4.

Each laboratory UCS test sample was paired with adjacent PLT Is(50) values in order to estimate a correlation coefficient enabling approximations UCS from the field PLT results. Figure 5-1 contains a plot of the 2018 UCS vs. PLT Is(50) correlation for each of the three primary rock types. The approximation of UCS values for each of the field Is(50) tests permitted the development of essentially continuous profiles of intact rock strength down each drillhole.

Figure 5-1: Correlation of Laboratory UCS and Field Point Load Index Test Results



Source: JDS (2019)

The strength profile allowed weaker zones to be identified that are not commonly sampled for laboratory testing due to either difficulties in obtaining solid intact samples and/or the susceptibility of the samples to damage during shipping. The PLT's also provide a check against the IRS hardness values recorded by the loggers. Table 5-1 contains a summary of UCS values correlated from PLTs by rock type and oxide zone for the combined 2015 and 2018 geotechnical investigations.

Laboratory UCS and field PLT Is(50) results are plotted with the field estimates of intact rock strength or hardness on the geotechnical core logs presented in Appendix A. As illustrated on the logs presented in Appendix A, the PLT derived UCS strengths are generally consistent with the values and variation of the laboratory UCS and the intact rock strength estimates recorded

by the loggers. In some cases the field logging estimates were higher than the laboratory and PLT derived UCS values.

Table 5-1: Summary of UCS Values Correlated from PLTs

Pit	Rock Types	Oxide Zone	No. of Tests	UCS Converted from PLT (MPa)[1]			
				Average	Std. Dev.	Min.	Max.
Supremo	Gneiss (MXF/MxM/FG)	Oxide	16	49	25.1	7	97
		Upper Trans	12	71	29.9	7	120
		Middle Trans	54	73	30.8	11	156
		Lower Trans	94	81	30.5	6	133
		Fresh	260	87	28.6	3	164
Double Double	Gneiss (MxF/MxM)	Oxide	-	-	-	-	-
		Upper Trans	-	-	-	-	-
		Middle Trans	3	29	5.6	22	33
		Lower Trans	11	35	16.2	17	59
		Fresh	14	54	31.5	7	103
	Schist (BtS)	Fresh	20	92	43.6	34	176
Latte	Schist (BtS/Bts_carb)	Oxide	1	46	-	46	46
		Upper Trans	10	58	28.8	23	108
		Middle Trans	21	42	14.6	20	72
		Lower Trans	48	53	27.7	7	124
		Fresh	49	45	27.6	7	127
Kona	Granite (GG)	Oxide	-	-	-	-	-
		Upper Trans	3	62	7.2	56	70
		Middle Trans	5	60	20.1	36	85
		Lower Trans	8	87	15.9	67	107
		Fresh	26	97	30.1	33	151

Source: JDS (2019)

Notes:

[1] Excludes breaks where the sample broke along a pre-existing weakness such as healed joints or foliation.

5.3 Rock Mass Classification

Core logging and laboratory test data obtained from the 2015 geomechanical drillholes was used for empirical rock mass characterization according to the Bieniawski (1989) Rock Mass Rating

(RMR) system. The RMR system consists of five primary parameters: unconfined compressive strength (UCS), rock quality designation (RQD), discontinuity spacing, joint conditions (Jc) and groundwater. Dry conditions were assumed for the RMR calculations as groundwater pressures are commonly accounted for during slope stability analysis using effective stress type analyses. Similarly, the RMR values were not discounted for adverse joint set orientations joint orientations. The RMR values, with the maximum possible (or most competent rock mass) being 100 for each run, are displayed on the geomechanical core logs presented in Appendix A.

Overall, RMR characterization provides a useful starting point for determining trends in overall rock mass quality and delineating geomechanical domain. However, it is important to note that when combining or averaging the individual RMR parameters over a distance such as a core run interval, important small-scale details such as weak features in the core can become obscured or hidden by the overall RMR value calculated for the interval. For this reason it is important that major structures or weak features observed in the core are logged and analyzed independent of the combined RMR data as was done for the geomechanical drillholes.

Results of the rock mass characterization suggest that, with the exception of the oxide materials which will be mostly mined and processed, the rock mass at Coffee is generally of 'Fair' to 'Good' geomechanical quality according to the Bieniawski (1989) criteria. Table 5-2 contains a summary of rock mass characteristic data derived from the combined 2015 and 2018 GI for each of the three primary rock types and oxide zones.

Table 5-2: Summary of Rock Mass Classification Data

Pit	Lithology	Oxide Zone	No. of Tests	RMR (Bieniawski, 1989)			
				Average	Std. Dev.	Min.	Max.
Supremo	Gneiss (MXF/MxM/FG)	Oxide	27	59	9.9	39	76
		Upper Trans	32	61	11.1	35	77
		Middle Trans	87	61	9.1	34	78
		Lower Trans	180	66	11.2	34	91
		Fresh	391	69	10.8	31	91
Double Double	Gneiss (MxF/MxM)	Oxide	-	-	-	-	-
		Upper Trans	-	-	-	-	-
		Middle Trans	5	58	6.3	50	68
		Lower Trans	13	66	11.5	42	82
		Fresh	20	62	8.7	48	80
	Schist (BtS)	Fresh	21	64	9.7	42	93
Latte	Schist (BtS/Bts_carb)	Oxide	28	54	8.2	32	73
		Upper Trans	16	56	13.0	36	78
		Middle Trans	34	69	9.5	37	83
		Lower Trans	100	67	10.5	33	91
		Fresh	90	61	10.2	28	82

Pit	Lithology	Oxide Zone	No. of Tests	RMR (Bieniawski, 1989)			
				Average	Std. Dev.	Min.	Max.
Kona	Granite (GG)	Oxide	-	-	-	-	-
		Upper Trans	10	58	16.0	30	77
		Middle Trans	27	69	8.1	38	77
		Lower Trans	6	77	9.2	61	85
		Fresh	34	77	8.1	81	93

Source: JDS (2019)

The values in Table 5-2 were calculated excluding the upper, surface weathered materials. Soil coverage is very minimal in the pit areas. The depth of soils and heavily weathered bedrock is typically between 3 and 8 m below ground surface with local areas reaching up to 15 m, based on the 13 geotechnical drillholes.

5.4 Rock Mass Shear Strength

The shear strength/normal stress relationship describes the ultimate shear strength available at a given point within a slope as a function of the effective normal stress acting on that point. Based on review of the lithology, RQD, rock mass rating and intact rock strength, three geomechanical units were identified; the Gneiss, Schist and Granite. Rock mass shear strength/normal stress relationships were developed for the using the Generalized Hoek-Brown criterion (Hoek, et al., 2002).

The Generalized Hoek-Brown criterion defines curvilinear shear strength envelopes that are considered effective representations of intact rock and heavily jointed rock mass behavior. As discussed in Hoek, et al (2002), the following equation defines the rock mass shear strength envelope according to the Generalized Hoek-Brown criterion:

$$\sigma_1' = \sigma_3' + \sigma_{ci}\left(m_b \frac{\sigma_3'}{\sigma_{ci}} + s\right)^a \quad (1)$$

$$m_b = m_i e^{\left(\frac{GSI-100}{28-14D}\right)} \quad (2)$$

$$s = e^{\left(\frac{GSI-100}{9-3D}\right)} \quad (3)$$

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{-GSI/15} - e^{-20/3}\right) \quad (4)$$

Where σ1' and σ3' are the effective major and minor principal stresses and σ_{ci} is the uniaxial compressive strength of the rock.

The Geologic Strength Index (GSI) was developed as a qualitative assessment of the lithology, structure/blockiness and condition of discontinuity surfaces in a rock mass by Hoek as input into the Generalized Hoek-Brown shear strength criterion in lieu of the RMR due to increasing realization that a system based more heavily on fundamental, largely subjective geological observations than on potentially less reflective, wholly objective, "numbers" was needed (Hoek, 1994). In practice, the GSI ranges from a value of zero for very weak, intensely sheared and fractured rock masses up to a maximum value of 100 for intact or very massive rock with very few, widely spaced discontinuities. GSI was estimated using the relationship proposed by Hoek et al. (1997): GSI ~ RMR89 – 5.

The disturbance factor, D, depends on the degree of disturbance that the rock mass is expected to be subject to as a result of blast damage and stress relaxation caused by excavation of the pit. The disturbance factor ranges from zero, for wholly undisturbed, confined rock masses, to 1 for very disturbed rock masses. For surface mining operations, Hoek et al., 2002 recommends a D of 0.7 for carefully controlled blasting and a D of 1 for heavy large-scale production blasting. The rock mass disturbance zone is typically on the order of 10 m to 50 m and does not apply to the entire rock mass behind the slope.

As described by Hoek (1983), the Hoek-Brown intact material constant mi is very approximately analogous to the angle of friction of the conventional Mohr-Coulomb failure criterion, controlling the curvature of the intact failure envelope and thus, the rate at which the shear strength increases with confinement. Higher mi values (in the order of 15 to 32), give steeply inclined strength envelopes and high instantaneous friction angles at low normal stress levels. These high mi values tend to be associated with stronger brittle igneous and metamorphic rocks such as andesites, gneisses and granites. Lower mi values (in the order of 3 to 7), give lower instantaneous friction angles and tend to be associated with more ductile carbonate rocks such as limestone or dolomite. Different samples of the same rock type can also have varying mi values depending on the granularity and interlocking of the crystal structure (Marinos and Hoek, 2000).

As discussed in Section 4.2, mi values of 18 and 19 were estimated for the Gneiss and Schist rock types respectively. Insufficient data was available to develop a triaxial curve for the Kona Granite and as such, a conservative estimate of 23 was made based on SRK (2016) and typical values published by Marinos & Hoek (2000). Rock mass strength parameters derived from the 2015 and 2018 geotechnical logging and laboratory test data are summarized in Table 5-3.

Table 5-3: Design Rock Mass Parameters

Pit	Rock Type	Oxidation Group	Intact Rock		Rock Mass		
			m_i	UCS (MPa)	GSI	D	Density (kN/m^3)
Supremo	Gneiss	Oxide	18	49	54	0.7	26.0
		Upper & Middle Trans	18	70	56		
		Lower Trans & Fresh	18	87	63		
Latte	Schist	Oxide	19	46	49	0.7	26.0
		Upper Trans	19	58	51		
		Middle & Lower Trans	19	52	62		
		Fresh	19	45	56		
Double Double	Gneiss & Schist	Middle & Lower Trans	18	34	62	0.7	26.0
		Fresh	18	54	58		
Kona	Granite	Middle Trans	23[1]	60	64	0.7	25.1
		Fresh	23[1]	97	72		

Source: JDS (2019)

Notes:

[1] Estimated based on published values due to insufficient number of laboratory test results.

5.5 Groundwater

Groundwater (pore water) pressure is an important component of slope stability. Pore water pressures act in direct opposition (as buoyant forces) to stabilizing forces, and as such, must be considered for the results of stability modeling to be realistic. A relatively free-draining slope will typically allow drawdown of the groundwater surface sufficiently deep within the slope so that pore water pressures are of minimal impact to slope stability. Since the rock mass comprising open pit benches has usually been at least moderately disrupted by production blasting, it is usually free-draining and, therefore, pore water pressures are seldom considered in bench scale stability analyses.

Groundwater levels for the stability analyses were estimated based on field hydrogeological investigations conducted by SRK (2015) and Lorax (2016) and subsequent three-dimensional groundwater modeling performed by Lorax (2017). The end-of-mining groundwater surface predicted by the Lorax (2017) groundwater model was used as the basis for the estimations. The 2017 numerical groundwater model was based on a March 2017 pit design that is slightly deeper in some areas. However, the surface is still considered a reasonable starting point for depressurization in lieu of any more specific information.

6 GEOLOGIC DISCONTINUITIES

The term discontinuity refers to any significant mechanical break or fracture in rock, across which there is negligible tensile strength. Discontinuities are formed by a wide range of geological processes, collectively including joints, faults, fissures, fractures, veins, bedding planes, foliation surfaces, shear zones, dikes and contacts. The most common discontinuities at Coffee are joints and foliation. Faults and shear zones were also occasionally encountered in the geotechnical drill core; however, due to the relatively poor rock quality commonly associated with larger scale structures such as faults and/or shear zones, relatively few were able to be confidently oriented.

Minor discontinuities, such as joints, fractures, foliation and bedding planes, represent an infinite population for practical purposes and, due to sampling limitations, are best modeled with stochastic (probabilistic) techniques. Major geologic structures are those features, such as faults, dikes, shear zones, and contacts that have dimensions on the same order of magnitude as the area being characterized. These structures are treated as individual elements for design purposes, as opposed to joints, which are handled statistically.

6.1 Structural Domains

Structural domains were developed based primarily on dominant discontinuity orientations obtained from the combined 13 geotechnical drillholes. These domains define reasonably large volumes where discontinuity patterns are similar enough on pit wall scale that they can be grouped together for analysis.

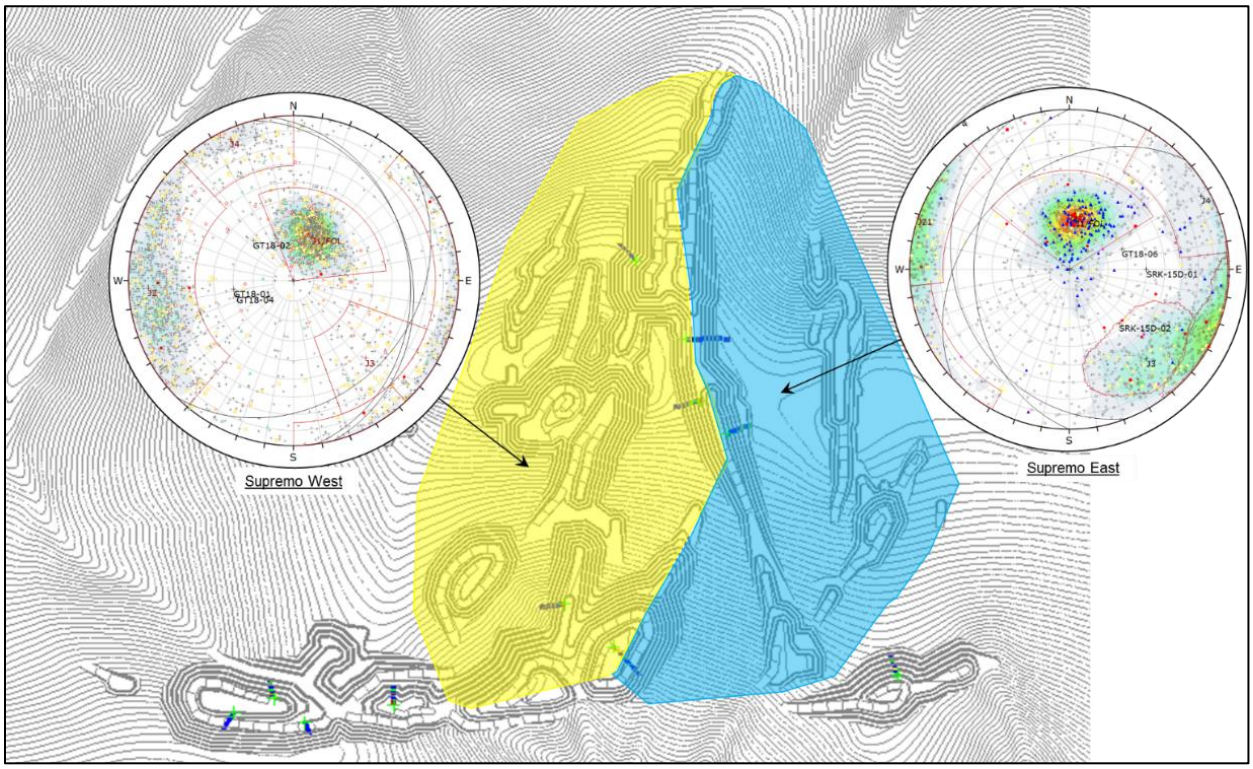
The pit areas were initially broken down into volumes or rock bound by known major faults and/or lithological contacts. Discontinuity orientation data from within each of these volumes was contoured on lower hemisphere, equal area percentage plots to identify dominant discontinuity set orientations using Dips software (Rocscience, 2019). A discontinuity ‘set’ is generally defined as a group of discontinuities that are anticipated to exhibit similar geotechnical conditions and are within a similar range of orientations, i.e., dip and dip direction. The discontinuity orientation data for each geotechnical drillhole and primary lithology were initially analyzed independently of each other to identify significant variations in the presence and the orientation of the various sets spatially across the pits.

Where similar, the initial areas were combined with neighboring areas forming larger volumes or structural domains. Directional biases were considered for each drillhole. Drillholes are directionally biased against encountering structures with dips and dip directions sub-parallel to the drillhole’s plunge and bearing.

A total of seven separate structural domains were developed for the pit slope stability analyses using this methodology. The Supremo, Latte and Double Double pits were divided into two separate domains each while Kona was considered as a single domain due to its small size. The individual domains delineated and their respective discontinuity orientation plots or stereonets are shown on Figure 6-1, Figure 6-2 and Figure 6-3 for the Supremo, Latte - Double Double and Kona pits, respectively. The discontinuity sets identified in the Supremo, Latte-Double Double and Kona pit domains are summarized in Table 6-1, Table 6-2 and Table 6-3, respectively. The

numbers in parentheses in Table 6-1 through Table 6-3 indicate the percentage of the total discontinuities identified in each domain that are contained within the respective set.

Figure 6-1: Supremo Pit Domain and Discontinuity Pole Plots



Source: JDS (2019)

Table 6-1: Supremo East and West Domain Discontinuity Sets

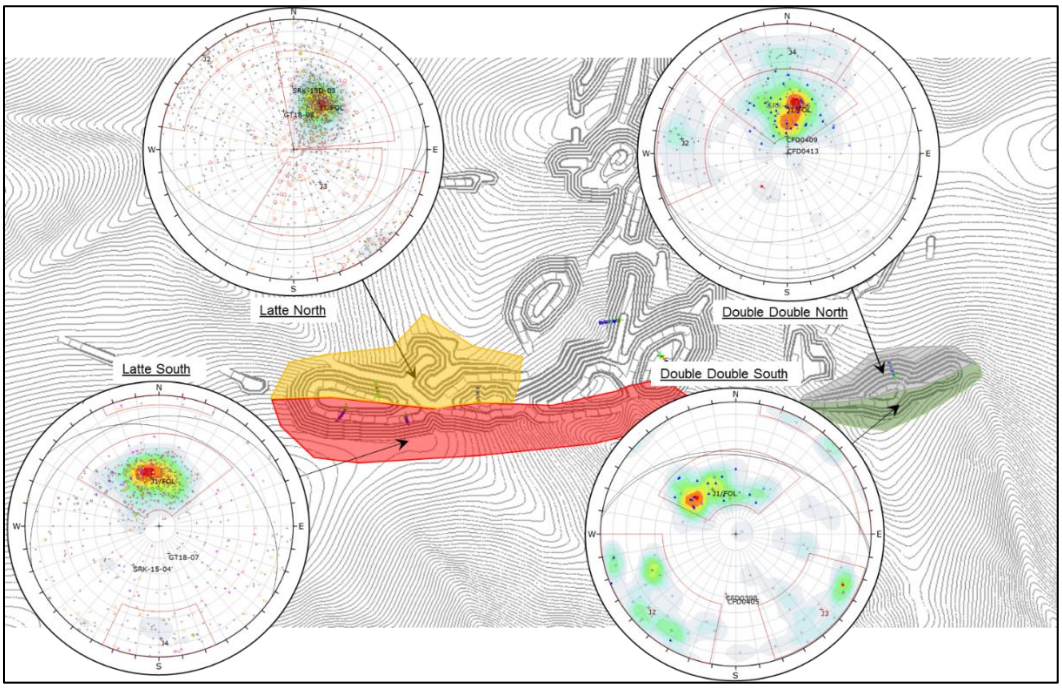
Pit Sector	Set ID	No.[1]	Mean Orientation		Potential Impact on Design
			Dip	Dip Dir.	
Supremo East	J1/FOL	451 (28%)	26	188	Very minimal impacts on stability due to dip direction perpendicular to pit walls except for a few very local areas.
	J2	363 (22%)	90	109	Minimal impacts on bench stability given near vertical dip. May cause localized sloughing where oblique to bench face.
	J3	275 (17%)	63	319	Minimal impacts on interramp/overall slope stability. Potential for planar instability along NW dipping, T4 pit wall benches, if present.
	J4	184 (11%)	84	241	Minor joint set. Minimal impacts on bench stability given near vertical dip.
Supremo West	J1/FOL	949 (33%)	24	203	Very minimal impacts on stability due to dip direction being perpendicular to pit walls except for a few very local areas.
	J2	1,263 (44%)	77	087	Minimal impacts on stability given sub-vertical dip. May be advantageous for N-NW striking walls, providing steep, stable surfaces to break to.
	J3	117 (4%)	54	317	Minor joint set. Potential to cause planar bench instability for NW dipping pit walls if becomes more prominent. Confirm during mining.
	J4	261 (9%)	83	156	Minor joint set, minimal impacts on bench stability given near vertical dip.

Source: JDS (2019)

Notes:

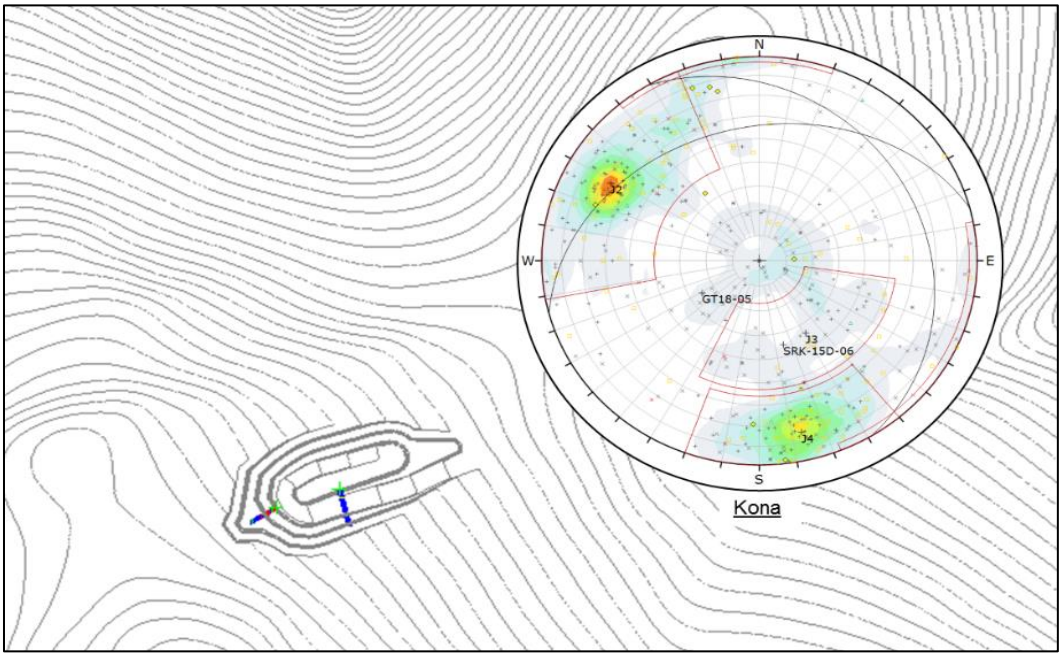
[1] Total number of discontinuities oriented per set. Number in parentheses is the percentage of the total number of discontinuities oriented.

Figure 6-2: Latte and Double Double Pit Domain and Discontinuity Pole Plots



Source: JDS (2019)

Figure 6-3: Kona Pit Domain and Discontinuity Pole Plot



Source: JDS (2019)

Table 6-2: Latte and Double Double Domain Discontinuity Sets

Pit Sector	Set ID	No.[1]	Mean Orientation		Potential Impact on Design
			Dip	Dip Dir.	
Latte North	J1/FOL	954 (58%)	29	57	Significant potential to impact stability of bench and interramp slope stability for north wall due to dip direction being parallel to wall dip direction.
	J2	174 (11%)	89	137	Minor joint set. Minimal impacts on bench stability given near vertical dip.
	J3	222 (14%)	26	321	Low confidence set. Potential to cause planar bench instability for NW dipping pit walls but generally has shallow dip. Needs confirmed during mining.
Latte South	J1/FOL	378 (57%)	31	171	Low risk of instability due to shallow dip into wall. Potential for step-path instability in south wall bench faces if combined with J4.
	J4	61 (9%)	75	359	Minor/low confidence set. If present, has potential to cause planar bench instability or, if combined with J1, step-path and/or toppling instability in south wall benches. Needs confirmed during mining.
DD North	J1/FOL	111 (45%)	30	180	Potential to impact stability of bench and interramp slope stability for north wall due to dip direction being parallel to wall dip direction.
	J2	32 (13%)	69	098	Minor joint set. Potential wedge formed with J4 but with moderate to steep LOI (63/137). Minimal potential for plane shear due to strike perpendicular to wall.
	J4	37 (15%)	70	181	Minor joint set. Potential wedge formed with J2 but with moderate to steep LOI (63/137). Minor potential for planar failures due to steep dip. May act as release for J1 planar instabilities. Needs confirmed during mining.
DD South	J1/FOL	25 (32%)	31	153	Minimal impact to south wall stability due to dip into pit wall.
	J2	27 (35%)	74	049	Minor joint set. Potential wedge formed with J3 but steep LOI (66/000). Minor potential for planar failures due to orientation relative to pit walls.
	J3	13 (17%)	74	312	Appears as minor joint set. Potential wedge formed with J2 but steep LOI (66/000). Low potential for planar failures for south wall due to steep dip.

Source: JDS (2019)

Notes:

[1] Total number of discontinuities oriented per set. Number in parentheses is the percentage of the total number of discontinuities oriented.

Table 6-3: Kona Domain Discontinuity Sets

Pit Sector	Set ID	No.[1]	Mean Orientation		Potential Impact on Design
			Dip	Dip Dir.	
Kona	J2	139 (33%)	67	119	Low probability of planar instabilities for S-SE dipping walls due to steep dip and curved NW pit walls. Potential wedge formed with J4 (49/058).
	J3	48 (12%)	34	329	Low confidence joint set. Minor potential for planar instabilities along SE wall if persistent but has shallow dip. Confirm during mining.
	J4	102 (24%)	75	347	Low probability of creating planar instabilities for N-NW dipping walls due to steep dip and curved nature of pit northerly dipping pit walls. Potential wedge formed with J2 (49/058).

Source: JDS (2019)

Notes:

[1] Total number of discontinuities oriented per set. Number in parentheses is the percentage of the total number of discontinuities oriented.

6.2 Kinematic Assessment

To assess which of the various discontinuity sets identified in each domain have potential to adversely impact bench stability for the various pit slope orientations, an initial kinematic assessment was completed for each pit using stereonets created with Dips Software (Rocscience, 2019). The orientation and variability of each set was graphically compared to the various pit slope dip directions to assess which sets, or combination of sets, have the potential to form 3D (planar or wedge) blocks that could displace under gravitational forces. Kinematic analyses can be considered conservative in that they do not consider the length or spacing of discontinuities which are more realistically assessed with more complex probabilistic type models.

Where relatively high likelihood of instabilities are suggested by the initial kinematic analyses, more detailed quantitative and/or probabilistic analyses should be carried out. Based on the structural domaining and kinematic assessment, the following conclusions can be made:

- The most dominant structural trend at Coffee is the south-southwest shallow to moderate dipping foliation and a vertical to steep east to east-southeast dipping joint set (J2) present at Supremo, Latte and Double Double;
- Foliation has a high potential to cause planar type instabilities in the north Latte pit wall due to the intense foliation. The foliation has similar potential in the Double Double north wall but is only considered moderate due to foliation being less intense in the gneiss. The J1/Foliation sets are likely to impact bench and interramp stability and should be accounted for in the north wall slope design parameters. Pit wall dip directions between 150° and 240° azimuth

will be susceptible to planar type displacements if bench face and interramp slope angles are over steepened;

- The vertical to steep east to east-southeast dipping joint set (J2) at Supremo, Latte and Double Double is not expected to have a significant impact on bench or interramp slope stability. It may cause local sloughing where persistent discontinuities strike slightly oblique to bench face. The set may even be advantageous for Supremo west walls providing a clean surface for the bench faces to break back to;

- The steeply south dipping set (J4) identified in Latte and Double Double could be considered as questionable due its being poor representation in the data set. If J4 does exist, it may combine with J1/foliation forming step-path, bench scale instabilities. Mapping should be carried out during initial pit excavation to confirm the presence of J4 and its potential implications;

- Double Double sets J2 and J4 have potential to combine forming wedge type bench instabilities if present. However given the 63° plunge of their line-of-intersection (LOI) and the southeast direction of its dip, such wedges are expected have minimal impact on wall stability;

- Double Double sets J2 and J3 also have potential to combine forming wedge type bench instabilities with their LOI plunging approximately 66° towards north. While the northerly plunge direction makes such a wedge kinematically viable, the 66° LOI dip suggests that the impact would be minor;

- Steep, north-northwest (J4) and southeast (J2) dipping joint sets are the most dominant trends at Kona. The sets have potential to for planar instabilities if undercut; however, given the J4 dip is near design bench face angle and that the northwest pit wall has such a tight radius of curvature (J2), impacts on pit wall stability are anticipated to be minimal;

- The combination of Kona sets J4 and J2 potentially form a kinematically viable wedge with a LOI plunge of 49° towards 058° which could limit achievable bench face angles for southwest corner of the pit. However impacts are expected to be minor since the portion of the pit wall susceptible to such instabilities is small section due to the tight radius of curvature in the southwest corner of the pit; and

- Based on the current understanding of major geologic structures and the current three-dimensional fault model (SRK, 2017), most major fault structures are either near vertical or are mined out with the ore and therefore are not expected to significantly impact final pit wall stability.

As is the case at all mine sites, deviation from the discontinuity sets identified in Table 6-1, Table 6-2 and Table 6-3 and/or additional sets not encountered by the oriented core or televiewer should be anticipated during mining of the pits. It is anticipated that the major, pit wall controlling structural trends have been identified during the current program and that additional sets or variations encountered during mining should have relatively minor, bench scale impacts. A proper geotechnical mapping program during the early stages of pit development will be necessary to verify the current assumptions and allow for slope design modifications, if appropriate.

7 BENCH DESIGN CONSIDERATIONS

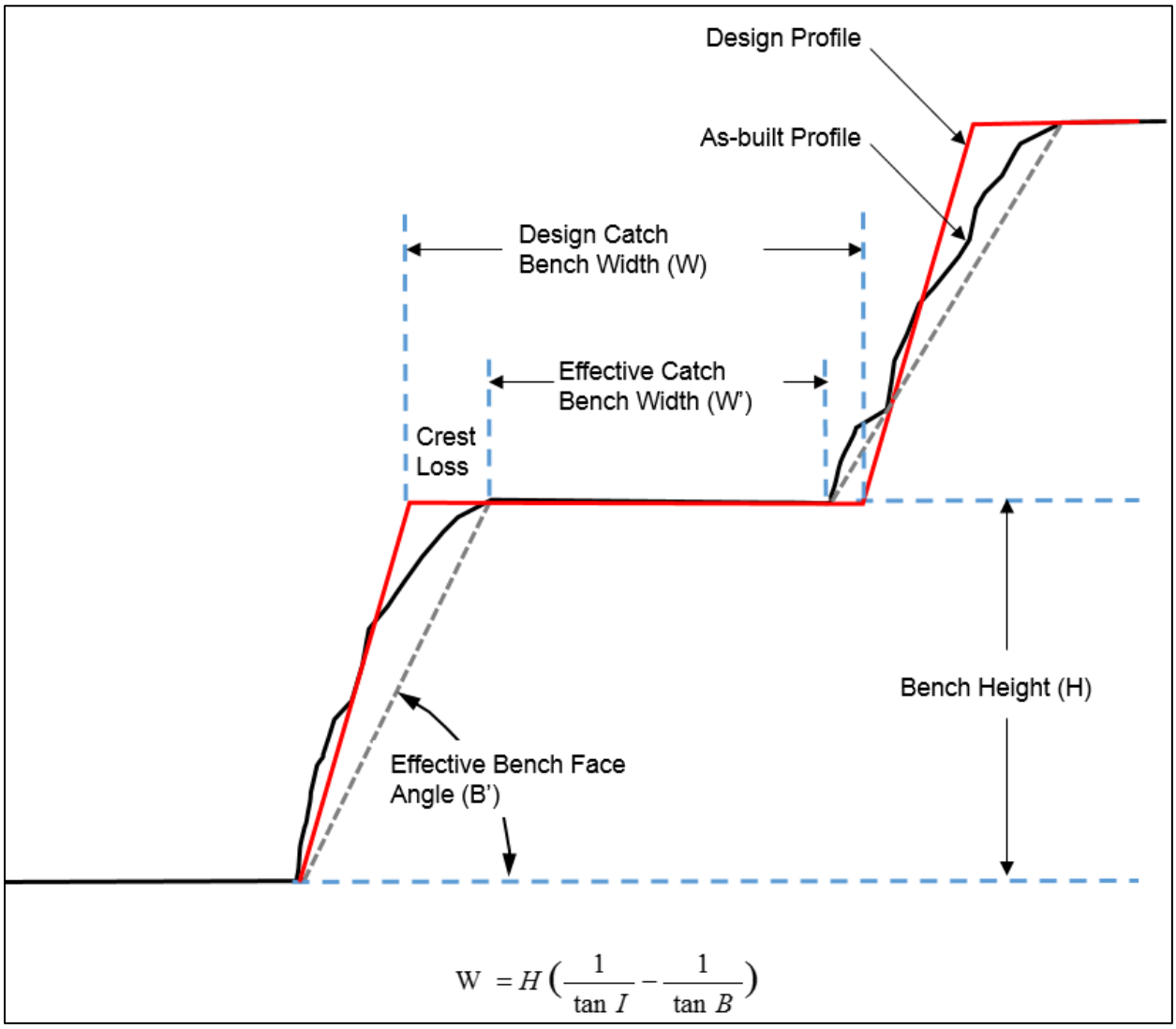
The consequences of an overall or high interramp slope failure on a final pushback commonly produce significant impact on mine economics. This is due to the fact that a substantial quantity of ore is frequently rendered uneconomic by the additional, unanticipated cost of removing the resulting failed material. The evaluation of the anticipated stability of final design slopes is therefore necessary and must be incorporated into final design recommendations.

Of similar importance and impact on the project economics, though not nearly as dramatic as large-scale slope failures, are the design and excavation of the benches and lower height interramp slopes, i.e., those slopes comprised of two to three benches. The overall slope designs cannot be achieved if benches cannot be safely and effectively established.

Although the expected performance of the overall and higher interramp slopes comprising the open pit can best be predicted and subsequently examined using rock mass failure models, the anticipated behavior of the bench and lower interramp slopes is most realistically assessed using analytical models that evaluate structurally controlled failure mechanisms. This is because rock structure, i.e., joints and other non-fault discontinuities, will most likely facilitate structurally controlled failures, whenever the site materials have relatively high rock mass strengths.

In strong, competent materials such as at Coffee, the development of rock mass failure in benches and in lower height interramp slopes is essentially precluded. Consequently, the evaluation of structurally controlled, or kinematic failure potential of benches and lower height interramp scale slopes, is the dominant consideration in the formulation of bench design recommendations. Common bench design terminology is explained in Figure 7-1.

Figure 7-1: Explanation of Bench Design Terminology



Source: JDS (2019)

7.1 Description of Methodology

The rock structure controlled primary failure mechanisms considered were simplified into one of three categories, i.e.:

- Plane shear failure, defined as translation (sliding) of a failure mass on a single geologic structure oriented essentially parallel with the slope being modeled;

- Simple wedge failure, defined as translation of a tetrahedral-shaped failure mass (bounded by the slope face, the essentially flat upper surface and two geologic structures, each oriented obliquely to the slope face) on either of the two lower bounding geologic structures or on both, i.e., down the line of their intersection; or

- Step path failure, defined as a translation similar to that of a plane shear mode but due to insufficient length of the plane shear set to foster a through-going failure surface, the failure path must step up to another discontinuity of the same set via a sub-perpendicular discontinuity joint set failing in tension, and with this alternation of sliding and stepping occurring until a path daylight at the top of the bench.

In all instances, the failure mechanism is only viable if:

- A potential failure mass exists, that is, if a geologic structure or structure set is present in a plane shear orientation relative to the slope being evaluated, or if two geologic structures or structure sets are present and oriented relative to each other and to the slope being studied in such a manner that a wedge tetrahedron; and

- Either the plane shear or the wedge line of intersection (between the two geologic structures) is “daylighted”, i.e., the potential plane(s) intersects the bench level above and the bench face and is flatter than the slope angle.

Geologic structure-controlled failure is only possible if discontinuities occur spatially so that a potential failure mass exists, and that mass is unconstrained at the slope face. Once it is determined that a viable potential failure mass does exist, the likelihood of geologic structure-controlled failure can be assessed by determining if the maximum shear resistance, which can be developed along the potential failure surface or surfaces, is greater than the driving forces acting to destabilize the mass.

The maximum available shear resistance is a function of both the structure continuity and its shear strength. For failure to occur along a discontinuous geologic structure, the non-fractured rock forming the intact portion(s) of the potential failure surface must fail. Intact rock strength for all but the weakest of rock tends to be higher than the stresses developed in bench and lower height interramp slopes. Consequently, the strength of intact rock is rarely exceeded. Seldom do failures of such scale occur along surfaces that are not of through-going, continuous geologic structures. The models considered for bench and lower height interramp slopes within the proposed open pit assume that failures could only develop along geologic structures which were continuous through the slopes. The available shear resistance then becomes a function solely of the discontinuity shear strength along the surface, given that a continuous structure(s) is present.

With the assumption of the necessity of continuous geologic structure(s) relative to the slope under consideration, the likelihood of the failure of bench or lower height interramp slope simplifies, becoming a function of:

- The likelihood that potential failure surface forming geologic structure(s) occur in the required orientation relative to the slope and, in the case of wedge failure, to each other;

- The likelihood that the shear stresses along the potential failure surface(s) exceed the maximum available shear resistance;

- The likelihood of geologic structure(s) continuity or, in the case of step path failure, path continuity on the appropriate scale;
- The likelihood of the potential failure surface(s) being daylighted; and
- The number of such structure(s).

7.2 Bench Design Conclusions

A comprehensive Probabilistic Bench Design Analysis was carried out by SRK (2016) using distributions of joint set properties (orientation, spacing and length) to evaluate structurally controlled failure mechanisms. Review of the fracture orientation data from the 2018 GI indicates refined but very similar dominant structural trends compared to 2015 investigation which was the basis of the SRK (2016) detailed Probabilistic Bench Design Analyses. As such, detailed bench design analyses were not carried out as part of the current update. The impact of discontinuities on stability was assessed with a more qualitative, kinematic assessment as discussed in Section 6.2.

As discussed in Section 6.2, the highest likelihood of bench instability is from planar failures fostered by foliation discontinuities in the Latte and Double Double north walls. The SRK (2016) detailed Probabilistic Bench Design Analyses were reviewed relative to the updated information and used to develop appropriate bench design recommendations for the Latte and Double Double north walls.

The following was concluded from the kinematic assessment (Section 6.2) regarding bench stability:

- Due mostly to the north-south orientation of the pit, benches at Supremo are not anticipated to be significantly impacted by structurally controlled instabilities. As such, a maximum achievable bench face of 75° was estimated for Supremo based on operational constraints as discussed below;
- The stability of benches on the north Latte and Double Double pit walls will likely be controlled by the dominant southerly (inward) dipping foliation discontinuities. The analyses indicate a maximum achievable bench face angle of approximately 65° for their north walls. Stability of the south and end pit wall benches are not anticipated to be governed by geologic structure controls and were, therefore, estimated to have a maximum achievable bench face of 75° based on operational considerations;
- Benches on the northwest Kona pit have a slightly higher probability of structurally controlled instabilities as a result of a moderately southeast dipping joint set (J2). The analyses indicate a design bench face angle of approximately 65° is appropriate for this sector of the pit. The remaining pit areas are not anticipated to be significantly impacted by geologic structure-controlled instabilities. A maximum achievable bench face of 75° was estimated for the remainder of the pit based on operational constraints; and
- Based on the Modified Ritchie Criteria as described by Call (1992), a minimum catch bench width of 8.5 m is recommended.

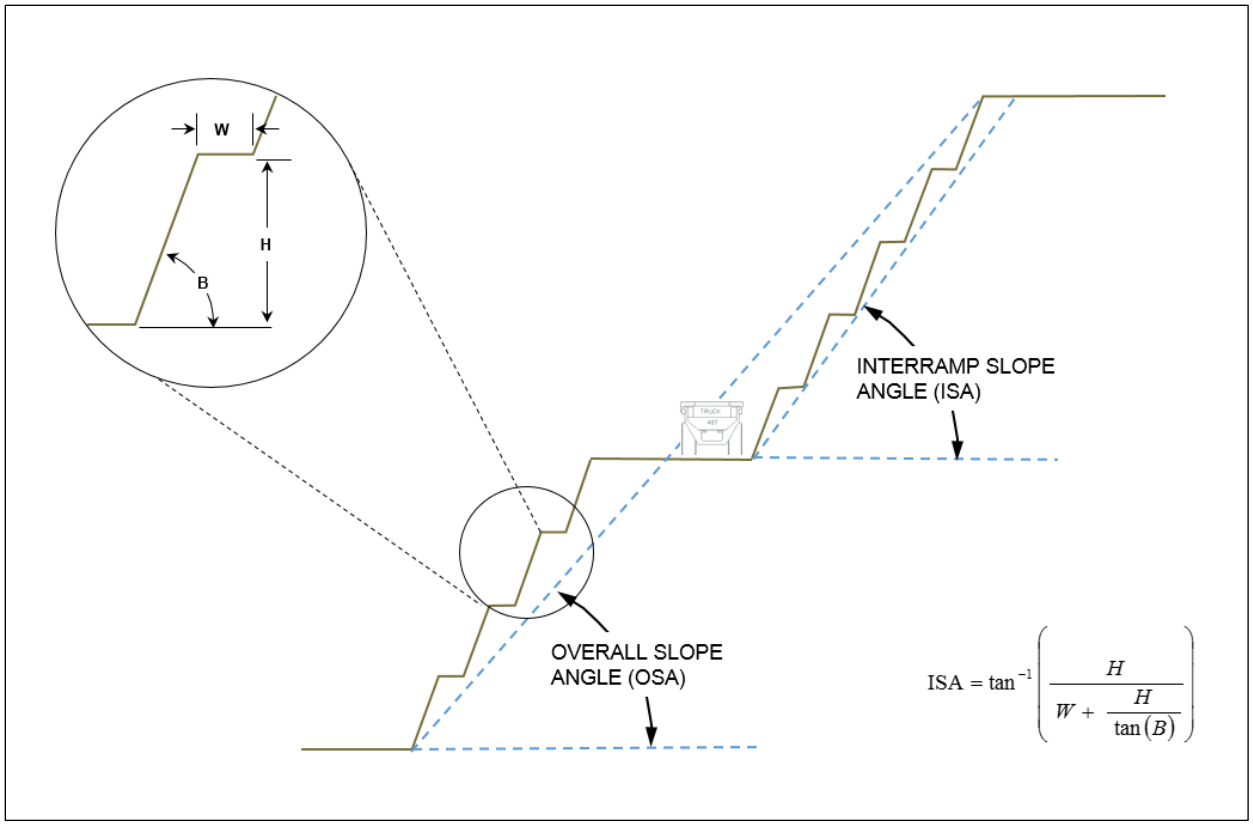
It should be noted that bench design and kinematic analyses are based solely on orientations of geologic structure and do not directly consider effects of weathering, alteration, blasting or excavation techniques. Depending on the quality of blasting and excavation practices, achievable bench face angles may be significantly reduced from the theoretical angles determined by these analyses. When taking these operational effects into consideration, it is rare to achieve bench face angles greater than about 70 to 75º, unless there is a steeper structure controlling the bench geometry. Increasing bench face angles to greater than about 75º may be achievable, but usually require more rigorous drilling and specialized controlled blasting techniques than are commonly practiced.

8 INTERRAMP / OVERALL SLOPE STABILITY ANALYSES

Based on the results of the Bench Design Analyses, recommendations for bench configurations and the resulting maximum interramp slope design were provided to Goldcorp for detailed pit designs incorporating necessary pit access ramps and infrastructure. Stability of the high interramp and overall slopes of the initial detailed pit designs were then evaluated.

Slope design involves analysis of the three major components of a pit slope: bench configuration, interramp angle, and overall slope angle, all as defined on Figure 8-1. The bench configuration, which is controlled by the bench face angle (BFA), bench height (BHT), and berm width (BWT), defines the interramp angle (IRA). The overall slope angle (OSA) consists of interramp sections separated by wide step-outs for haulage roads or mine infrastructure.

Figure 8-1: Pit Slope Design Components

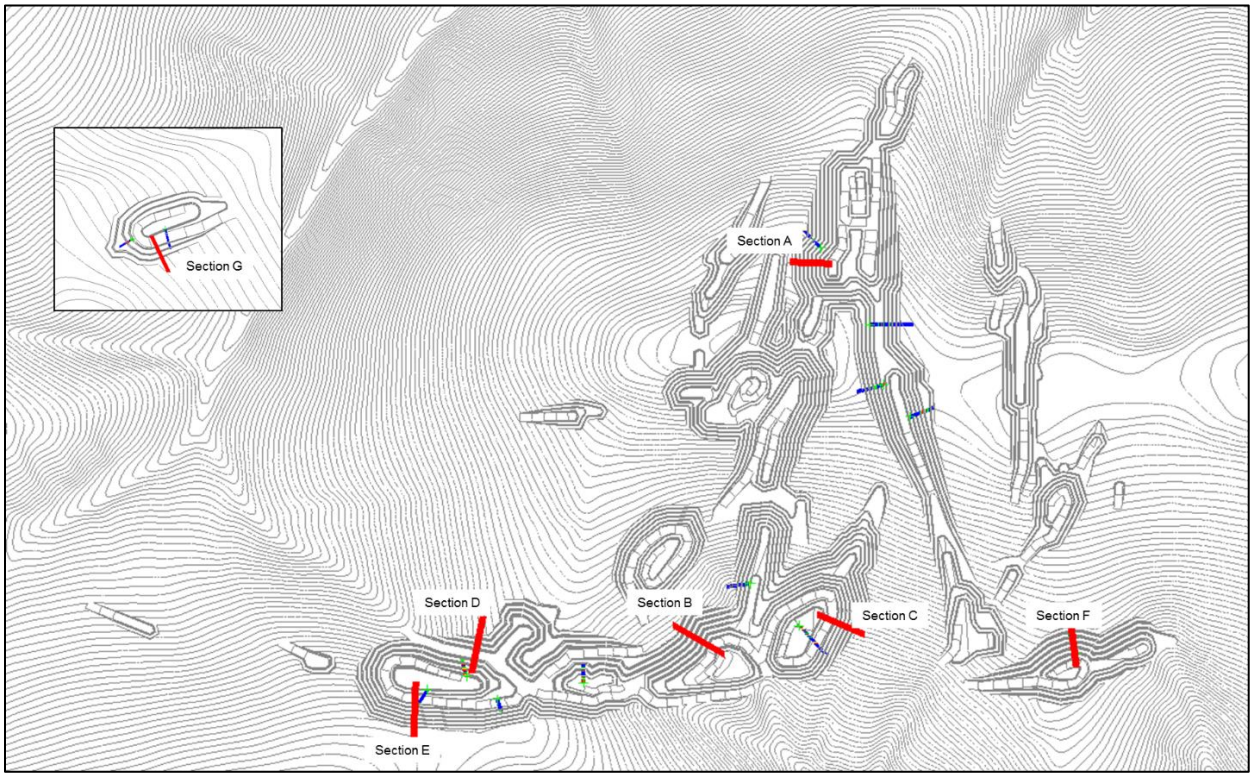


Source: JDS (2019)

8.1 Slope Stability Sections

Based on the results of the geomechanical characterization testing and initial detailed pit design geometries, critical slope stability cross-sections were selected for analysis. A total of seven critical sections were selected to verify stability of the ultimate pit designs. Critical sections are selected at locations where slope stability conditions are anticipated to be the most adverse such as where the slope height is at its maximum, pit wall materials are low strength and/or pore water pressures may be the highest. The traces of the critical sections are shown on Figure 8-2 with the geometry of each individual section shown in Appendix C.

Figure 8-2: Location of Critical Slope Stability Cross Sections



Source: JDS (2019)

8.2 Methodology

The seven critical cross-sections were analyzed using the slope stability modeling software, Slide (Rocscience, 2018), which uses two-dimensional, limited equilibrium methods with output in

terms of safety factors. Spencer's method of slices was used for the analyses due its consideration of both force and moment equilibrium and is typically less conservative compared to methods that consider only force equilibrium.

To construct the model geometries, vertical cross sections were cut through the respective final pit designs and the primary structures using Vulcan Mine Planning Software (Maptek, 2018). Multiple failure modes were analyzed including overall and interramp slopes and localized failures associated with geological contacts and/or faults. The non-circular, "path" search method was used or the final analyses in all cases.

8.3 Geomechanical Parameters

As discussed in Section 5.5, the Hoek-Brown (Hoek, et al., 2002) criteria was used to represent the shear strength–normal stress relationship for the rock masses for slope stability modeling. The respective average properties were used to represent the rock mass and joint strengths for each of the primary rock types. The rock mass and joint strength parameters are summarized in Table 4-2 and Table 5-3, respectively.

Slide's Generalized Anisotropic shear strength model was used to simulate the weaker strength of the rock parallel to foliation and, to a lesser extent, the dominant joint sets. The Generalized Anisotropic Strength model assigns a weaker strength to any potion of a potential failure surface that is parallel to the joint of foliation planes. The foliation and joint parallel shear strengths were developed using an equivalent strength material approach based on Jennings' (1972) equations:

$$c_{eq} = (1-k)c + kc_j \quad (5)$$

$$tan(\phi_{eq}) = (1-k)\tan(\phi) + k\tan(\phi_j) \quad (6)$$

Where c and ϕ are the cohesion and friction angle, respectively, of the intact rock bridges, c_j and ϕ_j are the cohesion and friction angle of the discontinuities and k is the coefficient of continuity along the failure plane. Given the lack of discontinuity length information at this stage of the project, the analyses were conducted using conservative continuity coefficients of 0.7 for joints, 0.80 for the intense schist foliation and 0.75 for the gneiss foliation. The isotropic, Hoek-Brown rock mass shear strength was used to represent the intact rock bridges.

Based on anecdotal evidence that earthquake ground accelerations are not known to have been the cause of any rock slope failures in mining and that there is little or no experience to suggest that rock slope stability is susceptible to seismic loading, a seismic (or pseudostatic) stability analysis was not performed. This is a common industry assumption for mining rock slope stability.

8.4 Results of Interramp/Overall Stability Analysis

Based on accepted engineering experience, interramp/overall slope designs that yield factors of safety (FOS) of 1.3 for slopes with high failure consequences and 1.2 for low failure consequences are appropriate for most open pit mines. Slopes of high failure consequence are generally those slopes that are critical to mine operations, such as those on which major haul roads are established, those providing ingress or egress points to the pit, or those underlying infrastructure such as processing facilities or structures.

The results of the overall slope angle (OSA) and interramp slope angle (ISA) stability analyses are summarized in Table 8-1 for each of the seven critical sections analyzed. Graphical output files showing the critical failure and FOS calculated by Slide for each individual analysis are presented in Appendix C.

Table 8-1: Results of Overall / Interramp Slope Stability Modeling

Pit	Section	Slope Design			Safety Factor	
		Max. Height (m)	OSA (°)	ISA (°)	ISA	OSA
Supremo	A	190	56	55	3.8	2.8
	B	170	49	51	3.3	2.9
	C	180	53	55	2.1	2.3
Latte	D	150	44	47	1.3	1.3
	E	180	53	55	2.1	2.0
Double Double	F	140	44	46	1.7	1.9
Kona	G	90	47	52	3.4	3.9

Source: JDS (2019)

Results of the overall slope stability analyses demonstrate that the bench configuration-based slope angles either meet or exceed the minimum acceptable safety factor of 1.3 for slopes with high failure consequences. Critical failure surfaces were typically non-circular, partially through the intact rock mass and partially along the discontinuities as defined in Section 8.3.

The results indicate that the stability of the Coffee open pit slopes is anticipated to be controlled by achievable bench face angles and not the stability of interramp or overall slope angles. Calculated safety factors for some sections are considered relatively high for typical open pit slope designs; however, steepening of the interramp slope angles would require either steeper bench face angles or reducing the design catch bench width which is not recommended due to the lack of outcrop to record actual structural information. With detailed geomechanical/ geological bench mapping and good quality wall control blasting practices during operation, opportunity may exist to steepen the interramp angles based on the newly acquired and more accurate information.

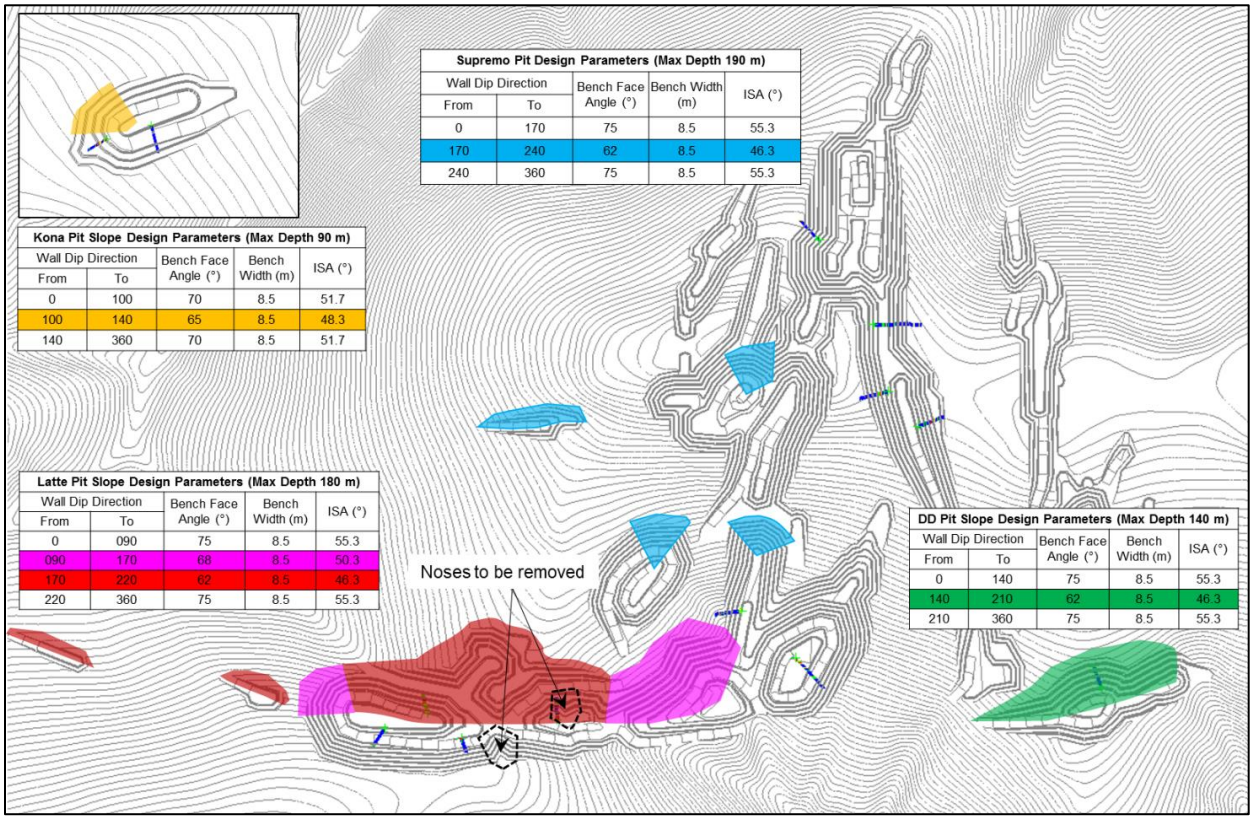
The use of a disturbance factor “D” equal to 0.7 for the entire rock mass is considered conservative given that blast damage and relaxation for relatively small open pits such as the Coffee pits would typically only extend a maximum distance of up to approximately 50 m. Beyond this disturbed zone, a D factor of zero should typically be used which would increase the rock mass strength and safety factors. However, given that the critical surfaces produced by the models are typically near 50 m from the face (approximate limits of the disturbed zone), more detailed modeling or zoning of the D factor would not have a significant impact on the results.

9 PIT SLOPE DESIGN RECOMMENDATIONS

Recommendations for Geotechnical Pit Slope design Parameters are summarized in Table 9-1 and shown graphically on Figure 9-1. In addition to the recommendations in Table 9-1 and Figure 9-1, continuous bench stacks or interramp slope heights should not exceed a height of approximately 100 m (vertically) without a minimum 15 m wide geotechnical berm, haul road or other wide step-out for infrastructure.

The current pit design incorporates multiple 'noses' which typically perform poorly in pit walls due to the lack of confinement on their sides and the increased probability of a geologic structure(s) penetrating from one side to the other, resulting instability. Given the dominant east-west structure at Latte and Double Double, the likelihood of a structure penetrating fully through the nose and causing a bench or multi bench failure is high. Interramp slopes within the noses should be reduced or the noses should be removed completely.

Figure 9-1: Pit Slope Design Recommendations



Source: JDS (2019)

Table 9-1: Recommended Pit Slope Design Parameters

Pit	Max. Slope Height (m)	Wall Dip Direction		Bench Face Angle (°)	Bench Height (m)	Min. Bench Width (m)	Max. ISA (°)
		From (°)	To (°)				
Latte	170	0	90	75	20	8.5	55.3
		90	170	68	20	8.5	50.3
		170	220	62	20	8.5	46.3
		220	360	75	20	8.5	55.3
Supremo	180	0	170	75	20	8.5	55.3
		170	240	62	20	8.5	46.3
		240	360	75	20	8.5	55.3
Double Double	135	0	140	75	20	8.5	55.3
		140	210	62	20	8.5	46.3
		210	360	75	20	8.5	55.3
Kona	100	0	100	70	20	8.5	51.7
		100	140	65	20	8.5	48.3
		140	360	70	20	8.5	51.7

Source: JDS (2019)

Double (20 m high) benches are recommended instead of single (10 m high) benches because properly executed double benches typically result in steeper effective bench face angles due to the confinement on the lower lift(s). For example, the upper bench lift, adjacent to a planned catch bench, is unconfined or free-faced in the upward direction and, consequently, some level of crest loss is unavoidable; however, for the lower lift(s), where there will not be a catch bench left adjacent to the blast, the confinement from the rock above effectively eliminates the potential for crest loss, assuming proper controlled blasting procedures are followed.

In addition, the probability of a discontinuity penetrating through a double bench is lower than that of a single bench, given the increase in bench height and corresponding increase in discontinuity length required to penetrate the bench. The use of double benches also results in wider catchments which are more likely to retain rock fall and provide access to benches for cleaning. Careful cleaning and scaling is required for double benches which, considering the bench height relative to scaling equipment reaching capabilities, must be done after each lift.

The recommended bench design assumes high quality wall control blasting including properly designed pre-split and/or or trim blasting adjacent to final walls. Depending on the quality of blasting and excavation techniques, achievable bench face angles might be greatly reduced from the theoretical angles determined by these analyses. It is recommended that field trials be performed of various controlled basting techniques, carefully documenting the results to confirm that the actual slope designs are being achieved or, if necessary, to serve as the basis of slope angle refinements.

10 ASSESSMENT OF FUTURE GEOMECHANICAL WORK

Two additional diamond geotechnical drillholes are recommended to be completed with future resource drilling. The collar coordinates and drillhole orientations are summarized in Table 10-1. Both holes should be surveyed with televiewer equipment similar to what was completed for the 2018 GI.

Table 10-1: Recommended Additional Geotechnical Drillholes

Hole ID	Easting (UTM)	Northing (UTM)	Elevation (masl)	Depth (m)	Azi. (º)	Inc. (º)
GT19-08	583,845	6,973,327	1,030	160	315	-60
GT19-09	582,770	6,973,200	1,100	190	200	-60

Proposed drillhole GT19-08 is designed to characterize the northeast-southwest oriented wall between the southern Supremo T3 and Latte structures that did not exist in previous pit designs. The purpose of drillhole GT19-09 is to better characterize geologic structure in Latte south wall. It is currently unclear whether an east-west striking, sub-vertical (orthogonal to foliation) joint set exists. If present, this set could lead to step path or toppling type instability in the south wall.

A thorough Geological and Geomechanical Bench Face Mapping Program should be undertaken, on a continuing basis, beginning in the early stages of development to verify structural conditions are consistent with assumptions presented herein and to identify local variations in structural conditions that might increase the risk of localized instabilities. The geomechanical data collection should concentrate on providing important data such as discontinuity persistence, spacing and variations in orientation that will allow further refinement of the bench design. The data collected should be used to confirm parameters used in the Geotechnical Models contained herein and, if determined to be other than assumed in this study, to further refine the analyses providing more accurate estimates of anticipated slope behavior.

As part of the Geologic Mapping Program, any significant structures or fault zones encountered should be mapped and digitized electronically and incorporated into the 3D Fault Model. This will allow projection of such structures to future pit slopes, highlighting areas of potentially instability and allow refinements to the slope design, if necessary. The accurate orientation and projection of fault structures is difficult based strictly on core drilling unless the structures cause a significant offset in mineralization, or a marker horizon is present. As such, the identification, mapping and analysis of fault structures of identified in pit walls will be a necessary and ongoing process during pit development.

A Slope Monitoring Program should be designed to ensure that the slopes are behaving as anticipated and warn if significant movements occur. The monitoring program should include a network of survey prisms monitored and analyzed regularly. If significant movements are noted, additional prisms should be installed along with extensometers to monitor any tension cracking.

11 CLOSURE

Analyses and recommendations presented herein are based on ultimate pit designs and resource as described in this report, and, as such, any significant changes to mine plans or pit configuration should be reviewed by JDS to verify that recommendations will remain valid for the new plans.

JDS is pleased to have the opportunity to be of service to Newmont and trusts that we have addressed the pertinent issues related to the Coffee feasibility pit slope update at this time. Should you, however, have any queries or comments on our visit or on the contents of this report, please do not hesitate to contact us.

Signed on this 9th day of August 2023.

PROFESSIONAL ENGINEER
YUKON TERRITORY
MICHAEL E. LEVY
8/9/2023

Michael Levy, P.Eng.
Geotechnical Manager

12 REFERENCES

Bieniawski Z.T., Engineering Rock Mass Classifications, John Wiley & Sons, New York, 1989.

Call, R.D., Slope Stability, SME Mining Engineering Handbook, Ch.10.4, 1992.

Hoek E., Strength of jointed rock masses. Twenty-third Rankine Lecture, Geotechnique, 1983:23 (3):187-223.

Hoek E. and Brown E.T., Practical Estimates of Rock Mass Strength. International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts, 1997:34 (8):1165-1186.

Hoek, E., Carranza-Torres CT, Corkum B., Hoek-Brown Failure Criterion – 2002 Edition. In: Proceedings of the Fifth International North American Rock Mechanics Symposium, Toronto, Canada, Vol. 1, 2002. p. 267-273.

JDS Energy & Mining, Inc. (2016) NI 43-101 Feasibility Study Technical Report for the Coffee Gold Project, Report Date: February 18, 2016.

Lorax Environmental Ltd., 2016, Coffee Gold Feasibility Study: Appendix J2: Hydrogeology, report prepared for Kaminak Gold Corporation dated February 1, 2016.

Maptek Pty. Ltd., Lakewood, Colorado, 2015 Vulcan 9.1.

Marinos, P. Hoek, E., GSI: Geologically Friendly Tool for Rock Mass Strength Estimation, Proc. GeoEng2000 Conference, Melbourne. 1422-1442.

SRK Consulting (U.S.), Inc., Updated Preliminary Geotechnical Assessment for the Coffee Gold Project, draft report dated November 11, 2013.

SRK Consulting (U.S.), Inc., 2015. Hydrogeologic Investigations Report, prepared for Kaminak Gold Corporation dated December 18, 2015.

SRK Consulting (U.S.), Inc., 2016. Feasibility Pit Slope Stability Evaluation, Coffee Gold Project, prepared for Kaminak Gold Corporation dated March 11, 2016.

Tetra Tech Canada Inc. (2019) Fall 2018 Testpitting Program Data Report, Coffee Gold Project. Report prepared for JDS Energy & Mining Inc. dated January 9, 2019.

Rocscience, Inc., Toronto, Ontario, 2017. RocData, 5.009, Rock, soil and discontinuity strength analysis software.

Rocscience, Inc., Toronto, Ontario, 2018. Slide 8.023, 2-dimensional limit equilibrium slope stability analysis software.

Rocscience, Inc., Toronto, Ontario, 2019. Dips 7.015, Visualization and analysis software for orientation based geologic data.

APPENDIX A

GEOTECHNICAL CORE LOGS

DRILLHOLE LOG: GT18-01

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-15 **TO:** 2018-10-18
DIP: -60 **AZIMUTH:** 255
COORDINATES: E: 584000.058 **N:** 6973569.835 **Elev.:** 1053.376

TOTAL DEPTH: 175
PAGE: 1 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 9.05
PLANNED HOLE ID: GT18-01

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

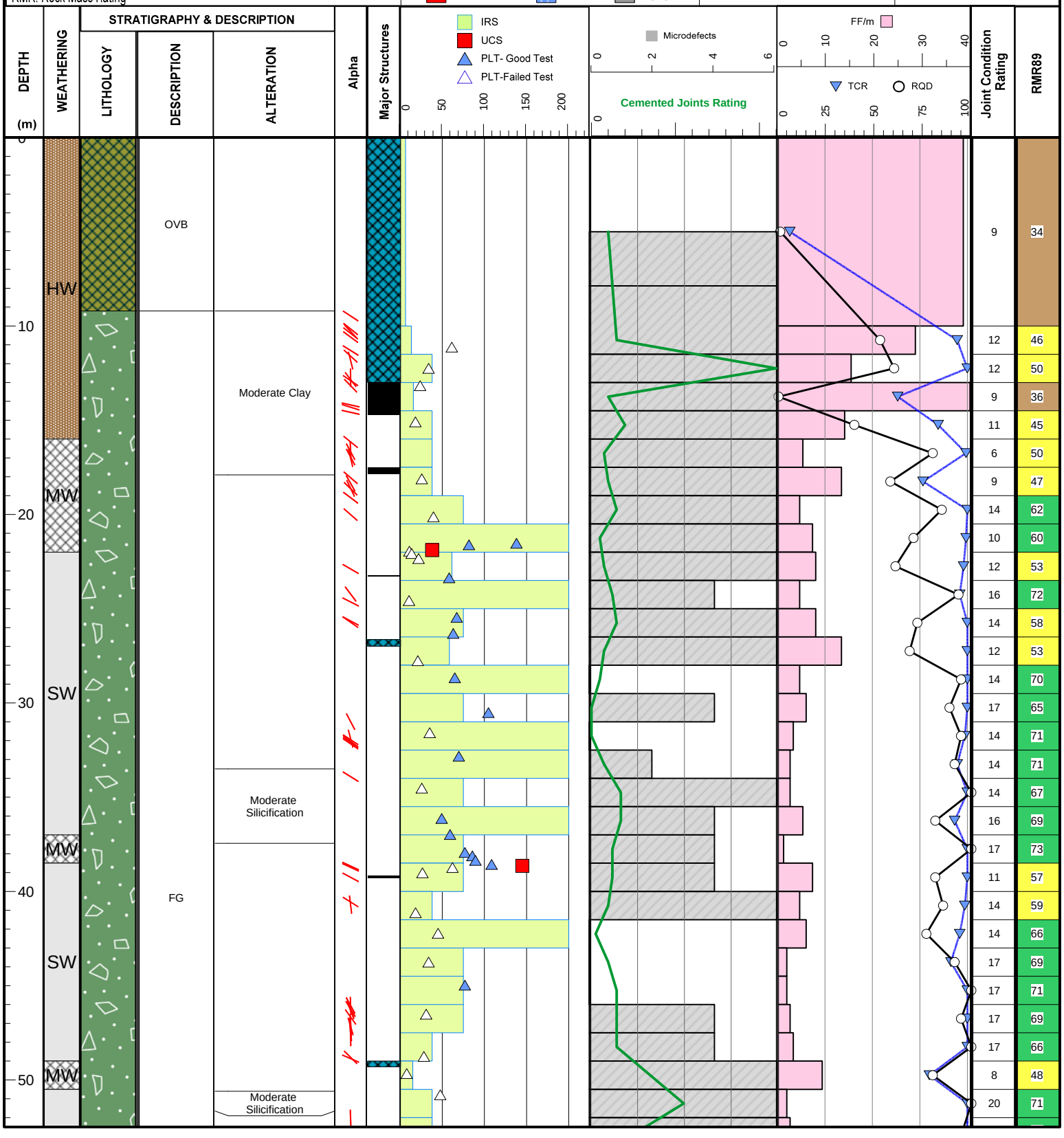
OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100



DRILLHOLE LOG: GT18-01

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-15 **TO:** 2018-10-18
DIP: -60 **AZIMUTH:** 255
COORDINATES: E: 584000.058 **N:** 6973569.835 **Elev.:** 1053.376

TOTAL DEPTH: 175
PAGE: 2 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 9.05
PLANNED HOLE ID: GT18-01

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	STRATIGRAPHY & DESCRIPTION: LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	IRS / UCS / PLT- Good Test / PLT-Failed Test	Microdefects / Cemented Joints Rating	FF/m / TCR / RQD	Joint Condition Rating	RMR89
60	SW									21	70
	MW									19	68
										12	54
										10	53
										19	73
										19	73
										10	57
										12	61
										23	69
										20	68
										19	69
70				Strong Silicification						20	67
	SW									19	68
										16	61
										21	71
										13	60
										17	75
										11	65
80										13	64
										20	69
										14	67
	FR									16	72
	SW									14	65
			MxM	Moderate Chlorite						14	70
	FR									23	74
90										12	64
	SW									18	70
	FR									16	67
										10	59
	SW									12	64
										25	72
										19	67
100										24	73
	FR									16	72
										16	67

DRILLHOLE LOG: GT18-01

AREA: Supremo

JDS Energy & Mining Inc.

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-15 **TO:** 2018-10-18
DIP: -60 **AZIMUTH:** 255
COORDINATES: E: 584000.058 **N:** 6973569.835 **Elev.:** 1053.376

TOTAL DEPTH: 175
PAGE: 3 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 9.05
PLANNED HOLE ID: GT18-01

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	IRS / UCS / PLT- Good Test / PLT-Failed Test (0, 50, 100, 150, 200)	Microdefects / Cemented Joints Rating (0, 2, 4, 6)	FF/m (0, 10, 20, 30, 40) / TCR / RQD (0, 25, 50, 75, 100)	Joint Condition Rating	RMR89
110	SW		FG	Moderate Silicification						17	70
										22	80
										19	78
										22	80
										21	78
										19	78
										19	76
										21	83
	MW									9	53
120	SW									12	70
										15	76
										19	72
										19	76
	MW									12	60
										19	73
	SW									21	78
130										16	70
										21	73
				Strong Clay						7	37
	CW		FC	Strong Clay						7	37
										10	36
				Intense Sericitisation						9	51
										8	34
140	HW									9	54
	MW									20	74
				Strong Sericitisation						14	63
	HW									17	64
										12	41
	CW									13	54
										14	52
150			YO	Strong Silicification / Strong Clay						10	38
	HW									12	61
	MW		FC	Moderate Silicification						9	51
	HW									14	57
				Moderate Silicification / Strong Chlorite						19	73
	SW		UM								

DRILLHOLE LOG: GT18-01

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-15 **TO:** 2018-10-18
DIP: -60 **AZIMUTH:** 255
COORDINATES: E: 584000.058 **N:** 6973569.835 **Elev.:** 1053.376

TOTAL DEPTH: 175
PAGE: 4 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 9.05
PLANNED HOLE ID: GT18-01

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

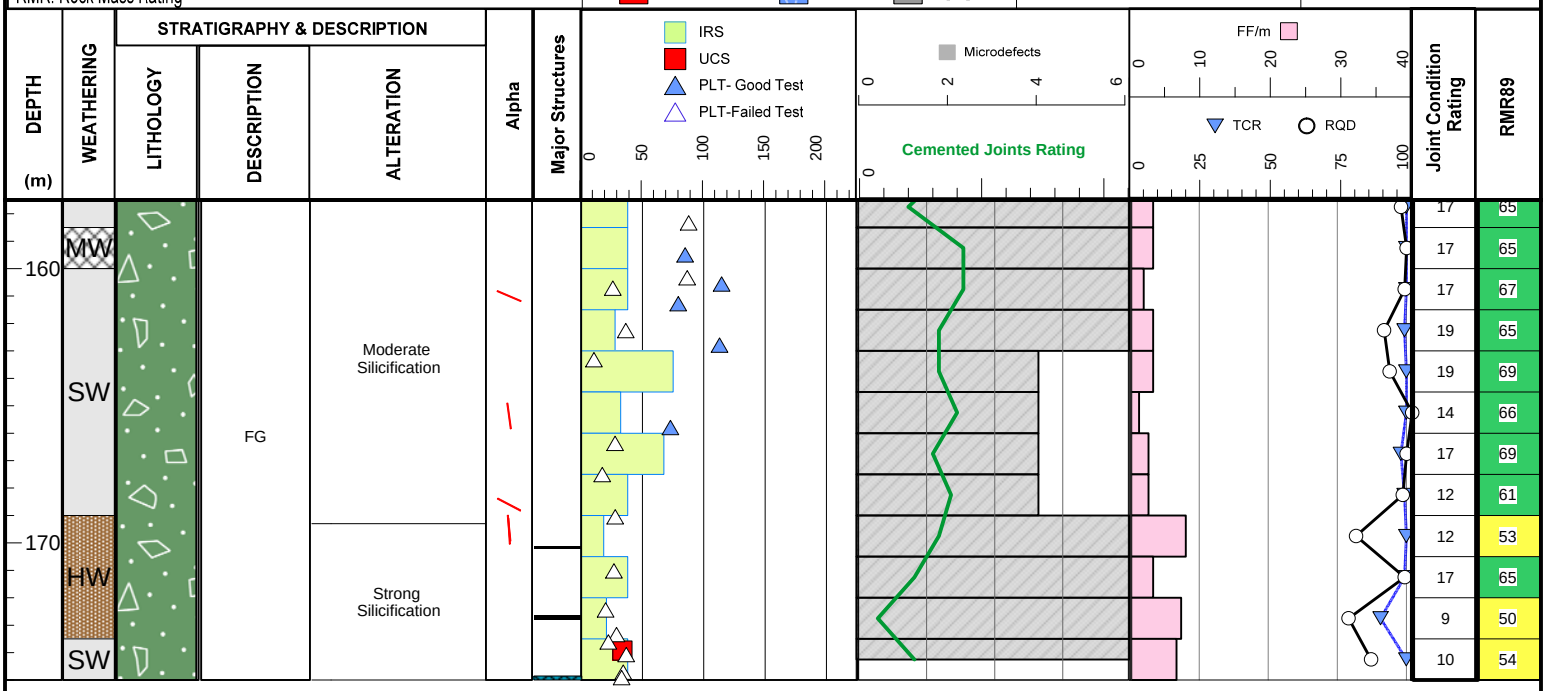
OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100



DRILLHOLE LOG: GT18-02

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-19 **TO:** 2018-10-22
DIP: -60 **AZIMUTH:** 310
COORDINATES: E: 584243.183 **N:** 6974730.05 **Elev.:** 1249.84

TOTAL DEPTH: 192
PAGE: 1 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 4.55
PLANNED HOLE ID: GT18-02

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

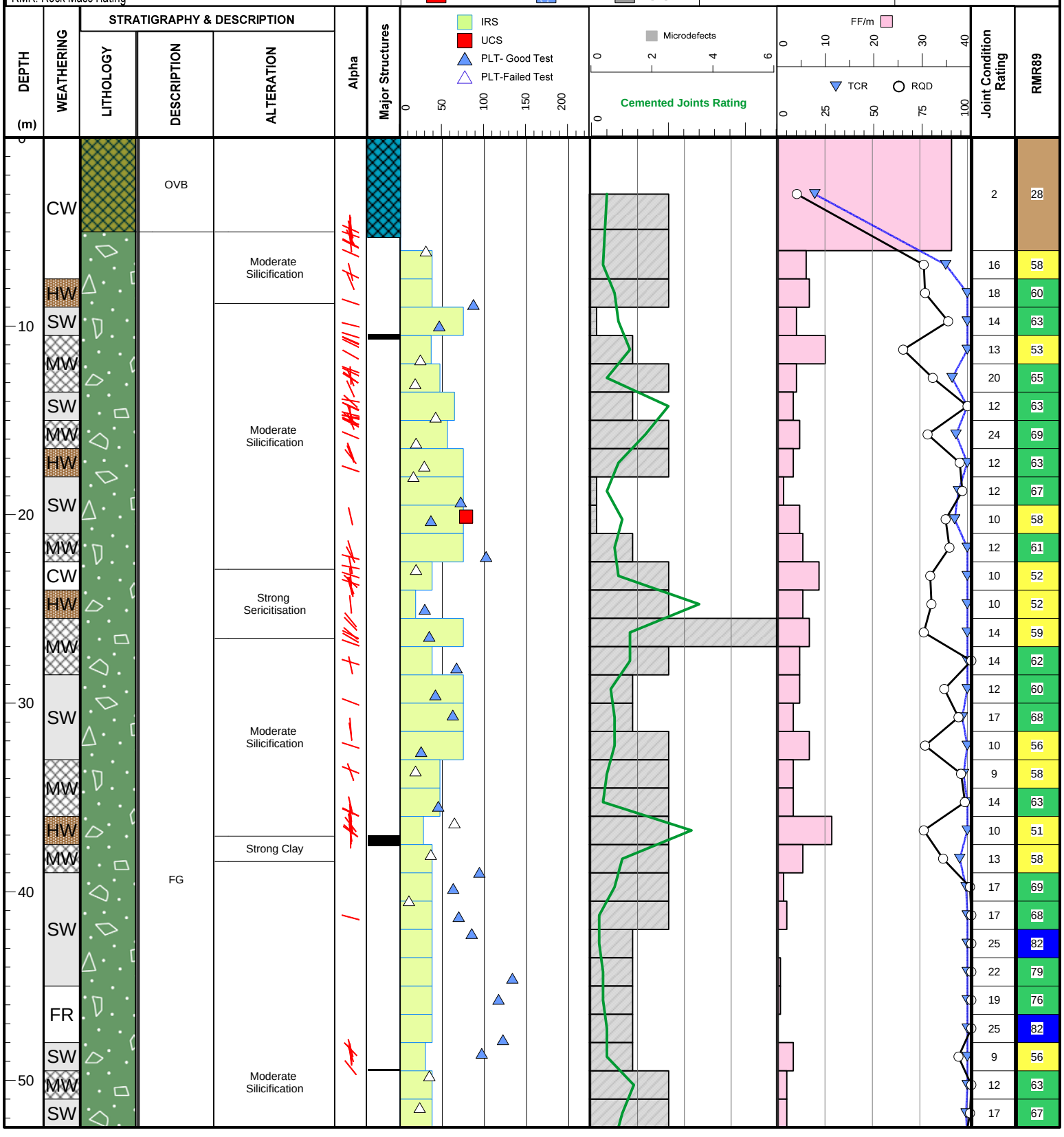
OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100



DRILLHOLE LOG: GT18-02

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-19 **TO:** 2018-10-22
DIP: -60 **AZIMUTH:** 310
COORDINATES: E: 584243.183 **N:** 6974730.05 **Elev.:** 1249.84

TOTAL DEPTH: 192
PAGE: 2 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 4.55
PLANNED HOLE ID: GT18-02

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

STRATIGRAPHY & DESCRIPTION

DEPTH (m)	WEATHERING	LITHOLOGY	DESCRIPTION	ALTERATION
60	MW			
	SW			
	FR			
	MW			Intense Sericitisation
	SW			
	FR			Moderate Silicification
70	SW			
	MW			
	SW		OG	Strong Chlorite
	MW			
80	SW			
90	MW			
	SW			
100	MW			

Alpha | Major Structures | IRS, UCS, PLT- Good Test, PLT-Failed Test (0, 50, 100, 150, 200) | Microdefects (0, 2, 4, 6) | Cemented Joints Rating (0) | FF/m (0, 10, 20, 30, 40) | TCR, RQD (0, 25, 50, 75, 100)

Joint Condition Rating	RMR89
12	64
15	65
17	66
17	65
17	65
17	68
7	51
17	69
17	69
17	69
17	65
17	66
16	63
17	68
16	64
11	52
15	64
15	66
14	62
16	64
6	49
13	61
12	66
14	66
12	61
7	47
7	45
16	72
10	61
11	62
19	72
14	61
14	61
10	59
14	68

DRILLHOLE LOG: GT18-02

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-19 **TO:** 2018-10-22
DIP: -60 **AZIMUTH:** 310
COORDINATES: E: 584243.183 **N:** 6974730.05 **Elev.:** 1249.84

TOTAL DEPTH: 192
PAGE: 3 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 4.55
PLANNED HOLE ID: GT18-02

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Broken, Core Loss, Sheared, Jointed

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	STRATIGRAPHY & DESCRIPTION: LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	IRS / UCS / PLT- Good Test / PLT-Failed Test (0, 50, 100, 150, 200)	Microdefects (0, 2, 4, 6) / Cemented Joints Rating	FF/m (0, 10, 20, 30, 40) / TCR / RQD (0, 25, 50, 75, 100)	Joint Condition Rating	RMR89
110										16	71
										17	77
										12	72
										25	85
										19	75
										17	77
										12	72
										25	82
										14	71
120				Moderate Silicification						12	69
										17	69
										17	69
	SW									12	62
										12	69
										25	82
										12	64
130			FG							12	64
										17	73
										17	67
										14	71
										12	62
										12	69
140										19	76
										19	76
										21	78
										25	85
										25	85
										14	74
	MW									19	73
										25	85
150										17	71
	SW									13	67
										17	77
										25	85
	MW									17	68

DRILLHOLE LOG: GT18-02

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-19 **TO:** 2018-10-22
DIP: -60 **AZIMUTH:** 310
COORDINATES: E: 584243.183 **N:** 6974730.05 **Elev.:** 1249.84

TOTAL DEPTH: 192
PAGE: 4 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 4.55
PLANNED HOLE ID: GT18-02

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	Joint Condition Rating	RMR89
160	SW						18	78
							14	70
	MW						19	74
				Moderate Silicification			13	60
	HW						16	63
							17	69
170							16	70
	MW						15	69
							19	73
				Moderate Silicification			15	67
							12	61
				Moderate Silicification			6	63
				Moderate Silicification			17	69
180							14	66
				Moderate Silicification			7	41
							8	43
				Moderate Silicification			8	41
				Moderate Silicification			9	42
	HW		YO	Strong Clay			7	40
							8	42
							11	43
190			FG	Moderate Silicification			12	47
							11	44

DRILLHOLE LOG: GT18-03

AREA: Latte

JDS Energy & Mining Inc.

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-04 **TO:** 2018-10-14
DIP: -65 **AZIMUTH:** 340
COORDINATES: E: 583016.422 **N:** 6973249.768 **Elev.:** 1090.315

TOTAL DEPTH: 155.1
PAGE: 1 **OF** 3
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 4.35
PLANNED HOLE ID: GT18-03

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

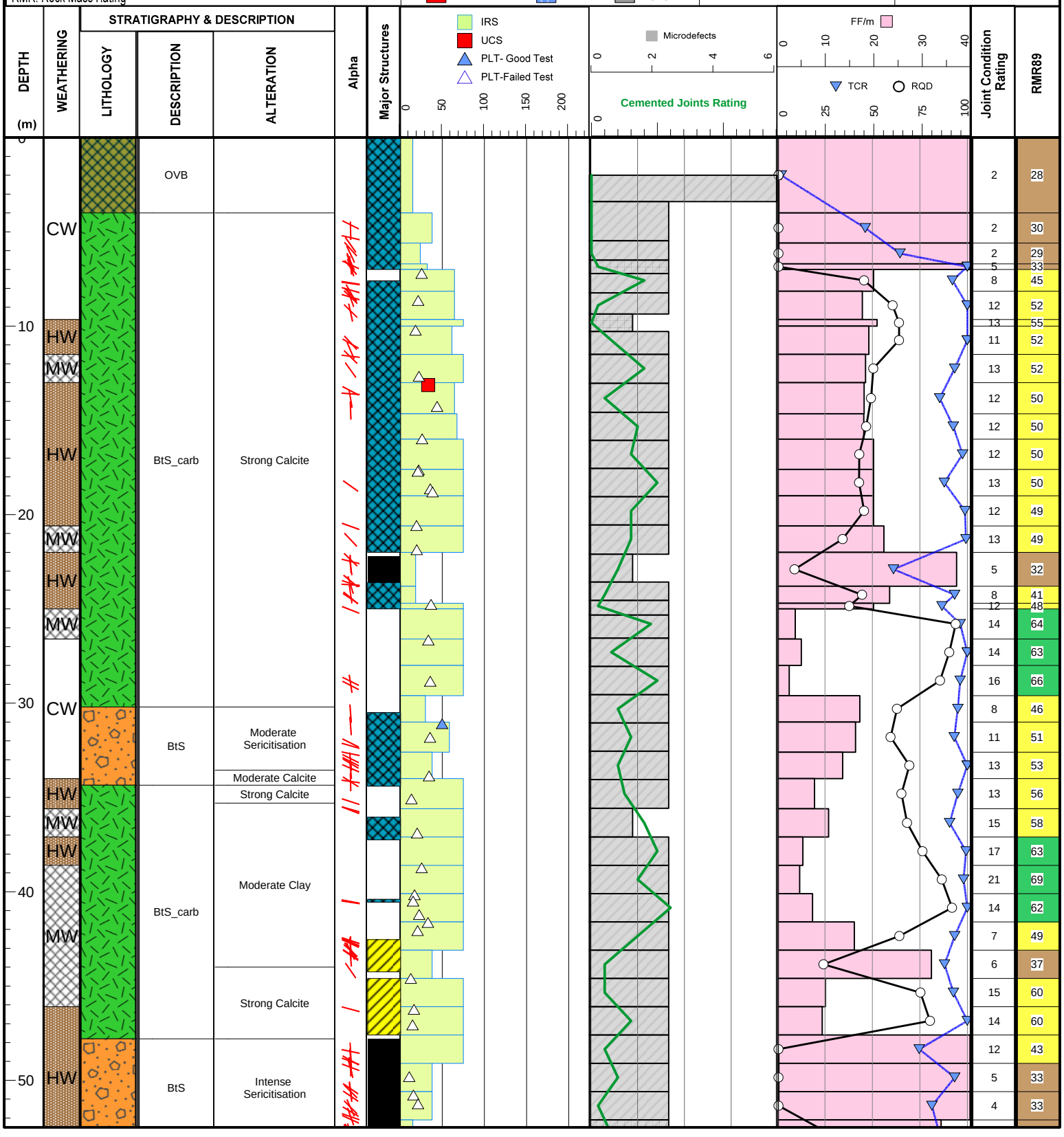
OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100



DRILLHOLE LOG: GT18-03

AREA: Latte

JDS Energy & Mining Inc.

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-04 **TO:** 2018-10-14
DIP: -65 **AZIMUTH:** 340
COORDINATES: E: 583016.422 **N:** 6973249.768 **Elev.:** 1090.315

TOTAL DEPTH: 155.1
PAGE: 2 **OF** 3
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 4.35
PLANNED HOLE ID: GT18-03

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

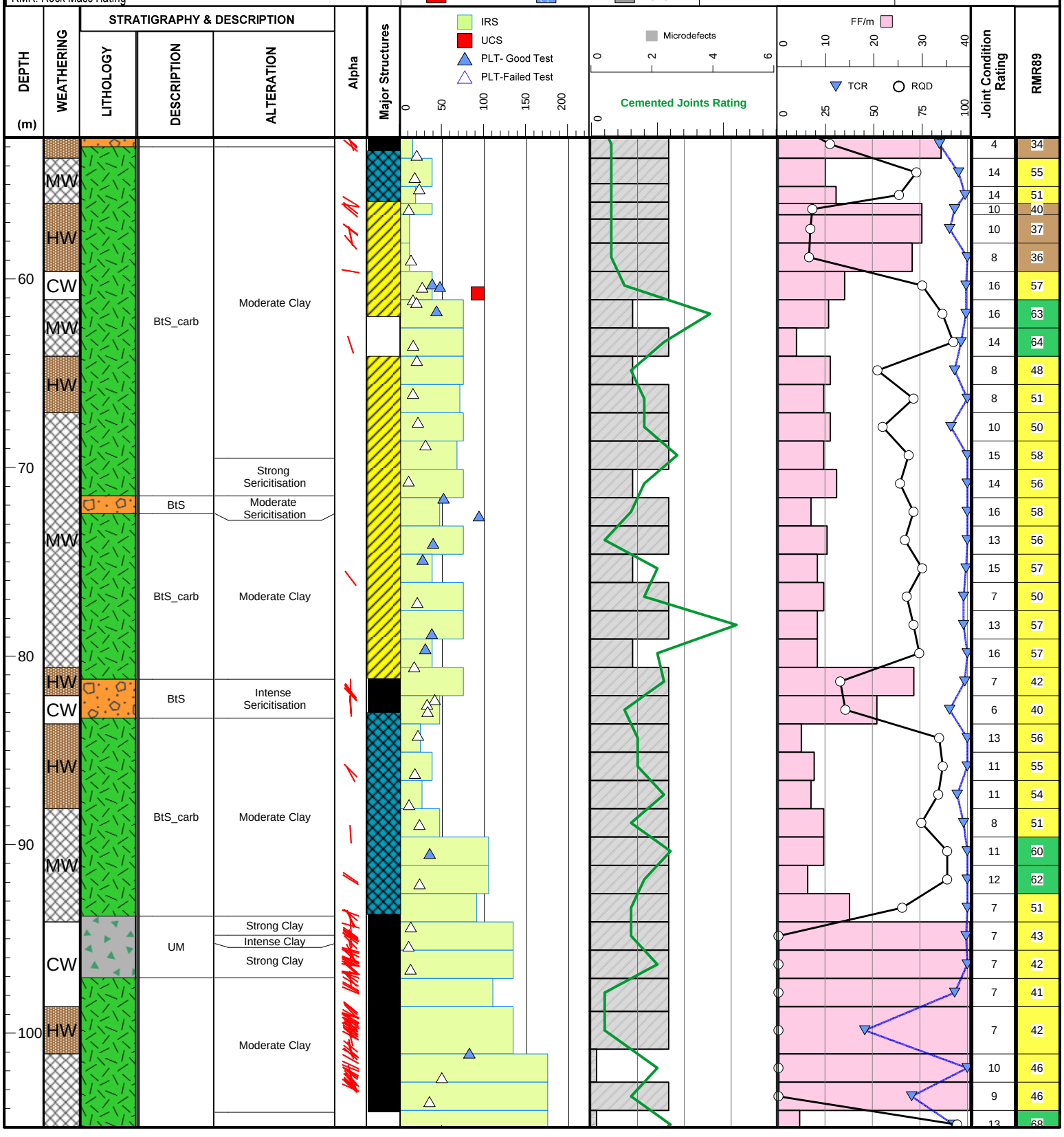
OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100



DRILLHOLE LOG: GT18-03

AREA: Latte

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-04 **TO:** 2018-10-14
DIP: -65 **AZIMUTH:** 340
COORDINATES: E: 583016.422 **N:** 6973249.768 **Elev.:** 1090.315

TOTAL DEPTH: 155.1
PAGE: 3 **OF** 3
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 4.35
PLANNED HOLE ID: GT18-03

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

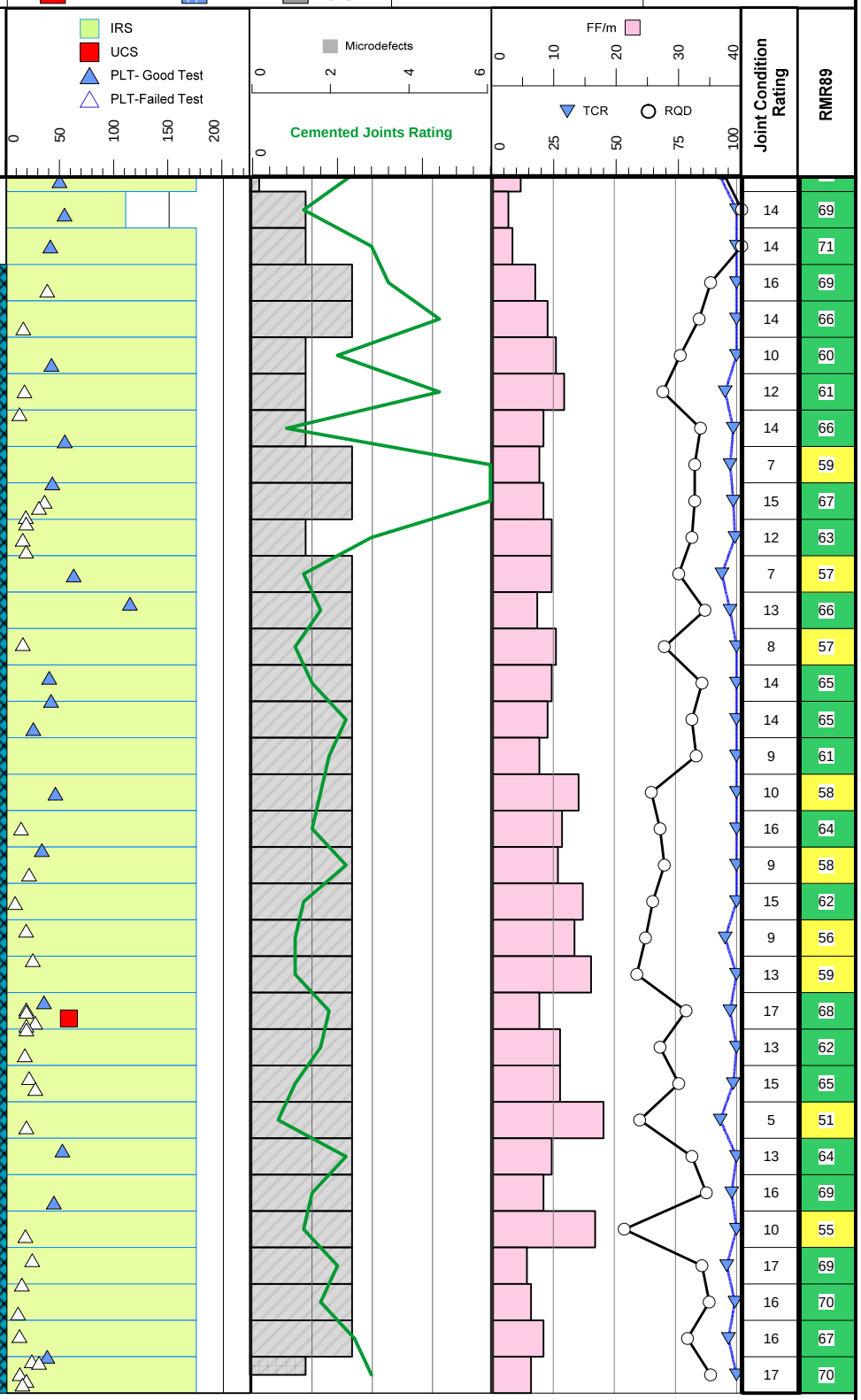
MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	LITHOLOGY	DESCRIPTION	ALTERATION
110			BtS_carb	Weak Clay
120	MW			Strong Chlorite
130				
140	SW			Weak Clay
	MW			
	SW			
150	MW			
	SW			



DRILLHOLE LOG: GT18-04

AREA: Supremo

JDS Energy & Mining Inc.

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-29 **TO:** 2018-11-01
DIP: -60 **AZIMUTH:** 250
COORDINATES: E: 584458.692 **N:** 6974257.559 **Elev.:** 1251.525

TOTAL DEPTH: 196
PAGE: 1 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH:
PLANNED HOLE ID: GT18-04

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Broken, Core Loss, Sheared, Jointed

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	LITHOLOGY	STRATIGRAPHY & DESCRIPTION: DESCRIPTION	STRATIGRAPHY & DESCRIPTION: ALTERATION	Alpha	Major Structures	IRS / UCS / PLT- Good Test / PLT-Failed Test (0, 50, 100, 150, 200)	Microdefects (0, 2, 4, 6) / Cemented Joints Rating (0)	FF/m (0, 10, 20, 30, 40) / TCR / RQD (0, 25, 50, 75, 100)	Joint Condition Rating	RMR89
0			OVB							15	52
										17	67
										14	63
										14	66
										12	63
10										19	77
	MW									16	64
										16	66
										20	72
										17	57
										17	62
20				Weak Clay						14	60
										12	57
										15	60
										15	59
			FG							12	60
										14	62
30	SW									10	57
										12	52
										14	69
	MW									12	60
										12	59
	SW									12	66
										14	73
40										16	70
	MW			Moderate Silicification						14	72
										16	77
										25	91
				Strong Clay						6	59
										7	64
	HW		YO	Intense Clay						6	59
50										6	50
				Moderate Clay						7	57

DRILLHOLE LOG: GT18-04

AREA: Supremo

JDS Energy & Mining Inc.

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-29 **TO:** 2018-11-01
DIP: -60 **AZIMUTH:** 250
COORDINATES: E: 584458.692 **N:** 6974257.559 **Elev.:** 1251.525

TOTAL DEPTH: 196
PAGE: 2 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH:
PLANNED HOLE ID: GT18-04

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	IRS / UCS / PLT- Good Test / PLT-Failed Test (0, 50, 100, 150, 200)	Microdefects / Cemented Joints Rating (0, 2, 4, 6)	FF/m (0, 10, 20, 30, 40) / TCR / RQD (0, 25, 50, 75, 100)	Joint Condition Rating	RMR89
60	MW									4	45
	HW									8	59
	MW									7	44
	SW		FG	Moderate Clay						9	47
	MW									9	54
70	SW									12	65
										17	68
										17	72
										16	70
										17	64
										17	67
										15	69
										15	69
										14	68
										15	70
										15	65
										17	74
80										17	74
										15	70
										15	72
										15	68
										15	59
										14	63
										15	64
										12	61
										16	62
90			IV	Moderate Silicification						18	69
										14	62
										16	57
										16	62
										12	54
										14	61
100										14	60
										18	68
										18	68

DRILLHOLE LOG: GT18-04

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-29 **TO:** 2018-11-01
DIP: -60 **AZIMUTH:** 250
COORDINATES: E: 584458.692 **N:** 6974257.559 **Elev.:** 1251.525

TOTAL DEPTH: 196
PAGE: 3 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH:
PLANNED HOLE ID: GT18-04

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

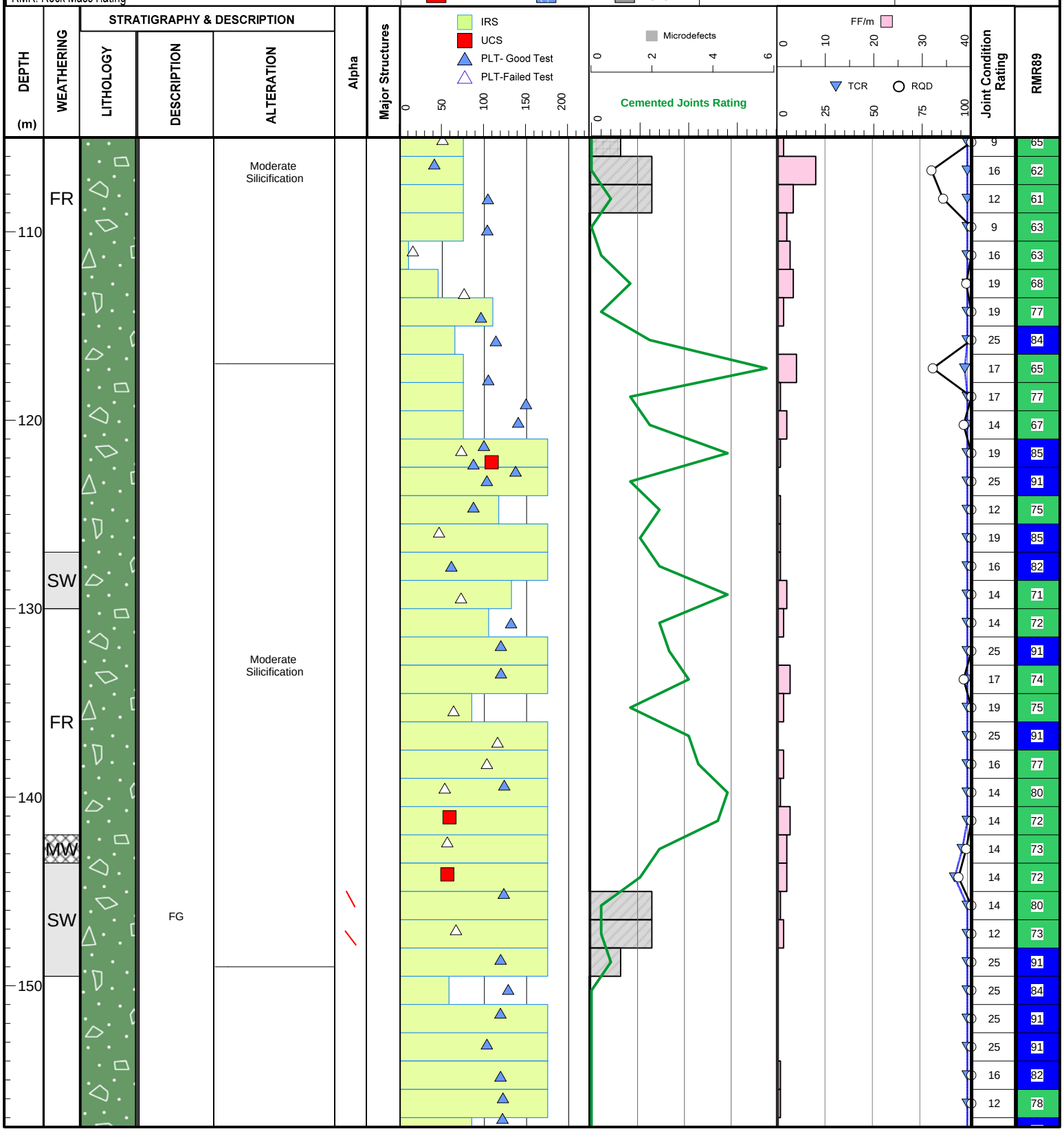
OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100



DRILLHOLE LOG: GT18-04

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-29 **TO:** 2018-11-01
DIP: -60 **AZIMUTH:** 250
COORDINATES: E: 584458.692 **N:** 6974257.559 **Elev.:** 1251.525

TOTAL DEPTH: 196
PAGE: 4 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH:
PLANNED HOLE ID: GT18-04

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	Joint Condition Rating	RMR89
160	FR			Moderate Silicification			25	86
							12	73
							16	82
							19	80
							12	69
							12	70
							25	91
							15	81
170							17	76
							12	70
	SW						19	77
							14	73
	FR						12	78
				Moderate Silicification			14	75
							25	91
180							14	75
				Moderate Silicification			14	73
	SW			Strong Clay			18	84
				Moderate Silicification			14	72
							25	84
							16	76
190	FR			Moderate Silicification			25	85
							16	76
							18	84
							12	71
							25	85

IRS, UCS, PLT- Good Test, PLT-Failed Test (0, 50, 100, 150, 200)
Microdefects (0, 2, 4, 6)
Cemented Joints Rating (0)
FF/m (0, 10, 20, 30, 40)
TCR, RQD (0, 25, 50, 75, 100)

DRILLHOLE LOG: GT18-05

AREA: Kona

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-09-25 **TO:** 2018-09-28
DIP: -65 **AZIMUTH:** 240
COORDINATES: E: 579630.566 **N:** 6973018.509 **Elev.:** 1274.694

TOTAL DEPTH: 105
PAGE: 1 **OF** 2
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 24.47
PLANNED HOLE ID: GT18-05

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	STRATIGRAPHY & DESCRIPTION: LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	IRS / UCS / PLT- Good Test / PLT-Failed Test (0, 50, 100, 150, 200)	Microdefects (0, 2, 4, 6) / Cemented Joints Rating	FF/m (0, 10, 20, 30, 40) / TCR / RQD (0, 25, 50, 75, 100)	Joint Condition Rating	RMR89
0	RS		OVB							2	33
	HW									2	39
	MW									2	33
	HW									2	33
	MW									2	39
	HW									9	45
	MW									7	44
	HW									16	69
	MW									8	45
	HW									8	53
10	MW		IV	Strong Silicification						10	53
	HW									9	50
	MW									16	67
	HW									11	48
	MW									12	53
	HW									6	43
	MW									16	66
	HW									14	51
	MW									8	44
	HW									12	61
	MW									16	67
	HW									12	59
	MW									9	49
	HW									11	37
	MW									14	45
20	HW									9	42
	MW									10	40
	MW									12	47
	MW									12	54
	MW									7	59
	MW									11	68
	MW									12	68
	MW									12	66
	MW									12	54
	SW		GG	Strong Silicification						11	61
30	MW									12	63
	MW									14	66
	HW			Moderate Silicification						3	46
	MW		IV	Strong Silicification						2	30
	HW									2	36
	MW									7	58
	HW									14	61
40	MW									12	63
	HW		YO	Strong Clay						4	38
	MW									2	30
	HW									2	30
	MW									2	39
	HW									3	49
	MW									25	84
	HW									2	33
	MW									2	37
	HW									2	38
	MW									2	38
50	HW			Strong Clay						2	39
	MW									3	45

DRILLHOLE LOG: GT18-05

AREA: Kona

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-09-25 **TO:** 2018-09-28
DIP: -65 **AZIMUTH:** 240
COORDINATES: E: 579630.566 **N:** 6973018.509 **Elev.:** 1274.694

TOTAL DEPTH: 105
PAGE: 2 **OF** 2
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 24.47
PLANNED HOLE ID: GT18-05

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

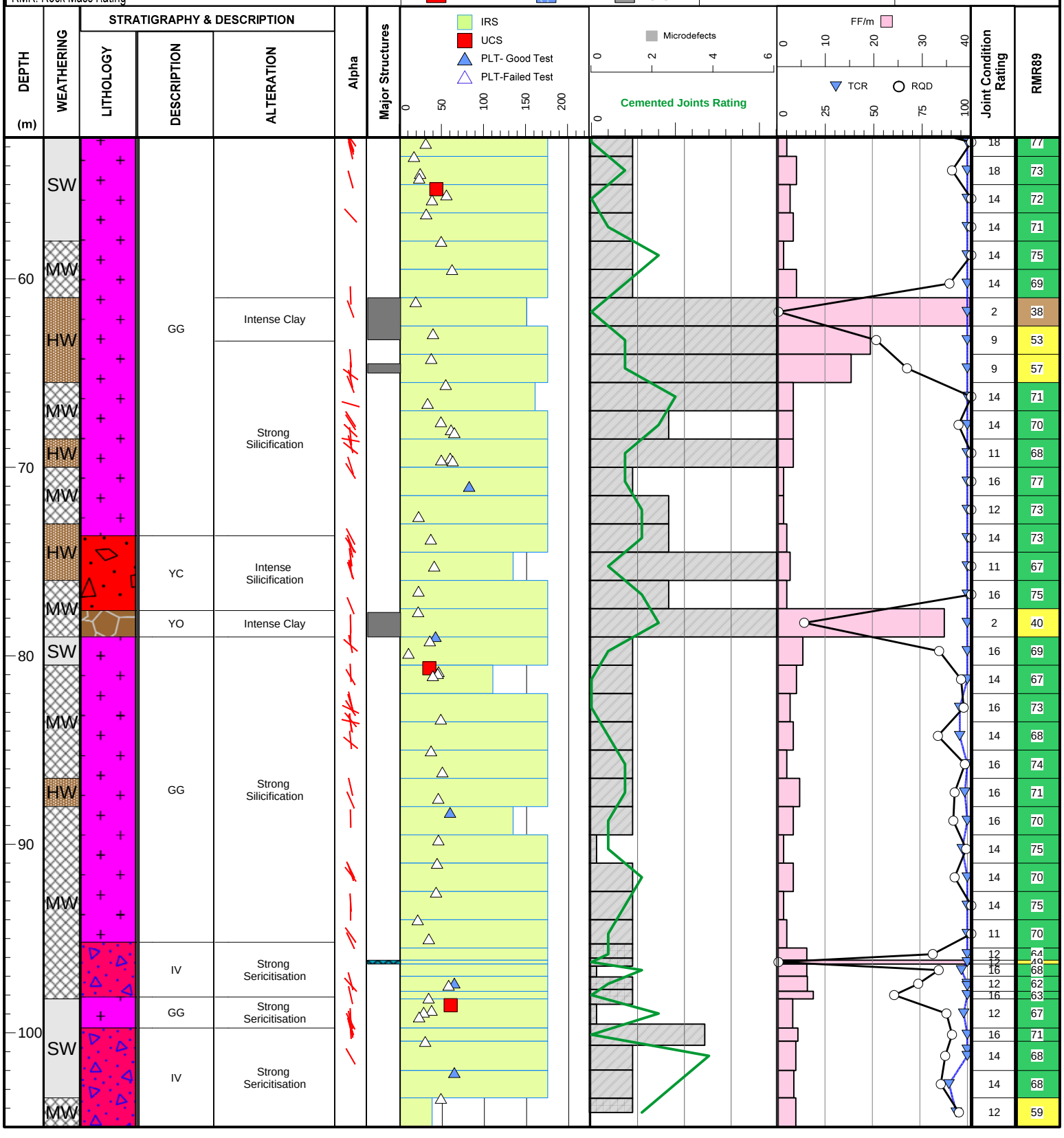
OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100



DRILLHOLE LOG: GT18-06

AREA: Supremo

JDS Energy & Mining Inc.

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-24 **TO:** 2018-10-27
DIP: -60 **AZIMUTH:** 70
COORDINATES: E: 584552.186 **N:** 6974147.563 **Elev.:** 1236.928

TOTAL DEPTH: 179.5
PAGE: 1 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH:
PLANNED HOLE ID: GT18-06

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	Joint Condition Rating	RMR89
0	HW		OVB				5	33
	MW						14	57
	SW						12	62
10	MW						12	58
							12	63
							17	66
							11	57
	SW						12	65
20							17	66
	MW						12	61
							12	63
							12	56
							22	74
							12	61
							14	64
							12	66
			FG	Weak Clay			12	63
30	HW						12	61
	MW						16	67
							14	66
							22	74
							17	73
							22	70
							15	62
40	SW						16	68
							17	70
							23	79
							10	69
							14	70
							18	77
	FR						14	80
50							17	69
							22	77

DRILLHOLE LOG: GT18-06

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-24 **TO:** 2018-10-27
DIP: -60 **AZIMUTH:** 70
COORDINATES: E: 584552.186 **N:** 6974147.563 **Elev.:** 1236.928

TOTAL DEPTH: 179.5
PAGE: 2 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH:
PLANNED HOLE ID: GT18-06

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

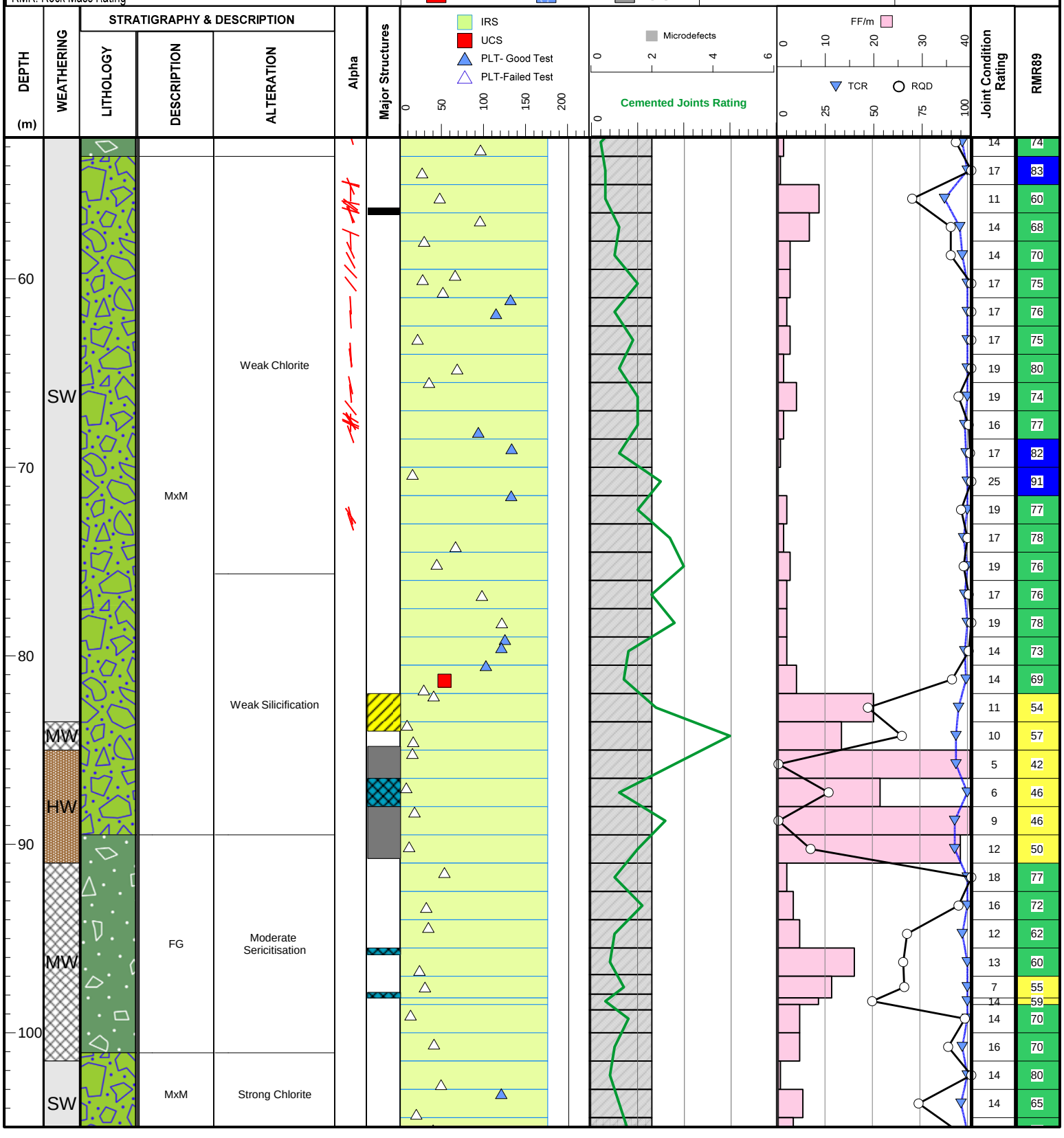
OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100



DRILLHOLE LOG: GT18-06

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-24 **TO:** 2018-10-27
DIP: -60 **AZIMUTH:** 70
COORDINATES: E: 584552.186 **N:** 6974147.563 **Elev.:** 1236.928

TOTAL DEPTH: 179.5
PAGE: 3 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH:
PLANNED HOLE ID: GT18-06

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	STRATIGRAPHY & DESCRIPTION: LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	IRS / UCS / PLT- Good Test / PLT-Failed Test (0, 50, 100, 150, 200)	Microdefects / Cemented Joints Rating (0, 2, 4, 6)	FF/m (0, 10, 20, 30, 40) / TCR / RQD (0, 25, 50, 75, 100)	Joint Condition Rating	RMR89
110	MW	FG		Moderate Sericitisation						12	68
										12	60
										8	51
										5	47
										5	53
										13	57
										14	66
										17	74
										17	76
120	SW			Weak Silicification						17	75
										15	71
										12	77
										12	71
										17	83
										12	61
										12	68
130	MW			Weak Clay						16	66
										14	66
										16	72
										12	71
										12	66
										14	72
										17	78
140	SW									25	91
										14	73
										16	77
	MW									16	75
										14	80
										14	68
										16	72
150	SW									14	79
	MW									14	74
										14	72
	SW									14	75
										25	91

DRILLHOLE LOG: GT18-06

AREA: Supremo

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-24 **TO:** 2018-10-27
DIP: -60 **AZIMUTH:** 70
COORDINATES: E: 584552.186 **N:** 6974147.563 **Elev.:** 1236.928

TOTAL DEPTH: 179.5
PAGE: 4 **OF** 4
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH:
PLANNED HOLE ID: GT18-06

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	STRATIGRAPHY & DESCRIPTION: LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	Joint Condition Rating	RMR89
160	MW			Weak Clay			17	76
							16	68
							16	73
							16	73
							14	75
	SW						25	91
							16	82
							14	73
170							14	71
							8	55
	MW						15	62
							15	64
							12	66
	SW						12	69
							14	75

Major Structures: IRS, UCS, PLT- Good Test, PLT-Failed Test (0, 50, 100, 150, 200)
Microdefects (0, 2, 4, 6) — Cemented Joints Rating
FF/m (0, 10, 20, 30, 40) — TCR, RQD (0, 25, 50, 75, 100)

DRILLHOLE LOG: GT18-07

AREA: Latte

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-01 **TO:** 2018-10-03
DIP: -70 **AZIMUTH:** 160
COORDINATES: E: 583126.872 **N:** 6973167.4 **Elev.:** 1115.343

TOTAL DEPTH: 145
PAGE: 1 **OF** 3
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 3.91
PLANNED HOLE ID: GT18-07

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	STRATIGRAPHY & DESCRIPTION: LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	Joint Condition Rating	RMR89
0	RS		OVB				2	39
				Strong Clay			16	70
							14	66
							12	68
				Strong Silicification			14	66
10							12	66
							14	71
							16	73
							17	73
				Strong Clay			12	67
							12	62
							14	68
20							16	75
	CW		BtS				16	81
							14	80
							17	82
				Strong Silicification			13	72
							12	65
							14	72
30							12	68
							12	70
				Strong Clay			14	76
							14	71
							17	83
							16	74
							12	68
							14	73
40							16	77
	HW		BtS_carb	Moderate Clay			16	74
							14	75
							25	90
	CW		YO	Moderate Silicification			14	75
							14	69
50							14	69
	HW						14	70

DRILLHOLE LOG: GT18-07

AREA: Latte

JDS Energy & Mining Inc.

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-01 **TO:** 2018-10-03
DIP: -70 **AZIMUTH:** 160
COORDINATES: E: 583126.872 **N:** 6973167.4 **Elev.:** 1115.343

TOTAL DEPTH: 145
PAGE: 2 **OF** 3
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 3.91
PLANNED HOLE ID: GT18-07

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	STRATIGRAPHY & DESCRIPTION: LITHOLOGY	DESCRIPTION	ALTERATION	Alpha	Major Structures	IRS / UCS / PLT- Good Test / PLT-Failed Test	Microdefects / Cemented Joints Rating	FF/m / TCR / RQD	Joint Condition Rating	RMR89
60	CW			Strong Sericitisation						14	71
	HW									12	70
	CW									12	73
	HW									7	66
	CW									14	71
70	MW			Strong Sericitisation						16	73
	HW			Moderate Sericitisation						16	82
	CW									14	80
	MW									14	75
	HW									14	70
	CW									17	78
	MW									4	63
80	HW									25	91
	MW		BtS							12	68
	SW									16	72
	MW									10	71
	HW									12	70
	MW									10	63
90	HW			Strong Calcite						14	68
	MW									16	82
	HW									12	68
	MW									12	68
	HW									14	80
100										18	83
										14	70
										12	70
										9	67
										16	77
										14	75
										13	65
										11	65
										11	62
										9	61
										12	73
										9	60

DRILLHOLE LOG: GT18-07

AREA: Latte

PROJECT: Coffee Slope Stability Update
LOCATION: Yukon, Canada
SITE & PROJECT No: GOLCOF02E
BORING DATE: 2018-10-01 **TO:** 2018-10-03
DIP: -70 **AZIMUTH:** 160
COORDINATES: E: 583126.872 **N:** 6973167.4 **Elev.:** 1115.343

TOTAL DEPTH: 145
PAGE: 3 **OF** 3
DRILL TYPE: Diamond
CORE DIA.: HQ3
CASING DEPTH: 3.91
PLANNED HOLE ID: GT18-07

DEFINTIONS

IRS: Intact Rock Strength (field est.)
Pt Load: Point Load Test (MPa)
TCR: Total Core Recovery
RMR: Rock Mass Rating
UCS: Uniaxial Compressive Strength (MPa)
FF/m: Fracture Frequency per metre
RQD: Rock Quality Designation

MAJOR LITHOLOGY

OVB, BtS, BtS_carb, FC, FG, FLT, GG, HU, IV, MxM, Yx, MxF, Ylim, YC, PB, YO, UM, OG

MAJOR STRUCTURES

Gouge, Core Loss, Jointed, Broken, Sheared

LEGEND OF RMR

0 - 20, 21 - 40, 41 - 60, 61 - 80, 81 - 100

DEPTH (m)	WEATHERING	LITHOLOGY	DESCRIPTION	ALTERATION	Joint Condition Rating	RMR89
110	MW		PB	Strong Calcite	9	63
					10	66
					12	73
					16	76
					18	79
					18	79
					16	72
					17	83
120					17	83
					12	73
					14	74
					16	77
					14	70
					14	72
					16	77
130	HW		BtS_carb	Strong Calcite	7	60
					12	69
					14	71
					14	69
					16	82
	MW				14	72
					14	71
140	HW				16	75
					6	62
	CW			Strong Clay	15	65
					15	65

Major Structures: IRS, UCS, PLT- Good Test, PLT-Failed Test (0, 50, 100, 150, 200)
Microdefects (0, 2, 4, 6) — Cemented Joints Rating (0)
FF/m (0, 10, 20, 30, 40) — TCR, RQD (0, 25, 50, 75, 100)

APPENDIX B

LABORATORY TEST RESULTS

DEPARTMENT OF
MINING ENGINEERING

Goodwin Hall
Queen's University
Kingston, Ontario, Canada K7L 3N6
Tel 613 533-2230
Fax 613 533-6597

March 11, 2019

Mr. Michael Levy
JDS Mining & Energy Inc.
14143 Denver West Parkway
Suite 100
Golden, CO 80401

Re: Core Testing – JDS Energy Corp. Coffee Project (P.O. #6448)

Mr. Masson:

One shipment of containers containing a total of sixty-nine (69) rock core specimens, including eleven spare direct shear and eight broken or limited length (too short to test) specimens was delivered to Queen's University for the purpose of conducting various strength tests (including UCS, triaxial confined compression, joint direct shear and Brazilian indirect tensile strength) on these specimens.

Tests were conducted according to the standards of the following organizations:

- The Complete ISRM (International Society of Rock Mechanics) Suggested Methods for Rock Characterization, Testing and Monitoring:1974-2006. April, 2007 Edition Prepared by the Commission on Testing Methods of the International Society for Rock Mechanics. Edited by R. Ulusay and J. A. Hudson. ISBN 978-975-93675-4-1.
- ASTM International Standards

Specific test protocols of each organization that were adhered to in conducting determinations that were undertaken for this report included:

-ISRM Suggested Methods for Determining Water Content, Porosity, Density, Absorption and Related Properties, pp. 85-98.

-ISRM Suggested Methods for Determining the Uniaxial Compressive Strength and Deformability of Rock Materials, pp. 151-156.
(also in accordance with Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens Under Varying States of Stress and Temperatures – ASTM D 7012-14)

-ISRM Suggested Methods for Determining the Strength of Rock Materials in Triaxial Compression, pp. 157-164.

(Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens Under Varying States of Stress and Temperatures – ASTM D 7012-14)

-ISRM Suggested Methods for Determining Tensile Strength of Rock Materials, (a) (Direct Tensile Strength); (b) (Brazilian Indirect Tensile Strength), pp. 182-183.
(also in accordance with (a) (Standard Test method for Direct Tensile Strength of Intact Rock Core Specimens – ASTM D 2936 – 08) and
(b) (Standard Test Method for Splitting Tensile Strength of Intact Rock Core Specimens – ASTM D 3967 – 08)), and

-ISRM Suggested Methods for Determining Shear Strength, pp. 165-176.
(Standard Test Method for Performing Laboratory Direct Shear Strength Tests on Rock Specimens Under Constant Normal Force – ASTM D 5607-08)

The samples that were subjected to unconfined and confined compression failure testing were subjected to a process of preparation that included:

-diamond sawing to prepare cylindrical samples having nearly parallel end faces at length-to-diameter aspect ratios no greater than 2.5-to-1 and no less than 2.0-to-1, where possible and depending on core lengths delivered
-diamond lathing, to prepare sample faces parallel to within $\pm$ 0.025 mm
-testing to failure within a Materials Testing System (MTS) Model 815 servo-controlled, electrohydraulic compression testing frame

These compression tests were performed under axial strain control at rates approximating 10^{-5} s^{-1}. For each unconfined compression strength test, simultaneous recordings of axial force, axial deformation (using strain gauges) and circumferential deformation (using strain gauges) were performed from which determination of standard failure parameters (UCS, Young's Modulus and Poisson's ratio) were made. For triaxial confined compression tests, no circumferential (ie.- lateral) deformation/strain was measured, thus no Poisson's ratio determinations were made. A summary of test data achieved for all successful tests, including photographs of pre- and post-test Brazilian tensile strength test specimens, is included in this portion of the submitted report (PART A).

Separate electronic file summaries, according to ASTM requirements that illustrate the pre- and post-test images and stress/strain responses of unconfined, triaxial confined and direct shear specimens, are also attached in a separate submission as PART B of this report.

Should you also require any additional information concerning work that has been performed, please do not hesitate to contact me by telephone at (613)-533-2198 or by FAX at (613)-533-6597.

Yours sincerely,



J. F. Archibald, Ph.D., P. Eng., FCIM

Summary of Strength Test Results
JDS Energy & Mining Inc. Coffee Gold Project (March, 2019)

Borehole (Depth, m)	**Density** (g/cm^3)	**Young's Modulus** (GPa)	**Poisson's ratio**	**UCS** (MPa)	**Sigma 1** **(MPa)**	**Sigma 3** **(MPa)**	**Brazilian Indirect Tensile Strength** (Values)/**Average** **(MPa)**
GT18-01 (21.79-22.00)	2.63	---	---	30.2 pf	---	---	---
GT18-01 (38.50-38.79)	2.65	23.892	0.16	134.2 pf	---	---	(3.4, 9.8, 10.9, 9.5)/**8.4**
GT18-01 (59.50-59.74)	2.70	---	---	57.6 pf	---	---	---
GT18-01 (73.00-73.45)	2.64	18.636	---	---	36.1 (f)	0.5	---
					---	2.0	
					---	5.0	
					---	10.0	
GT18-01 (99.42-99.70)	2.67	18.835	---	49.4 f	---	---	(16.4, 11.9, 12.4)/
GT18-01 (119.50-119.72)	2.62	Broken	Broken	Broken		1.0	---
						4.0	---
						10.0	---
						20.0	--
GT18-01 (139.68-139.92)	2.69	---	---	48.0 pf	---	---	---
GT18-01 (78.27-78.77)	2.67	18.784	---	---	46.5	1.0	---
					59.7	3.0	
					70.0	6.0	
					88.5 (pf)	12.0	
GT18-01 (173.80-174.05)	2.55	---	---	26.0 f	---	---	---
GT18-02 (19.98-20.23)	2.61	---	---	69.4 pf	---	---	(10.1, 10.2, 10.9)/**10.4**
GT18-02 (40.05-40.34)	2.65	26.802	---	---	128.4	1.0	---
					179.1	3.0	
					194.2	6.0	
					234.7 (pf)	12.0	
GT18-02 (61.23-61.50)	Broken	Broken	Broken	Broken	---	---	---
GT18-02 (82.06-82.28)	2.60	24.734	---	---	124.1	1.5	---
					155.6	4.0	
					196.9	9.0	
					227.9	15.0	
GT18-02 (100.21-100.50)	Broken	Broken	Broken	Broken	---	---	(4.3, 2.63, 16.6, 15.0)/**9.6**
GT18-02 (119.45-119.71)	2.92	---	---	47.2 f	---	---	(13.2, 10.7, 13.7)/**12.5**
GT18-02 (140.03-140.27)	2.64	27.806	---	---	239.2	2.0	---
					241.5	5.0	
					---	11.0	
					---	25.0	
GT18-02 (143.52-144.00)	2.61	---	---	83.2 (pf)	---	---	---
GT18-02 (159.69-159.93)	2.63	---	---	95.4 pf	---	---	(17.3, 22.1, 16.8)/**18.7**
GT18-02 (161.51-161.75)	256	19.111	0.11	45.0 pf	---	---	---
GT18-02 (181.16-181.40)	Broken	Broken	Broken	Broken	---	---	---
GT18-03 (13.00-13.26)	2.70	12.342	0.11	25.6 (pf)	---	---	---
GT18-03 (40.69-40.93)	Broken	Broken	Broken	Broken	---	---	(5.2, 3.9, 4.0, 4.4, 5.4, 2.6)/**4.3**

(pf) - indicates that failure occurred partially along pre-existing foliation surface

(f) - indicates that failure occurred fully along pre-existing foliation surface

(*) - direct shear sample failure data listed in following table

Borehole (Depth, m)	Density (g/cm^3)	Young's Modulus (GPa)	Poisson's ratio	UCS (MPa)	Sigma 1 **(MPa)**	Sigma 3 **(MPa)**	Brazilian Indirect Tensile Strength (Values)/Average **(MPa)**
GT18-03 (60.63-60.90)	2.70	17.216	0.09	82.9 (pf)	---	---	(6.4, 7.2, 14.4)/**9.3**
GT18-03 (118.82-119.03)	2.82	22.529	---	---	57.6	1.0	---
					82.0	4.0	
					120.9	10.0	
					180.6 (pf)	20.0	
GT18-03 (139.55-139.78)	2.70	---	---	49.4 pf	---	---	---
GT18-03 (154.02-154.26)	2.77	14.911	---	---	102.5	1.5	---
					115.1	4.0	
					131.3	9.0	
					150.9 (pf)	15.0	
GT18-04 (18.01-18.29)	2.62	---	---	76.5	---	---	(12.8, 9.6, 14.1, 10.5)/**11.8**
GT18-04 (41.50-41.70)	2.58	15.318	---	---	42.4	0.5	---
					92.1	3.0	
					137.4	6.0	
					147.5 (f)	12.0	
GT18-04 (60.46-60.78)	2.62	28.037	0.18	119.7	---	---	---
GT18-04 (80.50-80.85)	2.88	---	---	51.7 (pf)	---	---	---
GT18-04 (100.10-100.30)	2.63	27.447	---	---	22.1	1.0	---
					40.5	4.0	
					68.5	10.0	
					160.8 (pf)	20.0	
GT18-04 (122.10-122.36)	2.61	19.578	0.28	99.0	---	---	(18.0, 12.9, 17.4, 19.6)/**17.0**
GT18-04 (140.91-141.24)	2.60	---	---	50.3 (pf)	---	---	---
GT18-04 (143.86-144.34)	2.62	---	---	47.7 (pf)	---	---	---
GT18-04 (158.50-158.75)	2.66	---	---	125.5 (pf)	---	---	(13.7, 16.8, 17.6)/**16.0**
GT18-04 (180.31-180.57)	2.65	26.523	---	---	150.4 (pf)	2.0	---
					---	5.0	
					---	11.0	
					---	25.0	
GT18-04 (194.72-194.99)	2.61	---	---	92.6 (pf)	---	---	(16.1, 9.0, 13.1)/**12.7**
GT18-05 (28.00-28.27)	2.57	17.393	0.20	49.1 (pf)	---	---	---
GT18-05 (55.10-55.39)	2.43	---	---	35.0	---	---	(2.4, 2.2, 3.2)/**2.6**
GT18-05 (68.65-68.89)	Broken	Broken	Broken	Broken	---	---	---
GT18-05 (80.55-80.78)	2.37	---	---	26.9	---	---	---
GT18-05 (98.42-98.65)	2.60	13.568	0.07	51.5	---	---	---
GT18-06 (19.92-20.27)	2.63	---	---	83.9 (pf)	---	---	---
GT18-06 (40.00-40.27)	2.65	30.683	0.11	143.5 (pf)	---	---	---
GT18-06 (60.45-60.66)	2.85	28.359	---	---	29.9	1.0	---
					32.2	3.0	
					40.2	6.0	
					136.2	12.0	

(pf) - indicates that failure occurred partially along pre-existing foliation surface

(f) - indicates that failure occurred fully along pre-existing foliation surface

(*) - direct shear sample failure data listed in following table

Borehole (Depth, m)	**Density** (g/cm^3)	**Young's Modulus** (GPa)	**Poisson's ratio**	**UCS** (MPa)	**Sigma 1 (MPa)**	**Sigma 3 (MPa)**	**Brazilian Indirect Tensile Strength** (Values)/**Average (MPa)**
GT18-06 (81.20-81.44)	3.01	---	---	44.4 (pf)	---	---	---
GT18-06 (120.43-120.70)	Broken	Broken	Broken	Broken	---	---	(5.7, 4.7, 8.7)/**6.4**
GT18-06 (139.00-139.30)	2.66	25.600	---	---	90.5	1.0	---
					117.4	4.0	
					146.2	10.0	
					166.7	20.0	
GT18-06 (160.47-160.78)	2.43	---	---	44.5	---	---	(4.8, 4.7, 4.9)/**4.8**
GT18-06 (178.37-178.63)	2.65	---	---	90.9 (pf)	---	---	---
GT18-07 (15.25-15.51)	2.30	---	---	19.4 (pf)	---	---	(3.6, 2.6, 1.5)/**2.6**
GT18-07 (40.00-40.24)	2.64	23.258	---	---	53.1	0.5	---
					61. (pf)5	2.0	
					---	5.0	
					----	10.0	
GT18-07 (68.58-68.84)	2.54	4.984	0.09	32.0 (pf)	---	---	---
GT18-07 (82.00-82.27)	2.45	---	---	14.8 (pf)	---	---	(3.4, 3.9, 4.7)/**4.0**
GT18-07 (109.39-109.63)	2.36	17.346	---	---	35.6	0.5	---
					48.7	3.0	
					71.6	6.0	
					107.1 (pf)	12.0	
GT18-07 (120.06-120.38)	2.52	13.617	0.29	36.4 (pf)	---	---	(2.9, 1.8, 4.2)/**3.0**
GT18-03 (62.88-63.18)*	---	---	---	---	---	---	---
GT18-07 (56.50-56.80)*	---	---	---	---	---	---	---
GT18-01 (148.33-148.68)*	---	---	---	---	---	---	---
GT18-04 (164.50-165.14)*	---	---	---	---	---	---	---
GT18-04 (176.14-176.59)*	---	---	---	---	---	---	---
SPARE Direct Shear	Not	Tested					
*DS-01 (9.70-9.98)**	---	---	---	---	---	---	---
*DS-01 (13.00-13.66)**	---	---	---	---	---	---	---
*DS-01 (62.60-62.88)**	---	---	---	---	---	---	---
*DS-01 (73.00-73.45)**	---	---	---	---	---	---	---
*DS-01 (78.27-78.77)**	---	---	---	---	---	---	---
*DS-01 (81.81-82.24)**	---	---	---	---	---	---	---
*DS-01 (143.52-144.00)**	---	---	---	---	---	---	---
*DS-01 (143.86-144.34)**	---	---	---	---	---	---	---
*DS-01 (148.33-148.68)**	---	---	---	---	---	---	---
*DS-01 (150.23-150.62)**	---	---	---	---	---	---	---
*DS-01 (193.20-193.68)**	---	---	---	---	---	---	---

(pf) - indicates that failure occurred partially along pre-existing foliation surface

(f) - indicates that failure occurred fully along pre-existing foliation surface

(*) - direct shear sample failure data listed in following table

Summary of Residual Direct Shear Strength Test Results

Borehole-Sample (depth)	Apparent Cohesion (kPa)	Internal Friction Angle (°)
GT18-03 (62.88-63.18)	20	21.3
GT18-07 (56.50-56.80)	0	20.6
GT18-01 (148.33-148.68)	69	16.1
GT18-04 (164.50-165.14)	0	24.6
GT18-04 (176.14-176.59)	0	22.0
SPARE Samples (Holdover)		
DS-01 (9.70-9.98)	---	---
DS-01 (13.00-13.66)	---	---
DS-01 (62.60-62.88)	---	---
DS-01 (73.00-73.45)	---	---
DS-01 (78.27-78.77)	---	---
DS-01 (81.81-82.24)	---	---
DS-01 (143.52-144.00)	---	---
DS-01 (143.86-144.34)	---	---
DS-01 (148.33-148.68)	---	---
DS-01 (150.23-150.62)	---	---
DS-01 (193.20-193.68)	---	---



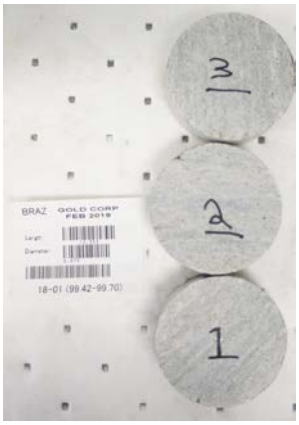
J. F. Archibald, Ph.D., P. Eng., FCIM

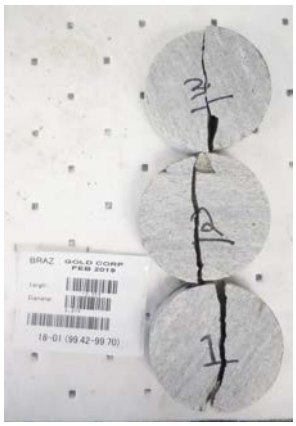
Pre-and Post-Test Photos of Brazilian Tensile Strength Samples





18-01 (38.50-38.79))





18-01 (99.42-99.70)





18-02 (19.98-20.23)



Post-test photo image missing

18-02 (100.21-100.50)





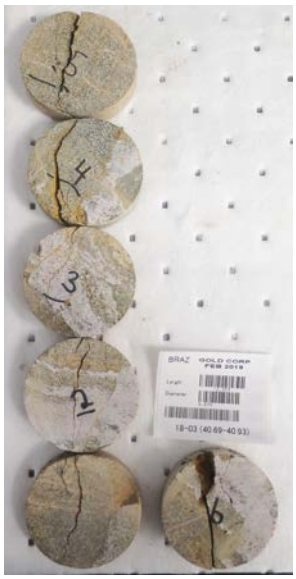
18-02 (119.45-119.71)





18-02 (159.69-159.93)





18-03 (40.69-40.93)





18-03 (60.63-60.90)





18-04 (18.01-18.29)





18-04 (122.10-122.36)



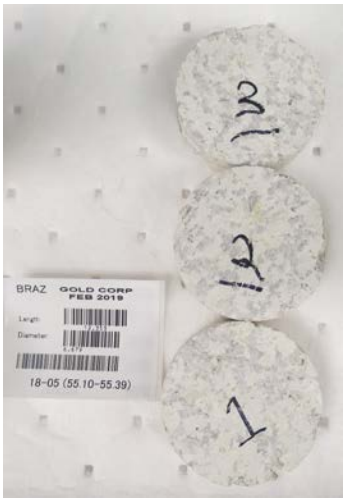


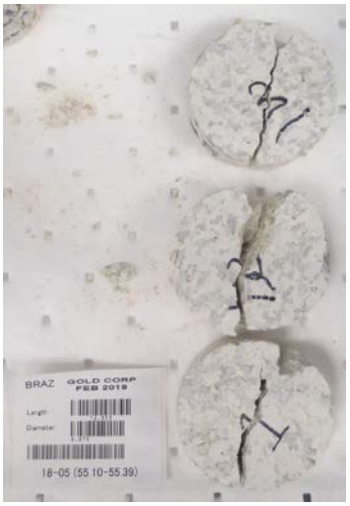
18-04 (158.50-158.75)





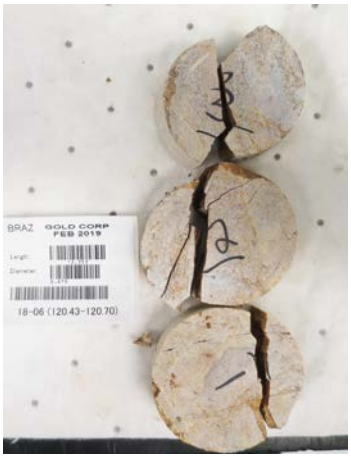
18-04 (194.72-194.99)





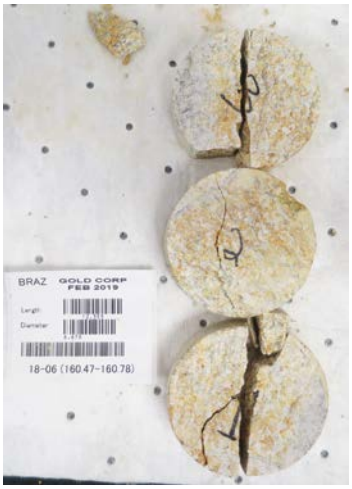
18-05 (55.10-55.39)





18-06 (120.43-120.70)





18-06 (160.47-160.78)





18-07 (15.25-15.51)





18-07 (82.00-82.27)





18-07 (120.06-120.38)

JDS Energy & Mining Inc.

Coffee Project

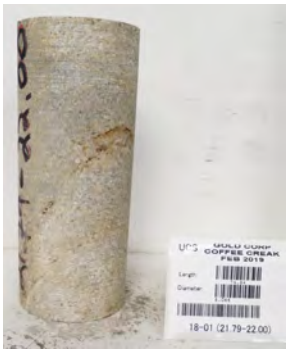
Core Sample Strength Tests

ASTM Data Sheets

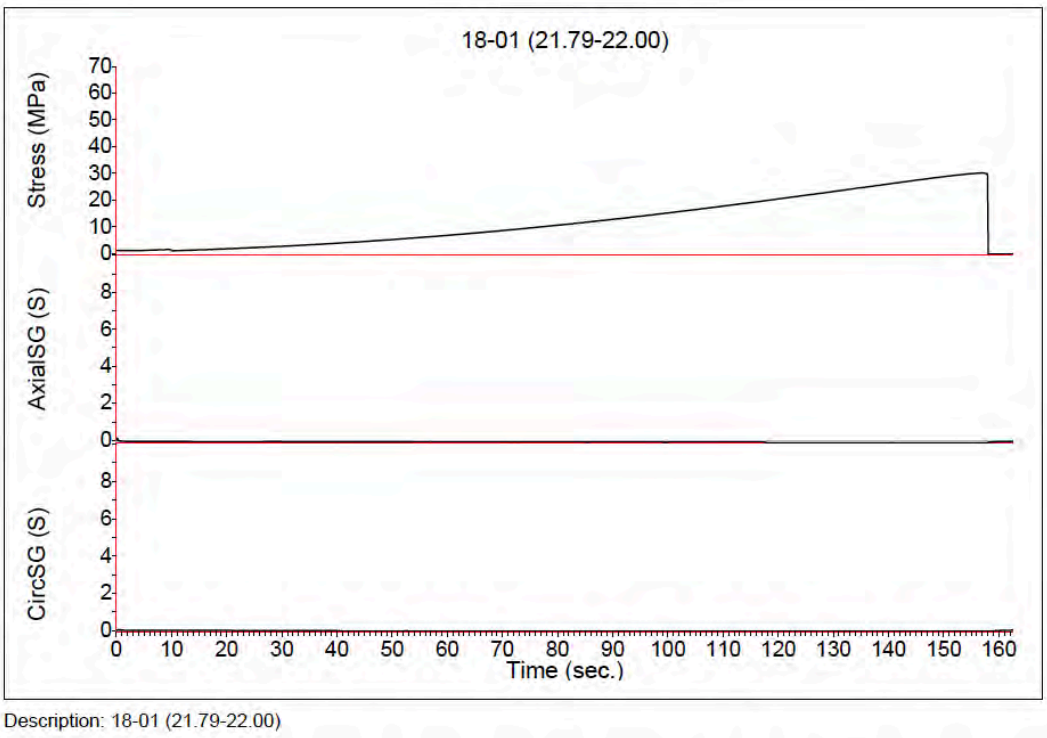
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-01	Sample ID: UCS (no moduli)
Depth: (21.79-22.00 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.07
Length, cm	14.64
Height-to-Diameter Ratio	2.41/1
Bulk Density, kg/m^3	2633
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	30.2
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-01 (21.79-22.00)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (50% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

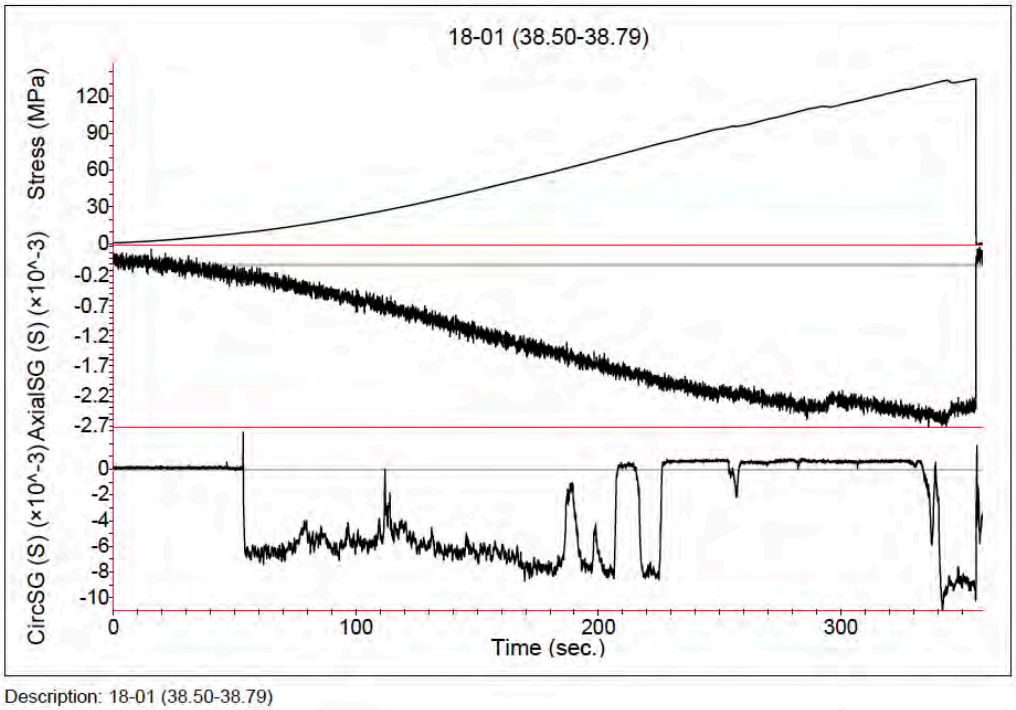
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-01	Sample ID: UCS
Depth: (38.50-38.79 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.05
Length, cm	14.96
Height-to-Diameter Ratio	2.47/1
Bulk Density, kg/m^3	2650
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	134.2
Young's Modulus, E (GPa)	23.892
Poisson's ratio	0.16







Description: 18-01 (38.50-38.79)

Remarks: Failed partially along pre-existing foliation at 20″ to core axis (50% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

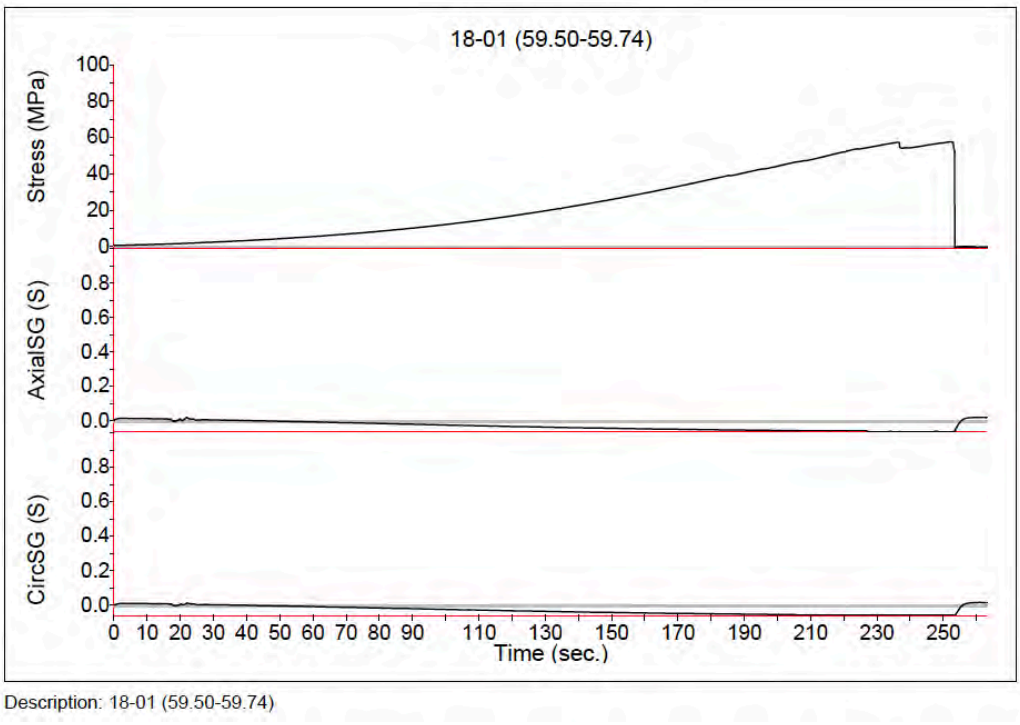
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-01	Sample ID: UCS (no moduli)
Depth: (59.50-59.74 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	14.71
Height-to-Diameter Ratio	2.43/1
Bulk Density, kg/m^3	2696
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	57.6
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-01 (59.50-59.74)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (90% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

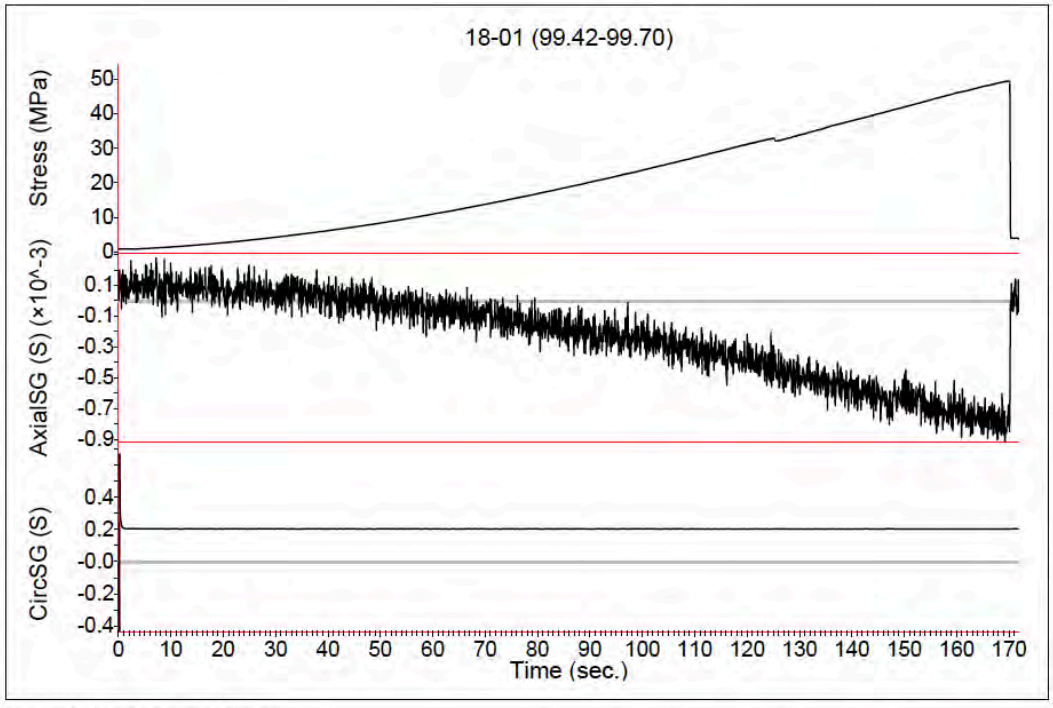
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-01	Sample ID: UCS
Depth: (99.42-99.70 m)	Date Sampled: NA
Lithological Description: Gneiss	

Specimen Parameters	
Diameter, cm	6.07
Length, cm	14.93
Height-to-Diameter Ratio	2.46/1
Bulk Density, kg/m^3	2670
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	49.4
Young's Modulus, E (GPa)	18.835
Poisson's ratio	---







Description: 18-01 (99.42-99.70)

Remarks: Failed fully along pre-existing foliation at 30″ to core axis (100% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

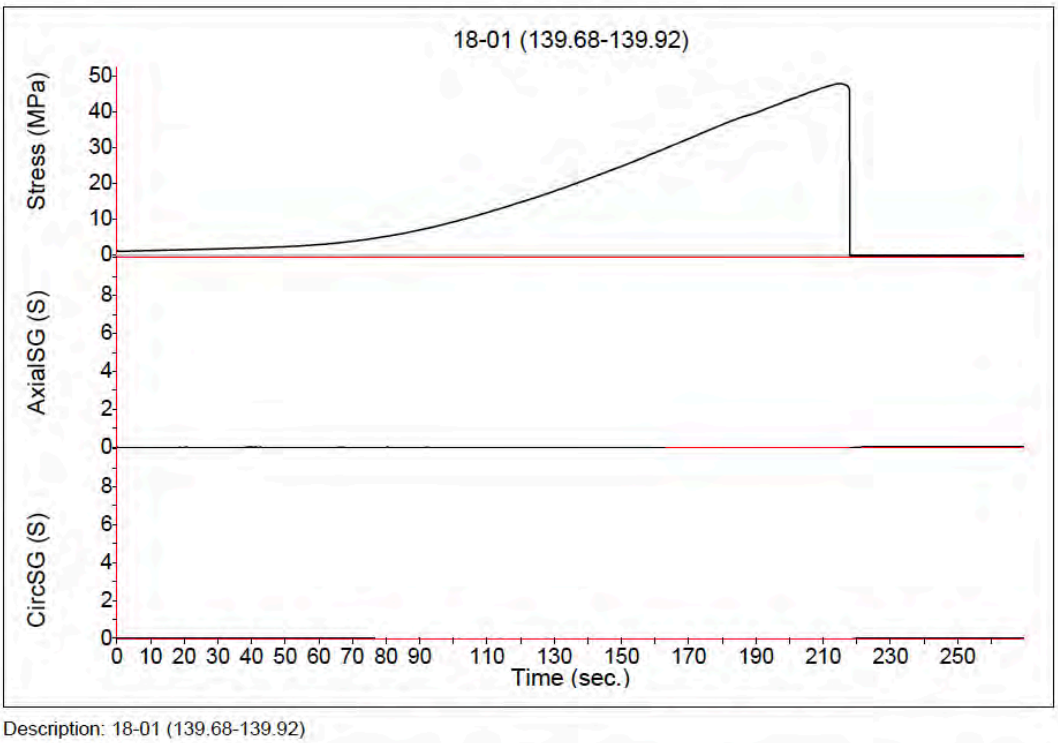
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-01	Sample ID: UCS (no moduli)
Depth: (139.68-139.92 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	13.61
Height-to-Diameter Ratio	2.25/1
Bulk Density, kg/m^3	2695
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	48.0
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-01 (139.68-139.92)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (90% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

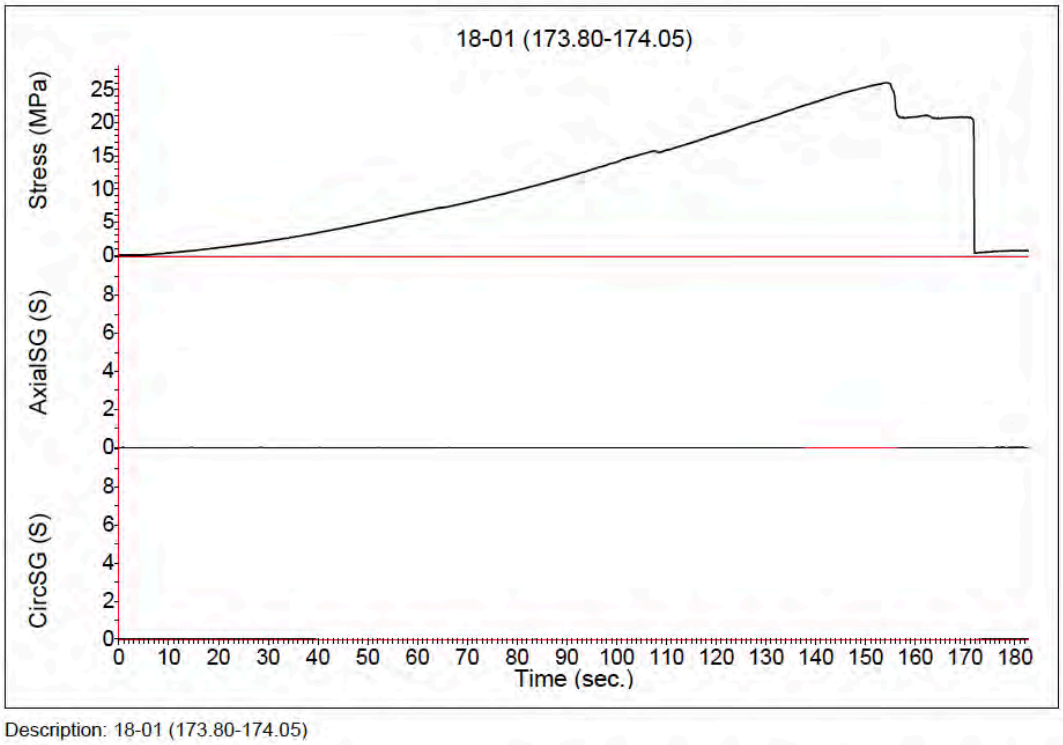
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-01	Sample ID: UCS (no moduli)
Depth: (173.80-174.05 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	14.89
Height-to-Diameter Ratio	2.46/1
Bulk Density, kg/m^3	2546
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	26.0
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-01 (173.80-174.05)

Remarks: Failed fully along pre-existing foliation at 10″ to core axis (100% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

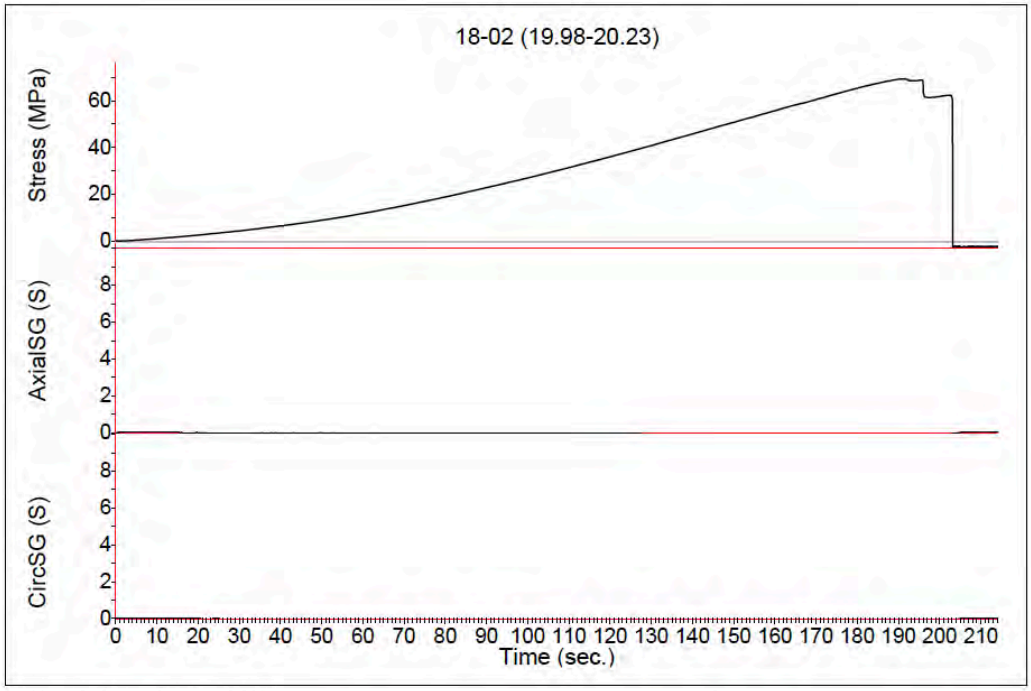
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-02	Sample ID: UCS (no moduli)
Depth: (19.98-20.23 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.09
Length, cm	13.41
Height-to-Diameter Ratio	2.20/1
Bulk Density, kg/m^3	2608
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	69.4
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-02 (19.98-20.23)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (90% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

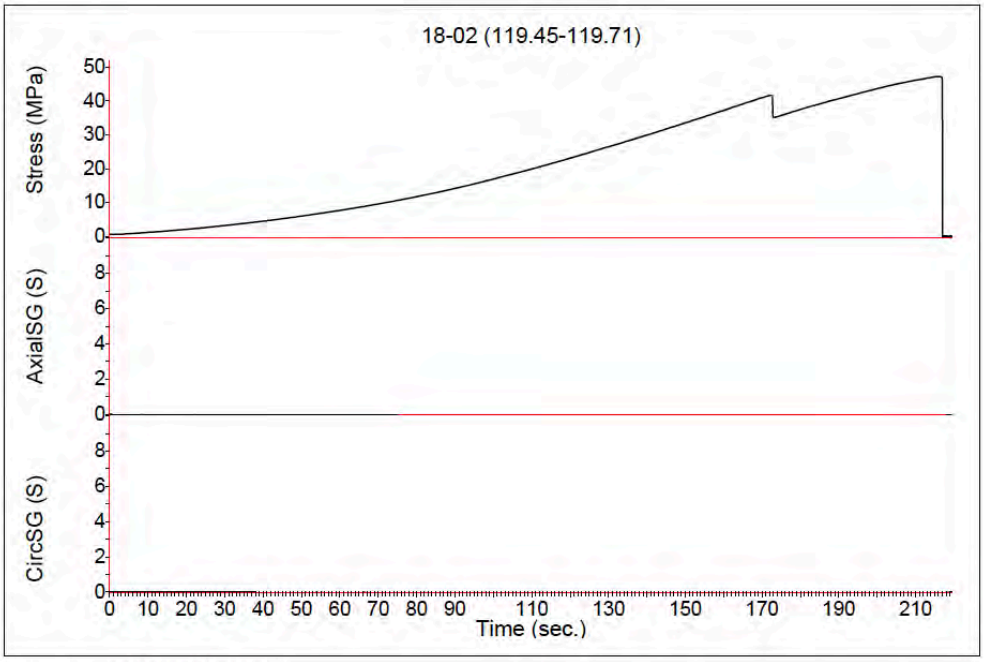
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-02	Sample ID: UCS (no moduli)
Depth: (119.45-119.71 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.10
Length, cm	14.99
Height-to-Diameter Ratio	2.46/1
Bulk Density, kg/m^3	2922
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	47.2
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-02 (119.45-119.71)

Remarks: Failed fully along pre-existing foliation at 30″ to core axis (100% failure on foliation surface)

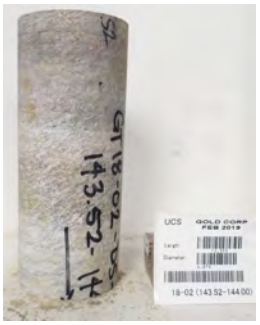
Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

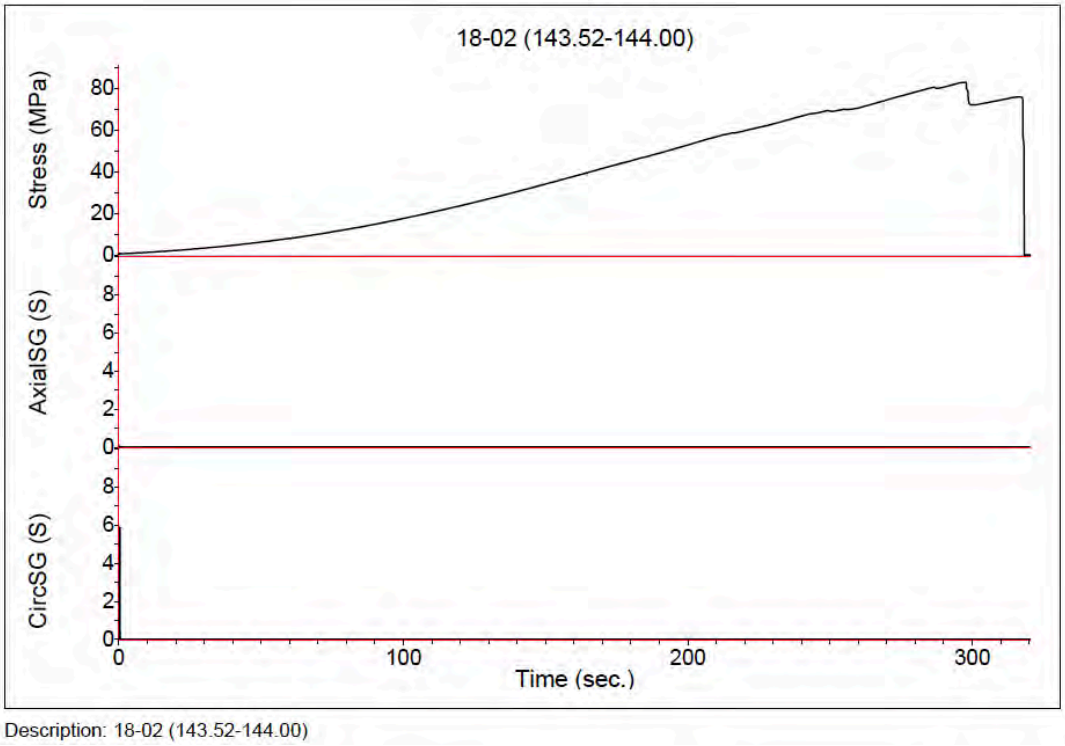
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-02	Sample ID: UCS (no moduli)
Depth: (143.52-144.00 m)	Date Sampled: NA
Lithological Description: Bioitite-feldspar schist with carbonate	

Specimen Parameters	
Diameter, cm	6.10
Length, cm	14.93
Height-to-Diameter Ratio	2.45/1
Bulk Density, kg/m^3	2610
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	83.2
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-02 (143.52-144.00)

Remarks: Failed partially along pre-existing foliation at 20″ to core axis (10% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

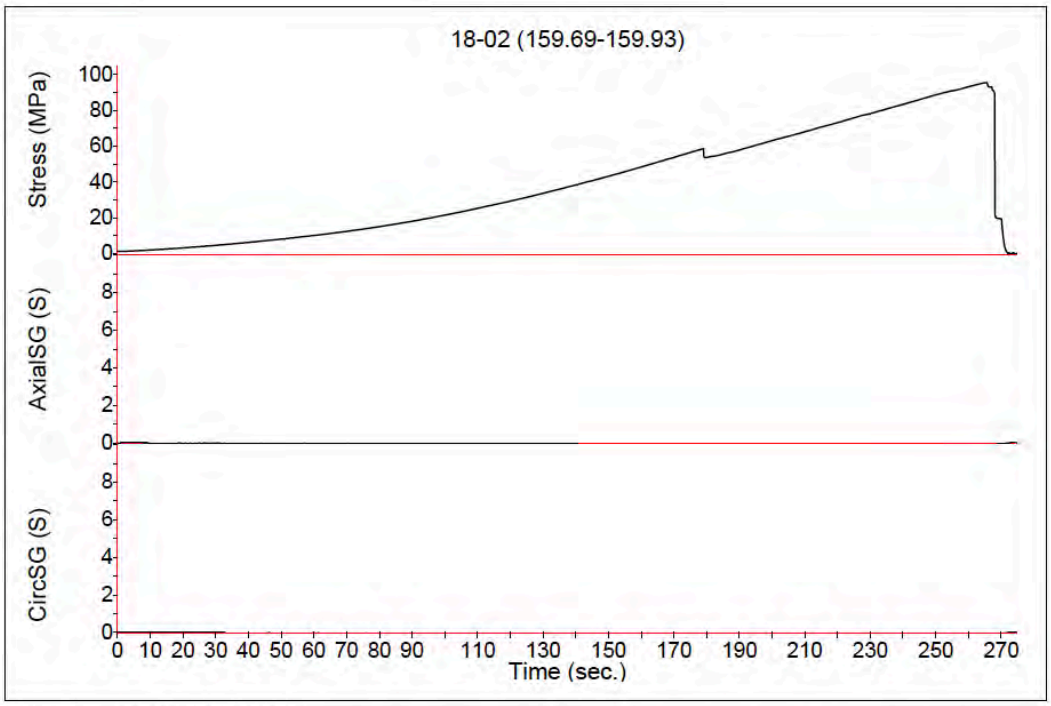
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-02	Sample ID: UCS (no moduli)
Depth: (159.69-159.93 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	13.58
Height-to-Diameter Ratio	2.23/1
Bulk Density, kg/m^3	2633
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	95.4
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-02 (159.69-159.93)

Remarks: Failed partially along pre-existing foliation at 15″ to core axis (90% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

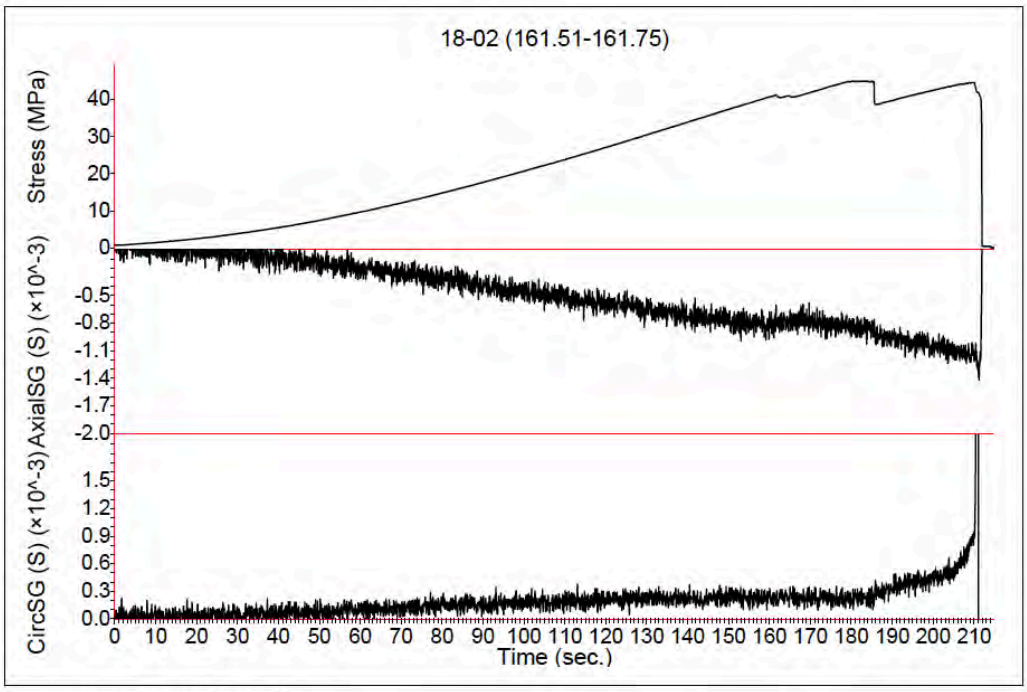
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-02	Sample ID: UCS
Depth: (161.51-161.75m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	14.69
Height-to-Diameter Ratio	2.42/1
Bulk Density, kg/m^3	2560
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	45.0
Young's Modulus, E (GPa)	19.111
Poisson's ratio	0.11







Description: 18-02 (161.51-161.75)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (75% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

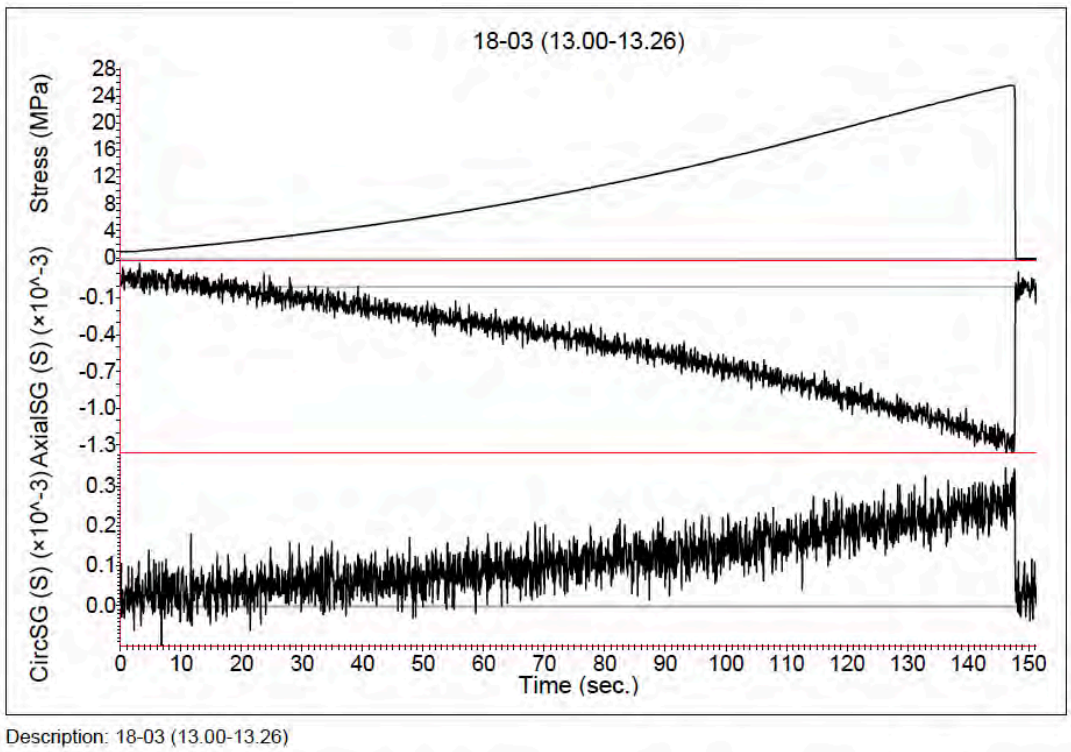
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-03	Sample ID: UCS
Depth: (13.00-13.26 m)	Date Sampled: NA
Lithological Description: Biotite-feldspar schist with carbonate	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	14.94
Height-to-Diameter Ratio	2.47/1
Bulk Density, kg/m^3	2700
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	25.6
Young's Modulus, E (GPa)	12.342
Poisson's ratio	0.11







Description: 18-03 (13.00-13.26)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (30% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

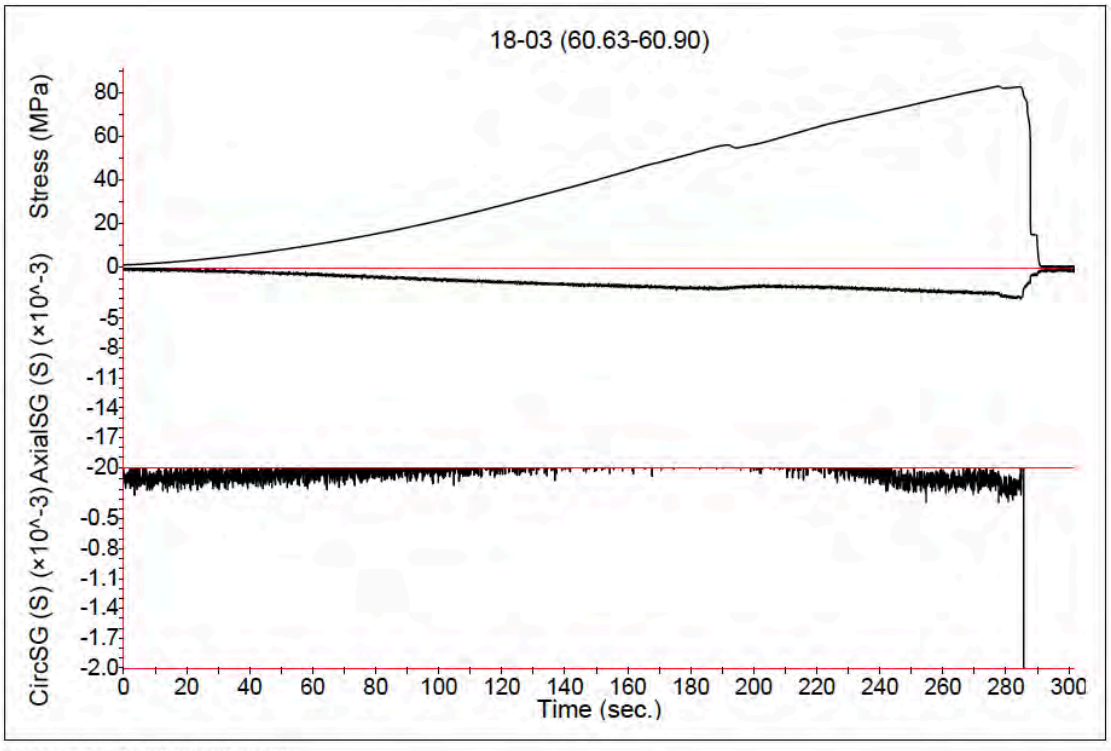
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-03	Sample ID: UCS
Depth: (60.63-60.90 m)	Date Sampled: NA
Lithological Description: Biotite-feldspar schist with carbonate	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	13.08
Height-to-Diameter Ratio	2.16/1
Bulk Density, kg/m^3	2700
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	82.9
Young's Modulus, E (GPa)	17.216
Poisson's ratio	0.09







Description: 18-03 (60.63-60.90)

Remarks: Failed partially along pre-existing foliation at 50″ to core axis (75% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

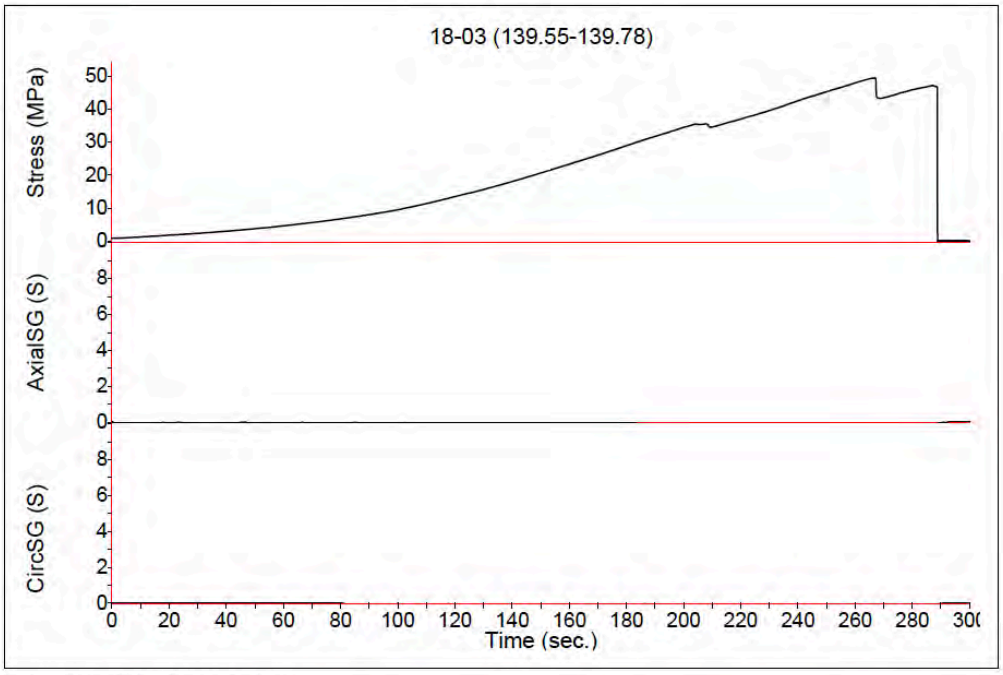
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-03	Sample ID: UCS (no moduli)
Depth: (139.55-139.78 m)	Date Sampled: NA
Lithological Description: Biotite-feldspar schist with carbonate	

Specimen Parameters	
Diameter, cm	6.07
Length, cm	14.84
Height-to-Diameter Ratio	2.44/1
Bulk Density, kg/m^3	2700
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	49.4
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-03 (139.55-139.78)

Remarks: Failed partially along pre-existing foliation at 20″ to core axis (75% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

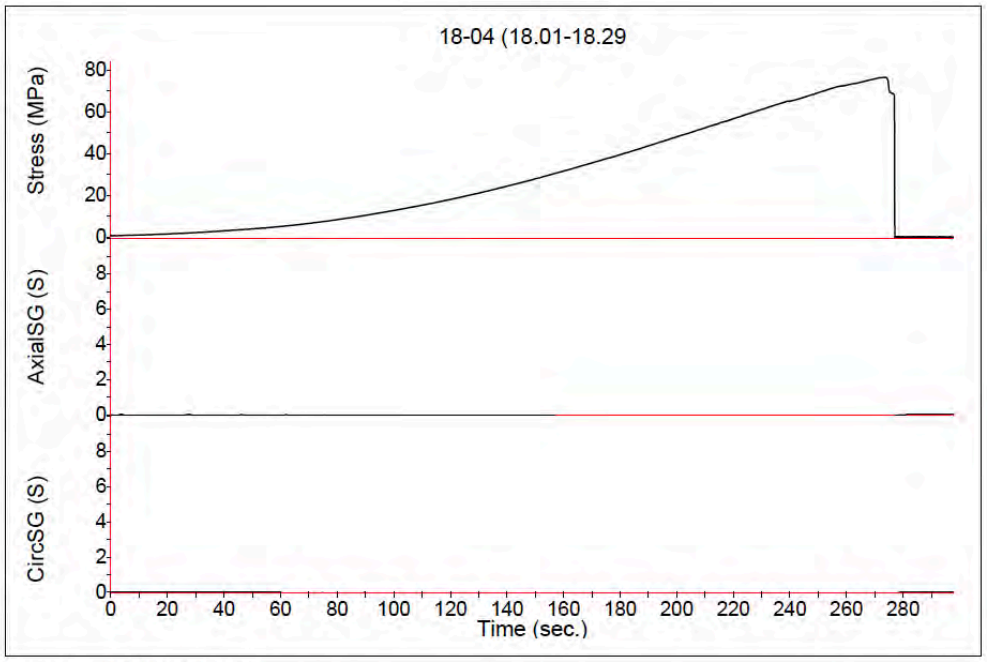
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-04	Sample ID: UCS (no moduli)
Depth: (18.01-18.29 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	14.85
Height-to-Diameter Ratio	2.44/1
Bulk Density, kg/m^3	2620
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	76.5
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-04 (18.01-18.29

Remarks: Failure completely through intact rock at 20″ to core axis

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

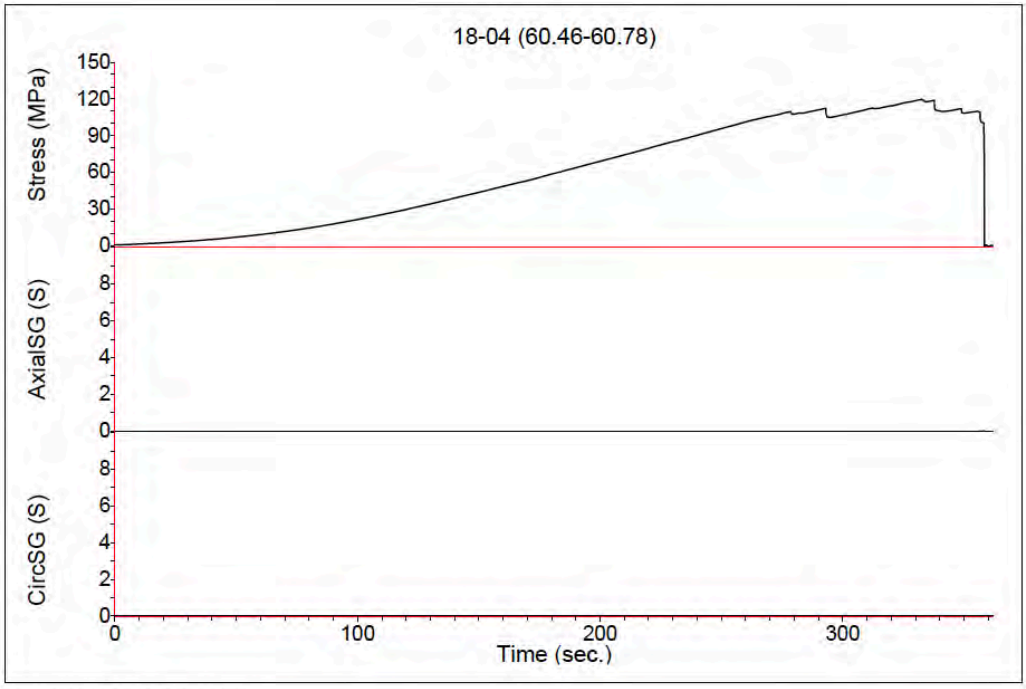
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-04	Sample ID: UCS
Depth: (60.46-60.78 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.09
Length, cm	14.87
Height-to-Diameter Ratio	2.44/1
Bulk Density, kg/m^3	2620
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	119.7
Young's Modulus, E (GPa)	28.037
Poisson's ratio	0.18







Description: 18-04 (60.46-60.78)

Remarks: Failure completely through intact rock parallel to core axis

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

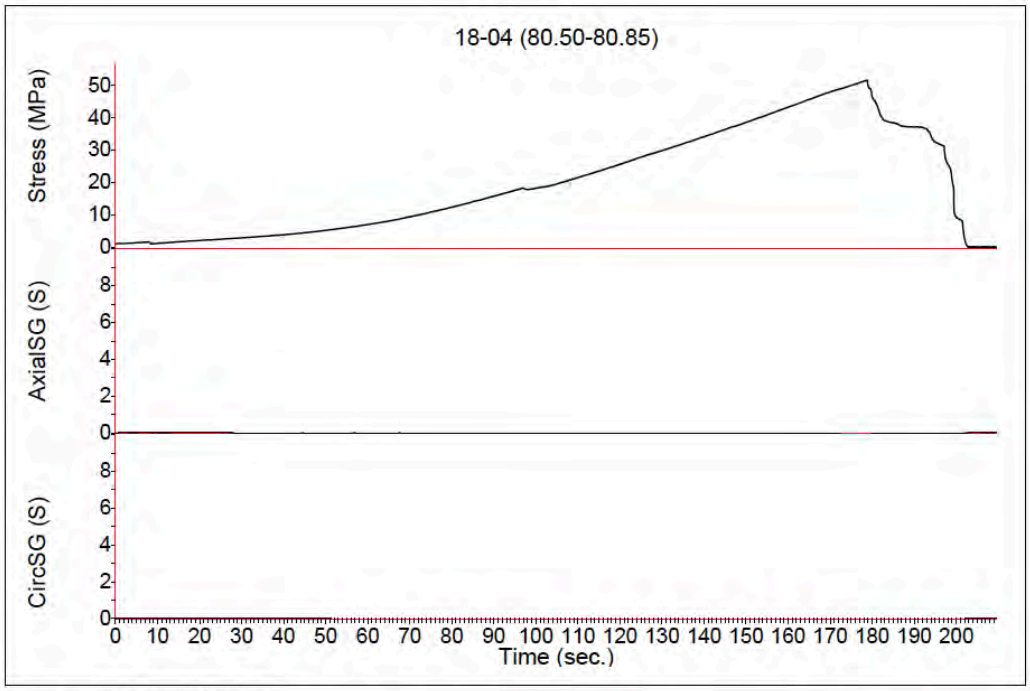
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-04	Sample ID: UCS (no moduli)
Depth: (80.50-80.85 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.03
Length, cm	12.56
Height-to-Diameter Ratio	2.08/1
Bulk Density, kg/m^3	2880
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	51.7
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-04 (80.50-80.85)

Remarks: Failed partially along pre-existing foliation at 50″ to core axis (50% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

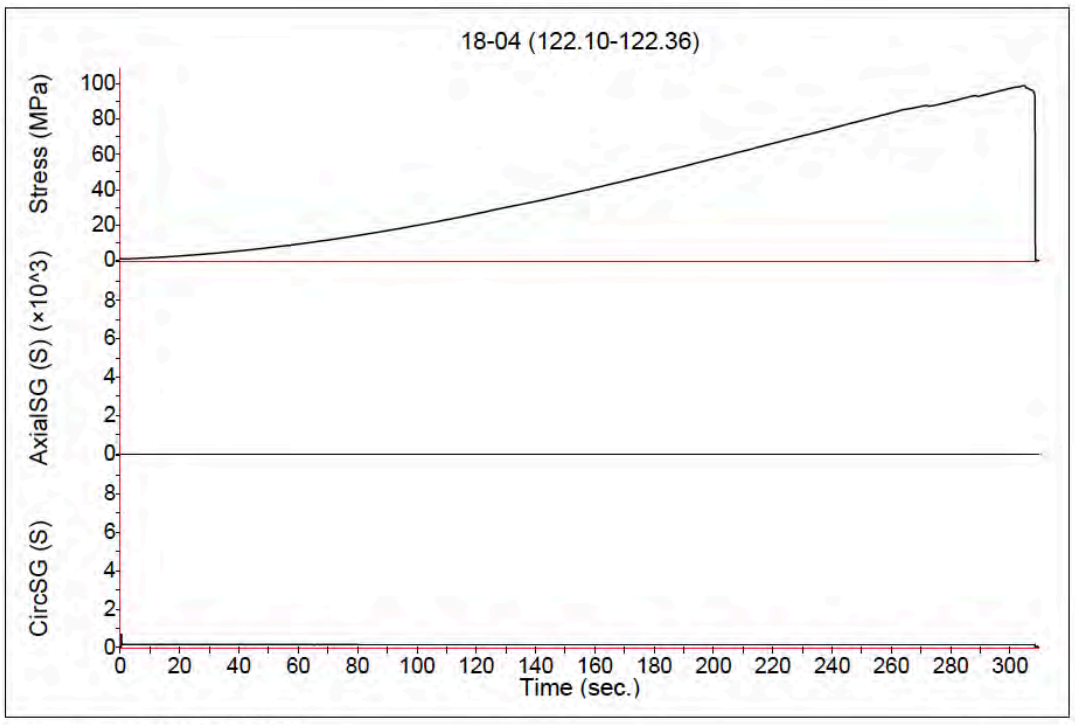
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-04	Sample ID: UCS
Depth: (122.10-122.36 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	14.85
Height-to-Diameter Ratio	2.45/1
Bulk Density, kg/m^3	2610
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	99.0
Young's Modulus, E (GPa)	19.578
Poisson's ratio	0.28







Description: 18-04 (122.10-122.36)

Remarks: Failure completely through intact rock parallel to core axis

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

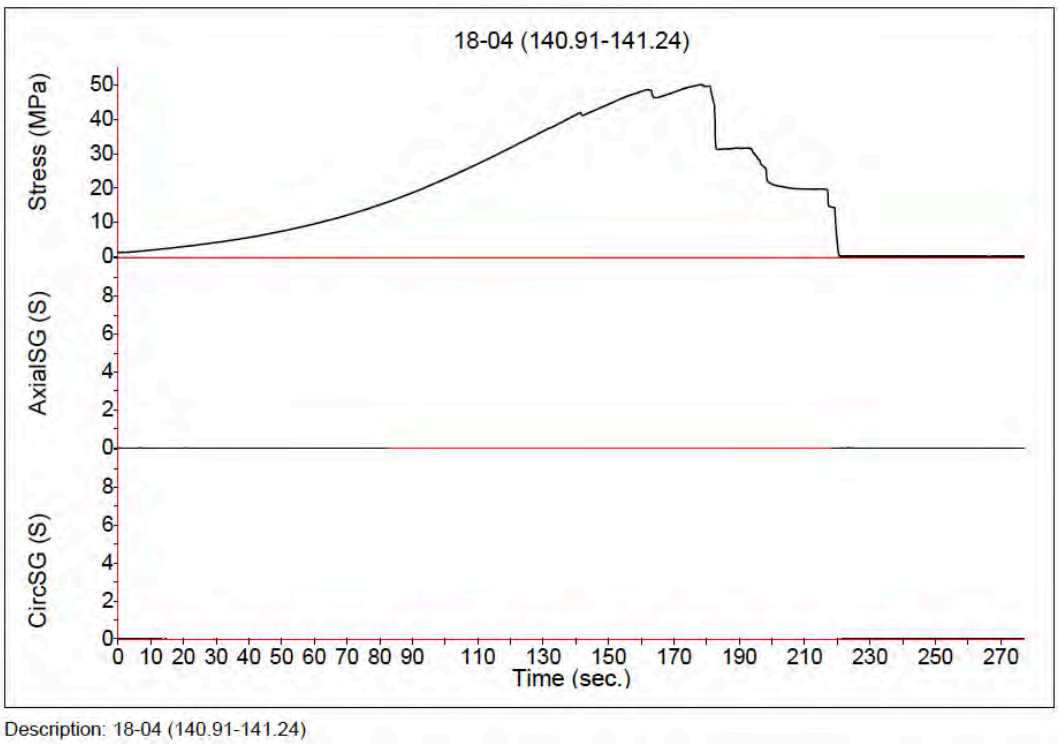
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-04	Sample ID: UCS (no moduli)
Depth: (140.91-141.24 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	11.88
Height-to-Diameter Ratio	1.96/1
Bulk Density, kg/m^3	2600
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	50.3
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-04 (140.91-141.24)

Remarks: Failed partially along pre-existing foliation at 35″ to core axis (85% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

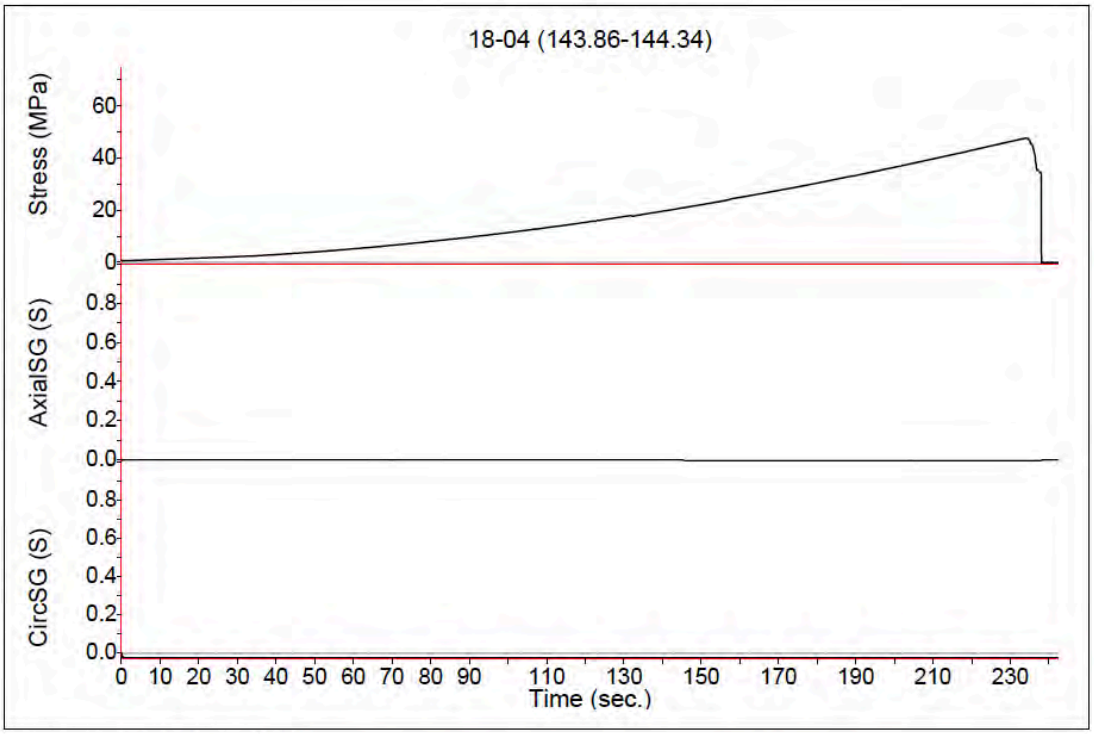
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-04	Sample ID: UCS (no moduli)
Depth: (143.86-144.34 m)	Date Sampled: NA
Lithological Description: Bioitite-feldspar schist with carbonate	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	15.00
Height-to-Diameter Ratio	2.47/1
Bulk Density, kg/m^3	2620
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	47.7
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-04 (143.86-144.34)

Remarks: Failed partially along pre-existing foliation at 40″ to core axis (60% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

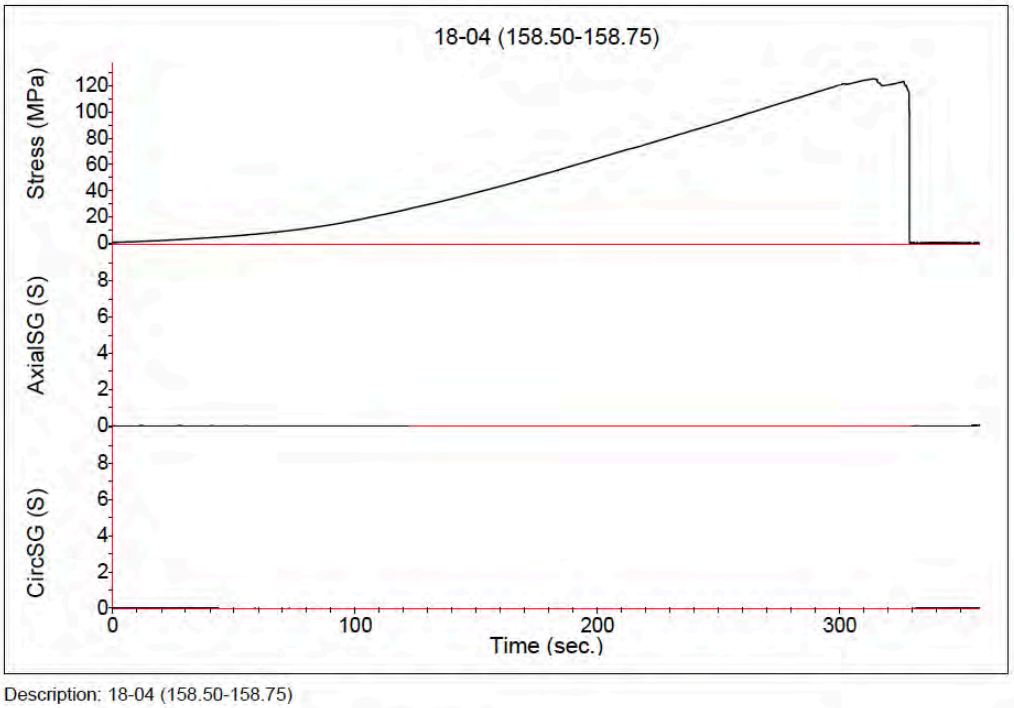
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-04	Sample ID: UCS (no moduli)
Depth: (158.50-158.75 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	14.98
Height-to-Diameter Ratio	2.47/1
Bulk Density, kg/m^3	2660
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	125.5
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-04 (158.50-158.75)

Remarks: Failed partially along pre-existing foliation at 40″ to core axis (25% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

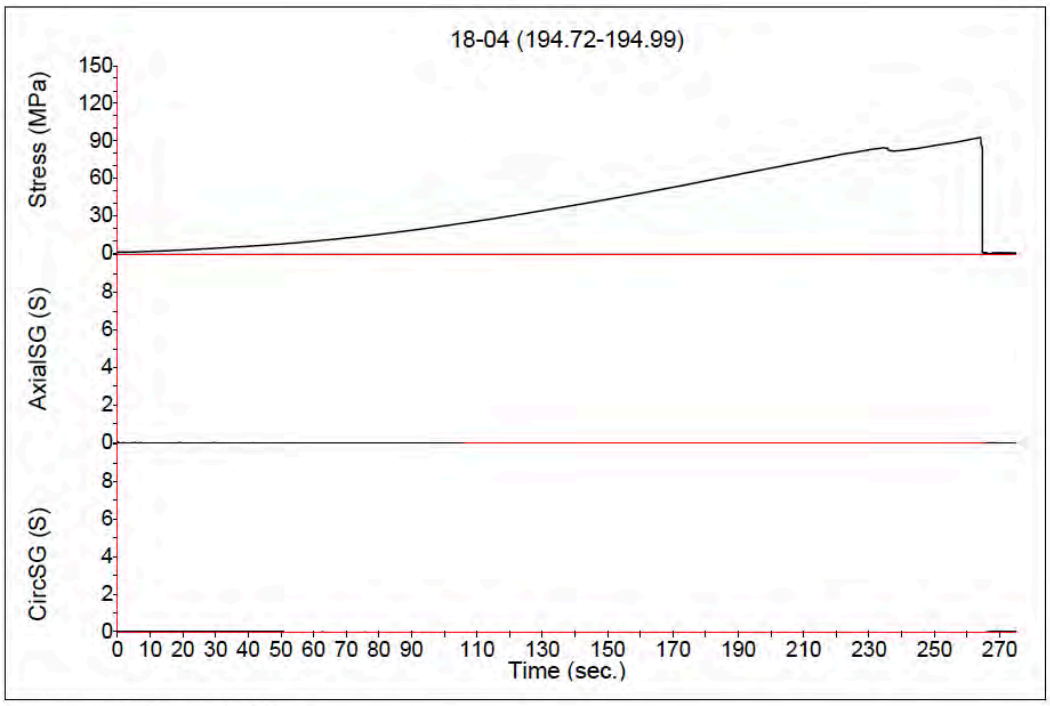
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-04	Sample ID: UCS (no moduli)
Depth: (194.72-194.99 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.06
Length, cm	15.14
Height-to-Diameter Ratio	2.49/1
Bulk Density, kg/m^3	2610
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	92.6
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-04 (194.72-194.99)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (20% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

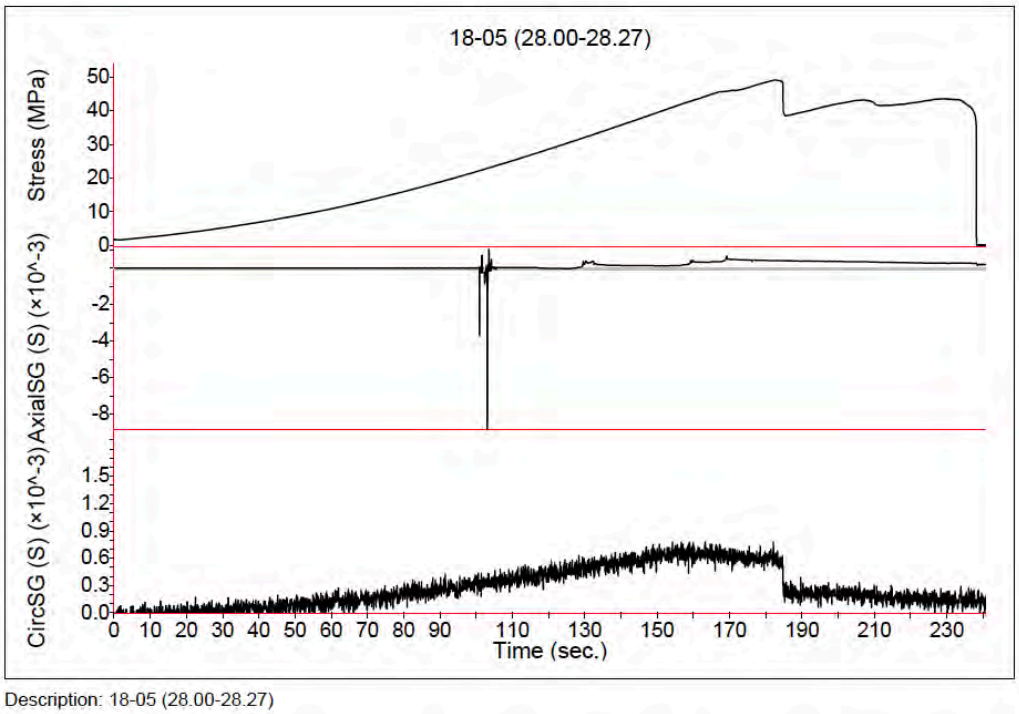
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-05	Sample ID: UCS
Depth: (28.00-28.27 m)	Date Sampled: NA
Lithological Description: Granite	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	13.46
Height-to-Diameter Ratio	2.21/1
Bulk Density, kg/m^3	2570
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	49.1
Young's Modulus, E (GPa)	17.394
Poisson's ratio	0.20







Description: 18-05 (28.00-28.27)

Remarks: Failed partially along pre-existing foliation at 20″ to core axis (60% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

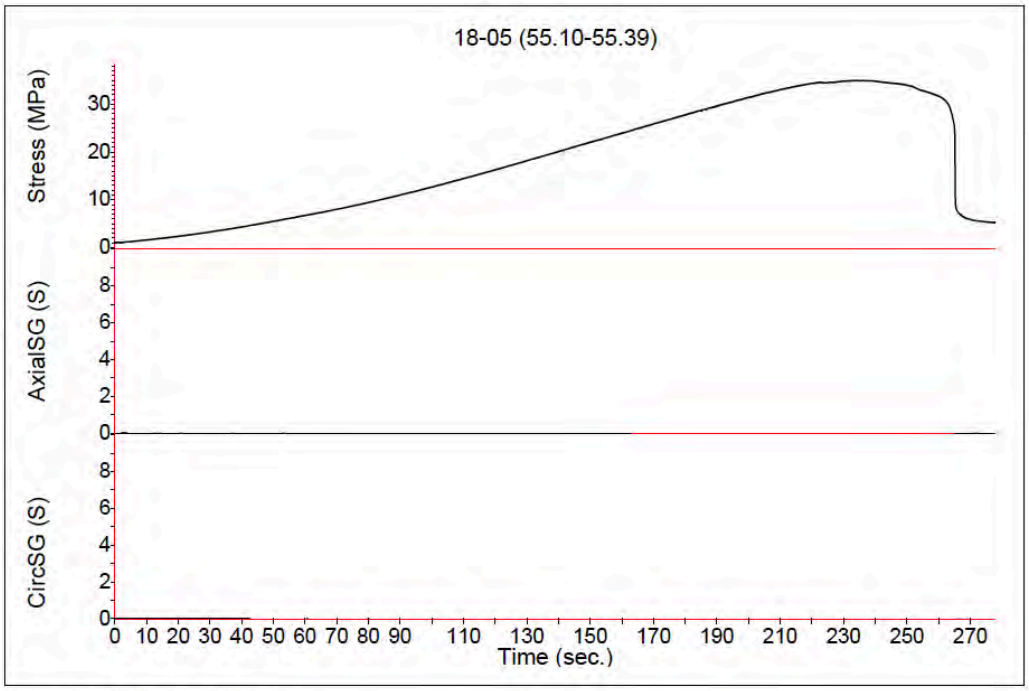
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-05	Sample ID: UCS (no moduli)
Depth: (55.10-55.39 m)	Date Sampled: NA
Lithological Description: Granite	

Specimen Parameters	
Diameter, cm	6.09
Length, cm	15.00
Height-to-Diameter Ratio	2.46/1
Bulk Density, kg/m^3	2430
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	35.0
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-05 (55.10-55.39)

Remarks: Failure completely through intact rock at 10″ to core axis

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

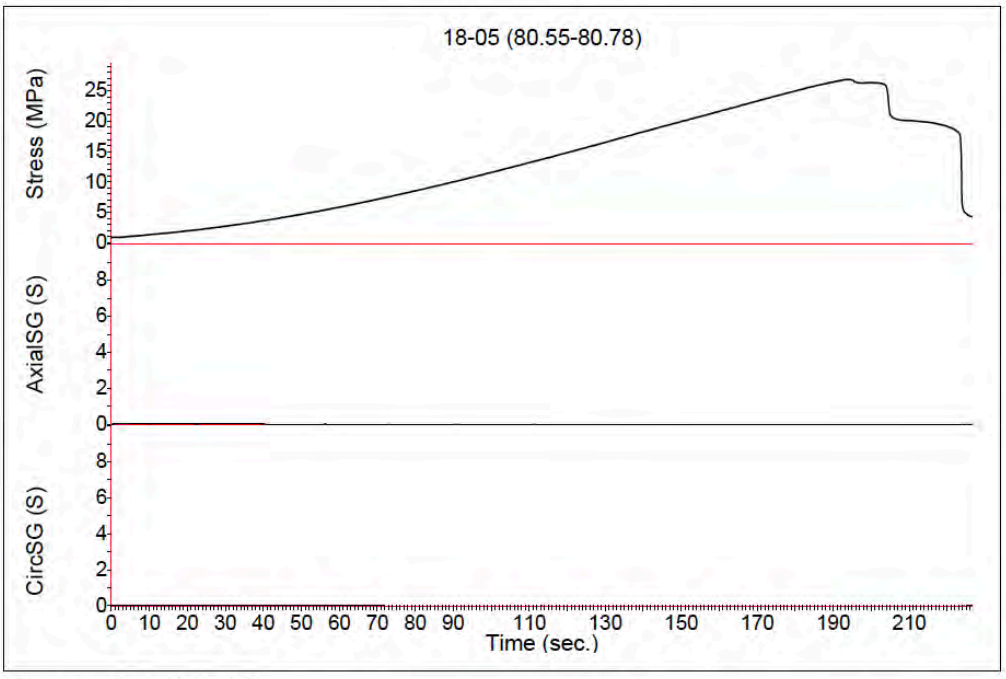
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-05	Sample ID: UCS (no moduli)
Depth: (80.55-80.78 m)	Date Sampled: NA
Lithological Description: Granite	

Specimen Parameters	
Diameter, cm	6.09
Length, cm	14.95
Height-to-Diameter Ratio	2.45/1
Bulk Density, kg/m^3	2370
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	26.9
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-05 (80.55-80.78)

Remarks: Failure completely through intact rock at 20″ to core axis

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

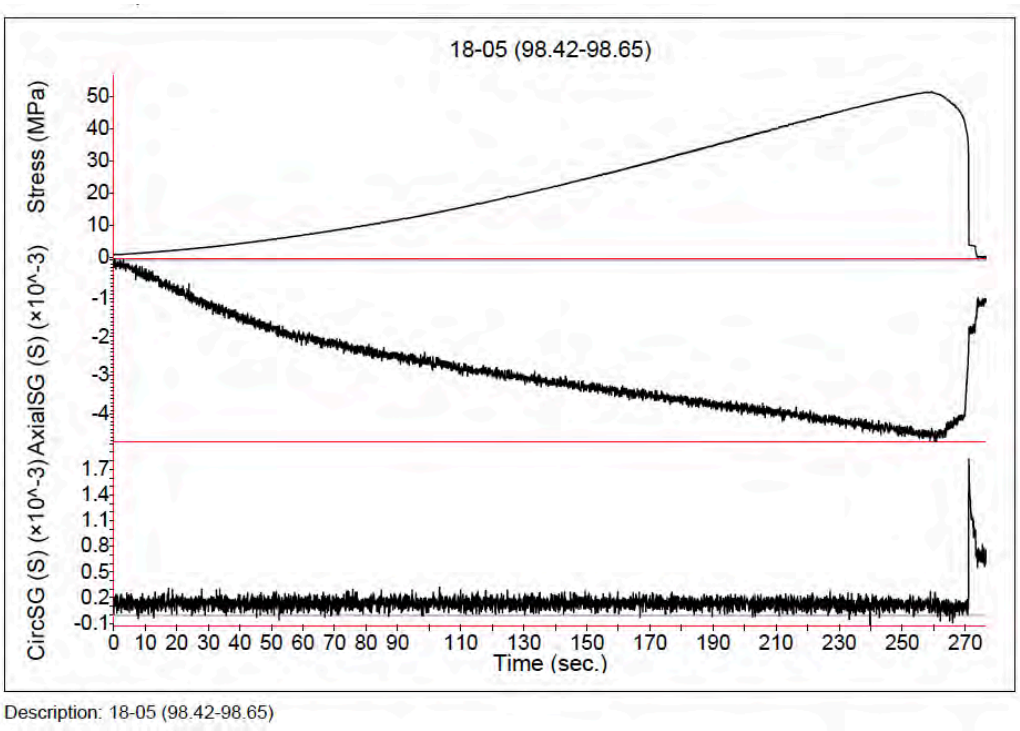
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-05	Sample ID: UCS
Depth: (98.42-98.65 m)	Date Sampled: NA
Lithological Description: Granite	

Specimen Parameters	
Diameter, cm	6.09
Length, cm	13.74
Height-to-Diameter Ratio	2.26/1
Bulk Density, kg/m^3	2600
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	51.5
Young's Modulus, E (GPa)	13.568
Poisson's ratio	0.07







Description: 18-05 (98.42-98.65)

Remarks: Failure completely through intact rock at 10″ to core axis

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

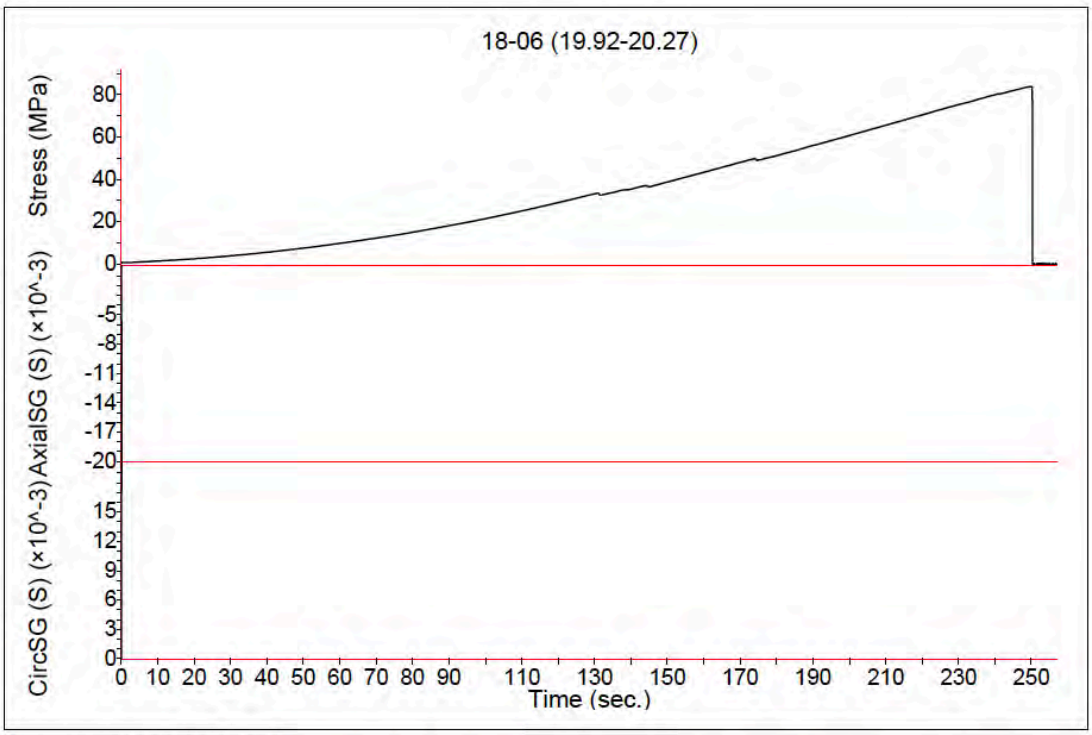
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-06	Sample ID: UCS (no moduli)
Depth: (19.92-20.27 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.07
Length, cm	13.52
Height-to-Diameter Ratio	2.23/1
Bulk Density, kg/m^3	2630
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	83.9
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-06 (19.92-20.27)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (40% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

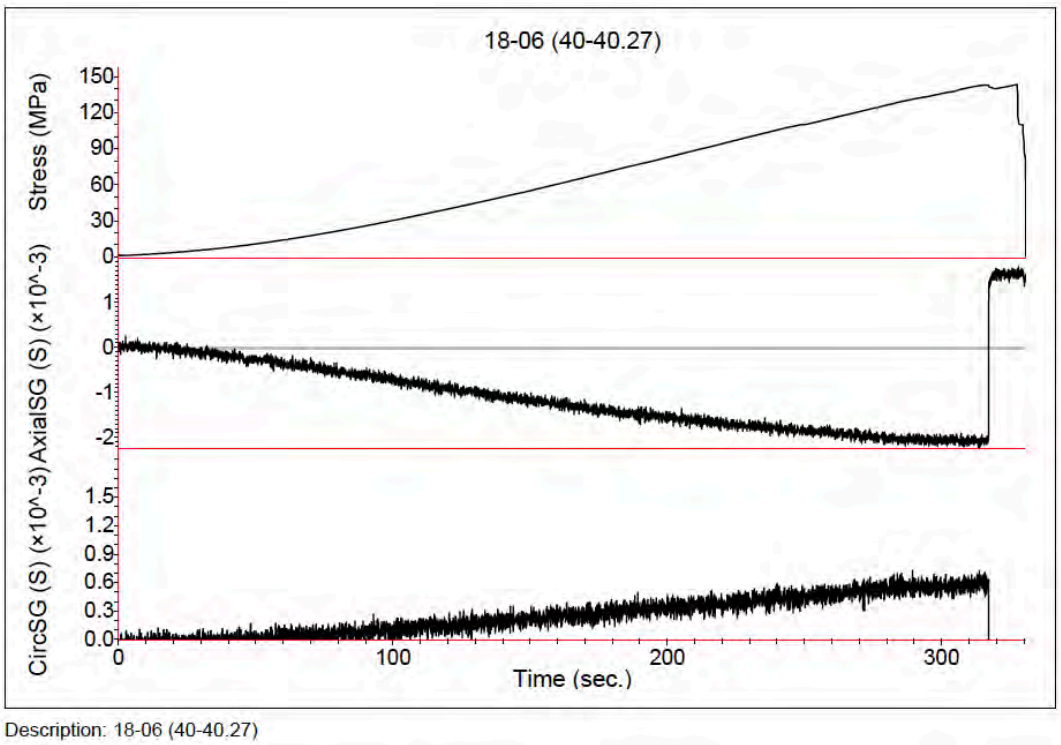
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-06	Sample ID: UCS
Depth: (40.00-40.27 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	13.52
Height-to-Diameter Ratio	2.22/1
Bulk Density, kg/m^3	2650
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	143.5
Young's Modulus, E (GPa)	30.683
Poisson's ratio	0.11







Description: 18-06 (40-40.27)

Remarks: Failed partially along pre-existing foliation at 15″ to core axis (50% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

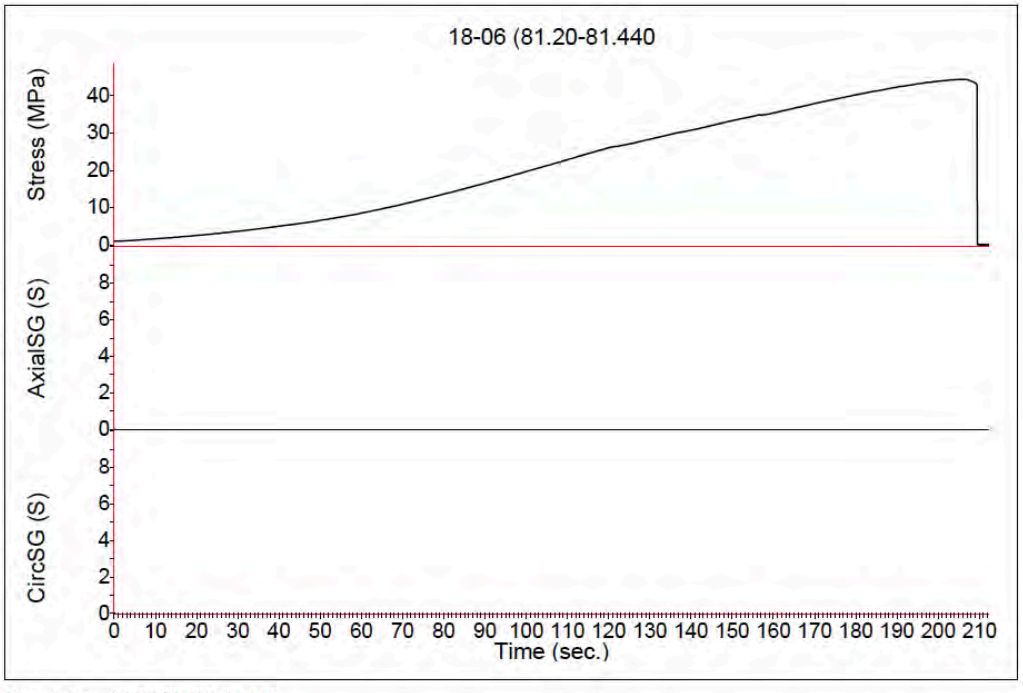
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-06	Sample ID: UCS (no moduli)
Depth: (81.20-81.44 m)	Date Sampled: NA
Lithological Description: Gneiss	

Specimen Parameters	
Diameter, cm	6.10
Length, cm	14.67
Height-to-Diameter Ratio	2.40/1
Bulk Density, kg/m^3	3010
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	44.4
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-06 (81.20-81.440

Remarks: Failed partially along pre-existing foliation at 10″ to core axis (75% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

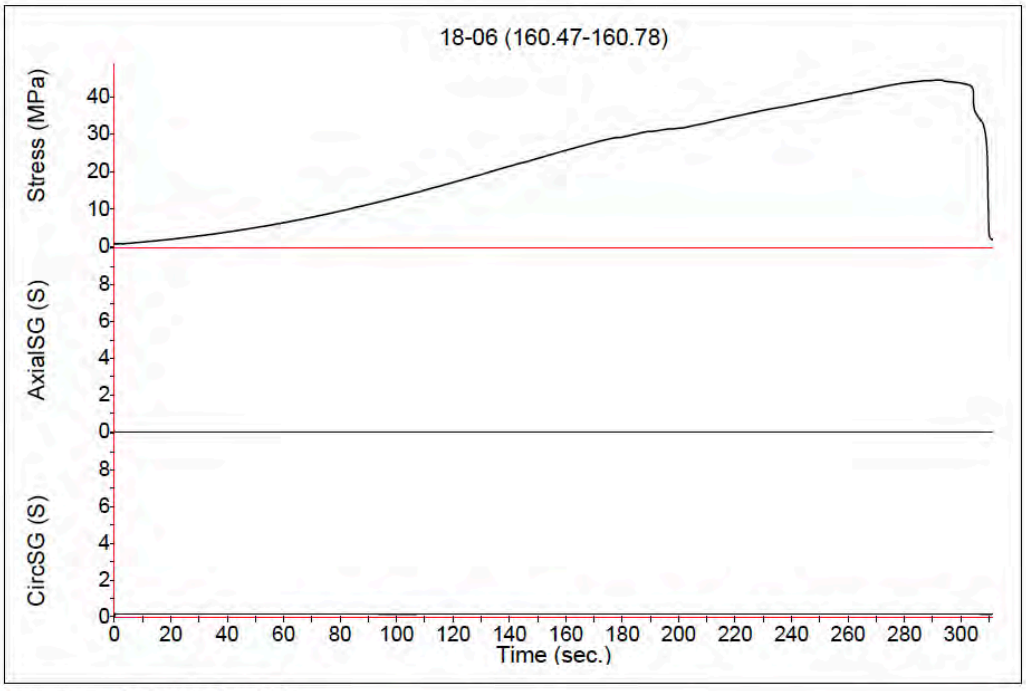
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-06	Sample ID: UCS (no moduli)
Depth: (160.47-160.78 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	14.93
Height-to-Diameter Ratio	2.46/1
Bulk Density, kg/m^3	2430
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	44.5
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-06 (160.47-160.78)

Remarks: Failure completely through intact rock parallel to core axis

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

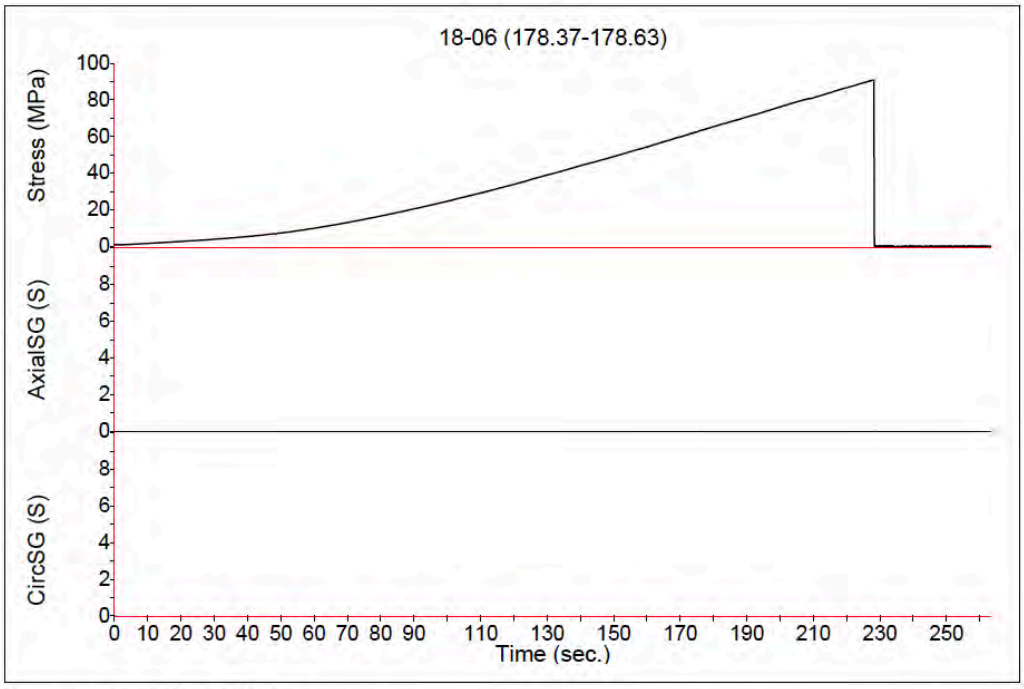
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-06	Sample ID: UCS (no moduli)
Depth: (178.37-178.63 m)	Date Sampled: NA
Lithological Description: Felsic Gneiss	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	14.66
Height-to-Diameter Ratio	2.41/1
Bulk Density, kg/m^3	2650
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	90.9
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-06 (178.37-178.63)

Remarks: Failed partially along pre-existing foliation at 20″ to core axis (30% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

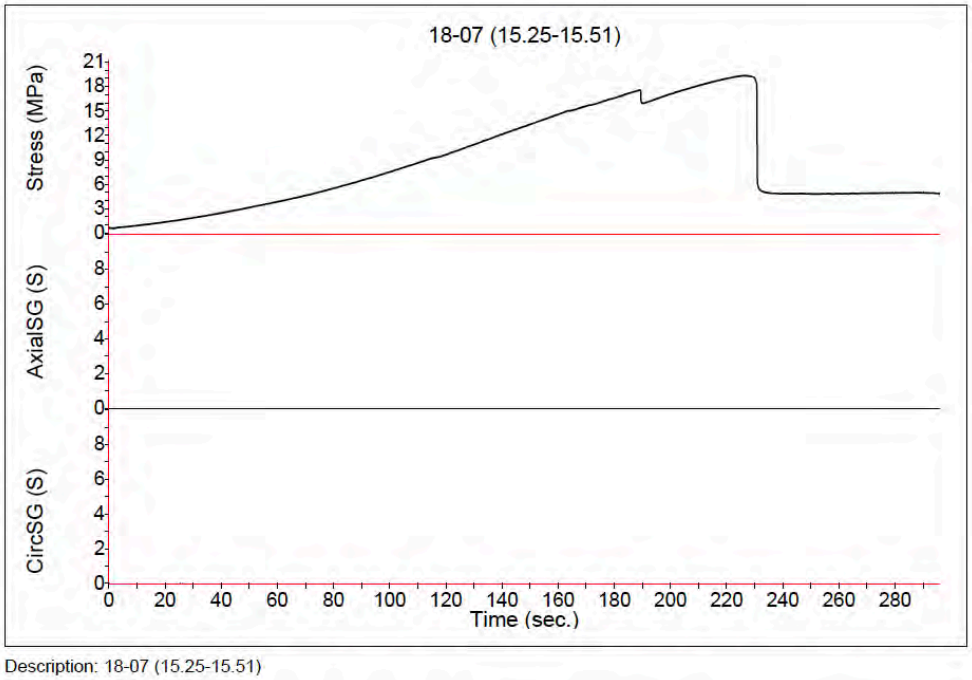
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-07	Sample ID: UCS (no moduli)
Depth: (15.25-15.51 m)	Date Sampled: NA
Lithological Description: Biotite-feldspar schist	

Specimen Parameters	
Diameter, cm	6.08
Length, cm	14.98
Height-to-Diameter Ratio	2.46/1
Bulk Density, kg/m^3	2300
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	19.4
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-07 (15.25-15.51)

Remarks: Failed partially along pre-existing foliation at 40″ to core axis (80% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

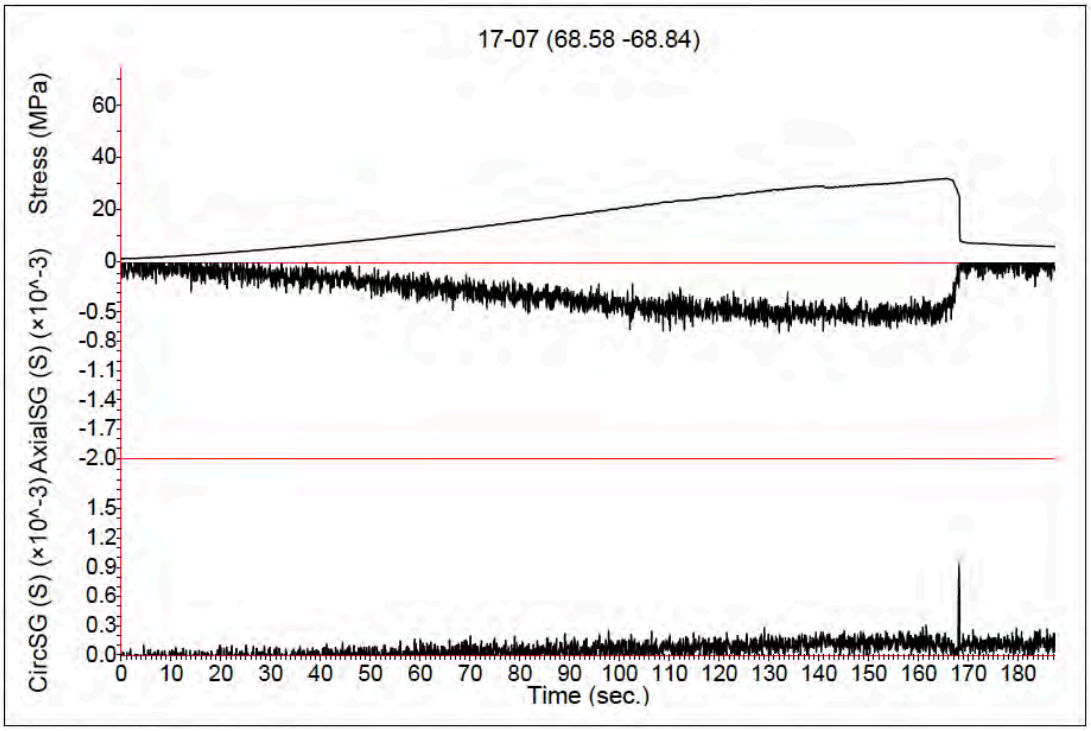
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-07	Sample ID: UCS
Depth: (68.58-68.84 m)	Date Sampled: NA
Lithological Description: Biotite-feldspar schist	

Specimen Parameters	
Diameter, cm	6.09
Length, cm	14.20
Height-to-Diameter Ratio	2.33/1
Bulk Density, kg/m^3	2540
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	32.0
Young's Modulus, E (GPa)	4.984
Poisson's ratio	0.09







Description: 17-07 (68.58 -68.84)

Remarks: Failed partially along pre-existing foliation at 5″ to core axis (50% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

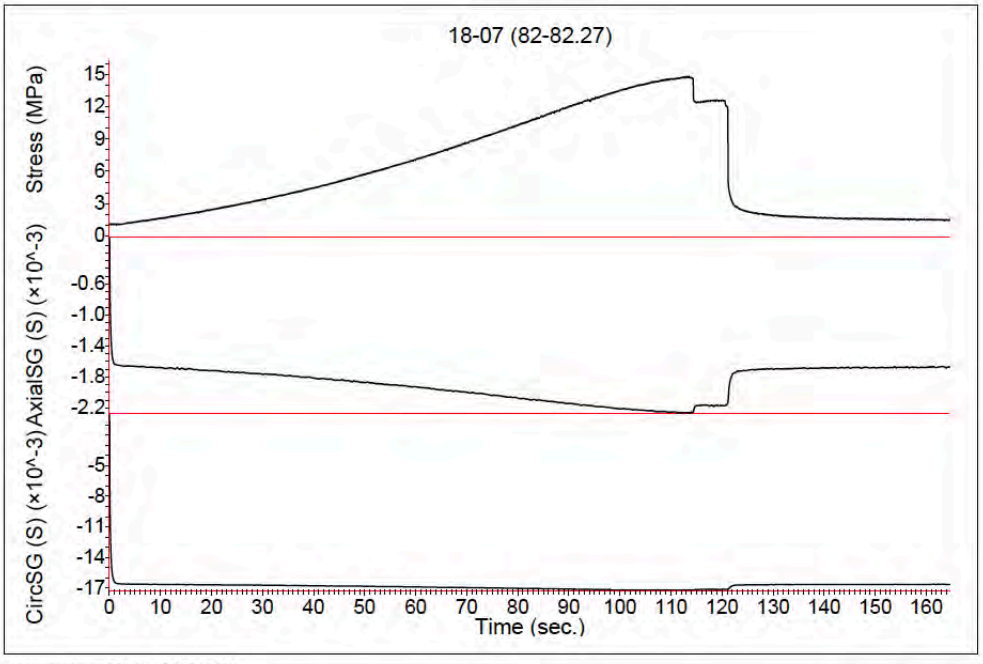
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-07	Sample ID: UCS (no moduli)
Depth: (82.00-82.27 m)	Date Sampled: NA
Lithological Description: Biotite-feldspar schist	

Specimen Parameters	
Diameter, cm	6.10
Length, cm	14.35
Height-to-Diameter Ratio	2.35/1
Bulk Density, kg/m^3	2450
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	14.8
Young's Modulus, E (GPa)	---
Poisson's ratio	---







Description: 18-07 (82-82.27)

Remarks: Failed partially along pre-existing foliation at 30″ to core axis (95% failure on foliation surface)

Performed By: P. Ross	Date: February 25, 2019
Verified By: J. F. Archibald	Date: February 25, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

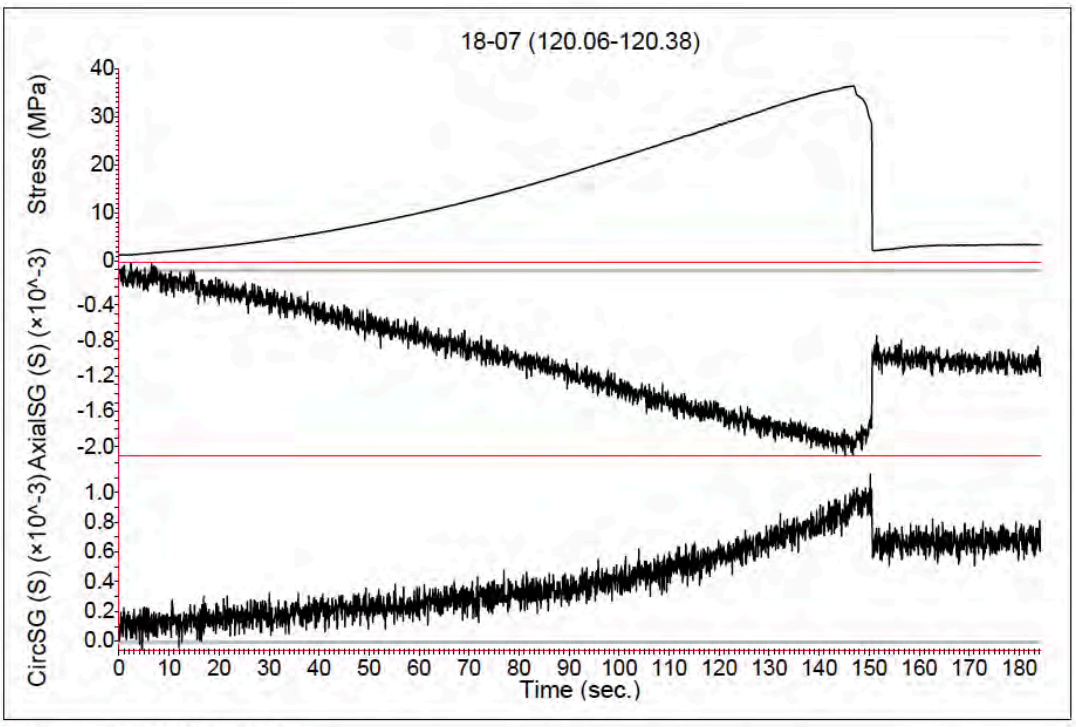
Client: JDS Mining & Energy Inc.	Lab: Queen's University
Project/Site: Coffee Gold Mine	Project No.: Unknown
Borehole No.: GT18-07	Sample ID: UCS
Depth: (120.06-120.38 m)	Date Sampled: NA
Lithological Description: Biotite-feldspar schist with carbonate	

Specimen Parameters	
Diameter, cm	6.10
Length, cm	11.43
Height-to-Diameter Ratio	1.87/1
Bulk Density, kg/m^3	2520
Moisture Condition	NA

Unconfined Compressive Strength (MPa)	36.4
Young's Modulus, E (GPa)	13.617
Poisson's ratio	0.29







Description: 18-07 (120.06-120.38)

Remarks: Failed partially along pre-existing foliation at 35″ to core axis (40% failure on foliation surface)

Performed By: P. Ross	Date: February 26, 2019
Verified By: J. F. Archibald	Date: February 26, 2019

Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression (ASTM D7012 D)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-01	**Sample**: Triaxial Confined
Depth: (73.00-73.45 m)	**Date Sampled**: NA
Lithological Description: Gneiss	

Initial Sample Parameters

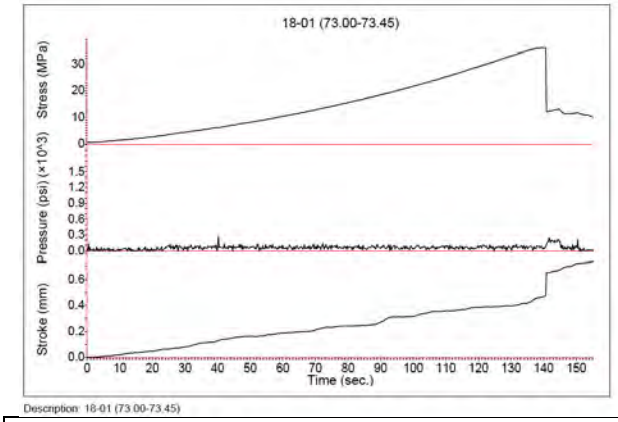
Specimen	GT18-01
Depth	(73.00-73.45 m)
Diameter, cm	6.07
Height, cm	13.70
Height-to-Diameter Ratio	2.26/1
Volume, cm^3	396.2
Mass, g	1047.3
Bulk Density, kg/m^3	2640
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	0.5	36.1
Confining Stress (b) and Fail Stress, MPa	2	---
Confining Stress (c) and Fail Stress, MPa	5	---
Confining Stress (d) and Fail Stress, MPa	10	---
Confining Stress (e) and Fail Stress, MPa	---	---
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.7







Remarks: Failed fully along pre-existing foliation at 25″ to core axis (100% failure on foliation surface); failure occurred during first confinement test thus single stage triaxial test only	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-01	**Sample**: Triaxial Confined
Depth: (787.27-78.77 m)	**Date Sampled**: NA
Lithological Description: Gneiss	

Initial Sample Parameters

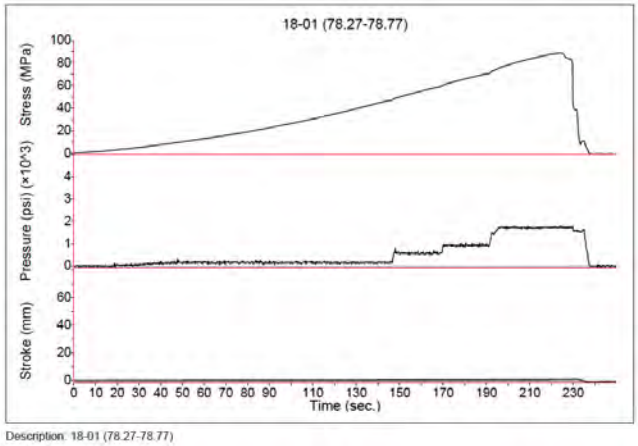
Specimen	GT18-01
Depth	(78.27-78.77 m)
Diameter, cm	6.08
Height, cm	13.63
Height-to-Diameter Ratio	2.24/1
Volume, cm^3	395.5
Mass, g	1057.7
Bulk Density, kg/m^3	2674
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1	46.5
Confining Stress (b) and Fail Stress, MPa	3	59.7
Confining Stress (c) and Fail Stress, MPa	6	70.0
Confining Stress (d) and Fail Stress, MPa	12	88.5
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.8







Remarks: Failed partially along pre-existing foliation at 20″ to core axis (85% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-01	**Sample**: Triaxial Confined
Depth: (119.50-119.72 m)	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Initial Sample Parameters

Specimen	GT18-01
Depth	(119.50-119.72 m)
Diameter, cm	6.06
Height, cm	13.70
Height-to-Diameter Ratio	2.26/1
Volume, cm^3	394.9
Mass, g	1036.1
Bulk Density, kg/m^3	2620
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1	---
Confining Stress (b) and Fail Stress, MPa	4	---
Confining Stress (c) and Fail Stress, MPa	10	---
Confining Stress (d) and Fail Stress, MPa	20	---
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.6



Broken during initial testing – no results

Remarks: Sample failed during test insertion and prior to confinement – no data acquisition	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-02	**Sample**: Triaxial Confined
Depth: (40.05-40.34 m)	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Initial Sample Parameters

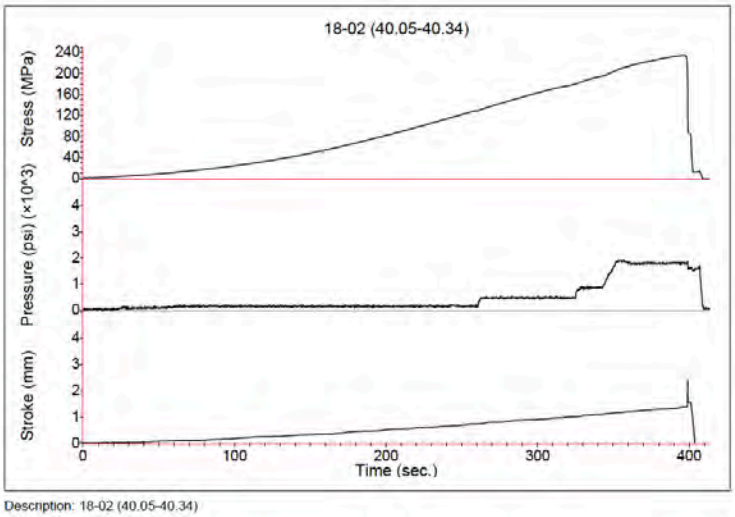
Specimen	GT18-02
Depth	(40.05-40.34 m)
Diameter, cm	6.10
Height, cm	13.55
Height-to-Diameter Ratio	2.22/1
Volume, cm^3	395.8
Mass, g	1047.6
Bulk Density, kg/m^3	2650
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1	128.4
Confining Stress (b) and Fail Stress, MPa	3	179.1
Confining Stress (c) and Fail Stress, MPa	6	194.2
Confining Stress (d) and Fail Stress, MPa	12	234.7
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	35.0







Description: 18-02 (40.05-40.34)

Remarks: Failed partially along pre-existing foliation at 25″ to core axis (10% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-02	**Sample**: Triaxial Confined
Depth: (82.06-82.28 m)	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Initial Sample Parameters

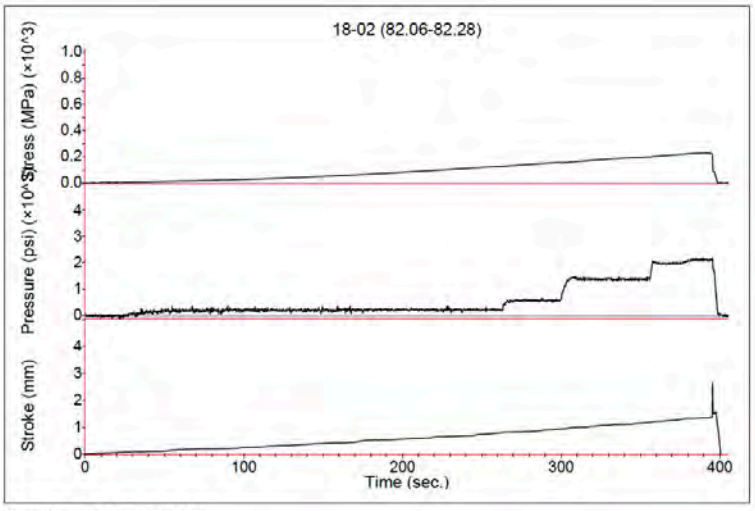
Specimen	GT18-02
Depth	(82.06-82.28 m)
Diameter, cm	6.10
Height, cm	11.08
Height-to-Diameter Ratio	1.82/1
Volume, cm^3	323.6
Mass, g	840.7
Bulk Density, kg/m^3	2600
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1.5	124.1
Confining Stress (b) and Fail Stress, MPa	4	155.6
Confining Stress (c) and Fail Stress, MPa	9	196.9
Confining Stress (d) and Fail Stress, MPa	15	227.9
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	42.8







Description: 18-02 (82.06-82.28)

Remarks: Failed fully along pre-existing foliation at 25″ to core axis (100% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-02	**Sample**: Triaxial Confined
Depth: (140.03-140.27 m)	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Initial Sample Parameters

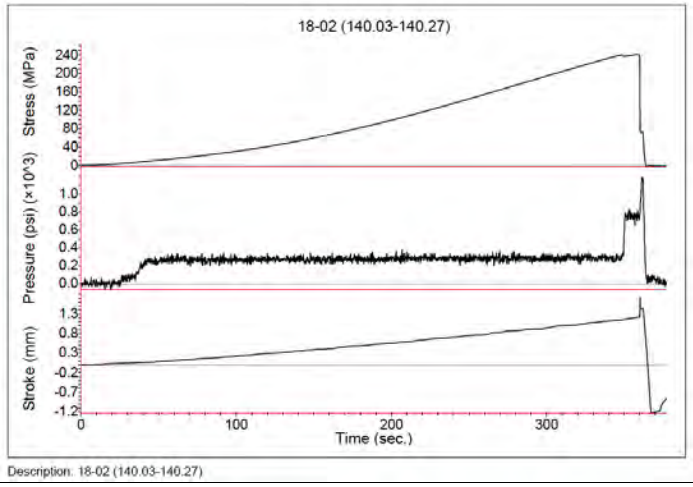
Specimen	GT18-02
Depth	(140.03-140.27 m)
Diameter, cm	6.10
Height, cm	13.73
Height-to-Diameter Ratio	2.25/1
Volume, cm^3	401.1
Mass, g	1057.4
Bulk Density, kg/m^3	2640
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	2	239.2
Confining Stress (b) and Fail Stress, MPa	5	241.5
Confining Stress (c) and Fail Stress, MPa	11	--
Confining Stress (d) and Fail Stress, MPa	25	--
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.5







Remarks: Sample failed along foliation at 20° to core axis after second confinement process step	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-03	**Sample**: Triaxial Confined
Depth: (118.82-119.03 m)	**Date Sampled**: NA
Lithological Description: Biotite-feldspar schist with carbonate	

Initial Sample Parameters

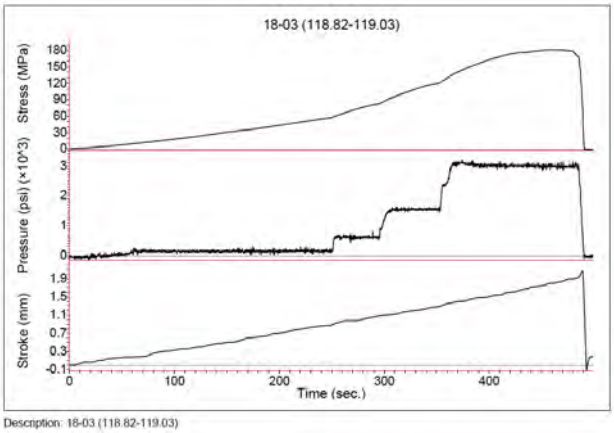
Specimen	GT18-03
Depth	(118.82-119.03 m)
Diameter, cm	6.07
Height, cm	13.62
Height-to-Diameter Ratio	2.24/1
Volume, cm^3	393.3
Mass, g	1112.2
Bulk Density, kg/m^3	2820
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1	57.6
Confining Stress (b) and Fail Stress, MPa	4	82.0
Confining Stress (c) and Fail Stress, MPa	10	120.9
Confining Stress (d) and Fail Stress, MPa	20	180.6
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.8







Remarks: Failed partially along pre-existing foliation at 30″ to core axis (35% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-03	**Sample**: Triaxial Confined
Depth: (154.02-154.26 m)	**Date Sampled**: NA
Lithological Description: Biotite-feldspar schist with carbonate	

Initial Sample Parameters

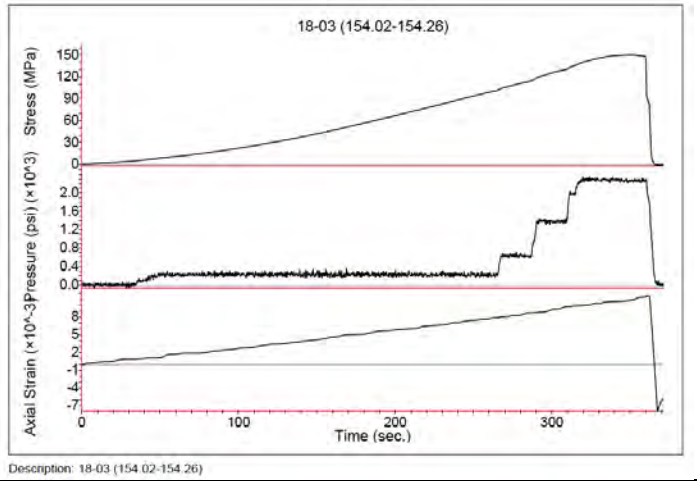
Specimen	GT18-03
Depth	(154.02-154.26 m)
Diameter, cm	6.08
Height, cm	13.50
Height-to-Diameter Ratio	2.22/1
Volume, cm^3	391.8
Mass, g	1087.3
Bulk Density, kg/m^3	2770
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1.5	102.5
Confining Stress (b) and Fail Stress, MPa	4	115.1
Confining Stress (c) and Fail Stress, MPa	9	131.3
Confining Stress (d) and Fail Stress, MPa	15	150.9
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	35.1







Remarks: Failed partially along pre-existing foliation at 45″ to core axis (10% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-04	**Sample**: Triaxial Confined
Depth: (41.50-41.70 m)	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Initial Sample Parameters

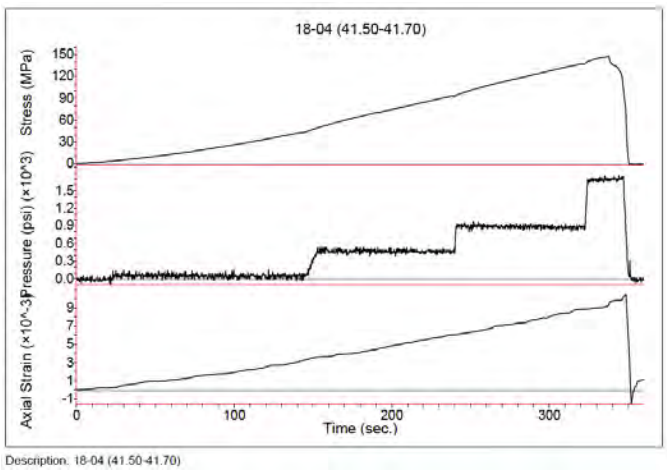
Specimen	GT18-04
Depth	(41.50-41.70 m)
Diameter, cm	6.07
Height, cm	13.64
Height-to-Diameter Ratio	2.25/1
Volume, cm^3	394.5
Mass, g	1015.9
Bulk Density, kg/m^3	2580
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	0.5	42.4
Confining Stress (b) and Fail Stress, MPa	3	92.1
Confining Stress (c) and Fail Stress, MPa	6	137.4
Confining Stress (d) and Fail Stress, MPa	12	147.5
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.8







Remarks: Failed fully along pre-existing foliation at 15″ to core axis (100% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-04	**Sample**: Triaxial Confined
Depth: (100.10-100.30 m)	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Initial Sample Parameters

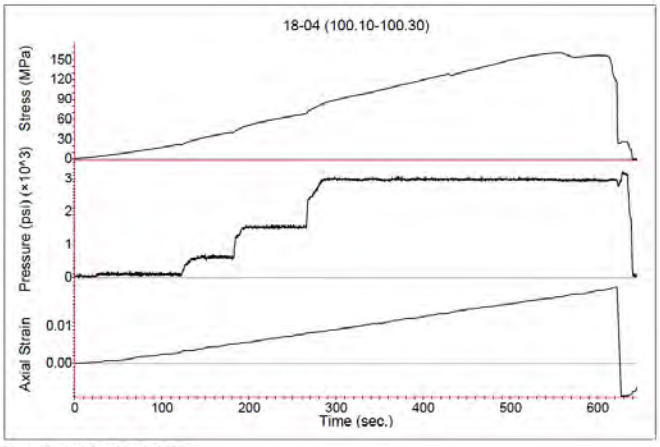
Specimen	GT18-04
Depth	(100.10-100.30 m)
Diameter, cm	6.06
Height, cm	13.63
Height-to-Diameter Ratio	2.25/1
Volume, cm^3	392.9
Mass, g	1033.9
Bulk Density, kg/m^3	2630
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1	22.1
Confining Stress (b) and Fail Stress, MPa	4	40.5
Confining Stress (c) and Fail Stress, MPa	10	68.5
Confining Stress (d) and Fail Stress, MPa	20	160.8
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.8







Remarks: Failed partially along pre-existing foliation at 30″ to core axis (45% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-04	**Sample**: Triaxial Confined
Depth: (180.31-180.57 m)	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Initial Sample Parameters

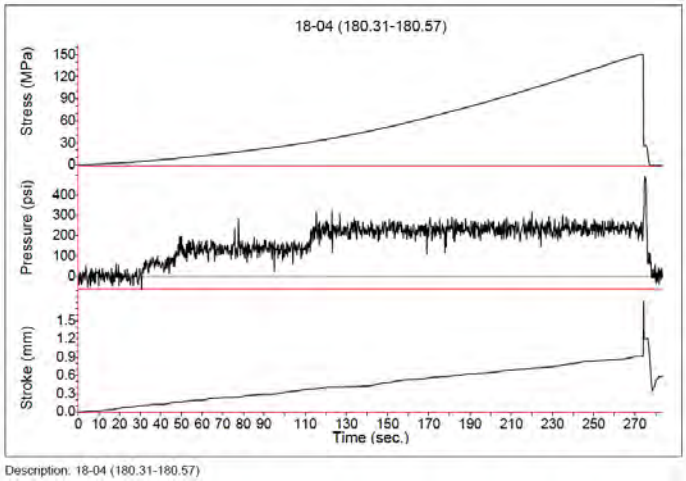
Specimen	GT18-04
Depth	(180.31-180.57 m)
Diameter, cm	6.05
Height, cm	13.61
Height-to-Diameter Ratio	2.25/1
Volume, cm^3	391.1
Mass, g	1034.8
Bulk Density, kg/m^3	2650
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	2	150.4
Confining Stress (b) and Fail Stress, MPa	5	---
Confining Stress (c) and Fail Stress, MPa	11	---
Confining Stress (d) and Fail Stress, MPa	25	---
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.9







Remarks: Sample failed partially along foliation at 30° to core axis (20% foliation) after first confinement process step – single stage test only	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-06	**Sample**: Triaxial Confined
Depth: (60.45-60.66 m)	**Date Sampled**: NA
Lithological Description: Gneiss	

Initial Sample Parameters

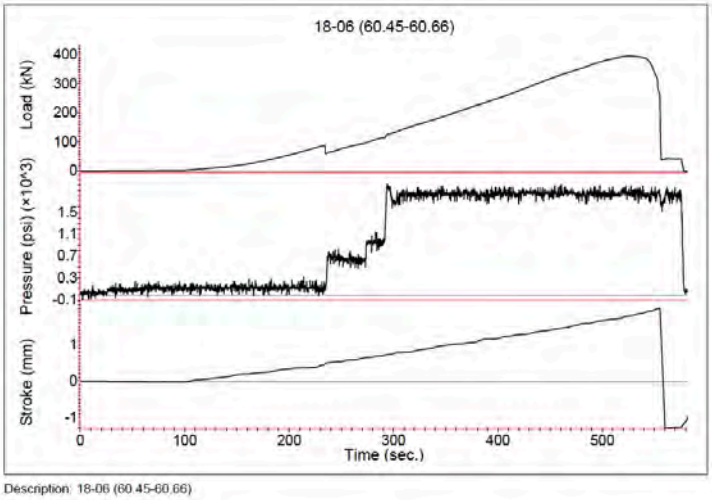
Specimen	GT18-06
Depth	(60.45-60.66 m)
Diameter, cm	6.08
Height, cm	13.56
Height-to-Diameter Ratio	2.23/1
Volume, cm^3	393.5
Mass, g	1120.9
Bulk Density, kg/m^3	2850
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1	29.9
Confining Stress (b) and Fail Stress, MPa	3	32.2
Confining Stress (c) and Fail Stress, MPa	6	40.2
Confining Stress (d) and Fail Stress, MPa	12	136.2
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	35.0







Remarks: Failed partially along pre-existing foliation at 30″ to core axis (50% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-06	**Sample**: Triaxial Confined
Depth: (139.00-139.30 m)	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Initial Sample Parameters

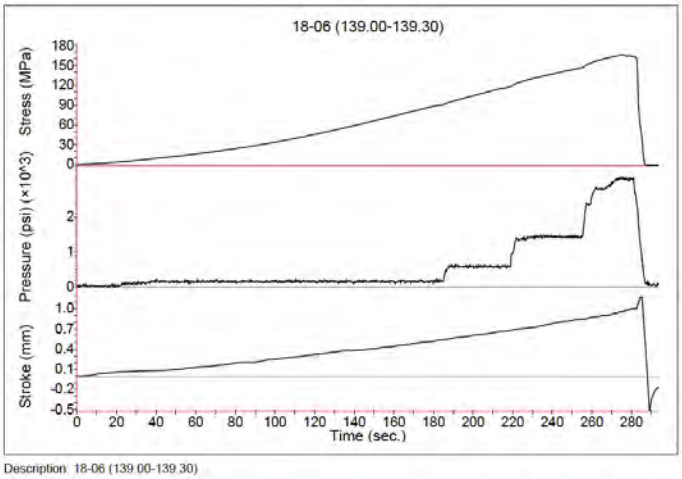
Specimen	GT18-06
Depth	(139.00-139.30 m)
Diameter, cm	6.06
Height, cm	13.61
Height-to-Diameter Ratio	2.25/1
Volume, cm^3	392.3
Mass, g	1043.1
Bulk Density, kg/m^3	2660
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	1	90.5
Confining Stress (b) and Fail Stress, MPa	4	117.4
Confining Stress (c) and Fail Stress, MPa	10	146.2
Confining Stress (d) and Fail Stress, MPa	20	166.7
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.9







Remarks: Failed partially along pre-existing foliation at 30″ to core axis (45% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-07	**Sample**: Triaxial Confined
Depth: (40.00-40.24 m)	**Date Sampled**: NA
Lithological Description: Biotite-feldspar schist with carbonate	

Initial Sample Parameters

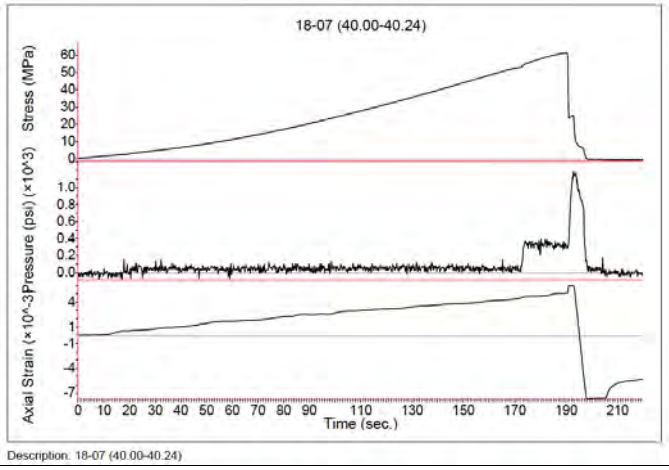
Specimen	GT18-07
Depth	(40.00-40.24 m)
Diameter, cm	6.08
Height, cm	13.74
Height-to-Diameter Ratio	2.26/1
Volume, cm^3	398.7
Mass, g	1051.5
Bulk Density, kg/m^3	2640
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	0.5	53.1
Confining Stress (b) and Fail Stress, MPa	2	61.5
Confining Stress (c) and Fail Stress, MPa	5	---
Confining Stress (d) and Fail Stress, MPa	10	---
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.5







Remarks: Sample failed along partially foliation at 40° to core axis (90% on foliation surface) after second confinement process step	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

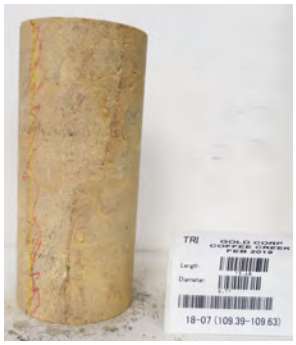
Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Mine	**Project No.**: Unknown
Borehole: GT18-07	**Sample**: Triaxial Confined
Depth: (109.39-109.63 m)	**Date Sampled**: NA
Lithological Description: Biotite-feldspar schist	

Initial Sample Parameters

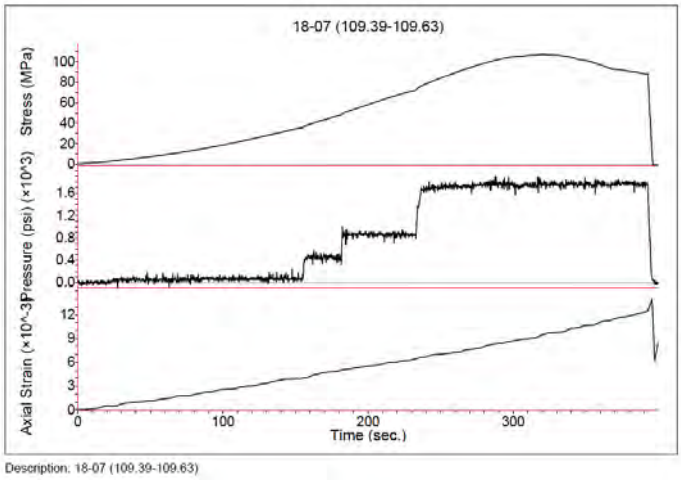
Specimen	GT18-07
Depth	(109.39-109.63 m)
Diameter, cm	6.11
Height, cm	13.68
Height-to-Diameter Ratio	2.24/1
Volume, cm^3	400.9
Mass, g	944.8
Bulk Density, kg/m^3	2360
Moisture Condition	As-received

Failed Sample Parameters

Specimen	Sigma 3	Sigma 1
Confining Stress (a) and Fail Stress, MPa	0.5	35.6
Confining Stress (b) and Fail Stress, MPa	3	48.7
Confining Stress (c) and Fail Stress, MPa	6	71.6
Confining Stress (d) and Fail Stress, MPa	12	107.1
Confining Stress (e) and Fail Stress, MPa		
Total Time to Failure, sec	---	
Strain Rate, microstrain/s	---	34.7







Remarks: Failed partially along pre-existing foliation at 30″ to core axis (70% failure on foliation surface)	
Performed by: Perry Ross	**Date**: March 8, 2019
Verified by: J. F. Archibald	**Date**: March 8, 2019

Triaxial Compressive Strength of Undrained Rock Core Specimen Without Pore Pressure Measurements (ASTM D7012 – Method A)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Project	**Project No.**: PO 6448
Borehole/Run: GT 18-04	**Sample ID:** GT 18-04 (164.50-165.14)
Depth: 164.50-165.14 m	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Sample Parameters

Specimen	GT 18-04 (164.50-165.14)
Nominal Cross-Sectional Area, cm^2	36.7
Moisture Condition	As-received

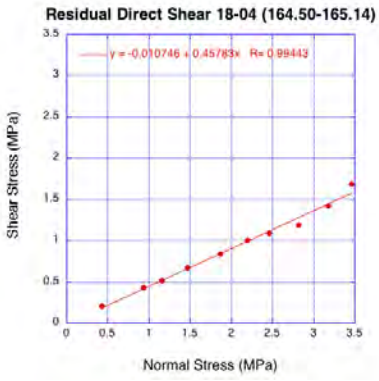
Residual Shear and normal stress data:

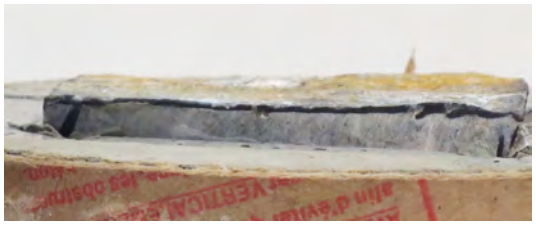
Normal Stress, MPa	0.43	0.93	1.16	1.47	1.87	2.20	2.46	2.82	3.18	3.46
Residual Shear Stress, MPa	0.20	0.43	0.52	0.67	0.84	1.00	1.09	1.19	1.42	1.68

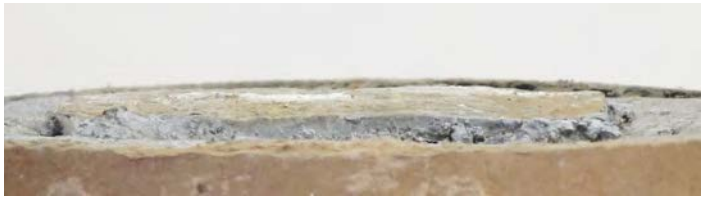


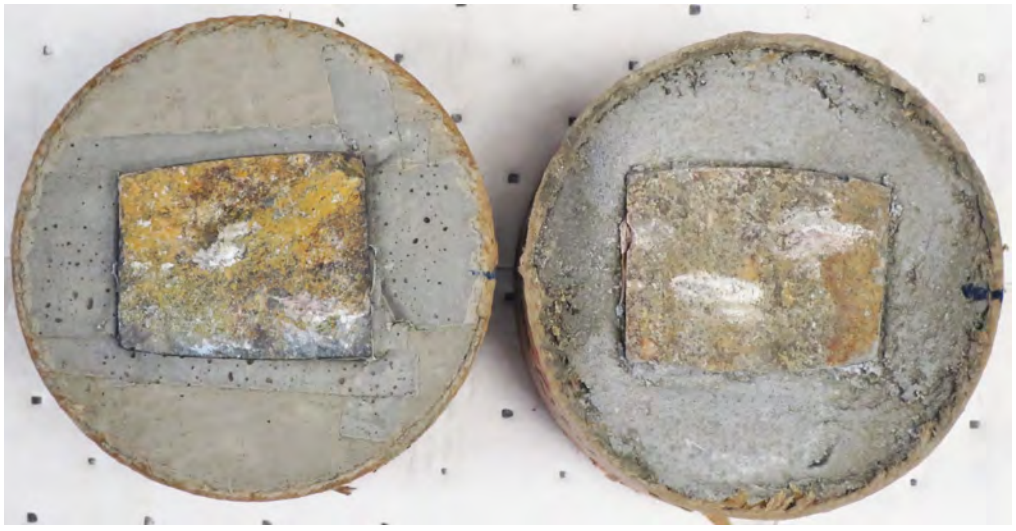
Cohesion = 0 kPa

Internal Friction Angle = 24.6°









Remarks: Undulating, regular shear sliding surface evident with smooth contact layer present across entire sliding plane surface	
Performed by: Perry Ross	**Date**: March 4, 2019
Verified by: J. F. Archibald	**Date**: March 4, 2019

Direct Shear Strength Tests of Rock Specimens (ASTM D5607-08)

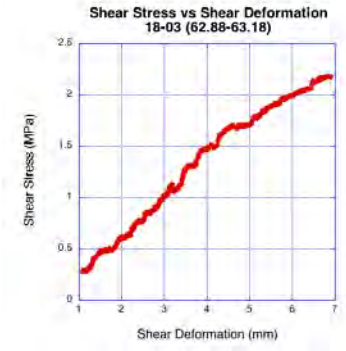
Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Project	**Project No.**: PO 6448
Borehole/Run: GT 18-03	**Sample ID:** GT 18-03 (62.88-63.18)
Depth: 62.88-63.18 m	**Date Sampled**: NA
Lithological Description: Biotite-feldspar schist with carbonate	

Sample Parameters

Specimen	GT 18-03 (62.88-63.18)
Nominal Cross-Sectional Area, cm^2	31.1
Moisture Condition	As-received

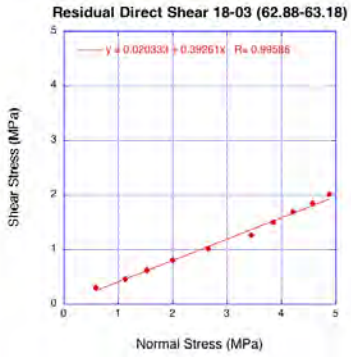
Residual Shear and normal stress data:

Normal Stress, MPa	0.58	1.13	1.53	2.00	2.65	3.45	3.85	4.21	4.57	4.88
Residual Shear Stress, MPa	0.31	0.46	0.63	0.80	1.02	1.26	1.50	1.69	1.85	2.01

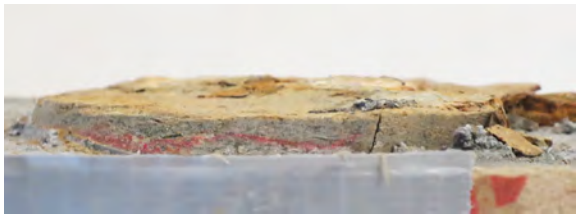


Cohesion = 20 kPa

Internal Friction Angle = 21.3 °









Remarks: Regular shear sliding surface evident with smooth, deformable contact layer occurring across sliding plane surface	
Performed by: Perry Ross	**Date**: March 4, 2019
Verified by: J. F. Archibald	**Date**: March 4, 2019

Direct Shear Strength Tests of Rock Specimens (ASTM D5607-08)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Project	**Project No.**: PO 6448
Borehole/Run: GT 18-07	**Sample ID:** GT 18-07 (56.50-56.80)
Depth: 56.50-56.80 m	**Date Sampled**: NA
Lithological Description: Biotite-feldspar schist	

Sample Parameters

Specimen	GT 18-07 (56.50-56.80)
Nominal Cross-Sectional Area, cm^2	48.0
Moisture Condition	As-received

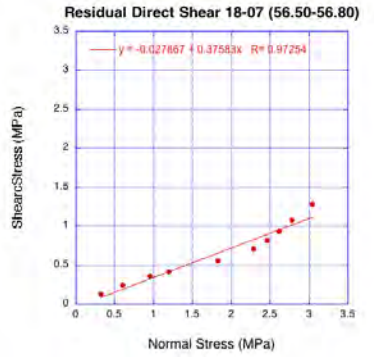
Residual Shear and normal stress data:

Normal Stress, MPa	0.32	0.60	0.95	1.20	1.83	2.29	2.46	2.62	2.78	3.04
Residual Shear Stress, MPa	0.13	0.24	0.36	0.42	0.55	0.71	0.82	0.93	1.08	1.28



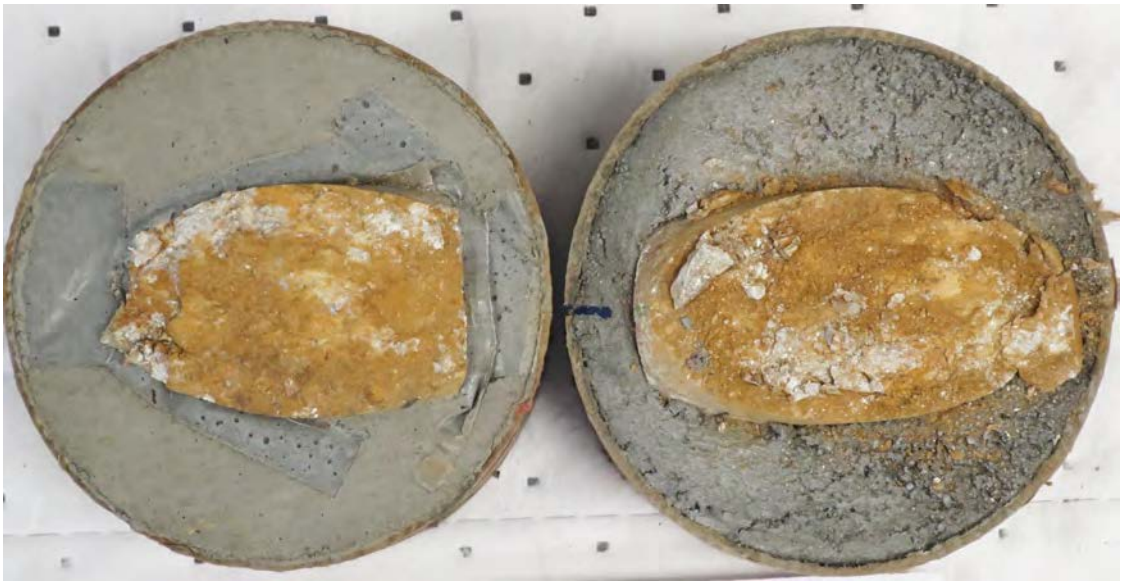
Cohesion = 0 kPa

Internal Friction Angle = 20.6°









Remarks: Regular shear sliding surface evident with smooth, deformable contact layer occurring across entire sliding plane surface	
Performed by: Perry Ross	**Date**: March 4, 2019
Verified by: J. F. Archibald	**Date**: March 4, 2019

Direct Shear Strength Tests of Rock Specimens (ASTM D5607-08)

Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Project	**Project No.**: PO 6448
Borehole/Run: GT 18-04	**Sample ID:** GT 18-04 (176.14-176.59)
Depth: 176.14-176.59 m	**Date Sampled**: NA
Lithological Description: Felsic gneiss	

Sample Parameters

Specimen	GT 18-04 (176.14-176.59)
Nominal Cross-Sectional Area, cm^2	47.1
Moisture Condition	As-received

Residual Shear and normal stress data:

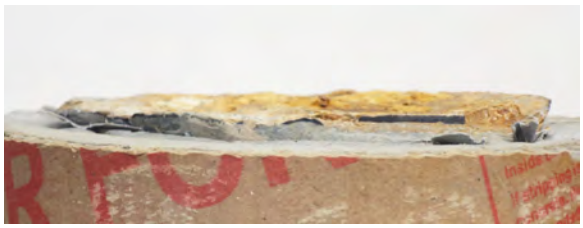
Normal Stress, MPa	0.33	0.80	1.07	1.32	1.54	1.90	2.27	2.56	2.95	3.18
Shear Stress, MPa	0.17	0.31	0.42	0.50	0.60	0.75	0.90	1.03	1.19	1.31



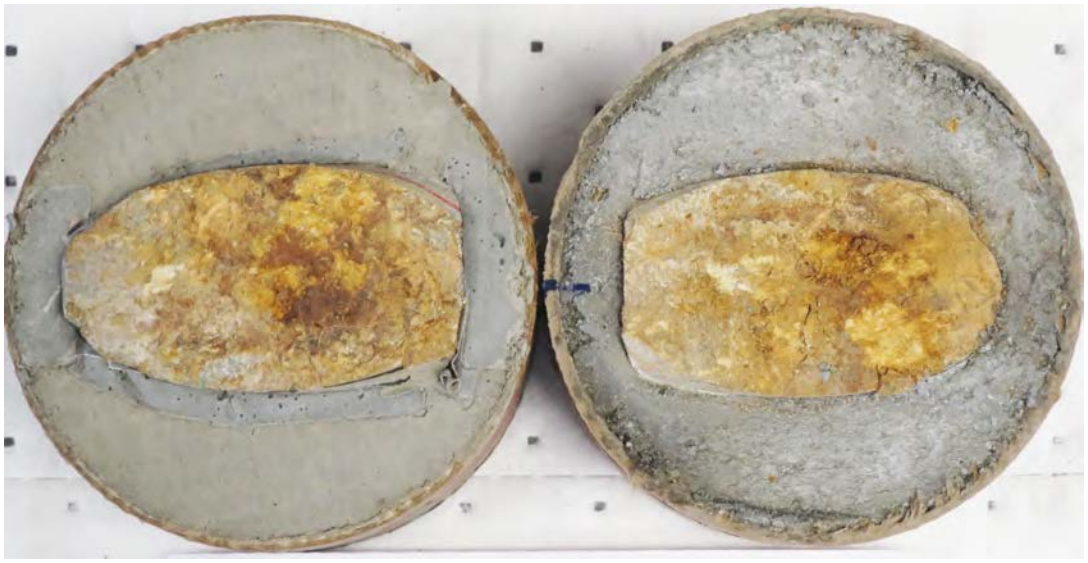
Cohesion = 0 kPa

Internal Friction Angle = 22.0 °









Remarks: Regular shear sliding surface evident with smooth, deformable contact layer occurring across entire sliding plane surface	
Performed by: Perry Ross	**Date**: March 4, 2019
Verified by: J. F. Archibald	**Date**: March 4, 2019

Direct Shear Strength Tests of Rock Specimens (ASTM D5607-08)

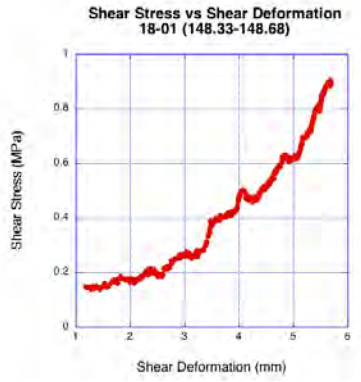
Client: JDS Mining & Energy Inc.	**Lab**: Queen's University
Project/Site: Coffee Gold Project	**Project No.**: PO 6448
Borehole/Run: GT 18-01	**Sample ID:** GT 18-01 (148.33-148.68)
Depth: 148.33-148.68 m	**Date Sampled**: NA
Lithological Description: Dacite	

Sample Parameters

Specimen	GT 18-01 (148.33-148.68)
Nominal Cross-Sectional Area, cm^2	35.4
Moisture Condition	As-received

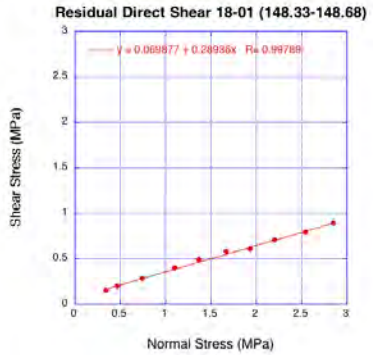
Residual Shear and normal stress data:

Normal Stress, MPa	0.34	0.47	0.74	1.10	1.37	1.67	1.93	2.20	2.54	2.85
Shear Stress, MPa	0.15	0.20	0.28	0.40	0.49	0.58	0.61	0.71	0.79	0.89



Cohesion = 69 kPa

Internal Friction Angle = 16.1 °









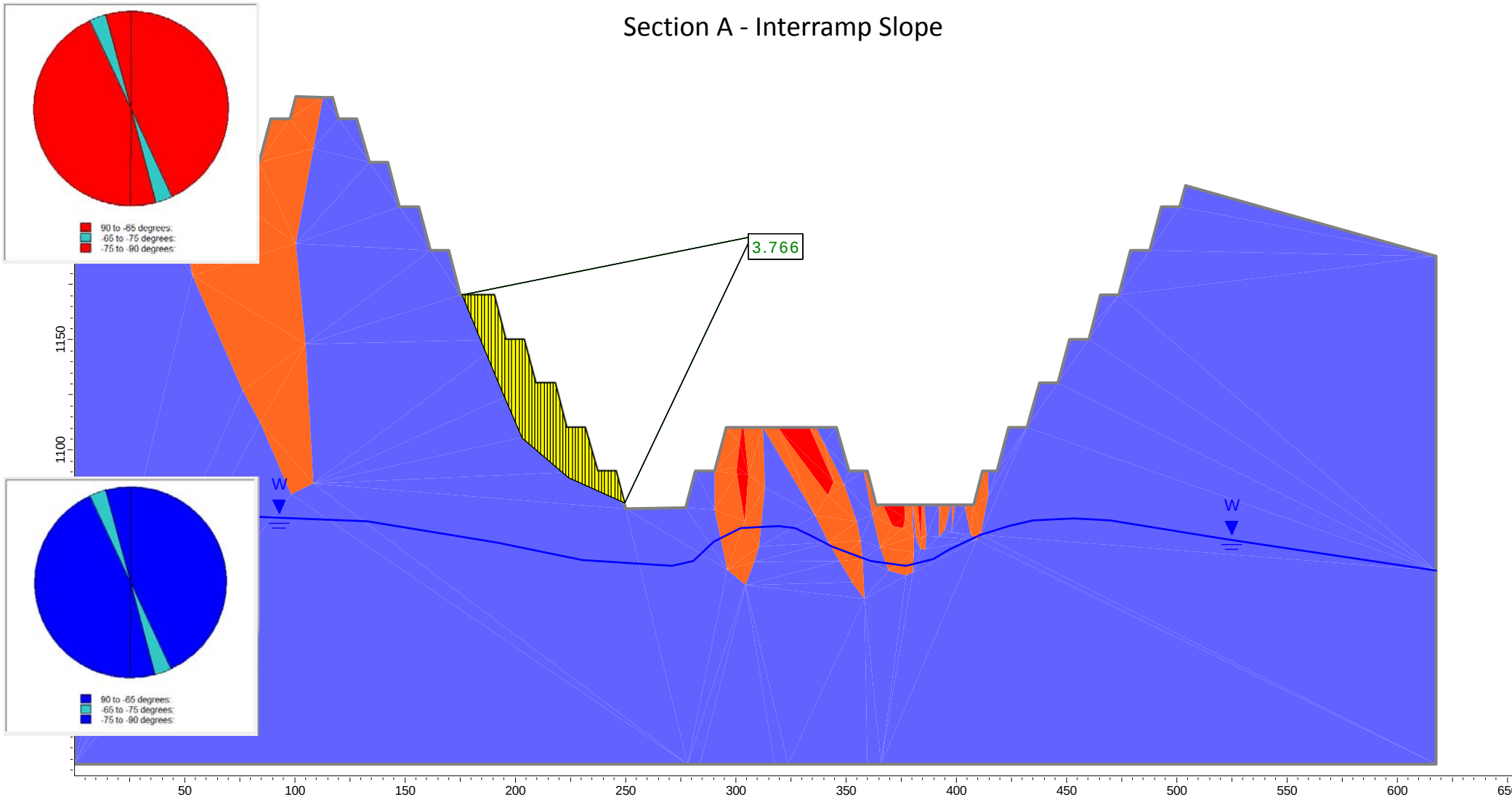
Remarks: Regular shear sliding surface evident with smooth contact layer occurring across sliding plane surface	
Performed by: Perry Ross	**Date**: March 4, 2019
Verified by: J. F. Archibald	**Date**: March 4, 2019

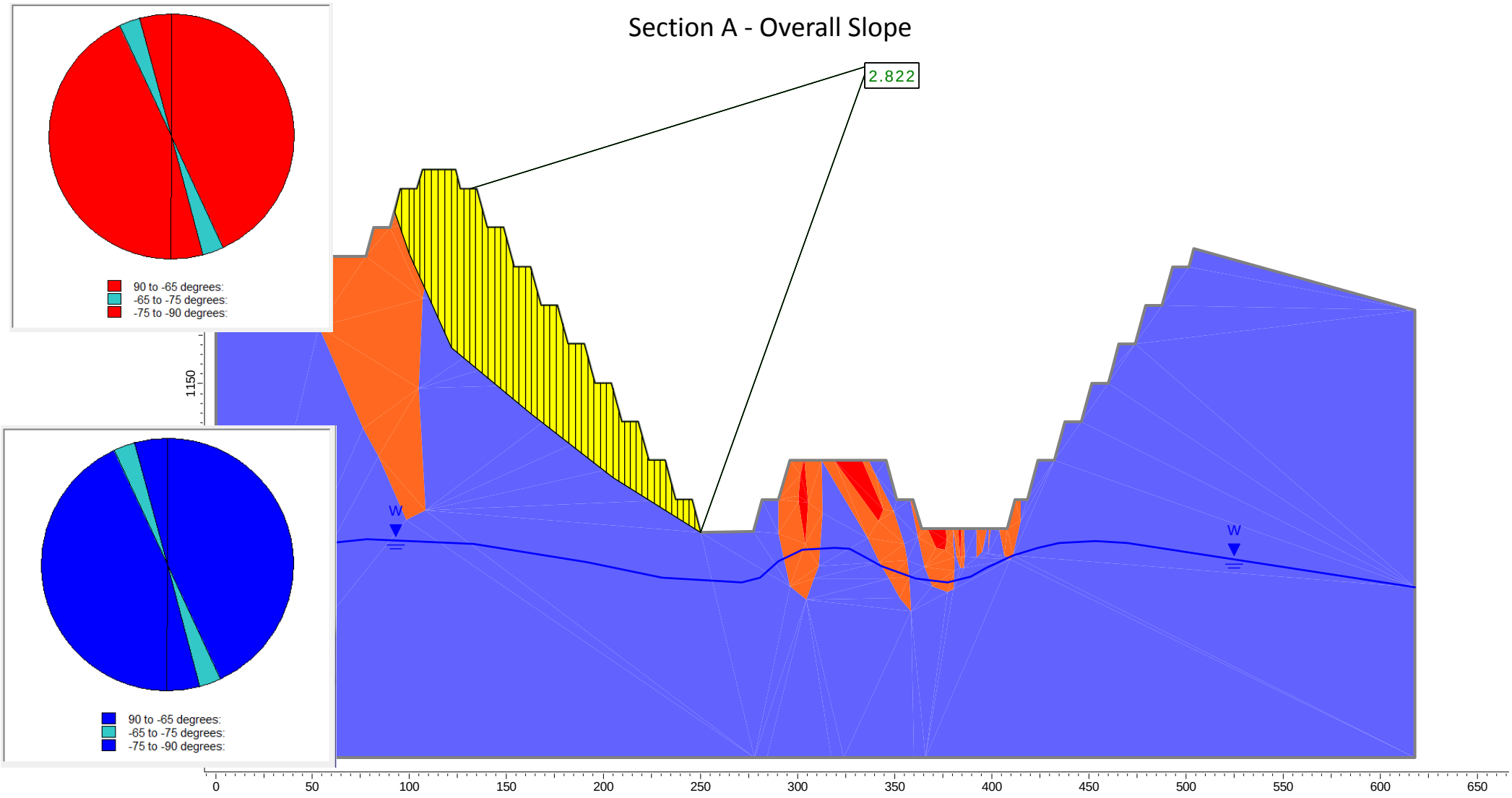
Direct Shear Strength Tests of Rock Specimens (ASTM D5607-08)

APPENDIX C

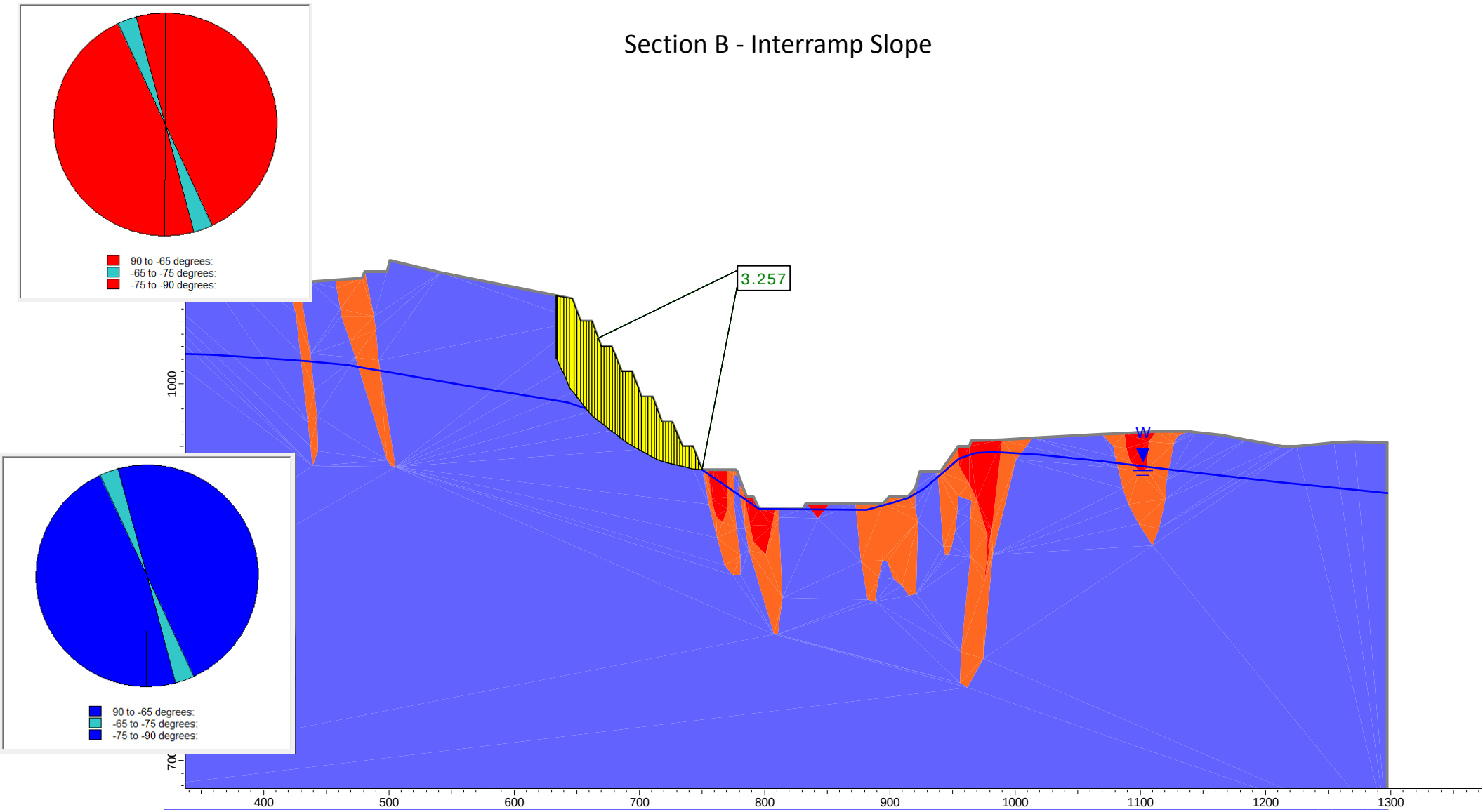
INTERRAMP/OVERALL STABILITY ANALYSES

Section A - Interramp Slope

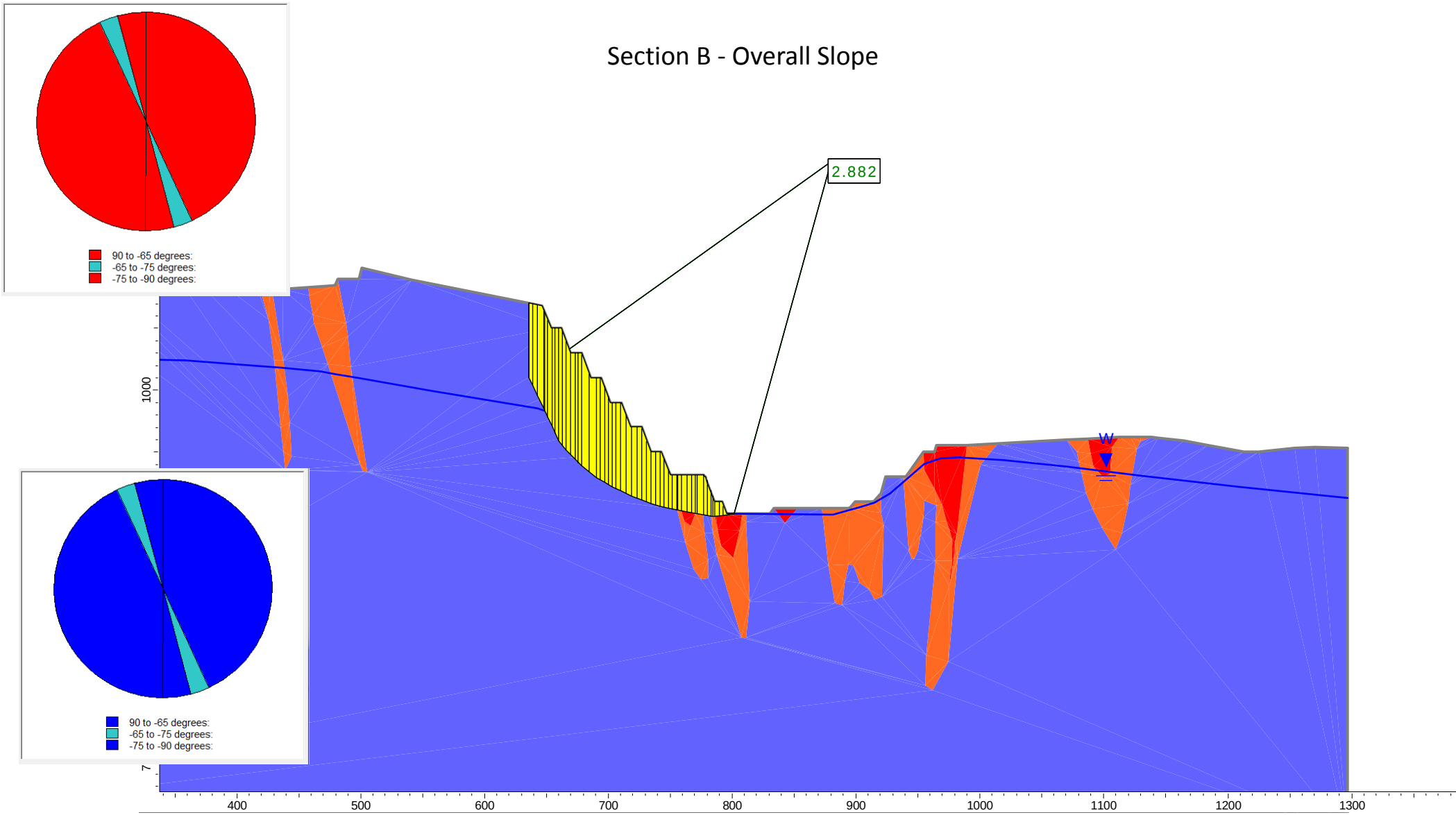



Section A - Overall Slope
2.822
90 to -65 degrees:
-65 to -75 degrees:
-75 to -90 degrees:
1150
W
W
90 to -65 degrees:
-65 to -75 degrees:
-75 to -90 degrees:
0
50
100
150
200
250
300
350
400
450
500
550
600
650

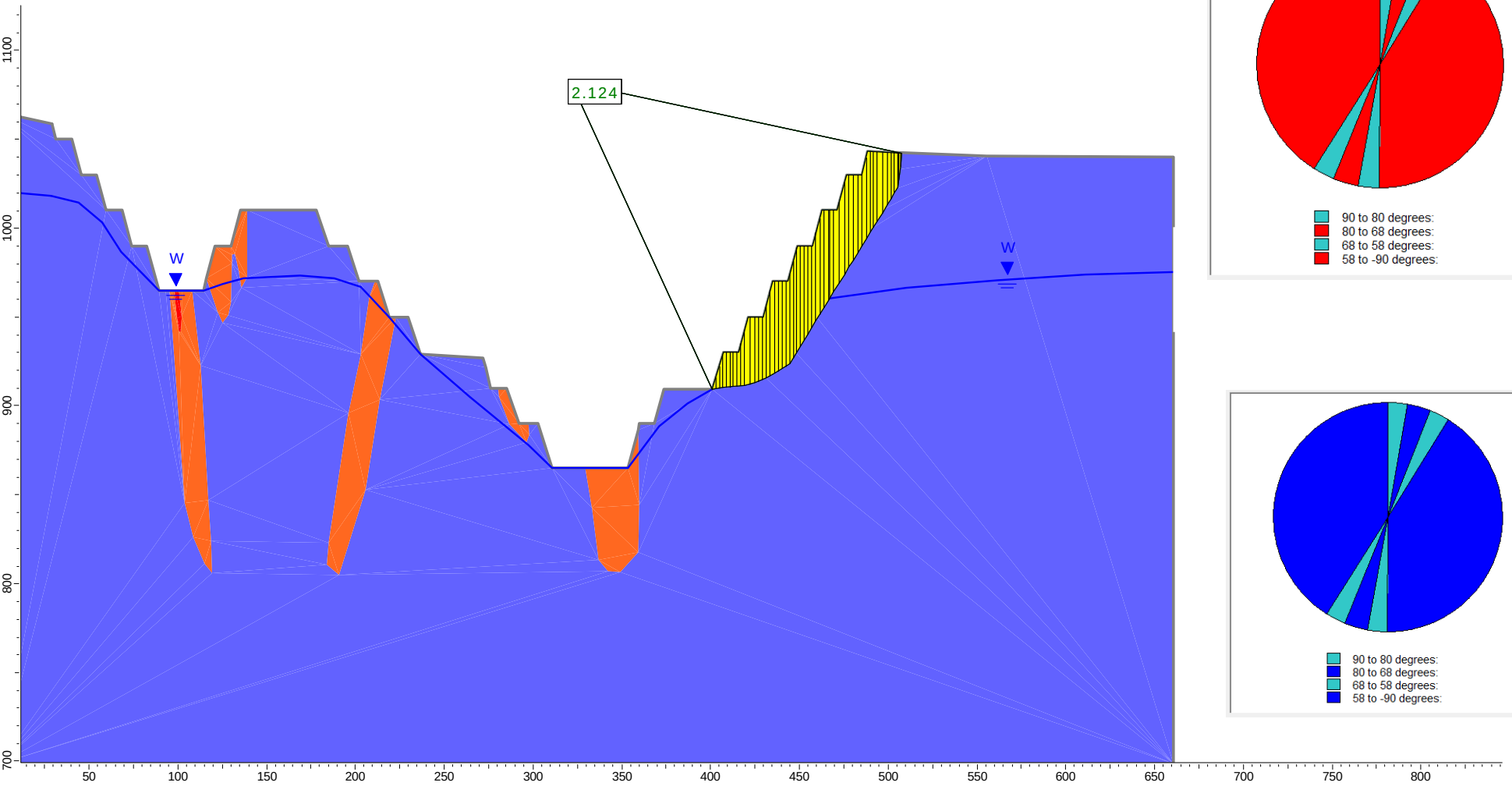
Section B - Interramp Slope



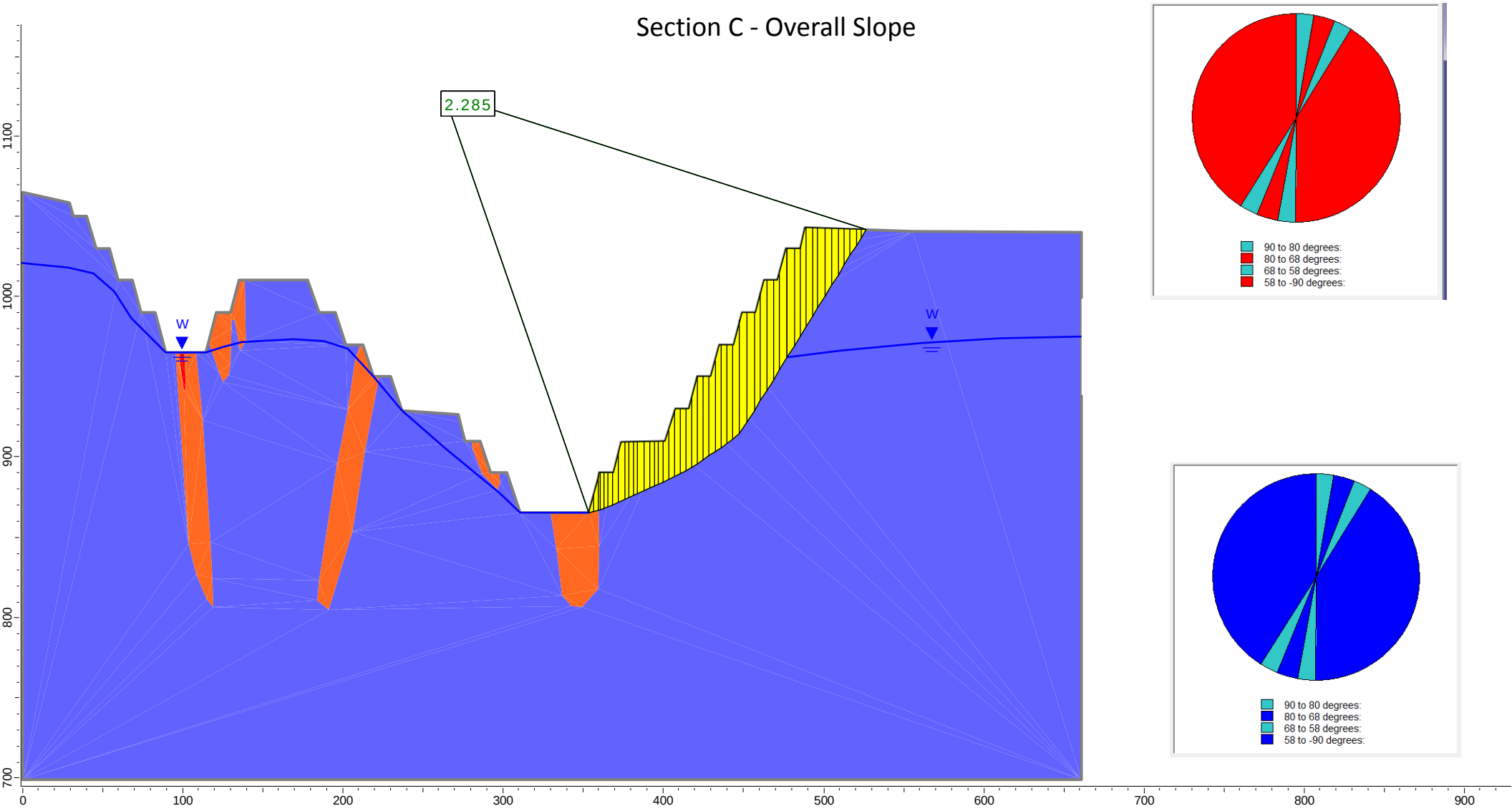
Section B - Overall Slope



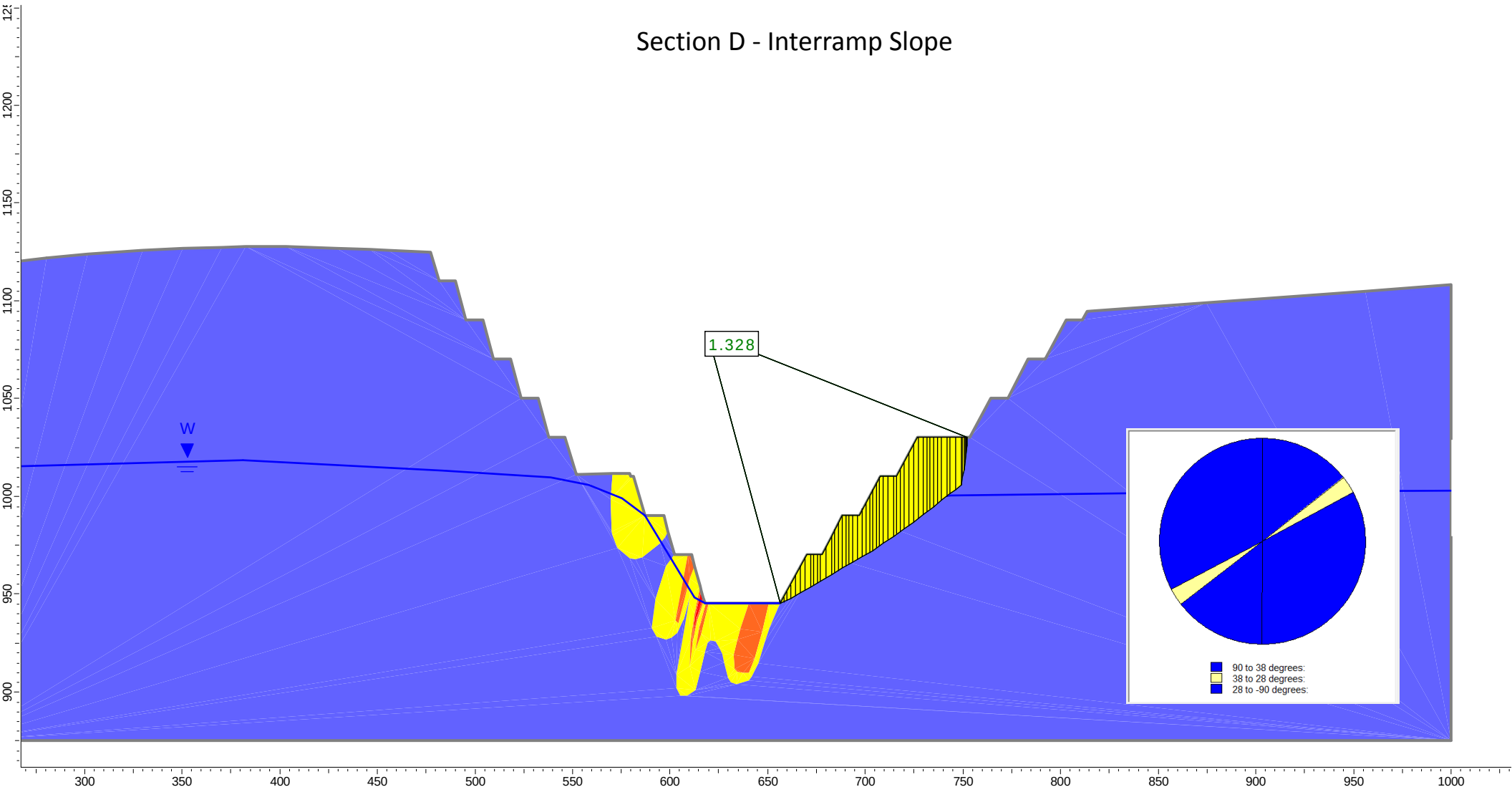
Section C - Interramp Slope



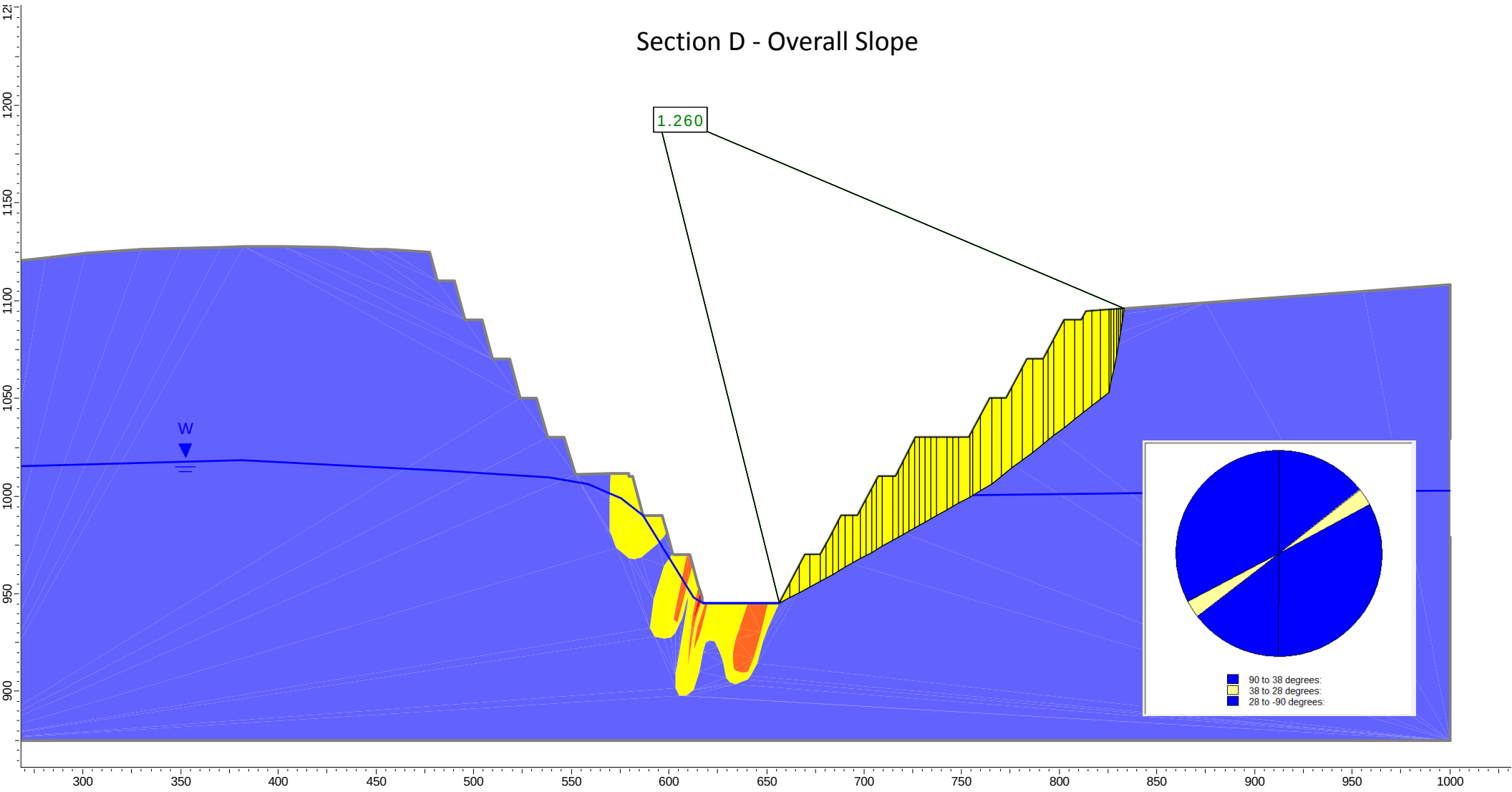
Section C - Overall Slope



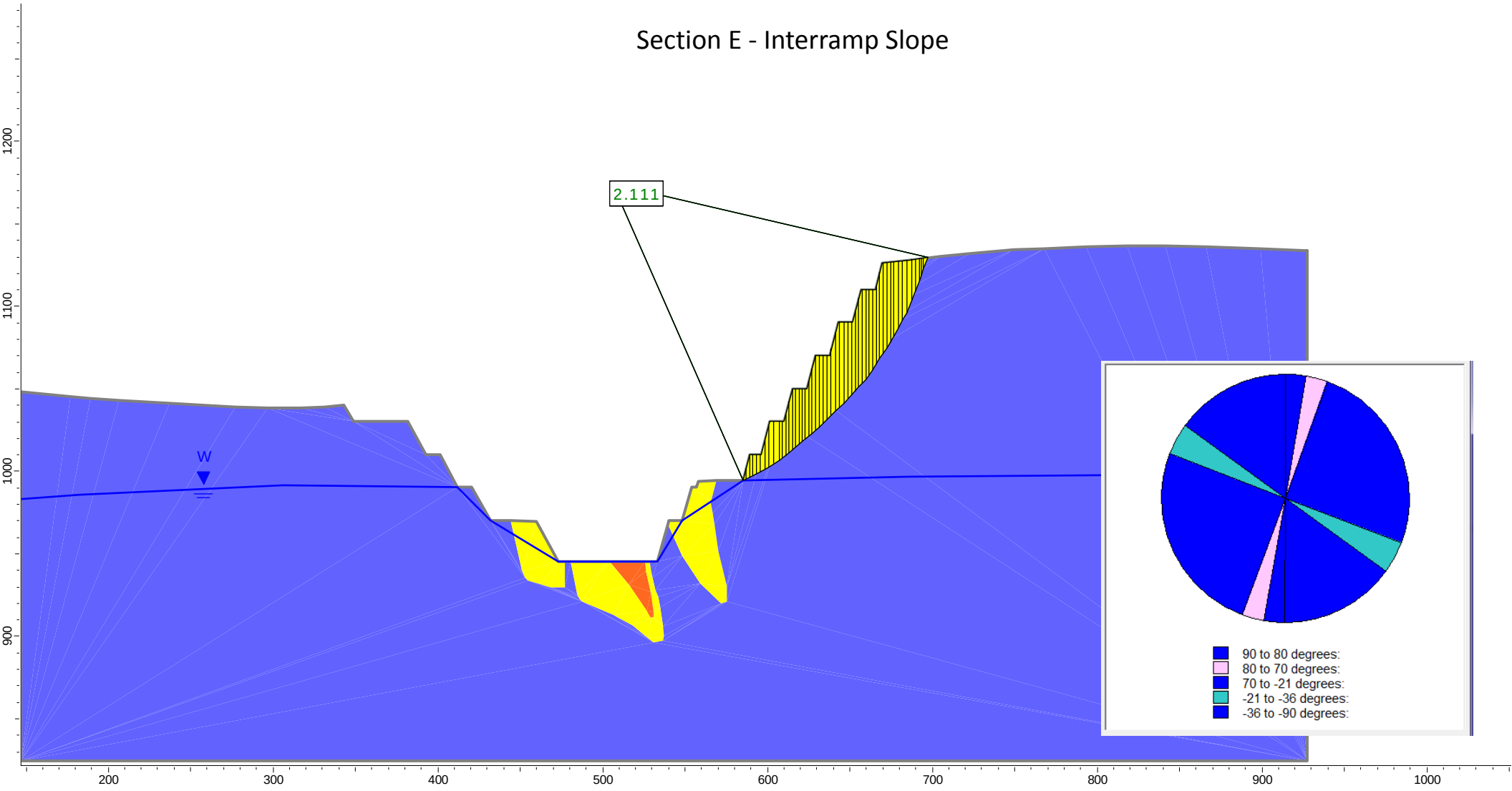
Section D - Interramp Slope



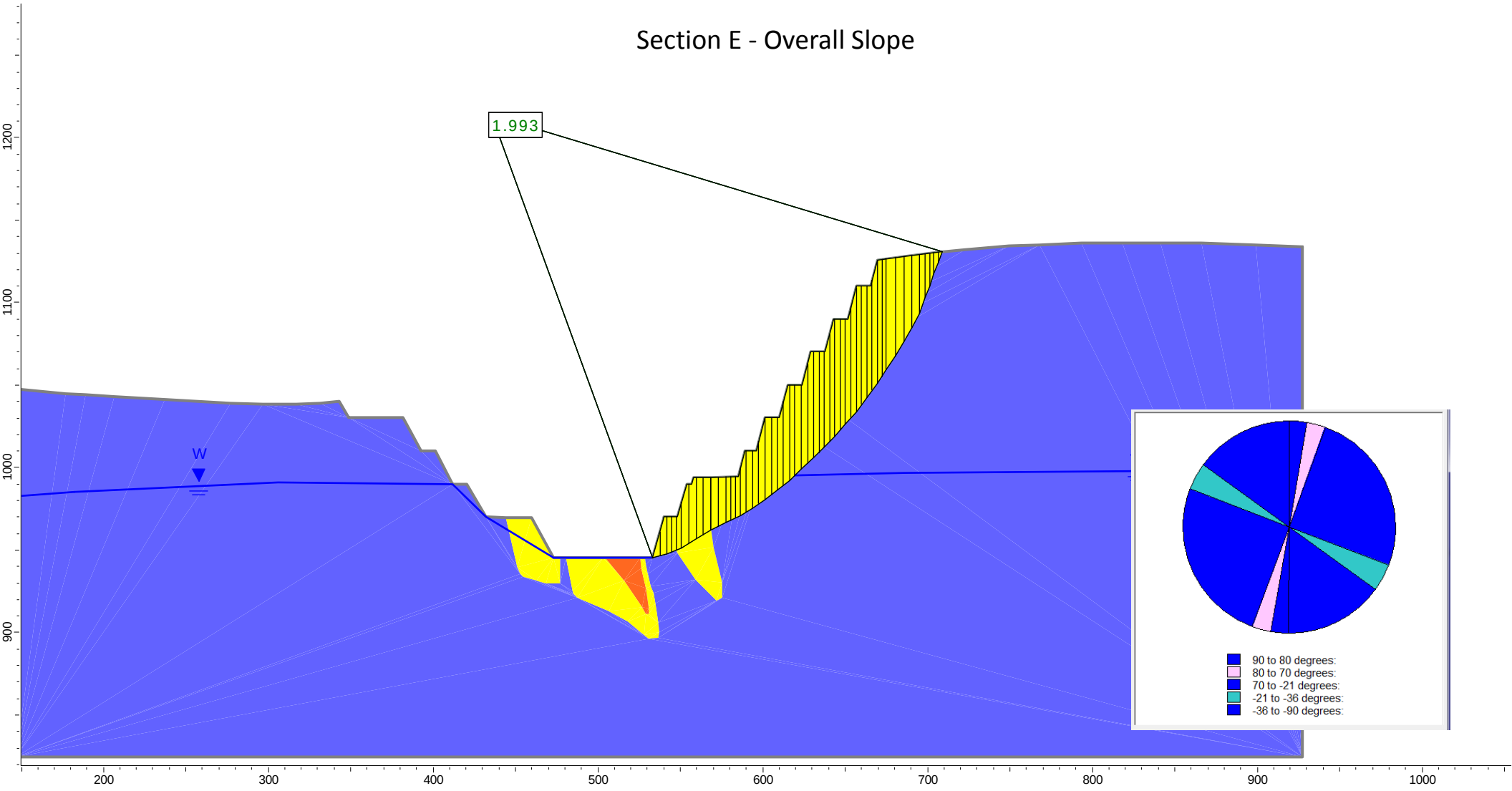
Section D - Overall Slope



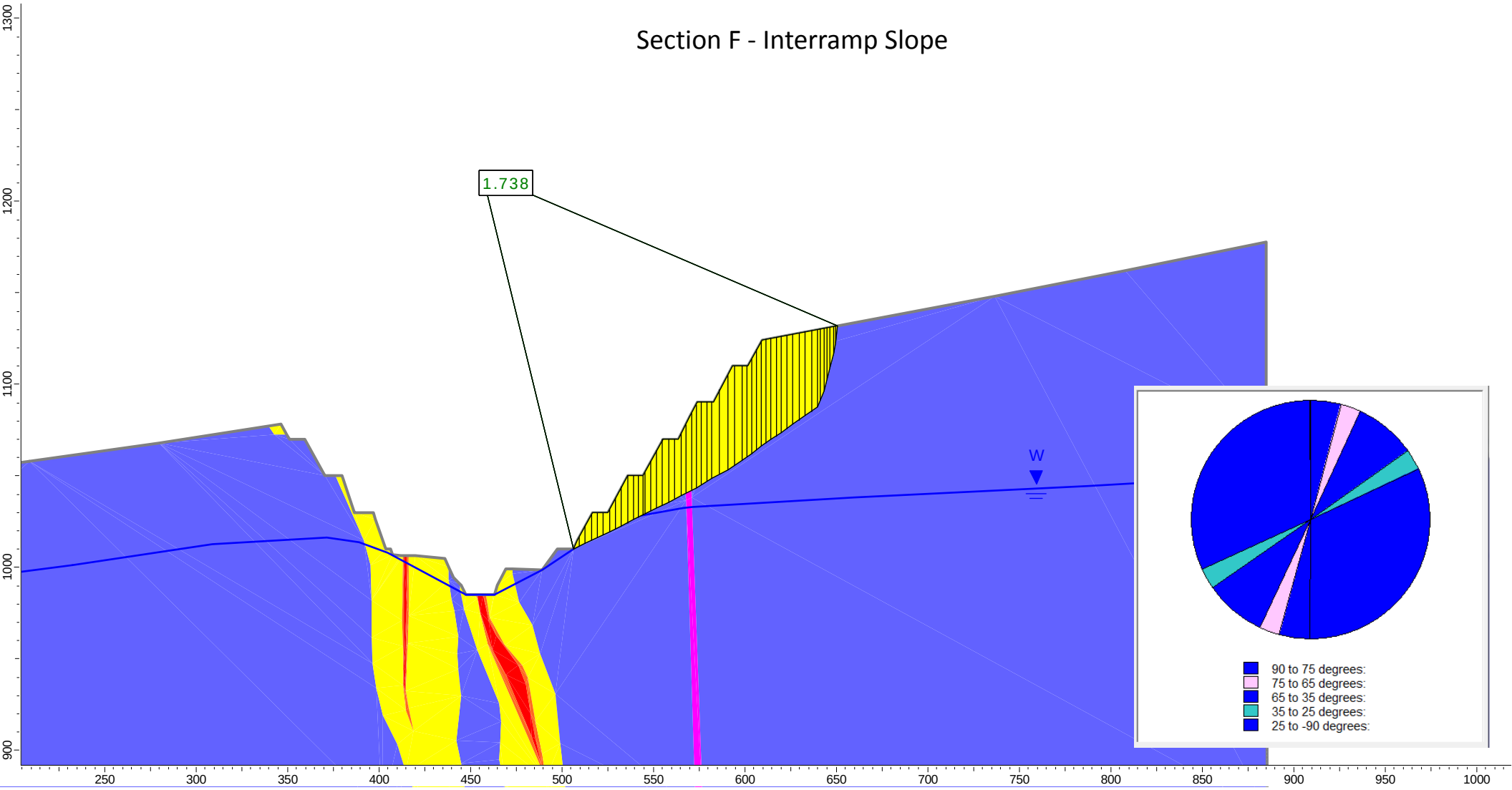
Section E - Interramp Slope



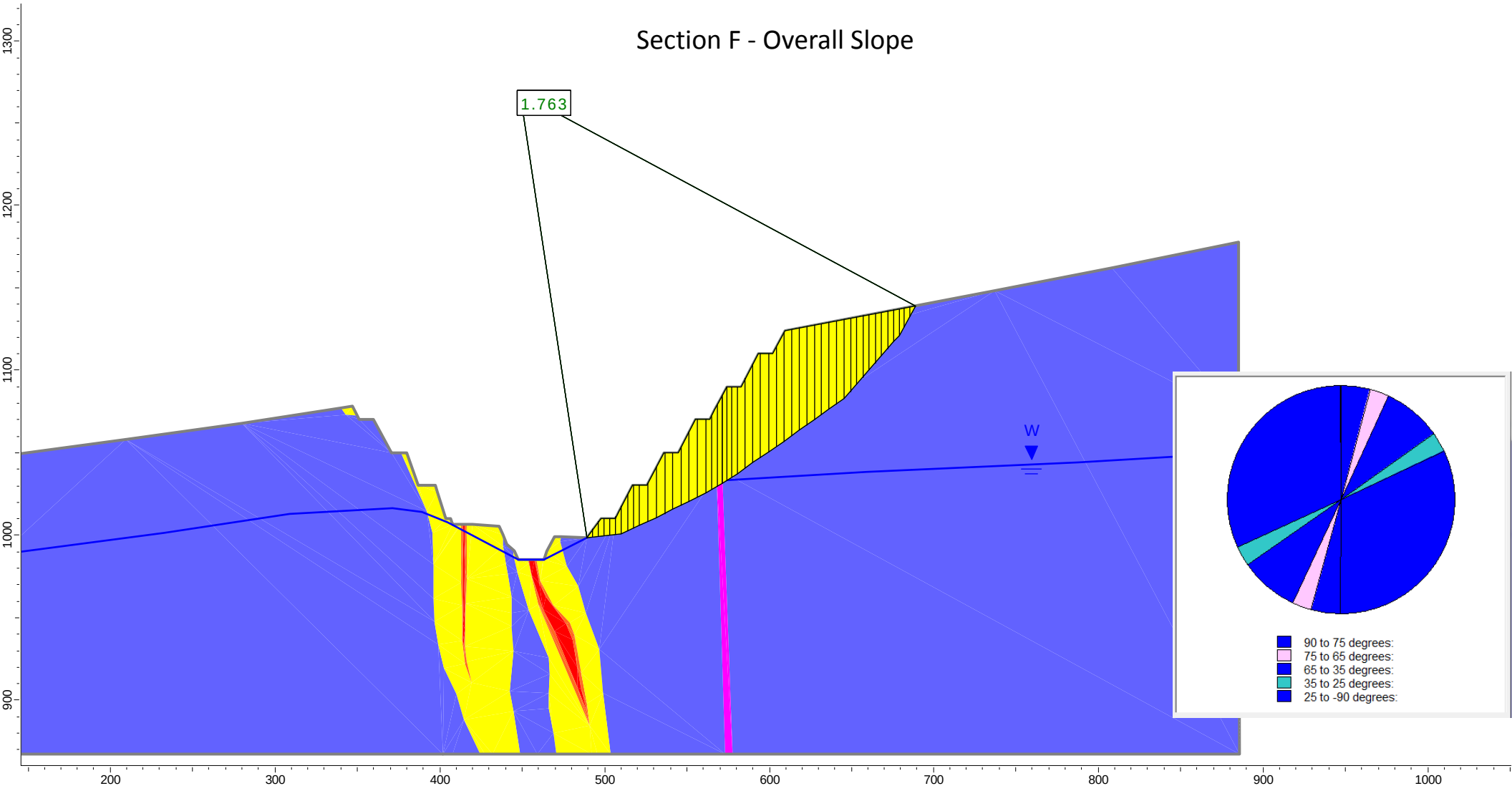
Section E - Overall Slope



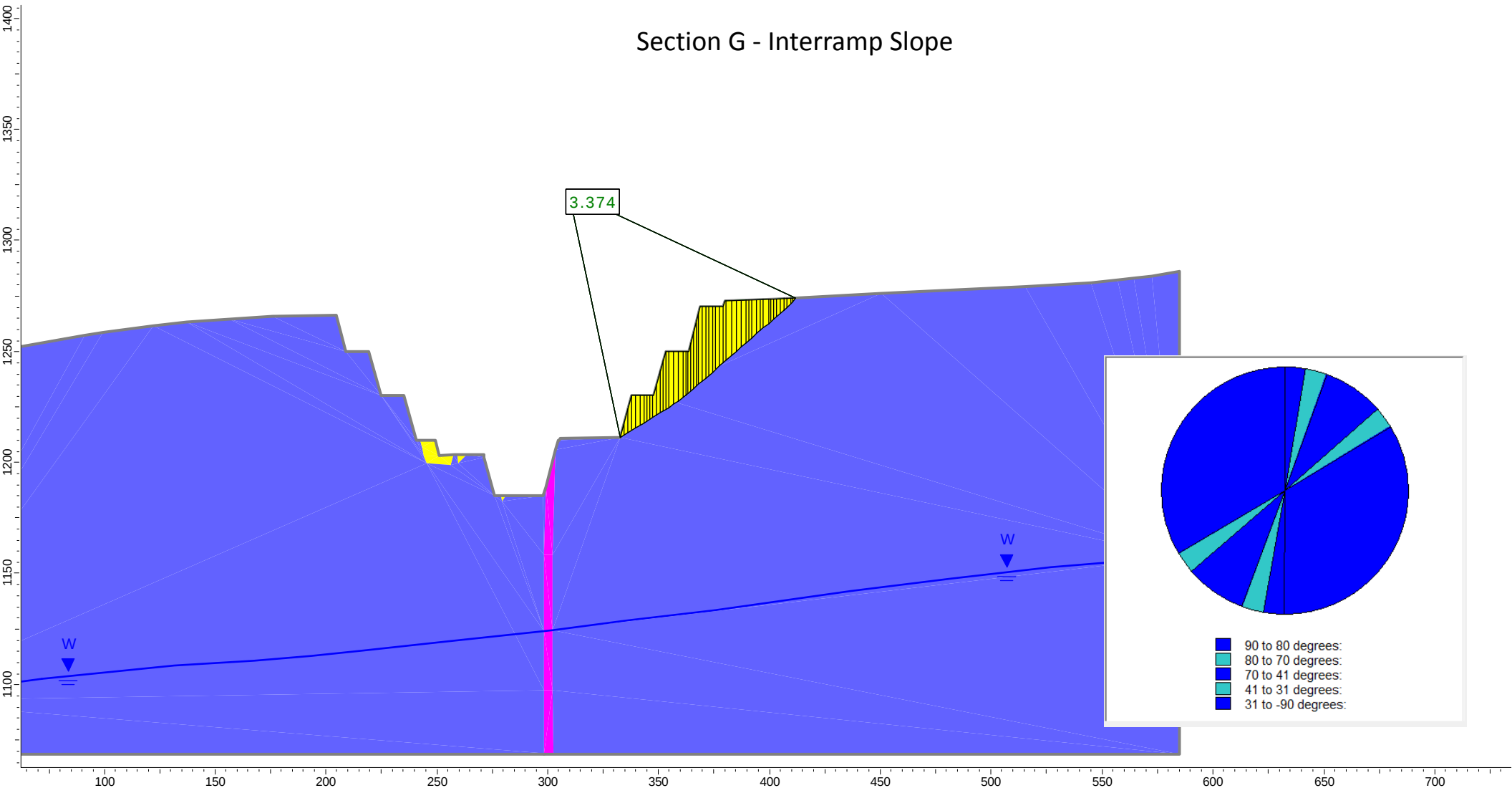
Section F - Interramp Slope



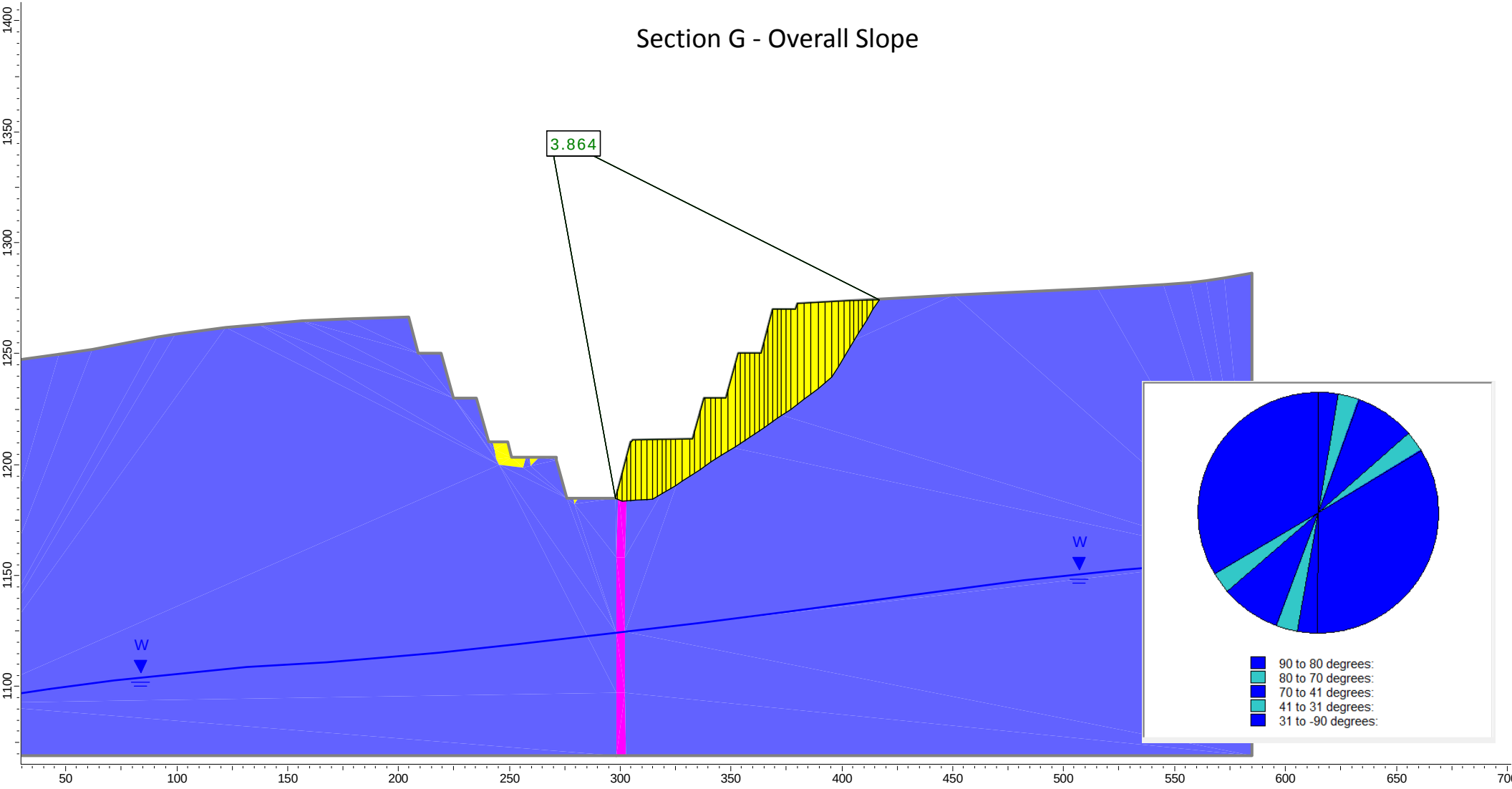
Section F - Overall Slope



Section G - Interramp Slope



Section G - Overall Slope



APPENDIX 5-B

Preliminary Slope Stability Analysis, Waste Rock Storage Facilities and Overburden Stockpiles

NEWMONT COPORATION
COFFEE GOLD PROJECT

PRELIMINARY SLOPE STABILITY ANALYSIS
WASTE ROCK STORAGE FACILITES AND STOCKPILES

REPORT DATE: APRIL 1, 2025



PREPARED FOR

NEWMONT COPORATION
Suite 3400, 666 Burrard St.,
Vancouver, BC V6C 2W2

PREPARED BY

JDS ENERGY & MINING INC.
Suite 900, 999 West Hastings St.,
Vancouver, BC V6C 2W2

Table of Contents

1 Facilities Overview 1-1
1.1 Alpha WRSF 1-1
1.2 Run of Mine Stockpile 1-1
1.3 Temporary Organics Stockpile 1-2
1.4 In-pit Backfill 1-2
2 Foundation Conditions 2-1
2.1 Alpha WRSF 2-1
2.2 Run of Mine Stockpile 2-3
2.3 Temporary Organics Stockpile 2-3
3 Geotechnical Material Properties 3-1
3.1 Waste Rock 3-1
3.2 Ice-poor Colluvium 3-3
3.3 Ice-rich Colluvium 3-3
3.4 Organic Soils 3-5
3.5 Weathered Bedrock 3-5
3.6 Fresh Bedrock 3-5
3.7 Pore Water Pressures 3-5
4 Slope Stability Analysis 4-1
4.1 Model Methodology 4-1
4.2 Design Acceptability Criteria 4-6
4.3 Slope Stability Modeling Results 4-8
5 Conclusions 5-1
6 References 6-1

List of Tables

Table 4-1: Suggested WRSF Stability Acceptance Criteria 4-6
Table 4-2: Factors of Safety Results 4-8

List of Figures

Figure 1-1: Site Layout 1-3
Figure 2-1: Location of Geotechnical Drillholes and Permafrost Mapping 2-2
Figure 3-1: Plot of Waste Rock Material Strengths 3-2
Figure 3-2: Location of Ice-rich Soil Slope 3-4
Figure 4-1: Alpha WRSF Critical Slope Stability Sections 4-1
Figure 4-2: Geometry of Alpha WRSF: Cross-Section A 4-2
Figure 4-3: Geometry of Alpha WRSF: Cross-Section B 4-2
Figure 4-4: ROM Stockpile Critical Slope Stability Section 4-3
Figure 4-5: Temporary Organics Stockpile Critical Slope Stability Section 4-4
Figure 4-6: Location of Supremo In-pit Backfill Critical Slope Stability Section 4-5

List of Appendices

Appendix A: Preliminary Slope Stability Model Results

INTRODUCTION

Newmont Corporation (Newmont) requested that JDS Energy & Mining, Inc. (JDS) conduct a Preliminary Slope Stability Analysis of the for the Coffee Gold Project proposed waste rock and stockpile facilities. This report summarizes the slope stability assessment of the proposed Alpha Waste Rock Storage Facility (WRSF) design, Temporary Organics Stockpile and Run of Mine (ROM) Stockpile. Additional slope stability analyses and reporting will be undertaken by JDS once the final mine plan is completed by Newmont.

This work was originally completed by JDS in 2018 and this update considers the results from the summer 2018 geotechnical field investigation which was completed after the 2018 analysis. Relevant details from the 2018 program are summarized in Section 2. Newmont has indicated that the original designs used for the 2018 analysis are still current.

The JDS scope of work pertains strictly to the physical stability of the WRSFs and overburden stockpile. Other design aspects of design such as geochemistry, water management and other environmental considerations are being assessed by others.

1 FACILITIES OVERVIEW

1.1 Alpha WRSF

The Alpha WRSF will be located on the southeastern limb of the Halfway Creek drainage basin (Figure 1-1). It will have an estimated minimum capacity of 245 Mt and a total footprint of 210 hectares. Construction of the Alpha WRSF will begin during pre-stripping and will continue until the end of LOM.

The Alpha WRSF will be built in a series of 40 m lifts in a bottom-up approach. A haul road will be developed along the east side of the WRSF. The toe of each lift is planned to be set back a minimum of 60 m from the crest of the previous bench, resulting in a final overall angle of 3.0 H:1V. The lowest elevation of the dump will be 815 m above sea level (masl), and the highest point will be 1,150 masl. The total maximum vertical stack of waste rock above the natural ground surface will be approximately 175 m.

The 40 m inter-bench slopes are designed at the natural angle of repose (35°) except for along the southern edge, where potentially ice-rich soils are anticipated. Inter-bench slopes in this area will be reduced to 26° (2H:1V) to reduce potential instabilities of the lower bench. The 26° slope angle will require shaping with dozers during placement.

For the purposes of effective water management, a rock drain will be developed beneath the Alpha WRSF. This drain will convey runoff from the upper portion of the Halfway Creek catchment, meteoric water infiltrating through the WRSF, and groundwater discharge to the Halfway Creek channel covered by the WRSF.

1.2 Run of Mine Stockpile

The Run of Mine (ROM) Stockpile will be located directly east of the primary crusher (Figure 1-1) and will store up to approximately 2.42 Mt of ROM mineralized material. The facility will have a footprint of approximately 14.4 ha. The amount of ROM material stored at the facility will fluctuate, with peak volumes occurring during the winter months of January to March when the crusher is not running. Seepage from the ROM stockpile will be collected in the Facility Pond and used as makeup water in the heap leach process. The ore stockpiled will be processed during the mine life and therefore the ROM stockpile will not remain at closure.

The ROM Stockpile will be constructed on top of a graded waste rock pad which will require approximately 3.6 Mt of material to construct. The waste rock pad will have a maximum slope height of approximately 60 m at the southeast corner and the ROM material will be stacked on top of the rock pad to a maximum height of approximately 30 m. The waste rock and ROM material slopes will be at their natural angle of repose (approximately 1.5H:1V) with a 12-m-wide safety berm between the two. This will result in a maximum overall slope height of approximately 90 m and overall slope angle of approximately 1.7H:1V.

1.3 Temporary Organics Stockpile

The Temporary Organics Stockpile will be located immediately north of the heap leach pad, near the top of a northeast facing slope. It will hold topsoil which will be removed from the Open Pits, heap leach pad, site infrastructure pads and portions of the WRSF footprints. The material will be progressively removed from the stockpile for reclamation purposes as certain areas of the Project are ready to be closed. The organic materials are not anticipated to be ice-rich.

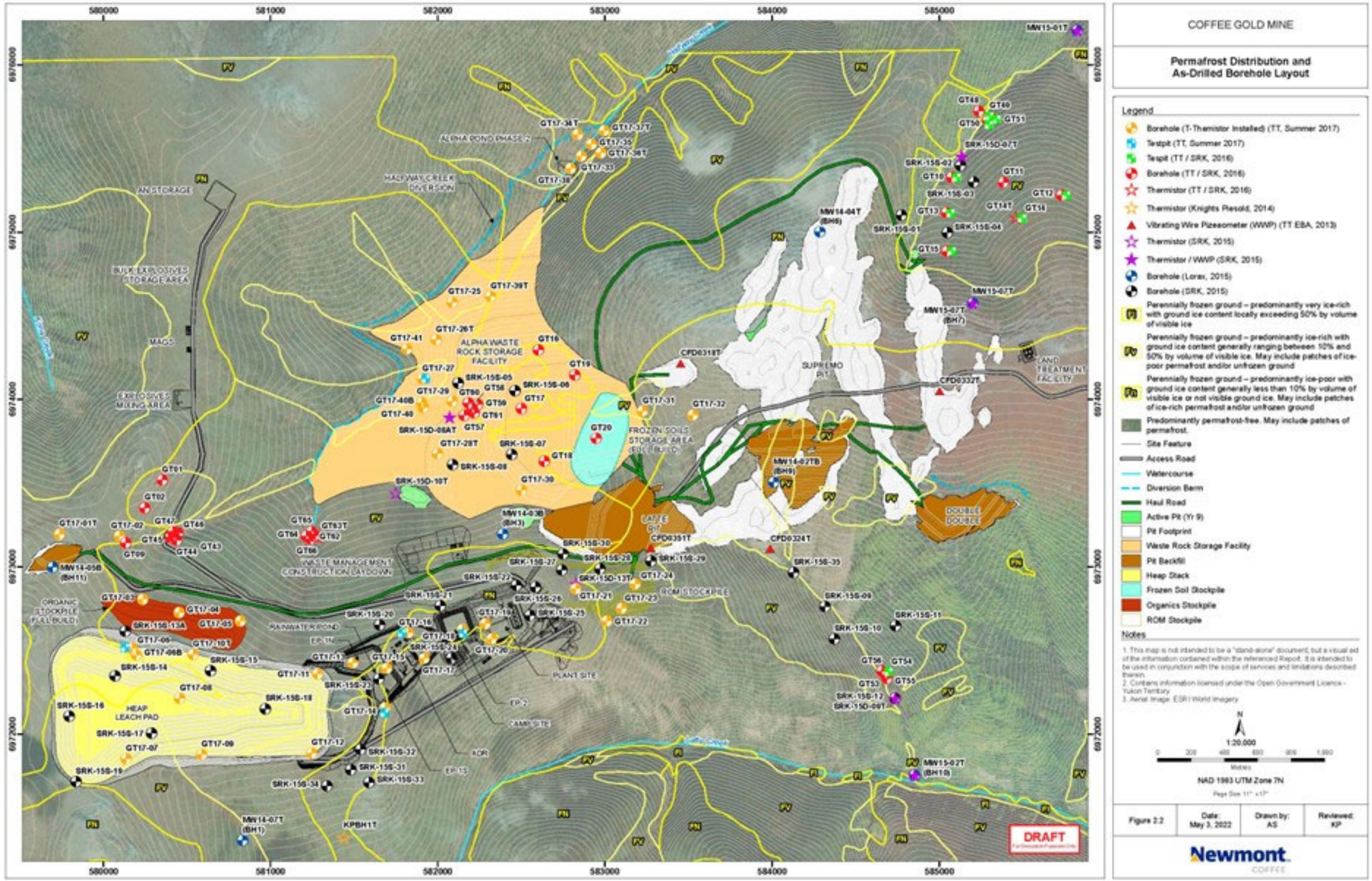
The Temporary Organics Stockpile has been designed with a footprint of 16.3 ha and a maximum capacity of 2.1 Mm^3. The stockpile has a maximum height of approximately 60 m with side slopes at approximately 2H:1V. Angle of repose for the organic materials is expected to be significantly lower than the waste rock because of their finer grain size. Minimal shaping or dozing is expected to achieve the 2H:1V design slope angle. The current estimated total amount of organics to be stripped from the site is approximately 1.5 Mm^3, assuming a 15% bulking factor.

1.4 In-pit Backfill

Approximately 50 Mt of waste rock will be backfilled into mined out pits at Latte (13 Mt), Supremo (27 Mt) and Double Double (10 Mt) in order to create causeways and facilitate ore haulage routes to the crusher (Figure 1-1).

In-pit backfilling will occur in the eastern portion of the Latte Pit to construct a causeway during Years 3 and 4. The southern portion of the Supremo Pit will also be backfilled to construct a causeway during Year 6 through Year 10 of the Project. The Double Double Pit will be backfilled completely during Years 10 and 11.

Figure 1-1: Site Layout



Source: Newmont (2023)

2 FOUNDATION CONDITIONS

2.1 Alpha WRSF

The west-facing slope (east side of Alpha WRSF) and portions of the southeast-facing slopes (northwest side Alpha WRSF) are interpreted to be mostly ice-poor or unfrozen. The area ranges from permafrost-free terrain on predominantly south-facing slopes to perennially frozen ground on slopes with less southern exposure, but also typically ice-poor.

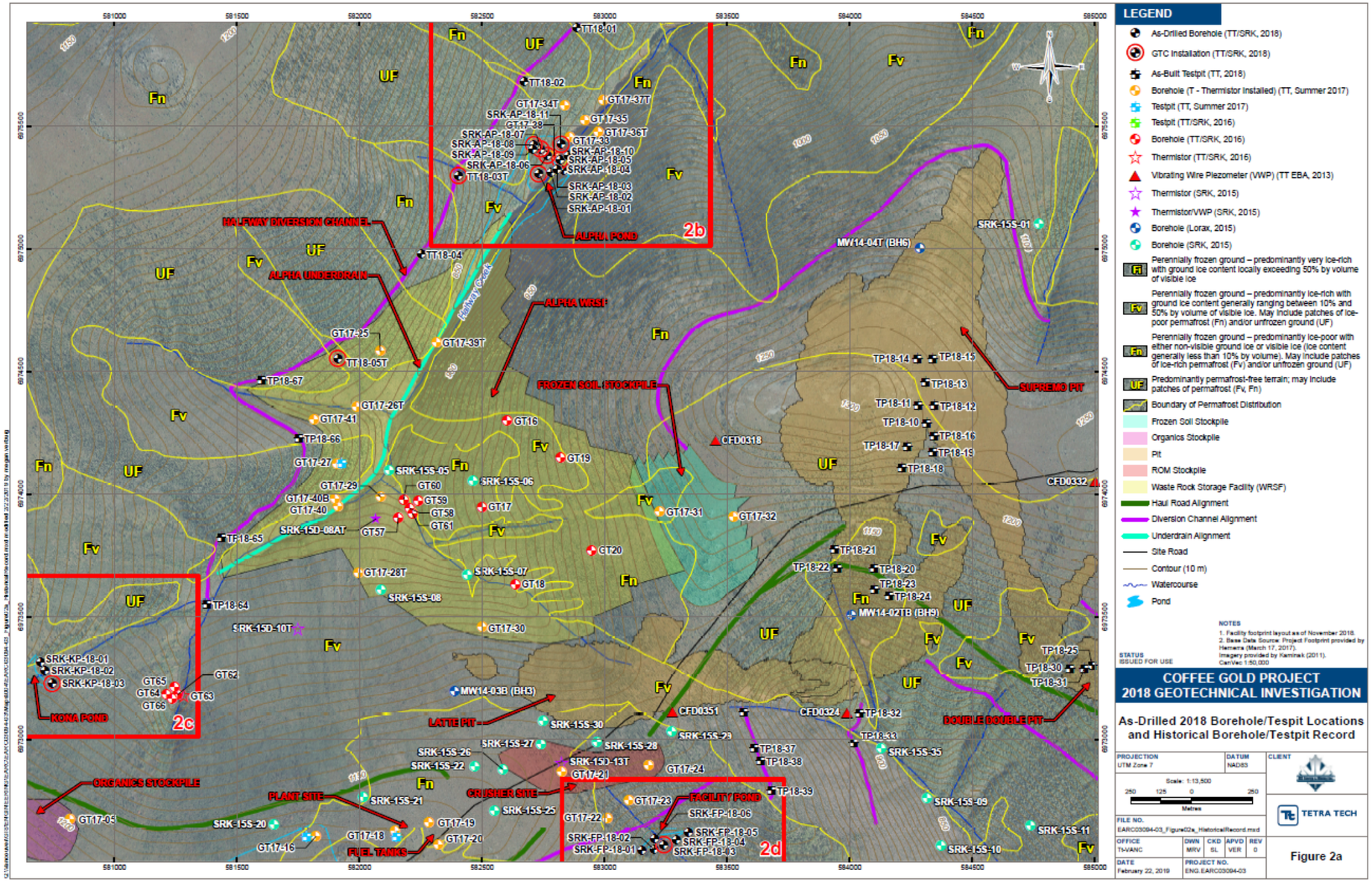
Drillholes GT-16 through GT-20 were drilled during the 2016 Tetra Tech drilling program and targeted the east side of the facility (Figure 2-1). A thin, dark brown fibrous moss organic layer was encountered at the surface of all the boreholes. The thin organic veneer in this area is underlain by relatively thin layers of perennially frozen sandy and gravelly colluvium with depths of up to 3.7 m. Bedrock gneiss was encountered at all the boreholes in this area except near the western terminus of the slope, where bedrock is composed of granite instead.

Drillholes GT17-25, GT17-26T and GT17-27 were drilled during the 2017 Tetra Tech drilling program and targeted the northwest side of the facility, across Halfway Creek. Light brown to green, coarse fibrous moss up to 200 mm thick was encountered at the surface. Dark brown to reddish brown fibrous peat up to 300 mm thick was found beneath the moss or at the surface in some areas. Poorly to well graded, grey to dark brown silt, sand, gravel, and cobble mixtures make up the remainder of the overburden. These drillholes encountered granite or gneiss bedrock at depths of between 1.0 to 3.4 m.

Drillhole TT18-05T was drilled during the Tetra Tech 2018 program to confirm the presence of ice-rich materials in a small drainage valley feeding into Halfway Creek. The hole indicated a similar organic cover and overburden soil materials as GT17-25, GT17-26T and GT17-27 but also encountered ice rich materials to a depth of 4 m below ground surface.

Drilling and test results indicate the north facing slope (beneath the south side of Alpha WRSF) has significantly deeper colluvium and ice-rich materials. Overburden soils from 7 m up to 32.6 m deep were encountered in drillholes GT17-29 and GT17-28T (Figure 2-1), respectively, in this area during the Tetra Tech (2017) drilling program. Although generally coarse grained, the soils are ice-rich within the upper approximately 2.5 m and were noted to contain ice down to bedrock. Ground temperatures of approximately -2° C were measured in a thermistor string installed in drillhole GT17-28T which is among the coldest ground temperatures recorded at the site. The deep soils, high ice content and cold ground temperatures are believed to be a result of the slope facing directly north.

Figure 2-1: Location of Geotechnical Drillholes and Permafrost Mapping



Source: Tetra Tech (2018)

2.2 Run of Mine Stockpile

The ROM Stockpile foundation is expected to be mostly permafrost-free on south facing slopes near the ridgetop. Slopes are southeast- to east-facing and dip 12° to 19° towards Coffee Creek. The area is vegetated in spruce with moss/shrubs-covered forest floor. One drillhole (GT17-24) and two test pits (TP17-25 and TP17-26) were completed within the facility footprint during the 2017 field investigation (Tetra Tech, 2017). The drillhole and test pits indicated permafrost-free conditions, which was also confirmed by a single bead thermistor installed by Tetra Tech in 2017 at nearby drillhole GT17-22.

Bedrock is very shallow beneath the proposed ROM Stockpile. The area typically has a thin veneer of organics over approximately 0.5 m of gravelly colluvium. Bedrock is heavily weathered down to a depth of approximately 1.2 m.

2.3 Temporary Organics Stockpile

Natural slope angles beneath the proposed Temporary Organics Stockpile are approximately 10° to 12°. Three drillholes (GT17-03, GT17-04 and GT17-05) and two test pits (TP17-01 and TP17-02) were completed within the footprint during the 2017 field investigations (Tetra Tech, 2017). Permafrost conditions were encountered in all three drillholes and both test pits. Warm (-0.4°C measured on October 4, 2017) permafrost was confirmed by single-bead thermistor installed at a depth of 7.1 m in GT17-03.

A thin (up to 200 mm thick), brown to reddish brown, fine to coarse fibrous moss layer was encountered at the surface. These thin organic mineral soils are underlain by brown to olive grey sand, silt, cobbles, and rubble up to 2.6 m thick, as found in GT17-25. Trace organics found within the silt and sand layer, at 1.3 m depth in GT17-05, suggest that this site is colluvial.

Granite bedrock was encountered in all three drillholes. Bedrock recovered from the drillholes was completely to moderately weathered and medium to coarse grained. Rust colored staining is apparent throughout the granite. Excess ice (Vx 2%) in frozen soil material infilling bedrock fractures was observed in GT17-04.

3 GEOTECHNICAL MATERIAL PROPERTIES

Based on the results of the various site geotechnical field and laboratory investigations (SRK 2016a, Tetra Tech 2016, 2017 and 2018) the foundation materials were divided into five different material types:

- Waste rock;
- Ice-poor colluvium;
- Ice-rich colluvium;
- Weathered bedrock; and
- Fresh bedrock.

3.1 Waste Rock

The waste rock material that will be stored in the Alpha WRSF is anticipated to consist mostly of competent gneiss and schist. A portion of the schist bedrock has potential to be anisotropic with the foliation forming a plane of weakness in some cases. The gneiss generally does not break preferentially on the foliation planes. UCS testing carried out as part of the SRK (2016b) pit slope evaluation indicated average UCS values of 90 and 94 MPa for the gneiss and schist, respectively.

Due to the large particle size of typical waste rock materials, laboratory testing is very rarely able to be carried out at the actual particle size as the overall test sample size required would greatly exceed the size and loading capacities of conventional testing equipment. Research investigations conducted by Linero and Palma (2007), Marsal and Resendiz (1975), Leps (1970) and others have carried out large-scale testing of dumped rock fill samples and demonstrated that, for high rock fill dumps such as the Alpha WRSF, the shear strength envelope is non-linear, being more frictional at lower confinement stresses (or depths) and more cohesive at higher confinement. This non-linear shear strength relationship is commonly represented using the two-component power law:

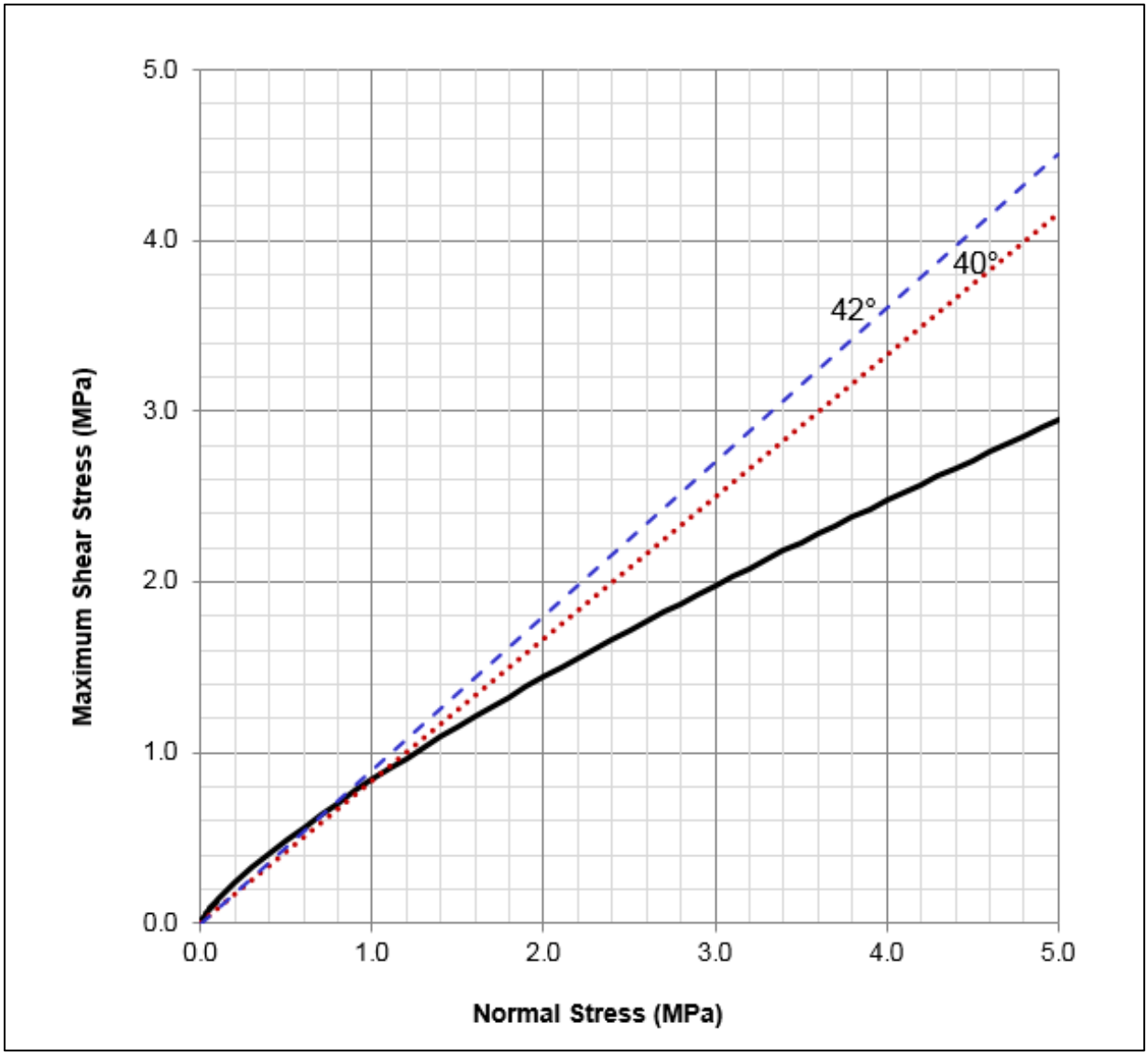
$$\tau = A\,\sigma_n{}^{b}$$

where τ is the shear strength (MPa), σ_n is the normal stress (MPa) and A and b are material constants which are estimated based on triaxial or direct shear test results.

Two small-scale triaxial shear strength tests (consolidated undrained) were completed on crushed waste rock samples by Knight Piésold and Co. (KP) (2015). The tests resulted in effective stress friction angles of 40° and 42°, for the granite and gneiss waste rock, respectively. The results are linear and likely representative of the shear strength at low confinement but may overestimate shear strengths at higher confinement levels where fracturing or shearing of waste rock particles may occur. As such, a non-linear shear strength curve was developed based on

the Linero and Palma (2007) research and the KP triaxial test data with an A value of 0.84 and b value of 0.78. The non-linear shear strength envelope developed is shown graphically on Figure 3-1 along with the two KP triaxial test results.

Figure 3-1: Plot of Waste Rock Material Strengths



Source: JDS (2018)

3.2 Ice-poor Colluvium

Most of the Coffee site is covered by approximately 0.5 to 3 m of colluvium soils with soil depths of up to approximately 8 m measured in drainage bottoms and valley inverts. The colluvium is typically coarse grained and consists of poorly to well-graded, grey to dark brown silt, sand, gravel. Cobble mixtures make up the remainder of the overburden. Any of these may be the dominant material. Subangular to angular granite and schist gravel and cobbles make up the coarse component. The upper approximately 20 to 30 cm typically contains organic materials.

For the JDS stability analysis, the colluvium layer was conservatively modeled as a 10 m thick layer, parallel to the native (pre-mine) ground surface for the Alpha WRSF. Similarly, a layer 2 to 3 m thick was used for the Stockpiles, based on specific drillhole and test pit information at the respective facilities.

Friction angles for the colluvium are based on five direct shear strength tests reported in SRK (2016a) and Tetra Tech (2016 and 2017). The tests were completed on relatively undisturbed silt colluvium samples with resulting friction angles ranging between 29° and 42° with 0.5 to 77 kPa cohesion, respectively. These tests are considered to be representative of ice-poor, thaw stable colluvium materials.

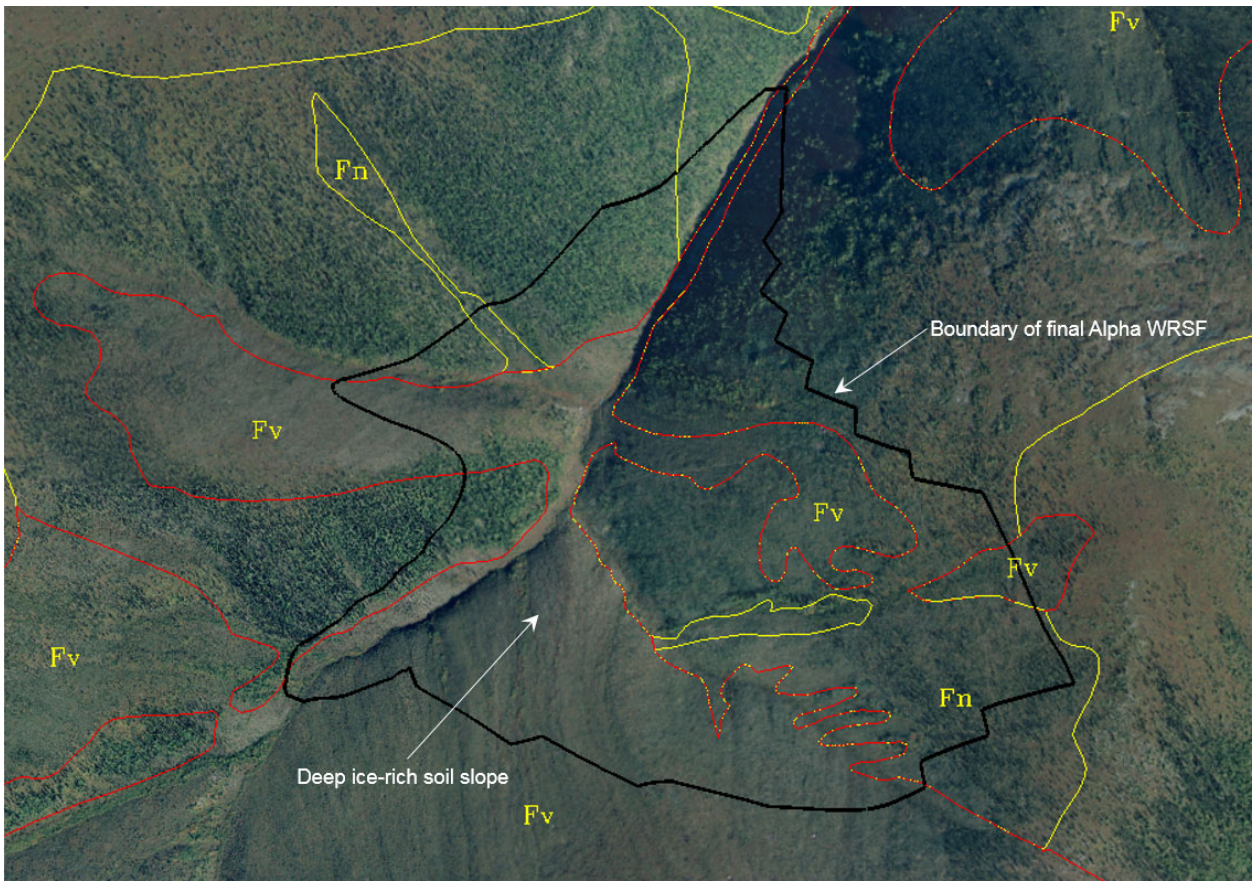
A conservative friction angle of 34° with zero cohesion was selected to represent the ice-poor colluvium material using a linear, Mohr-Coulomb shear strength criteria. This value is considered to be conservative because the initial 3 to 5 m of waste rock will be placed during the winter months when freezing of the waste rock is expected to occur, preserving the frozen foundation materials beneath. Frozen materials are expected to have considerably higher shear strength than a thawed material of the same composition.

3.3 Ice-rich Colluvium

Ice-rich soils at the Coffee site commonly occur in localized areas within drainage or valley bottoms and are relatively shallow. It is anticipated that most of the ice-rich materials in the foundation area will remain frozen, provided the foundation is covered with waste rock during the winter months as is currently planned. Anticipated long-term climate warming may thaw the ice-rich materials. However, long-term thawing is expected to occur at a sufficiently slow rate that pore water pressures created by thawing of the ice will be able to dissipate adequately and not lead to instabilities.

Unlike other areas across the Coffee site, the north facing slope located beneath the south side of the ultimate Alpha WRSF footprint (Figure 3-2) has significantly deeper colluvium and ice. Overburden soils from 7 m up to 32.6 m deep were encountered in drillholes GT17-29 and GT17-28T, respectively, in this area during the Tetra Tech (2017) drilling program. Although generally coarse grained, the soils are ice-rich within the upper approximately 2.5 m and were noted to contain ice down to bedrock. Ground temperatures of approximately -2° C were measured in a thermistor string installed in drillhole GT17-28Twhich is among the coldest ground temperatures recorded at the site. The deep soils, high ice content and cold ground temperatures are believed to be a result of the slope facing directly north.

Figure 3-2: Location of Ice-rich Soil Slope



Source: JDS (2018)

The materials in this slope were conservatively modeled using a zero friction, undrained shear strength of 80 kPa. This value is based on published shear strength test results for clayey silts and silty clays with high or medium ice content at a temperature of approximately -2° C (Johnson, 1981).

The design inter-bench slope angles are reduced from 35° to 24° for portions of the WRSF founded on this material. Angle of repose for the organic materials is expected to be significantly lower than the waste rock because of their finer grain size. Minimal shaping or dozing is expected to achieve the 2H:1V design slope angle. The Alpha WRSF is the only one of the facilities analyzed herein that is believed to potentially be impacted by ice-rich materials.

3.4 Organic Soils

The materials in the Temporary Organics Stockpile were modeled assuming a linear, Mohr-Coulomb shear strength envelop with 32° friction and 5 kPa cohesion.

3.5 Weathered Bedrock

Bedrock beneath the colluvium is typically heavily weathered for a depth of approximately 2 to 4 m and up to 13 m in Halfway Creek. This zone was assumed to consist of broken bedrock that is highly friable and readily breaks down to sand and gravel. The weathered bedrock zone can be variable in its thickness and geotechnical characteristics. The weathered bedrock zone was conservatively assumed to be a 20 m thick layer, beneath the colluvial soils for the Alpha WRSF analyses. A layer 3 to 4 m thick was used for the Stockpiles, based on specific drillhole and test pit information at the respective facilities.

Weathered bedrock shear strength was modeled using a linear, Mohr-Coulomb envelop with a friction angle of 45° and 20 kPa cohesion. This strength was developed using the Generalized Hoek-Brown criterion (Hoek, et al, 2002).

3.6 Fresh Bedrock

A fresh bedrock strength was used in the models of 46° and 1,300 kPa cohesion based on the available rock mass characteristics summarized in the SRK (2016b) pit slope geotechnical report. Significantly less emphasis was placed on determining a fresh bedrock strength than the overburden soils because, given the dramatic differences in strength between the in-situ fresh bedrock and the overburden soils/waste rock above, critical slip surfaces generated by the model will be through the overburden soils and possibly weathered bedrock. This was confirmed in the modeling results.

3.7 Pore Water Pressures

The near surface colluvial soils are commonly saturated during the late spring and summer months due to shallow seasonal thawing and the presence of underlying permafrost that hinders drainage. The piezometric surface was assumed to be coincident with the native (pre-mine) ground surface. The piezometric surface was used in the model to calculate hydrostatic pore water pressures within all foundation materials. It has been assumed for the analyses that the waste rock is sufficiently coarse to drain freely without the building of pore water pressures. However, a static water level approximately 10 m above the Halfway Creek invert was conservatively assumed for the Alpha WRSF Section A model. The use of an elevated water level in this area of the of the model is intended to simulate a reasonably high potential increase in pore water pressures, if the rock drain does not convey water as rapidly as anticipated from its design.

JDS notes that the reported piezometric levels represent an artificial and isolated occurrence which is relevant to the stability evaluation; however, this local water table does not represent the regional groundwater table.

4 SLOPE STABILITY ANALYSIS

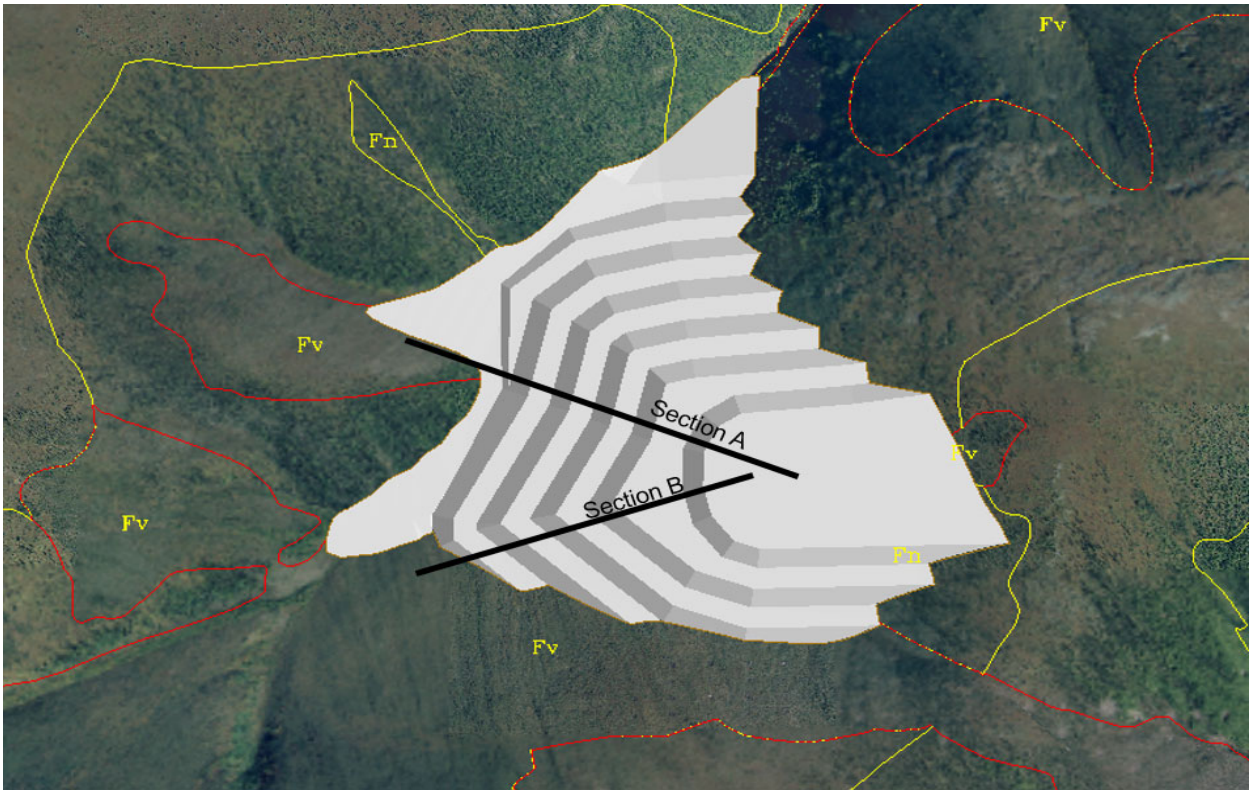
4.1 Model Methodology

Based on the anticipated foundation materials, the proposed interim and ultimate WRSFs and stockpile design configurations, critical cross-sections were selected for stability analyses. Two sections were developed and analyzed for the Alpha WRSF and one each for the Temporary Organics Stockpile and the ROM Stockpile. The cross-section locations were selected to represent idealized worst-case geometries and foundation conditions for the interim and final designs.

Figure 4-1 shows the location of the two slope stability section traces for the Alpha WRSF while Figure 4-2 and Source: JDS (2018)

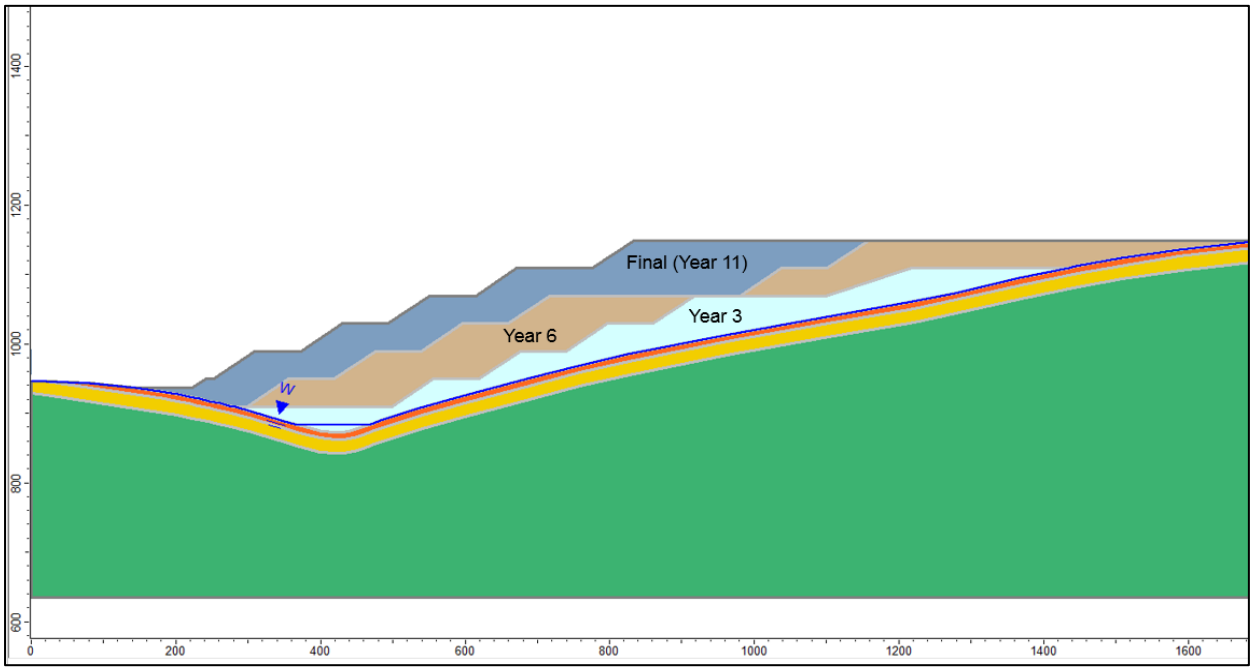
Figure 4-3 show the geometry of cross sections A and B, respectively. The traces of the slope stability cross sections for the ROM Stockpile and Temporary Organics Stockpile are shown on Figure 4-4 and Figure 4-5, respectively. The location of the Supremo in-pit backfill critical section is shown on Figure 4-6.

Figure 4-1: Alpha WRSF Critical Slope Stability Sections



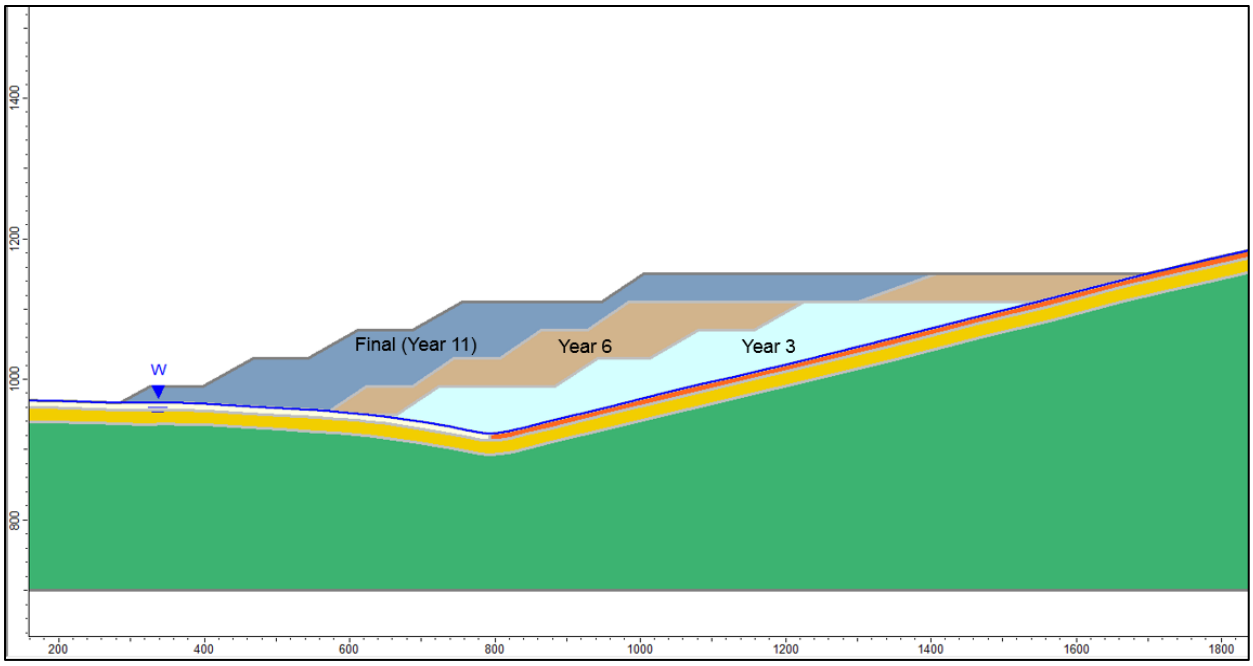
Source: JDS (2018)

Figure 4-2: Geometry of Alpha WRSF: Cross-Section A



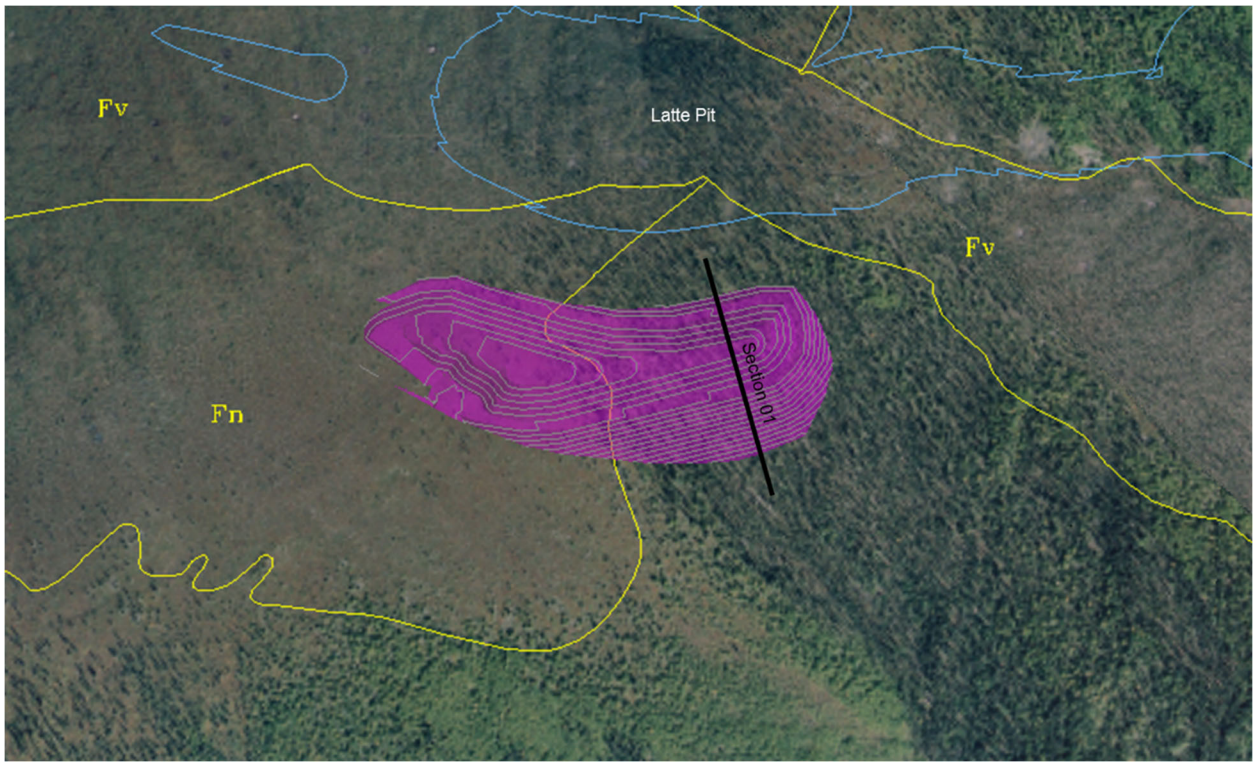
Source: JDS (2018)

Figure 4-3: Geometry of Alpha WRSF: Cross-Section B



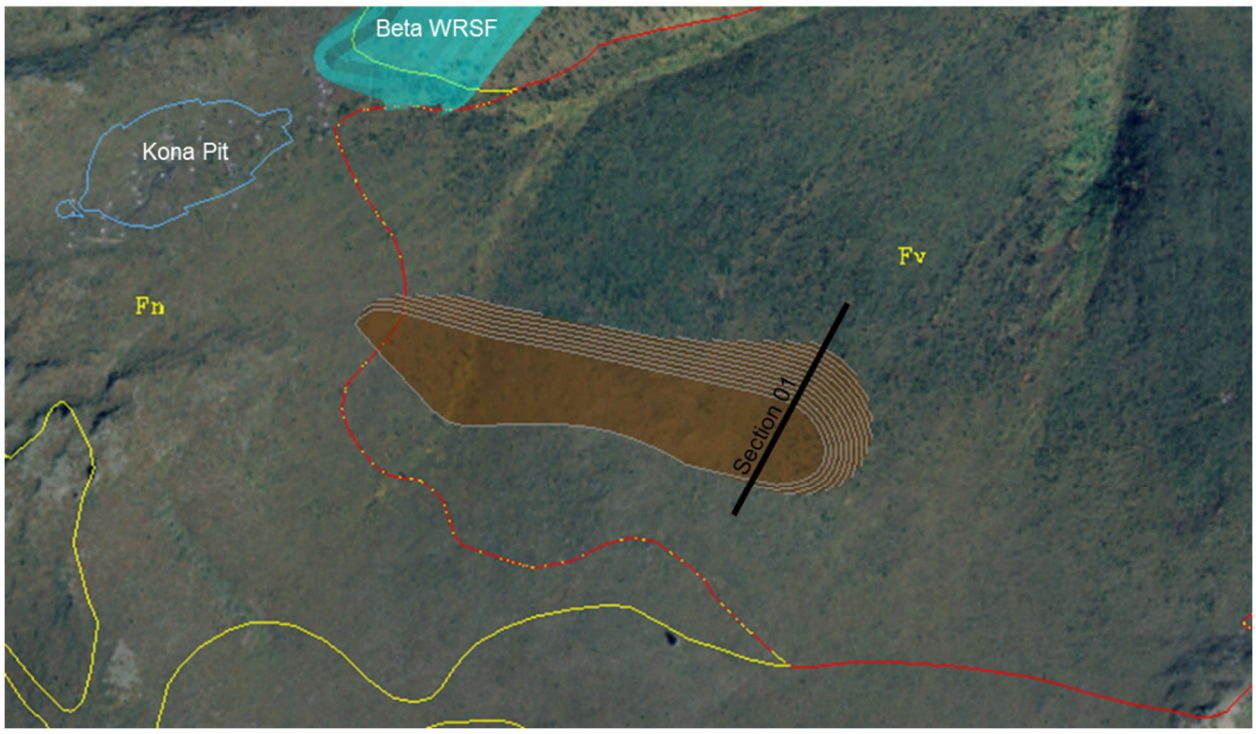
Source: JDS (2018)

Figure 4-4: ROM Stockpile Critical Slope Stability Section



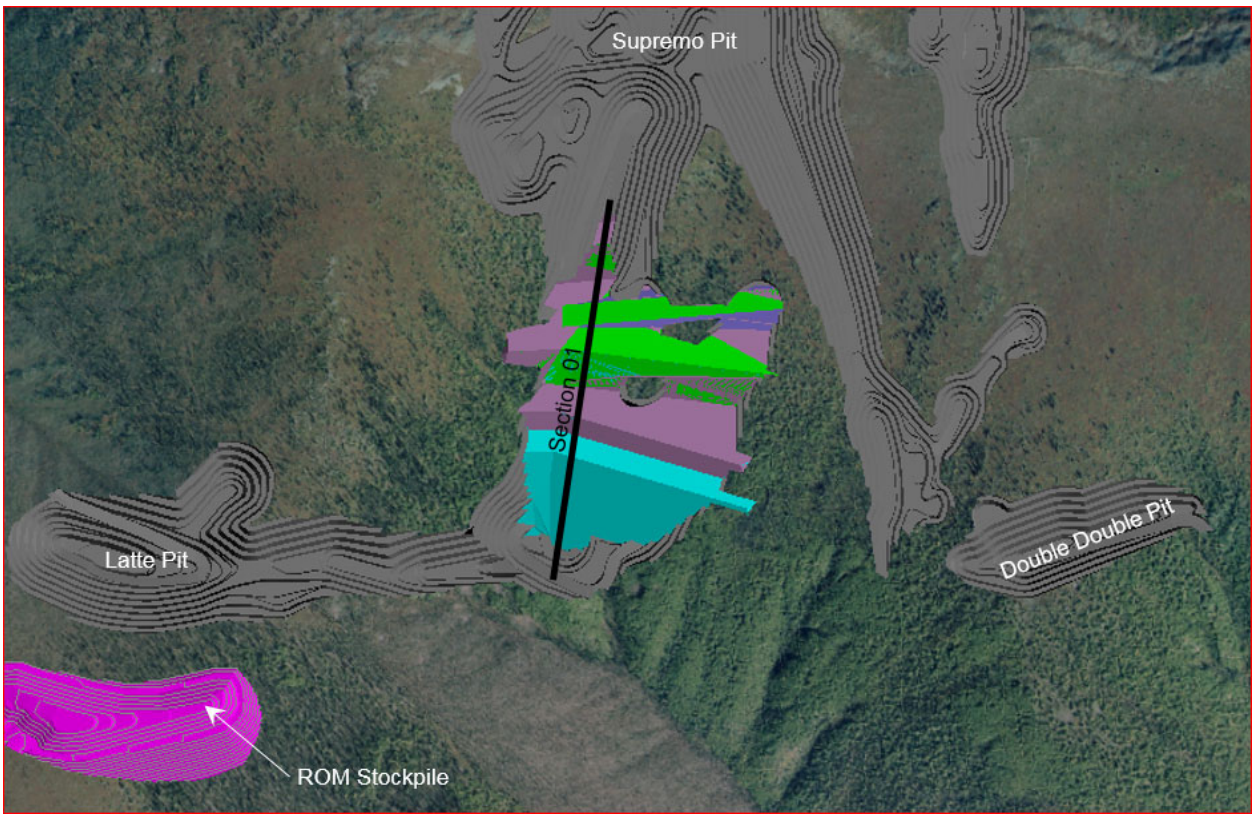
Source: JDS (2018)

Figure 4-5: Temporary Organics Stockpile Critical Slope Stability Section



Source: JDS (2018)

Figure 4-6: Location of Supremo In-pit Backfill Critical Slope Stability Section



Source: JDS (2018)

The cross-section geometries were loaded into the software program Slide 7.031 (Rocscience, 2018). Slide is a two-dimensional, limit equilibrium slope stability analysis program that analyzes slope stability by various methods of slices in terms of safety factors. The analysis results are reported for Spencer's method of slices because it satisfies both force and moment equilibrium, leading to more realistic safety factor calculations.

Each section was analyzed with both static and pseudostatic loading conditions. Pseudostatic analyses simulate seismic forces in terms of a horizontal acceleration expressed as a coefficient (or percent) of gravity (g). As recommended by the B.C. Mine Waste Rock Pile Research Committee (1991), the peak ground acceleration (PGA) corresponding to a 1:475 year event (or 10% probability of exceedance in 50 years) was used for the pseudostatic stability analyses. Based on the Natural Resources Canada, 2015 National Building Code Seismic Hazard Calculation, a PGA of 0.062 g is interpolated for the Coffee site. This value is also consistent with the MINES Group (2015) Seismic Design Report for the project which reports a PGA of 0.067 g for a 475 year return period.

When incorporating PGA in a slope stability model, it is common practice to reduce the PGA by a factor of 0.5 based on the research conducted by the U.S. Army Corps of Engineers (Hynes-

Griffen and Franklin, 1984). In summary, this reduction in acceleration is justified for earth and rock structures for the following reasons:

- Realization that sustained ground acceleration is typically less than half of the PGA, which is an instantaneous acceleration;
- Consideration that earth and rock structures effectively attenuate earthquake-induced accelerations; and
- Determination that deformations of less than one meter would result with this criterion.

As described in the MINES Group (2015) report and Read & Stacey (2009), Pyke (1997 & 1999) conducted subsequent analyses demonstrating that the seismic coefficient for pseudostatic analysis is less than or equal to half of the PGA, in almost all cases. Based on these guidelines, a pseudostatic seismic coefficient of 0.03 was selected for the analyses.

4.2 Design Acceptability Criteria

Design acceptability criteria for the analyses are based on the "Guidelines for Mine Waste Dump and Stockpile Design" (Hawley & Cunning, 2017). The suggested minimum Factor of Safety (FoS) presented in the guidelines are re-produced in Table 4-1, with each minimum FoS reflecting different levels of confidence in the understanding of site conditions, material parameters, and consequences of instability.

JDS considers the WRSFs and Stockpiles as currently designed to fall within the Moderate Consequence and High Confidence categories. Corresponding minimum recommended factors of safety are 1.2 to 1.3 for static and 1.0 to 1.05 for pseudostatic loading conditions according to the guidelines.

Table 4-1: Suggested WRSF Stability Acceptance Criteria

Consequence[1,3]	Confidence[2,3]	Static analysis		Pseudostatic	Maximum Allowable Strain
		Minimum FoS	Maximum PoF	Minimum FoS	
Low	Low	1.3 - 1.4	10 - 15%	1.05 - 1.1	≤ 1%
	Medium	1.2 - 1.3	15 - 25%	1.0 - 1.05	≤ 1.5%
	High	1.1 - 1.2	25 - 40%	1.0	≤ 2%
Moderate	Low	1.4 - 1.5	2.5 - 5%	1.1 - 1.15	≤ 0.75%
	Medium	1.3 - 1.4	5 - 10%	1.05 - 1.1	≤ 1%
	High	1.2 - 1.3	10 - 15%	1.0 - 1.05	≤ 1.5%
High	Low	≥ 1.5	≤ 1%	1.15	≤ 0.5%
	Medium	1.4 - 1.5	1 - 2.5%	1.1 - 1.15	≤ 0.75%

Consequence[1,3]	Confidence[2,3]	Static analysis		Pseudostatic	Maximum Allowable Strain
		Minimum FoS	Maximum PoF	Minimum FoS	
	High	1.3 - 1.4	2.5 - 5%	1.05 - 1.1	≤ 1%

Source: Hawley & Cunning (2017)

Notes:

1. Consequence

   Low Consequence: waste dumps and stockpiles with overall fill slopes less than 25° and less than 100 m high and repose angle slopes less than 50 m high. No critical infrastructure or unrestricted access within potential runout shadow. Limited potential for environmental impact. Long-term (> 5 years) exposure for sites subject to very low to low (< 350 mm) annual precipitation; medium-term (1-5 years) exposure for sites subject to moderate (350-1000 mm) annual precipitation; short-term (< 1 year) exposure for sites subject to high (1000-2000 mm) annual precipitation; dry season construction/operation only for sites subject to very high (> 2000 mm) annual precipitation or intensive rainy season(s).

   Moderate Consequence: waste dumps with overall fill slopes less than 30° and less than 250 m high, or with repose angle slopes less than 100 m high. No critical infrastructure or unrestricted access, or robust containment/mitigative measures to protect critical infrastructure and access within potential runout shadow. Potential for moderate environmental impact, but manageable. Long-term (> 5 years) exposure for sites subject to moderate (350-1000 mm) annual precipitation; medium-term (1-5 years) exposure for sites subject to high (1000-2000 mm) annual precipitation; short-term (< 1 year) exposure for sites subject to very high (> 2000 mm) annual precipitation or intensive rainy season(s).

   High Consequence: waste dumps with overall fill slopes more than 30° and more than 250 m high, or with repose angle slopes more than 200 m high. Critical infrastructure or unrestricted access within potential runout shadow with limited runout mitigation/containment measures. Potential for high environmental impact that would be difficult to manage. Long-term exposure (> 5 years) for sites subject to high (1000 – 2000 mm) annual precipitation; medium (1-5 years) exposure for sites subject to very high (> 2000 m) annual precipitation or intensive rainy season(s).

2. Confidence

   Low Confidence: limited confidence in foundation conditions, waste material properties, piezometric pressures, analysis technique or potential instability mechanism(s). Poorly defined or optimistic input parameters; high data variability. For proposed structures, investigations at the conceptual level with limited supporting data. For existing structures, poorly documented or unknown construction and operational history; lack of monitoring records; unknown or poor historical performance.

   Moderate Confidence: – moderate confidence in foundation conditions, waste material properties, piezometric pressures, analysis technique or potential instability mechanism(s). Input parameters adequately defined; moderate data variability. For proposed structures, investigations at the pre-feasibility level with adequate supporting data. For existing structures, reasonably complete construction documentation and monitoring records; fair historical performance.

   High Confidence: high confidence in foundation conditions, waste material properties, piezometric pressures, analysis technique or potential instability mechanism(s). Well-defined, conservative input parameters; low data variability. For proposed structures, investigations at the feasibility level with comprehensive supporting data. For existing structures, well documented construction and monitoring records and good historical performance.

3. In cases where the guidance for consequence or confidence conflicts or is unclear, selection of the appropriate level should be based on judgment, and the rational for the selection should be documented.

4.3 Slope Stability Modeling Results

Results of the stability analysis are summarized in Table 4-2. This tables outlines Factors of Safety for each section for static and pseudostatic loading conditions. Graphical outputs of each of the sections and cases are contained in Appendix A.

Table 4-2: Factors of Safety Results

Facility	Critical Section	Slope Analyzed [A]	Loading Conditions[B1]	Year 3	Year 6	Final Design
Alpha WRSF	Section A	Overall	Static	2.2	2.7	2.1
			Pseudostatic	2.0	2.4	2.4
	Section B	Overall	Static	1.3[C]	1.3[C]	1.3
			Pseudostatic	1.2 [C]	1.1 [C]	1.1
ROM Stockpile	Section 1	Toe	Static	-	-	1.2
			Pseudostatic	-	-	1.1
		Overall	Static	-	-	1.4
			Pseudostatic	-	-	1.3
Temporary Organics Stockpile	Section 1	Toe	Static	-	-	1.3
			Pseudostatic	-	-	1.2
		Overall	Static	-	-	1.3
			Pseudostatic	-	-	1.2
Supremo In-pit Backfill	Section 1	Overall	Static	-	-	1.6
			Pseudostatic	-	-	1.5

Source: JDS (2018)

Notes:

[A] Toe indicates critical slip surface was localized at the toe of the bottom lift. Overall slope indicates a critical slip surface at least 2 full benches in height.

[B] Pseudostatic analyses conducted with 0.03 g horizontal seismic coefficient.

[C] Critical failure surface through bottom lift only.

5 CONCLUSIONS

The results of the updated slope stability analyses of the Alpha WRSF indicate factors of safety that exceed the minimum acceptability criteria of 1.2 to 1.3 for static and 1.0 to 1.05 for pseudostatic loading conditions. With the exception of two cases, all of the other cases analyzed meet or exceed the upper bound ranges (1.3 for static and 1.1 for pseudostatic analyses) given by Hawley & Cunning (2017). The one exception is the static analysis of the toe of the ROM Stockpile, which yielded a safety factor of 1.2 but represents a small, localized instability at the toe only.

To achieve acceptable design criteria, the Alpha WRSF design inter-bench slope angles will be reduced from 35° to 24° for portions where the toe will be founded on the ice-rich materials (Figure 3-2). This localized area of the Alpha WRSF is the only portion of all of the facilities analyzed that is believed to have potential to be adversely impacted by the ice-rich materials.

The analyses presented herein represent the current mine facility designs and are based on the geotechnical information available at this time. As mine plans are finalized, the slope stability analyses will continue to be refined and updated with the new information.

6 CLOSURE

Analyses and recommendations presented herein are based on ultimate waste rock storage facility and stockpile designs as described in this report, and, as such, any significant changes to mine plans or design configurations should be reviewed by JDS to verify that recommendations will remain valid for the new plans.

JDS is pleased to have the opportunity to be of service to Newmont and trusts that we have addressed the pertinent issues related to the Coffee feasibility pit slope update at this time. Should you, however, have any queries or comments on our visit or on the contents of this report, please do not hesitate to contact us.

Signed on this 10th day of August 2023.

PROFESSIONAL ENGINEER
YUKON TERRITORY
MICHAEL E. LEVY
8/10/2023

Michael Levy, P.Eng.
Geotechnical Manager

7 REFERENCES

British Columbia Mine Waste Rock Pile Research Committee. 1991. *British Columbia Mined Rock and Overburden Piles Investigation and Design Manual, Interim Guidelines*. May. ISBN 0-7718-9118-0.

Hawley, M. and Cunning, J. (2017), *Guidelines for Mine Waste Dump and Stockpile Design*, CSIRO Publishing, Melbourne and CRC Press/Belkema, Rotterdam.

Hynes-Griffen, M.E. and Franklin, A.G., (1984). *Rationalizing the seismic coefficient method*. U.S. Army Corps of Engineers, Geotechnical Laboratory, Misc. Paper GL084-13.

Johnston, G.H., (1981) *Permafrost Engineering Design and Construction*, John Wiley & Sons and National Research Council of Canada.

Knight Piésold Consulting, (2015). *Coffee Gold Project, Report on Feasibility Study Level Geotechnical Investigations*. Prepared for Kaminak Gold Corporation. KP Project No. DV101-00562/03. March 12, 2015.

Leps, TM. (1970). *Review of shearing strength of rockfill*. Journal of the Soil Mechanics and Foundations Division, ASCE 96(4): pr. 1159-1170.

Linero, S., Palma, C., and Apablaza, R. (2007). *Geotechnical characterisation of waste material in very high dumps with large scale triaxial testing*. In Proceedings of the International Symposium on Rock Slope Stability in Open Pit Mining and Civil Engineering, Perth, Western Australia, 12–14 September 2007. Australian Centre for Geomechanics, Perth, Western Australia; the University of Western Australia, Perth, Western Australia. pp. 59–75.

Marshal, R.J. and Resendiz, D.R. (1975). *Presas de Tierra y Enrocamiento*. Mexico. Ed Limusa, pp. 237-239.

Read, J. and Stacey, P. (2009), *Guidelines for Open Pit Slope Design*, CSIRO Publishing, Melbourne and CRC Press/Belkema, Rotterdam.

Rocscience, Inc., Toronto, Ontario, 2018. Slide 7.031, *2-dimensional limit equilibrium slope stability analysis* software.

SRK Consulting (U.S.), Inc., (2016a*). 2015 Geotechnical Field Investigation Report, Coffee Gold Project*, Yukon Territory, Canada. Report prepared for Kaminak Gold Corporation dated January 4, 2016.

SRK Consulting (U.S.), Inc., (2016b). *Feasibility Pit Slope Stability Evaluation, Coffee Gold Project*, Yukon Territory, Canada. Report prepared for Kaminak Gold Corporation dated March 11, 2016.

Tetra Tech Canada Inc. (2016) *Fall 2016 Geotechnical Site Investigation Data Report, Coffee Mine Site, Coffee Gold Project*. Report prepared for Goldcorp Inc. dated March 20, 2017.

Tetra Tech Canada Inc. (2017) *Summer 2017 Geotechnical Investigation Data Report, Coffee Mine Site, Coffee Gold Project*. Report prepared for Goldcorp Inc. dated November 30, 2017.

The MINES Group Inc., (2015). *Coffee Gold Project Seismic Design Report*. Report prepared for Kaminak Gold Corporation dated August 10, 2015.

APPENDIX A

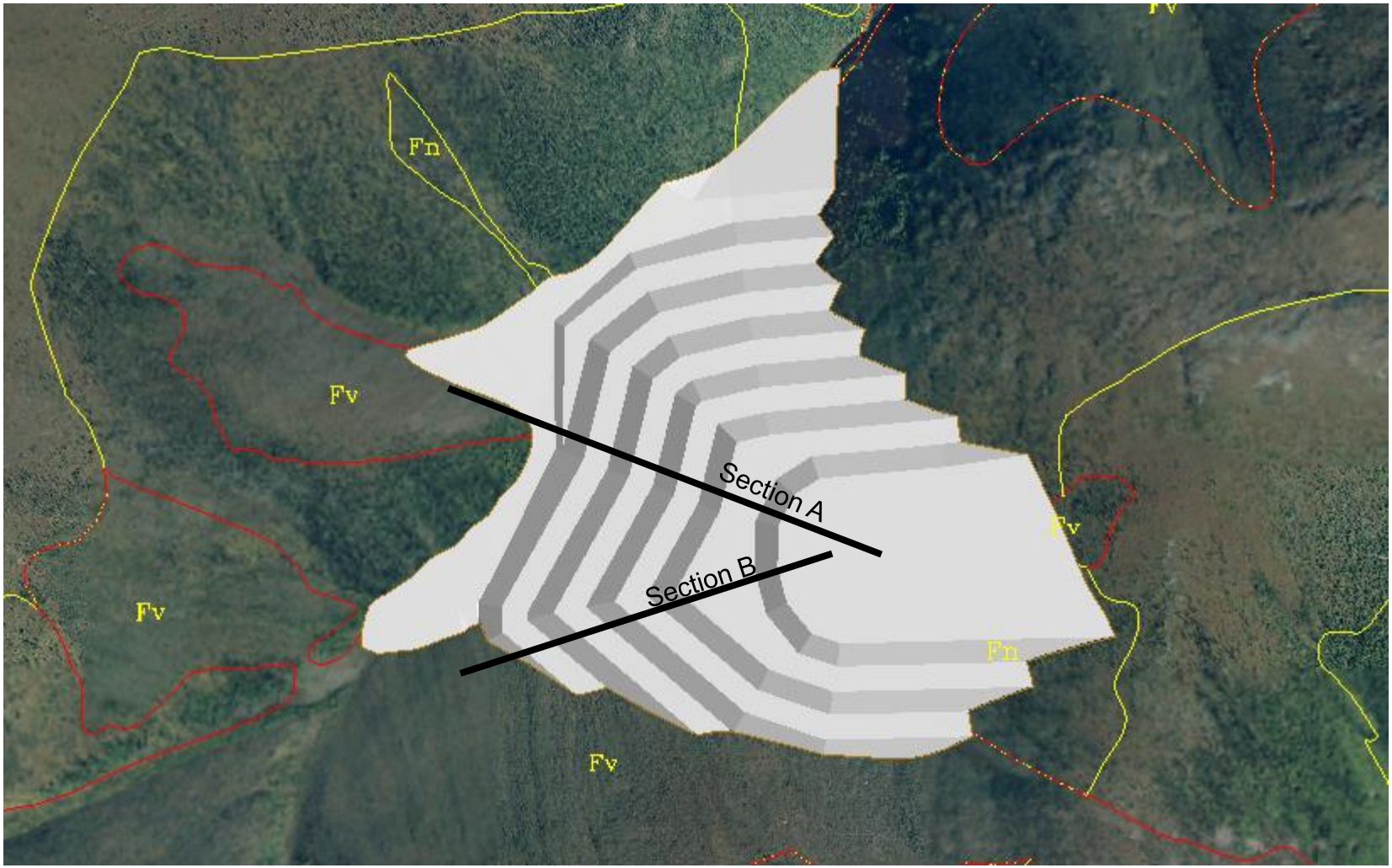
PRELIMINARY SLOPE STABILITY MODEL RESULTS



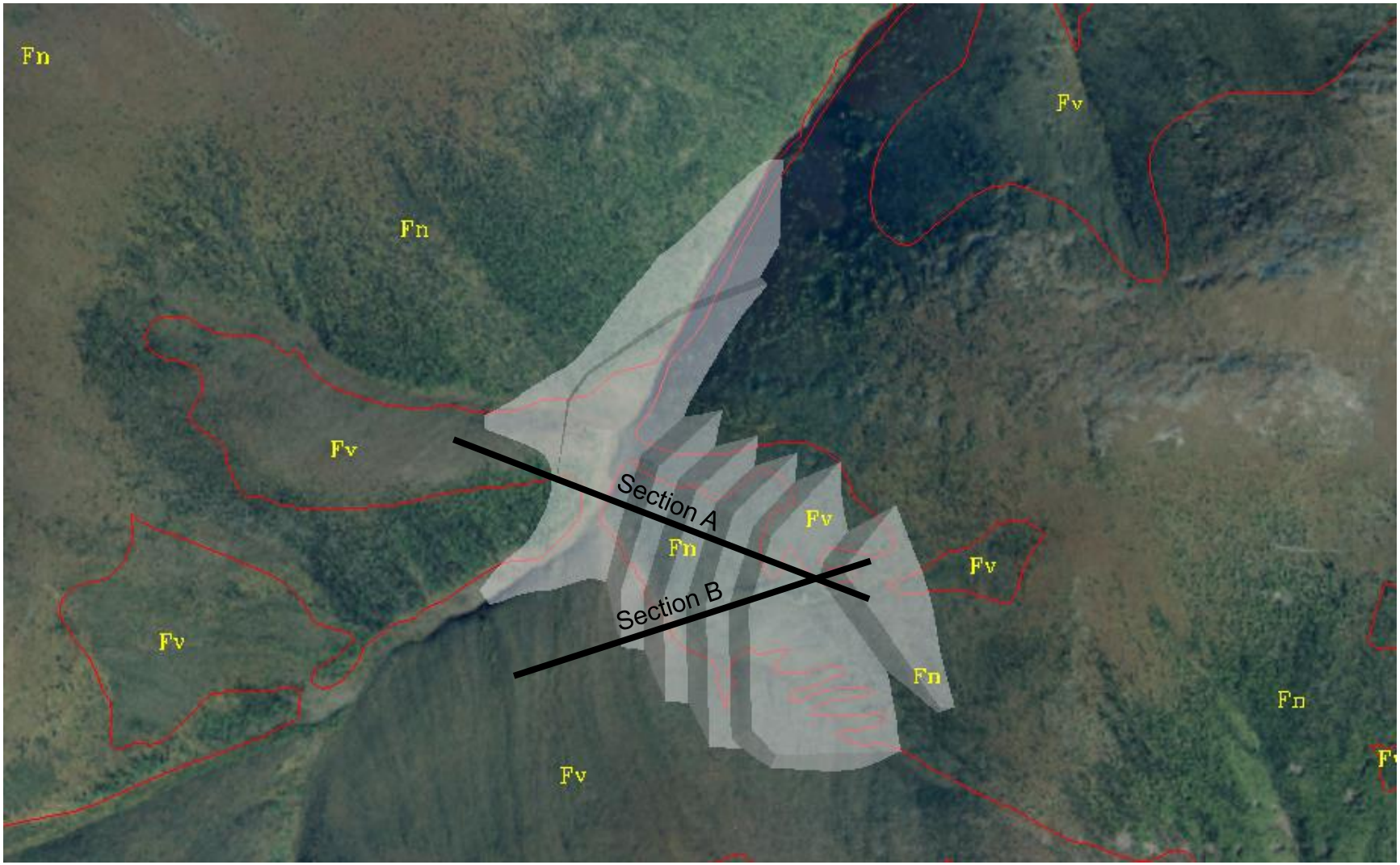
Coffee Gold Project

Appendix A: Preliminary Slope Stability Analysis Results for WRSF & Stockpile

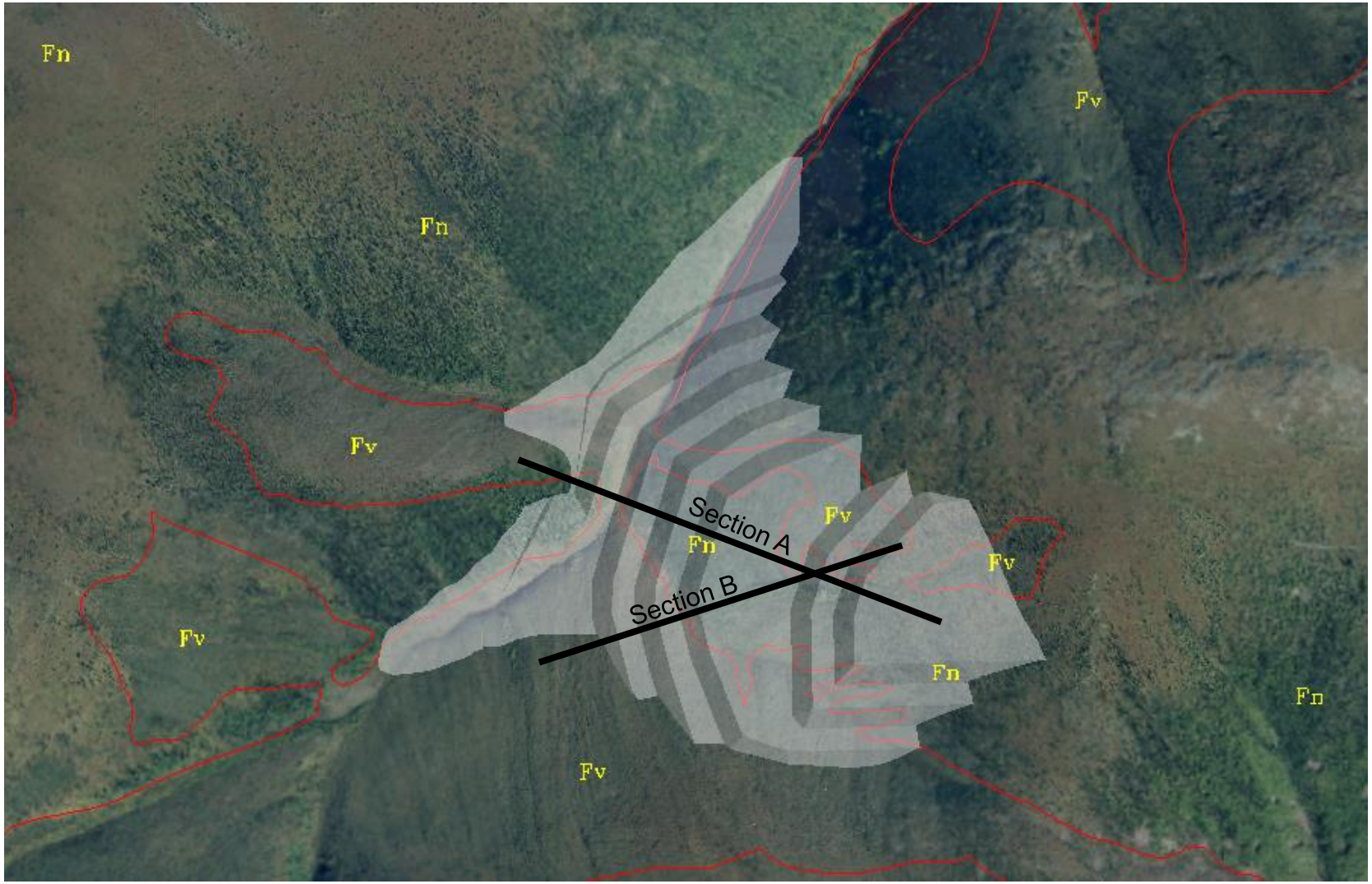
Location of slope stability cross-sections: Alpha



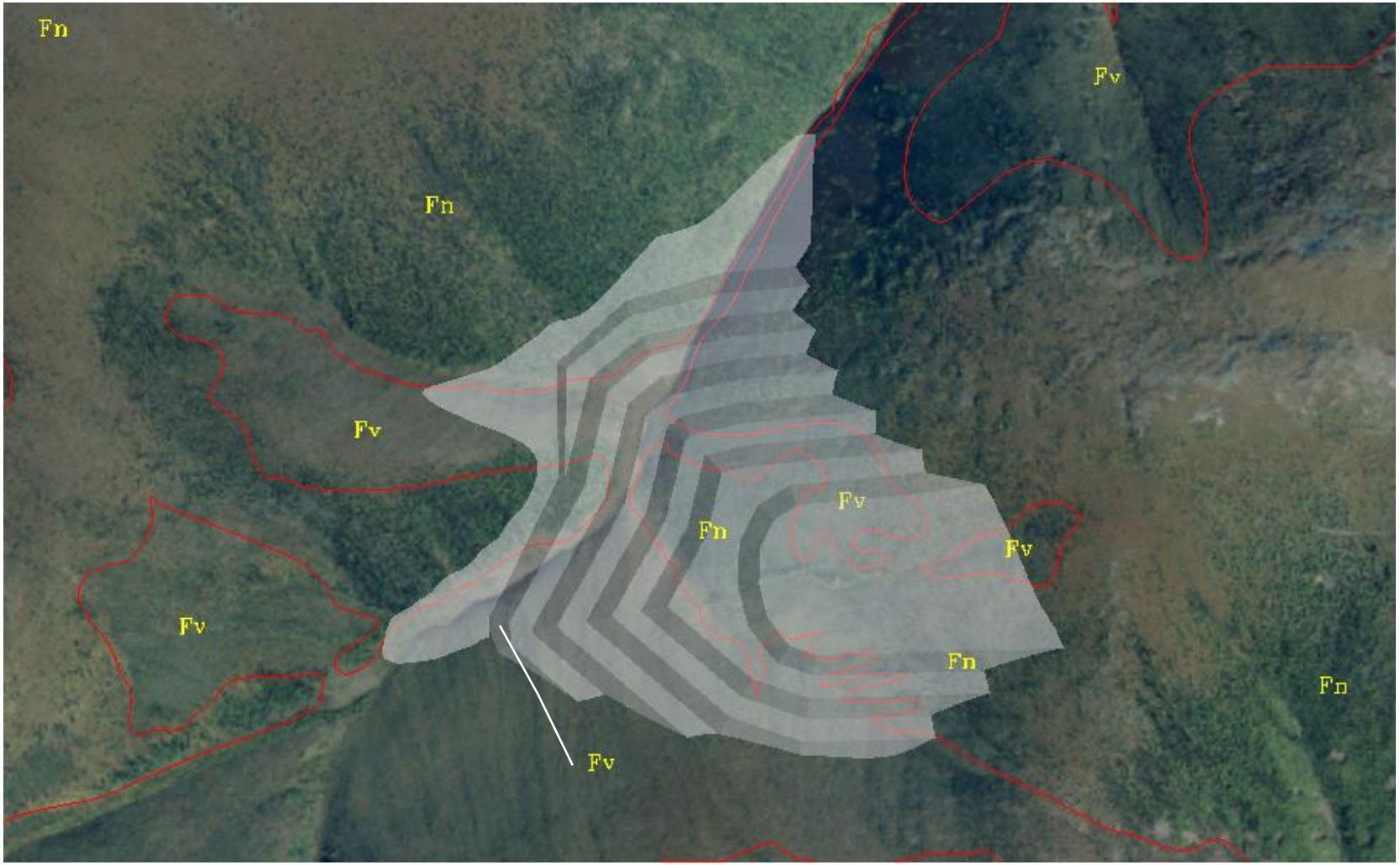
Year 3



Year 6

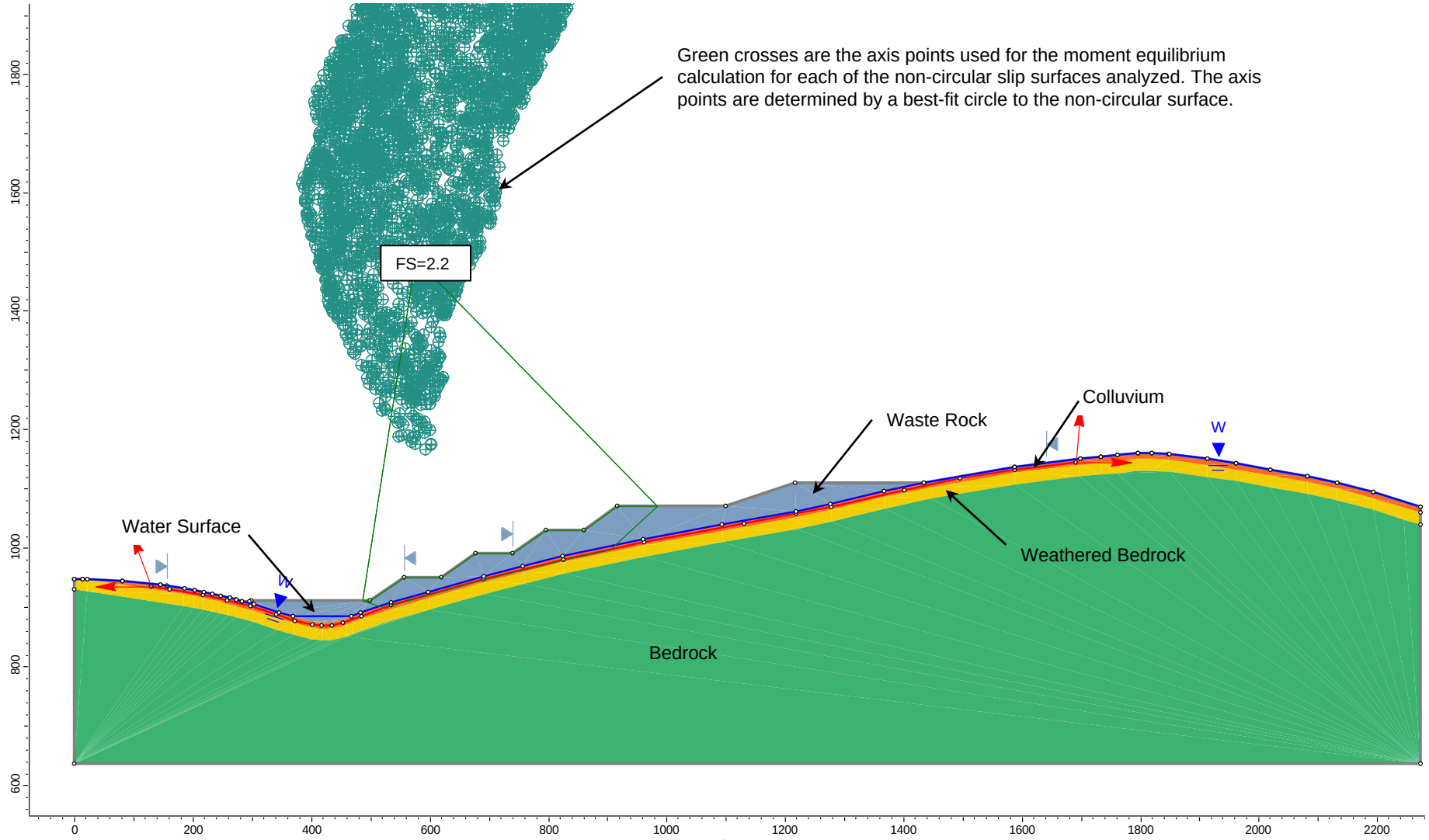


Year 11 (Final Design)

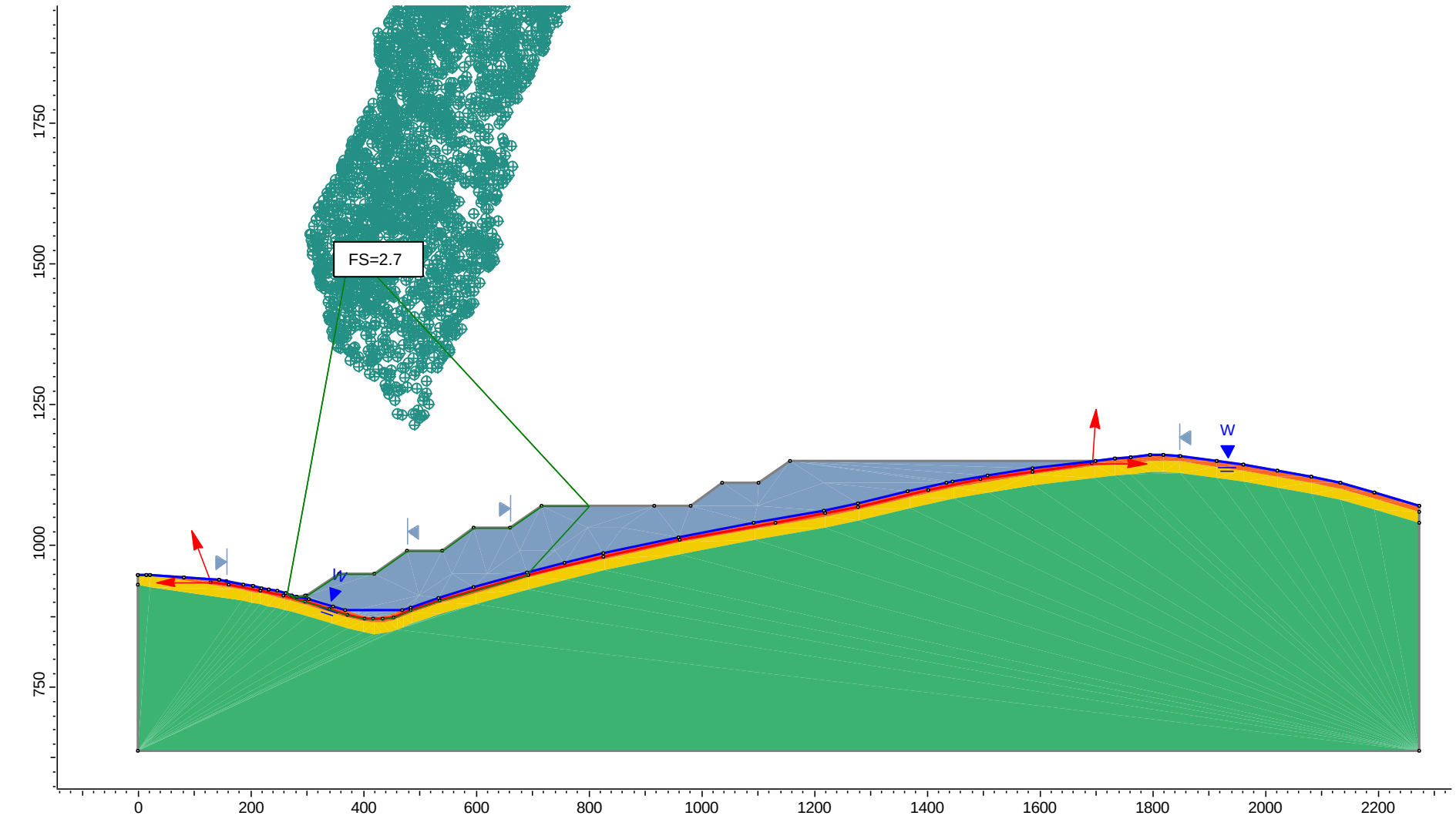


Alpha WRSF Section A Results

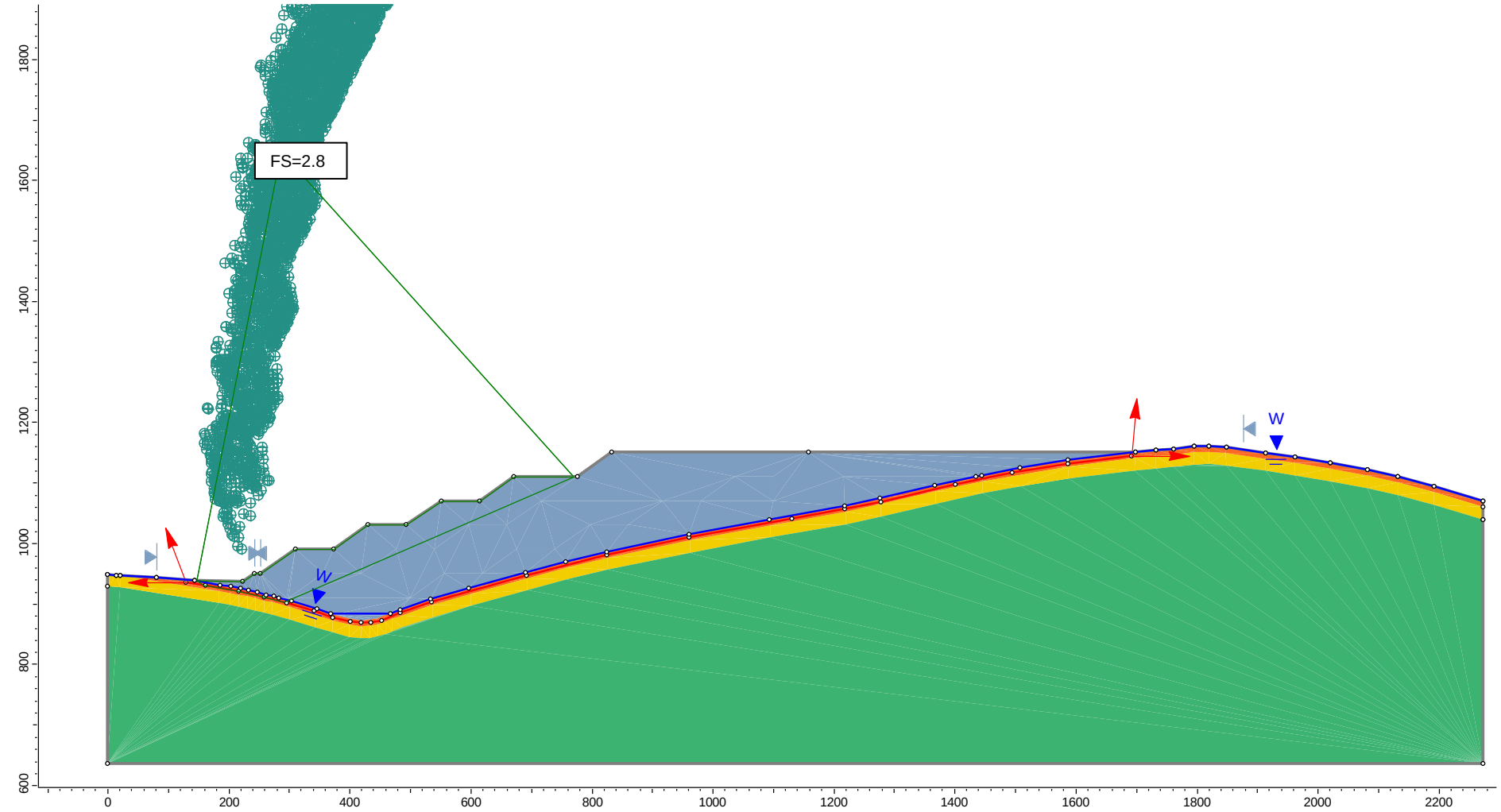
Alpha WRSF Section A, Year 3, Static



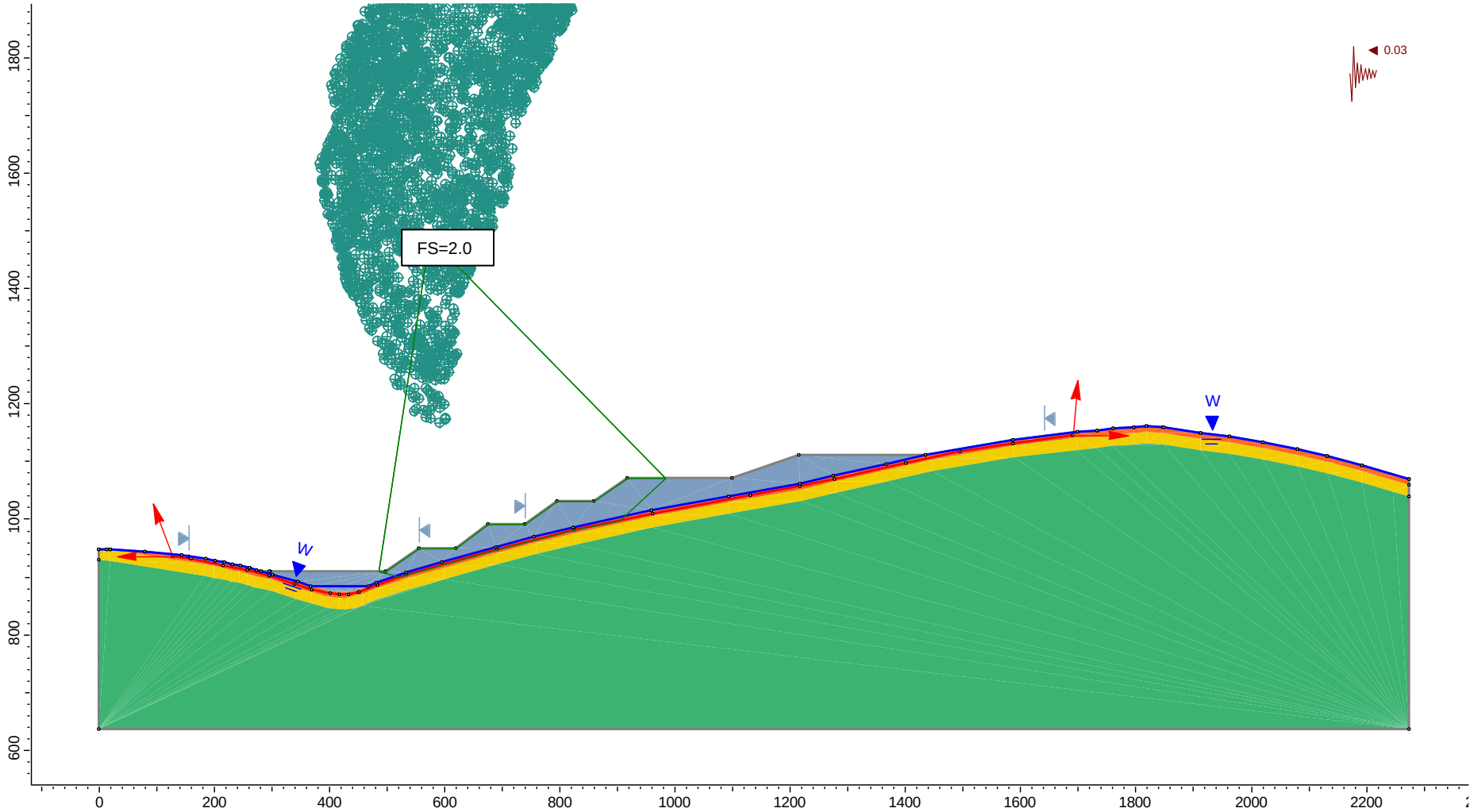
Alpha WRSF Section A, Year 6, Static



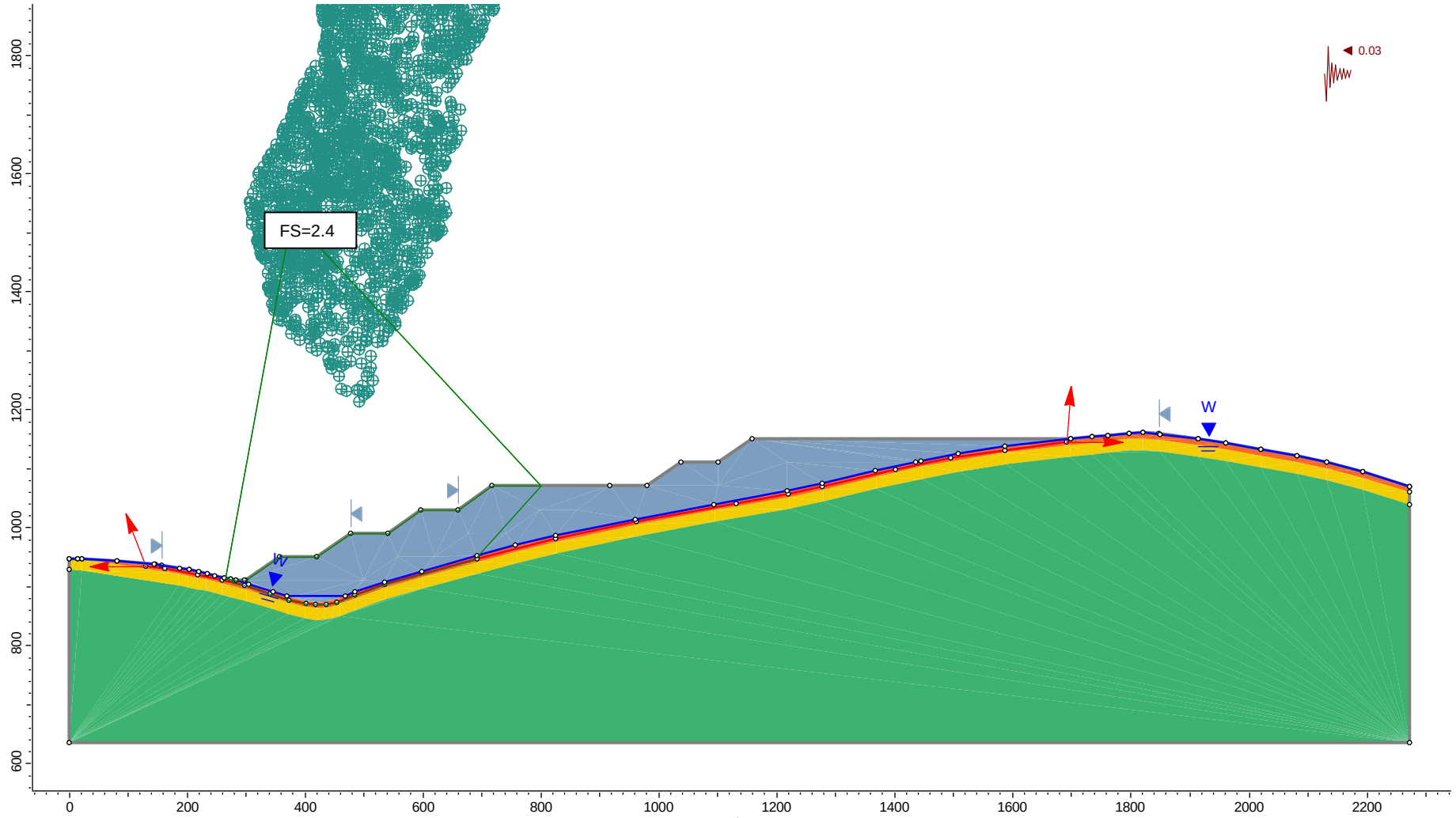
Alpha WRSF Section A, Year 11 (Final), Static



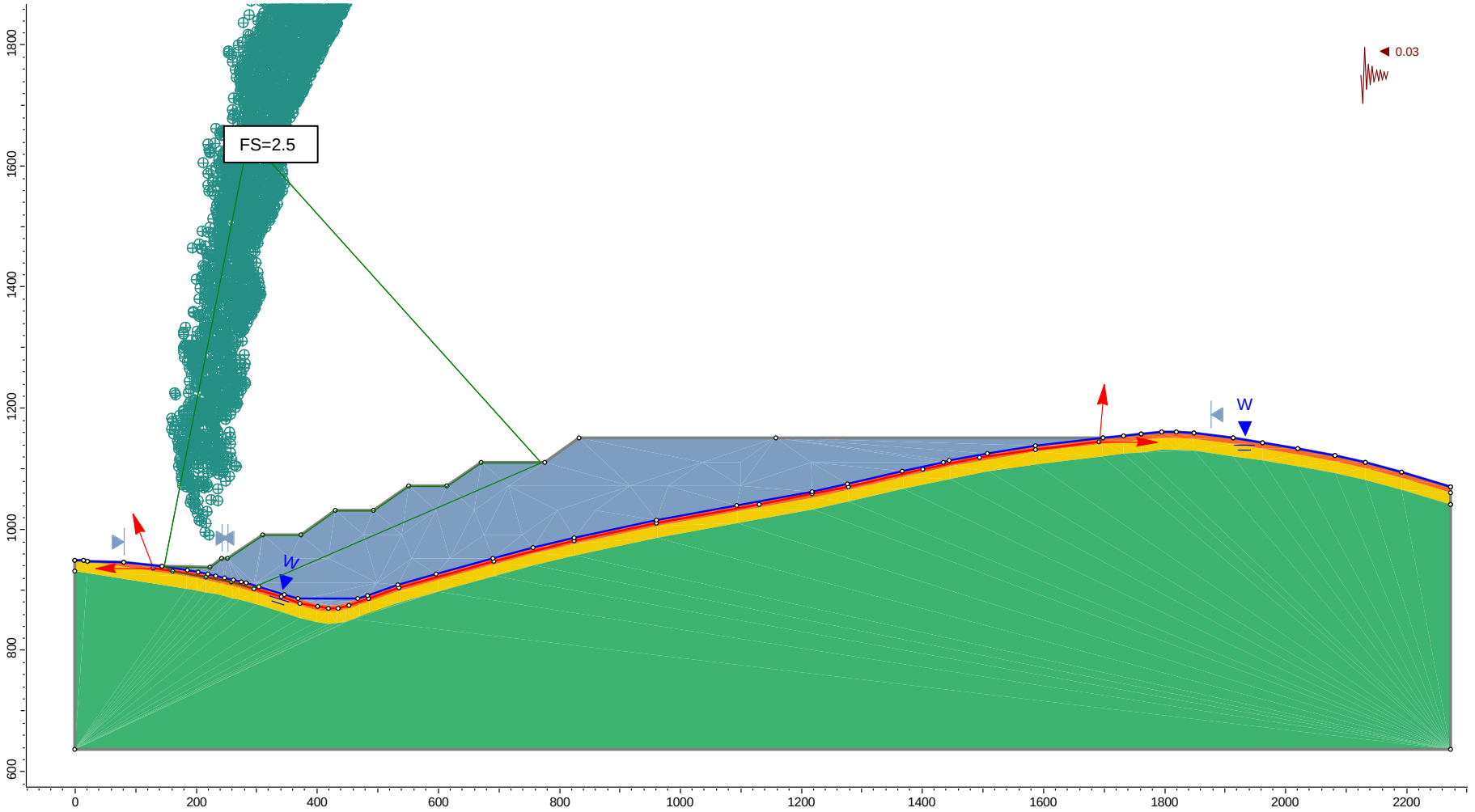
Alpha WRSF Section A, Year 3, Pseudostatic



Alpha WRSF Section A, Year 6, Pseudostatic

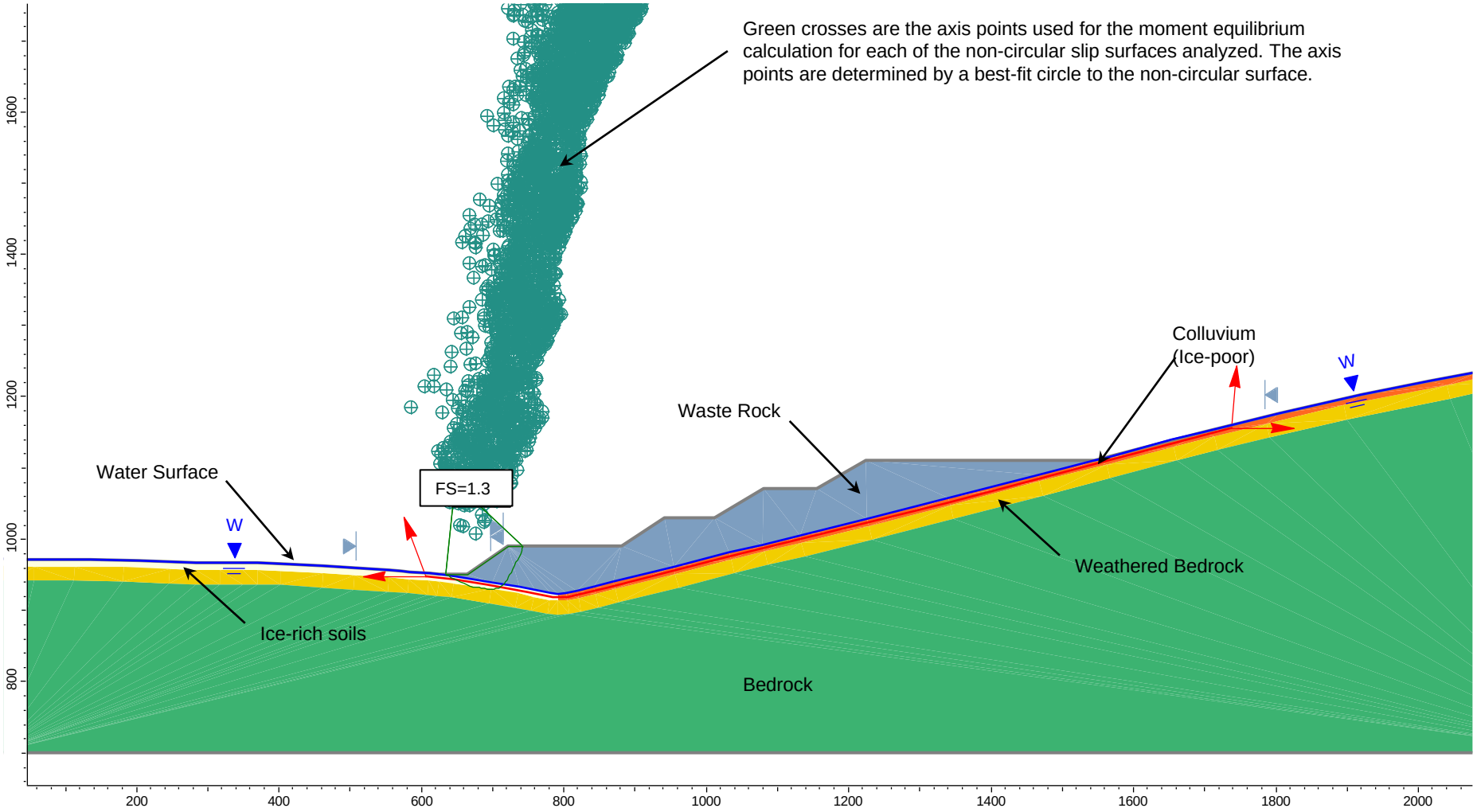


Alpha WRSF Section A, Year 11 (Final), Pseudostatic

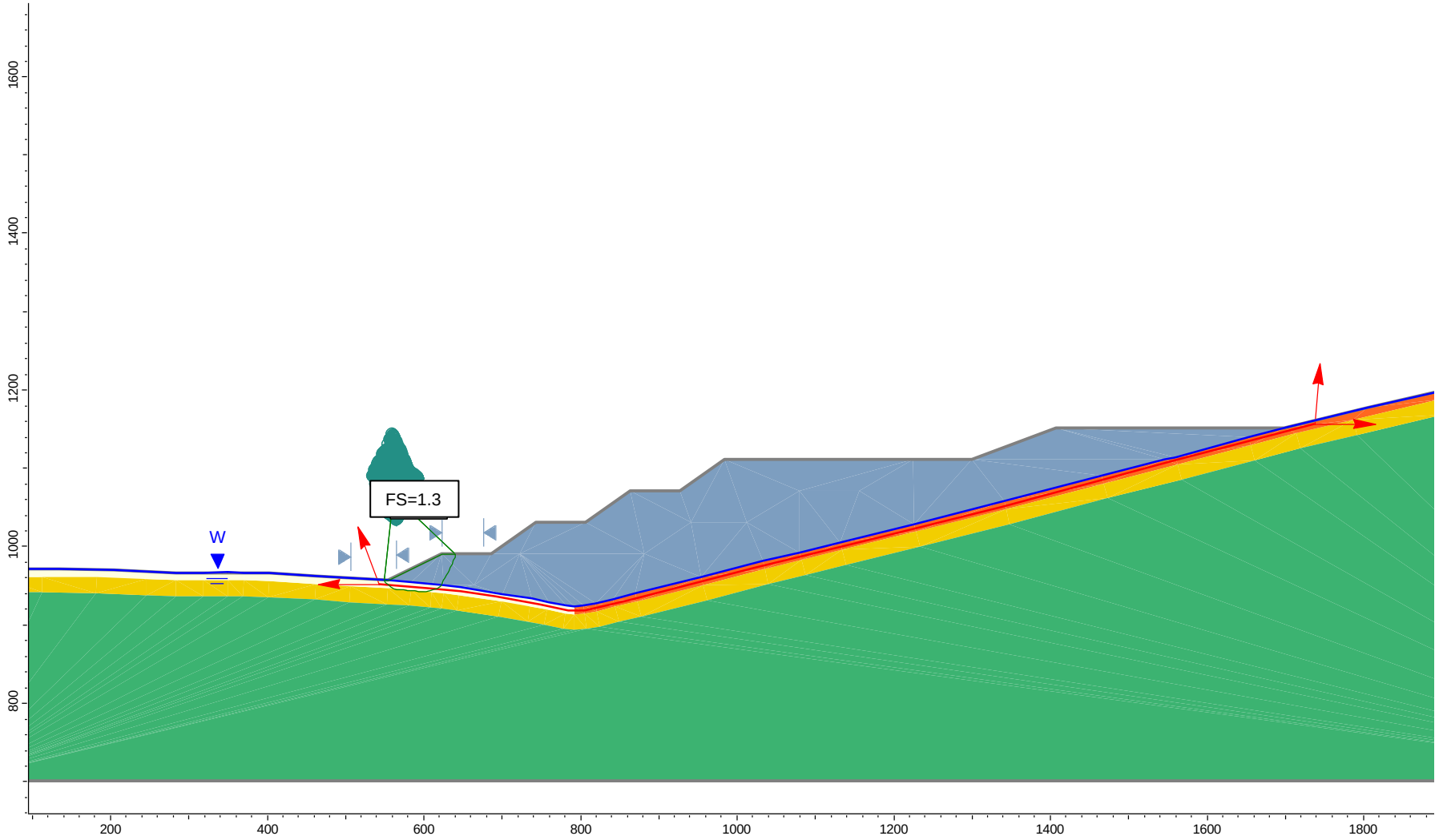


Alpha WRSF Section B Results

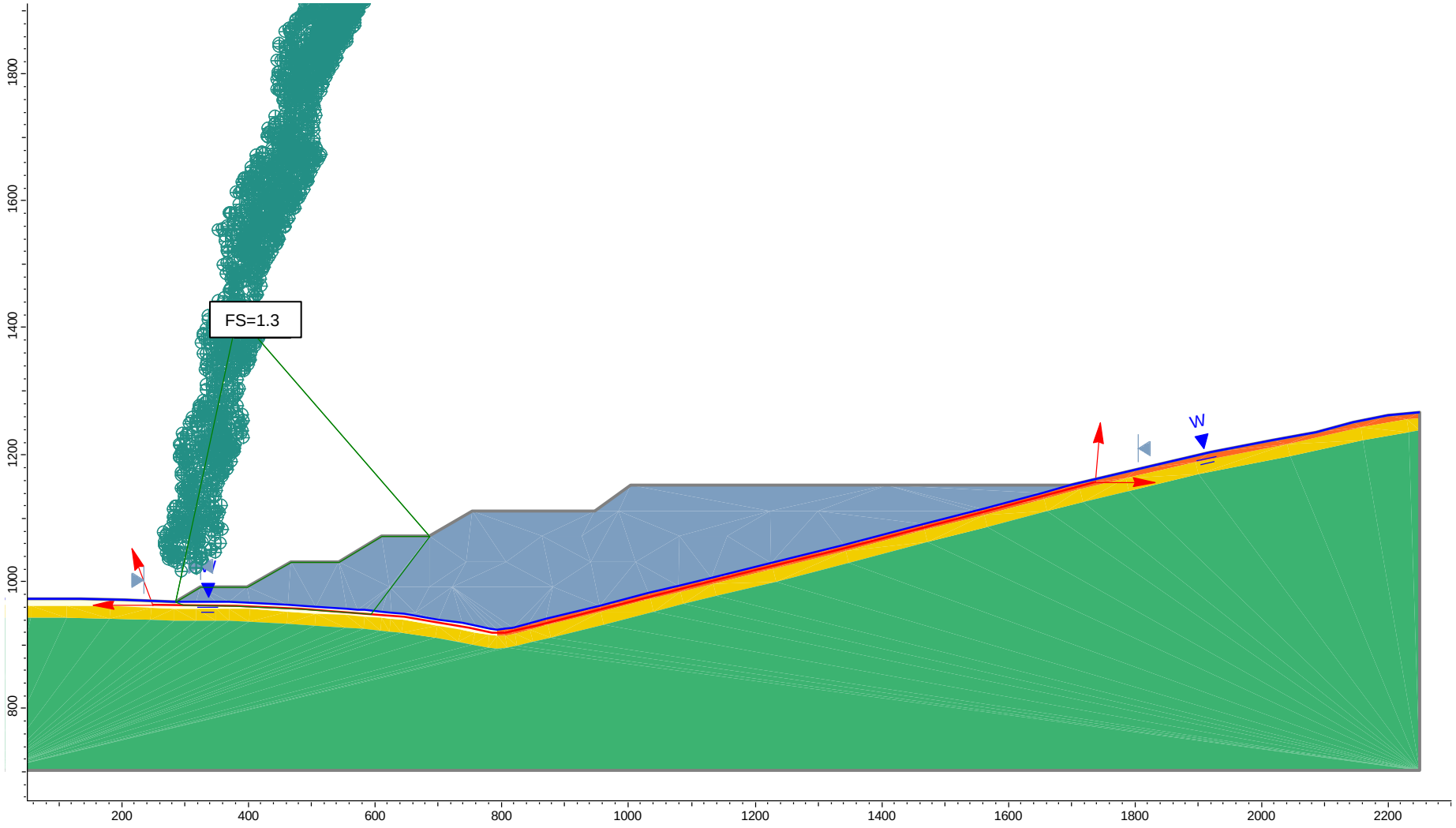
Alpha WRSF Section B, Year 3, Static



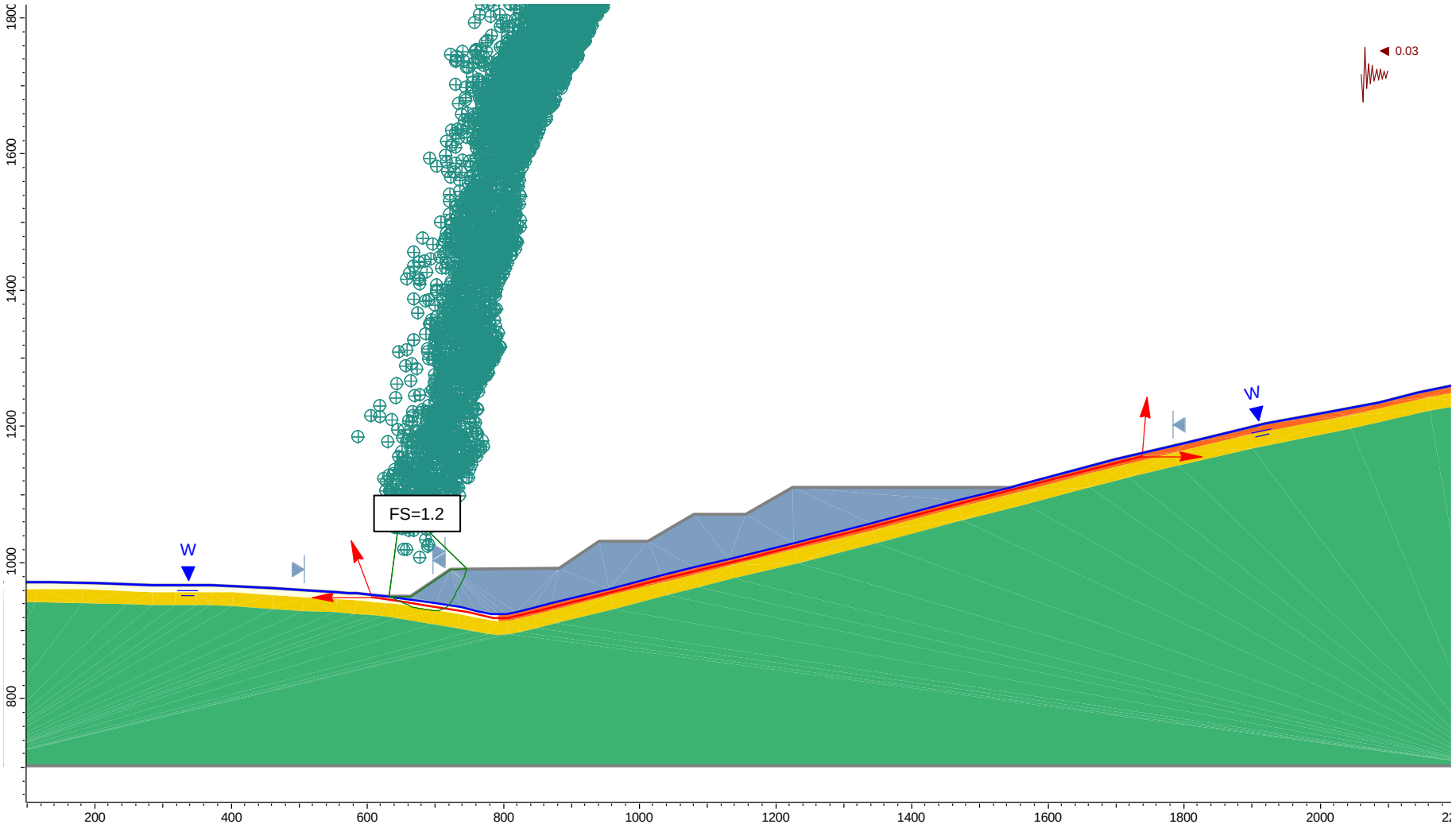
Alpha WRSF Section B, Year 6, Static



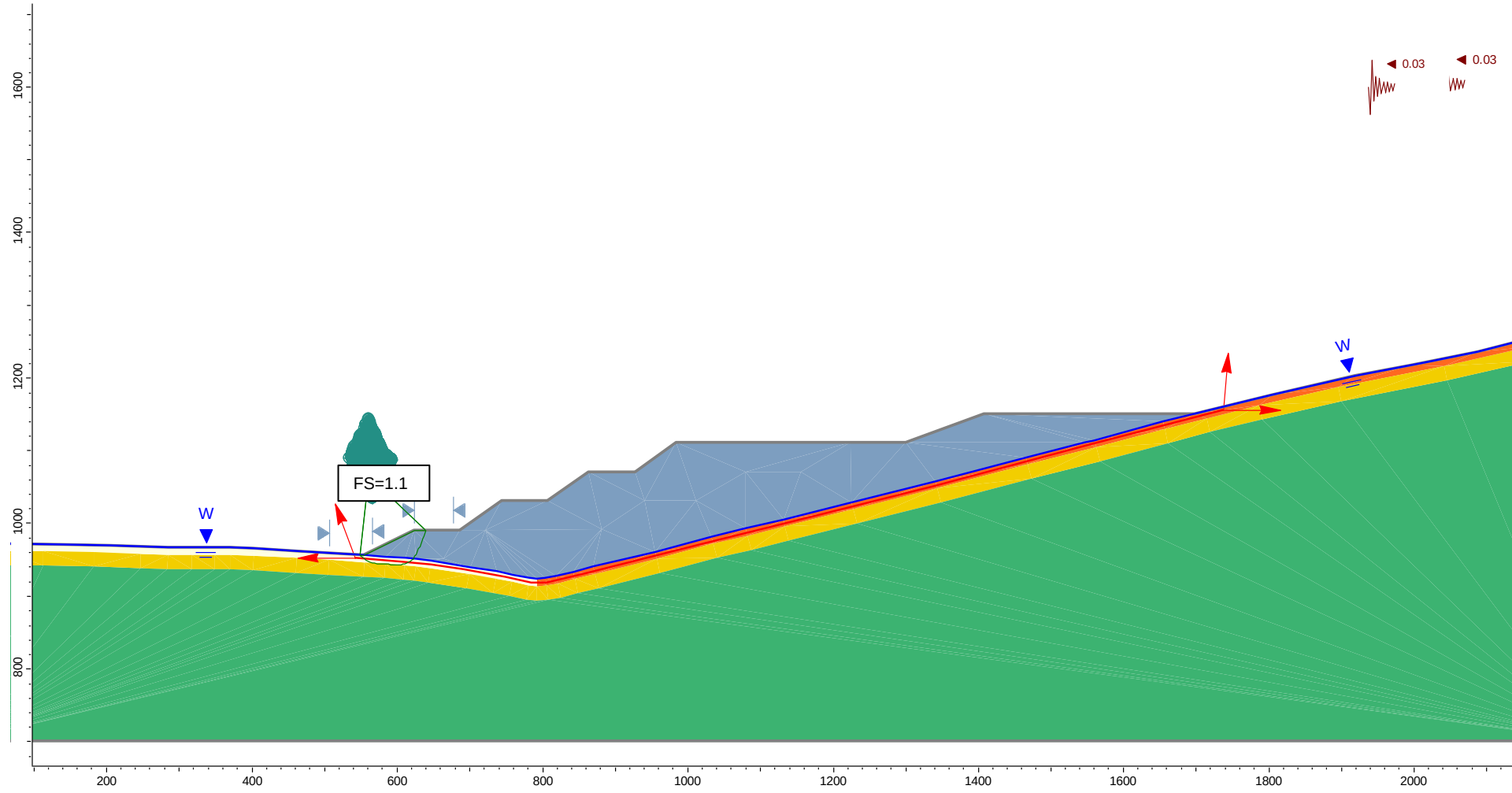
Alpha WRSF Section B, Year 11 (Final), Static



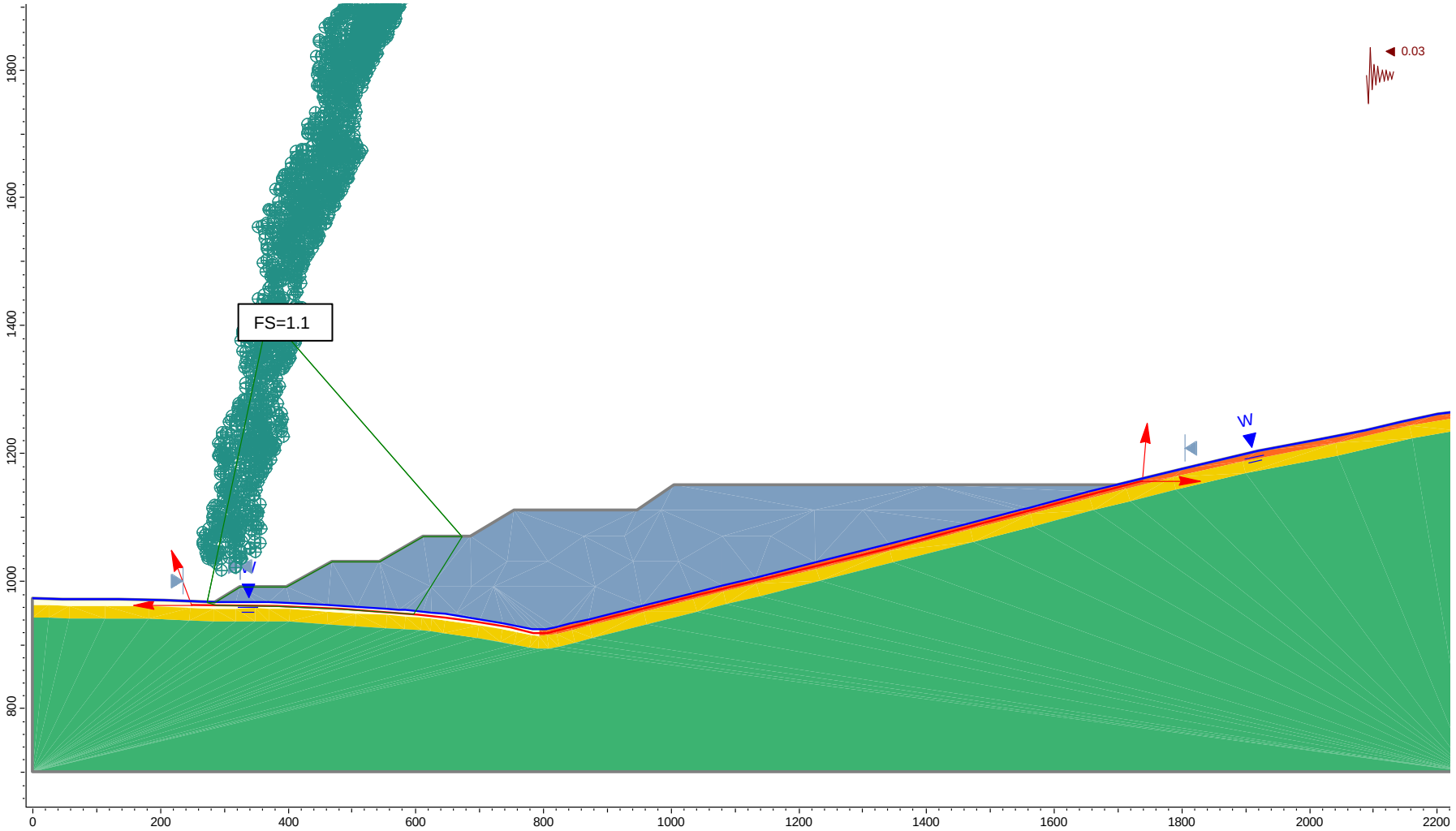
Alpha WRSF Section B, Year 3, Pseudostatic



Alpha WRSF Section B, Year 6, Pseudostatic

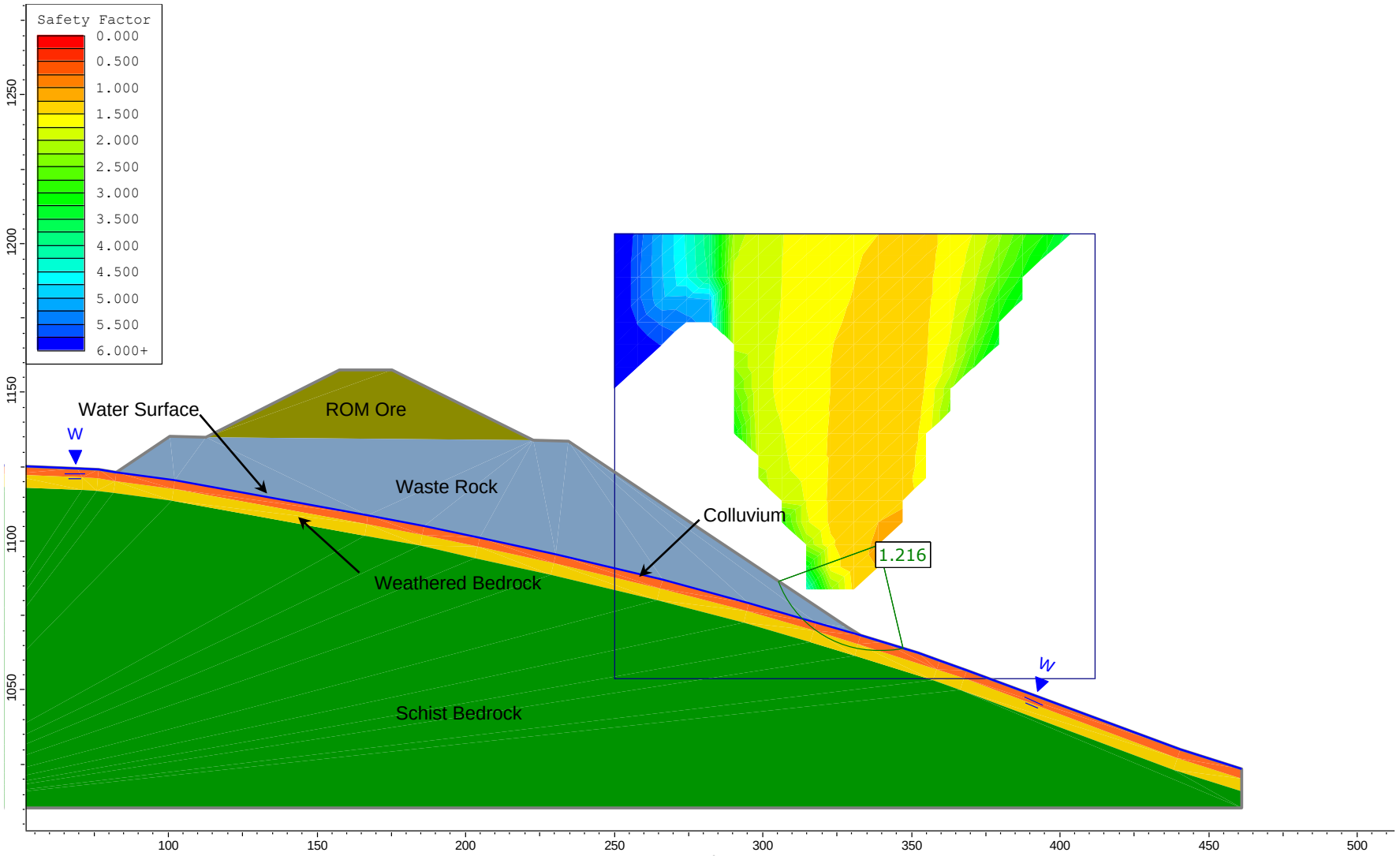


Alpha WRSF Section B, Year 11 (Final), Pseudostatic

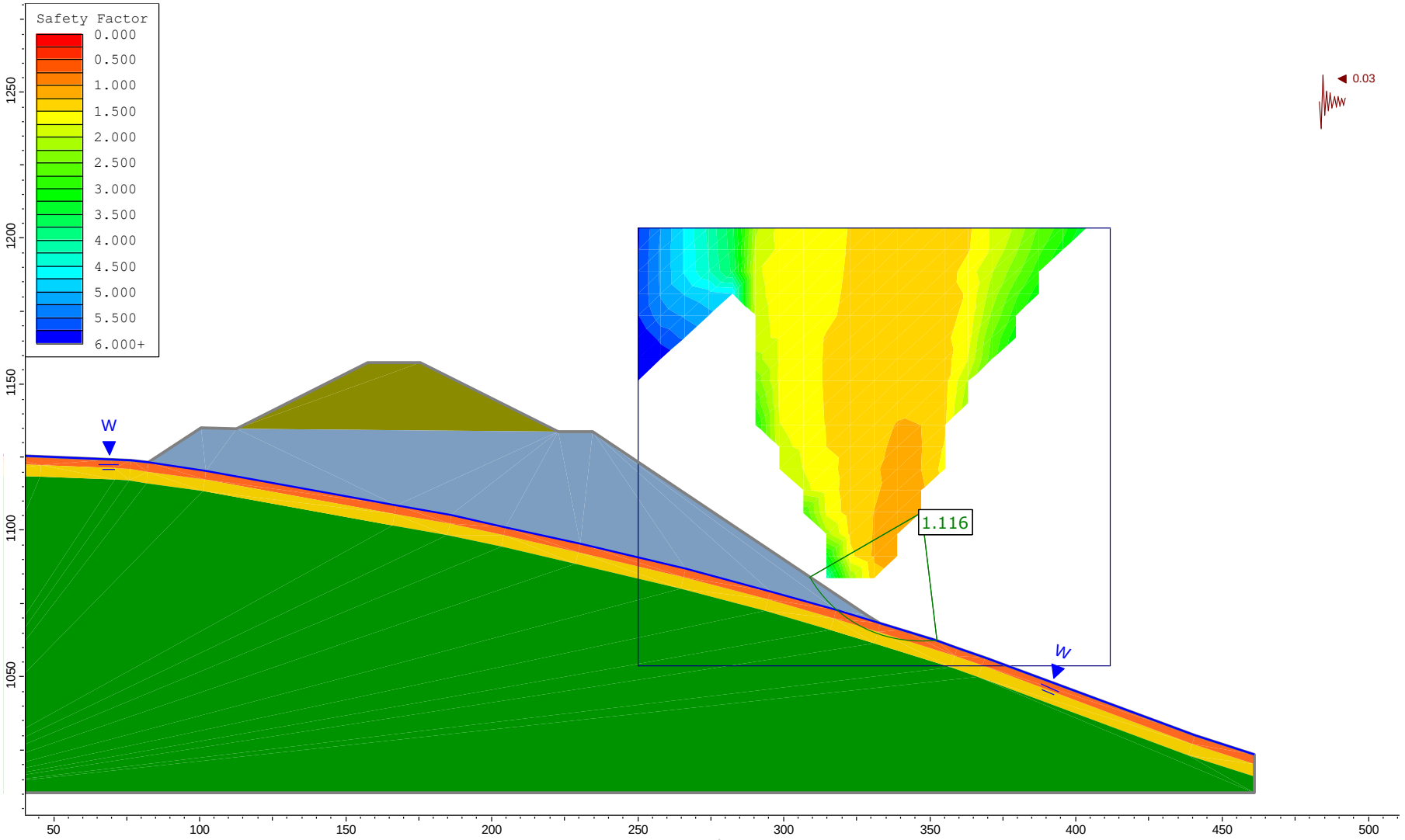


ROM Stockpile Results

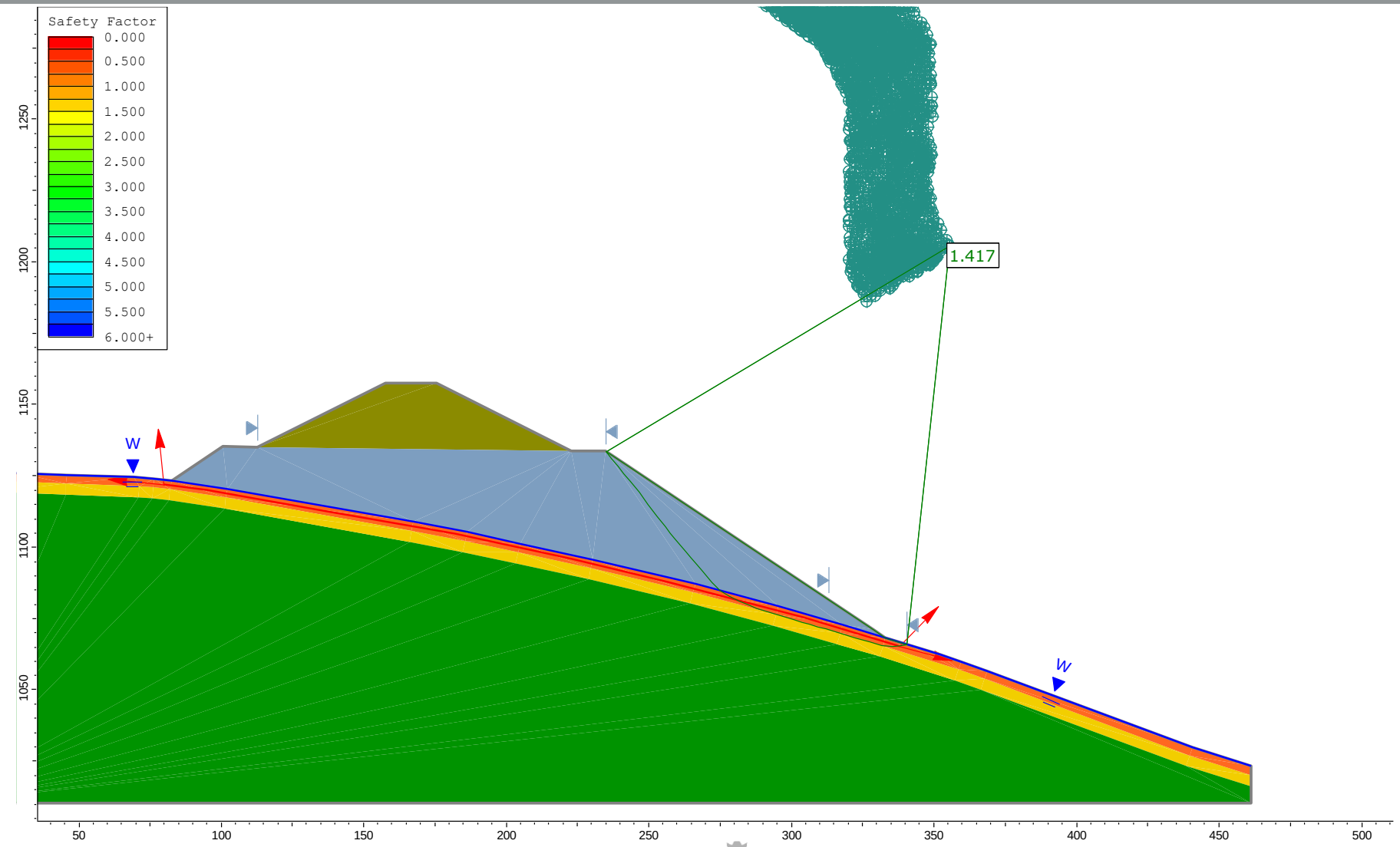
ROM Stockpile Results, Static (Toe)



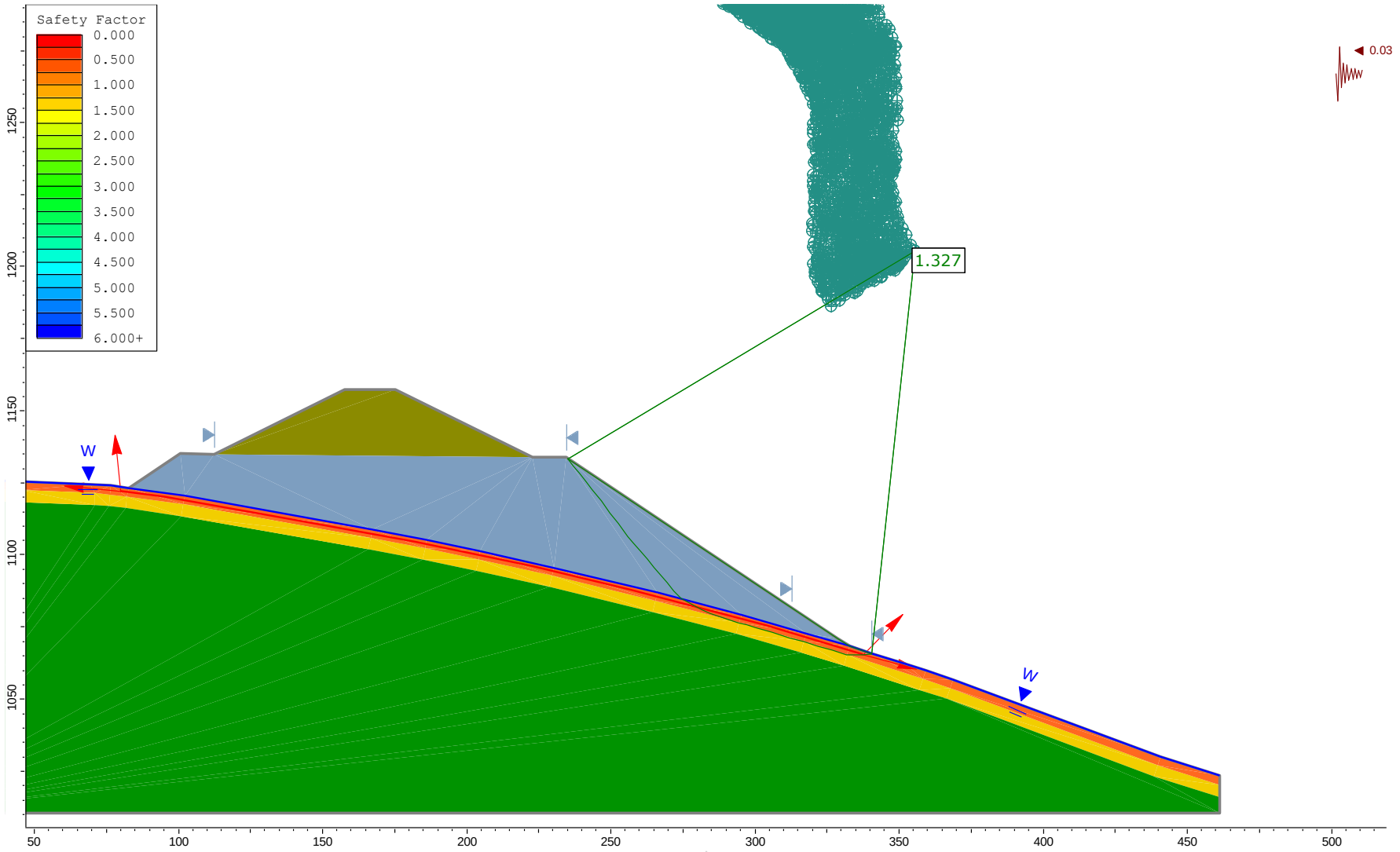
ROM Stockpile Results, Pseudostatic (Toe)



ROM Stockpile Results, Static

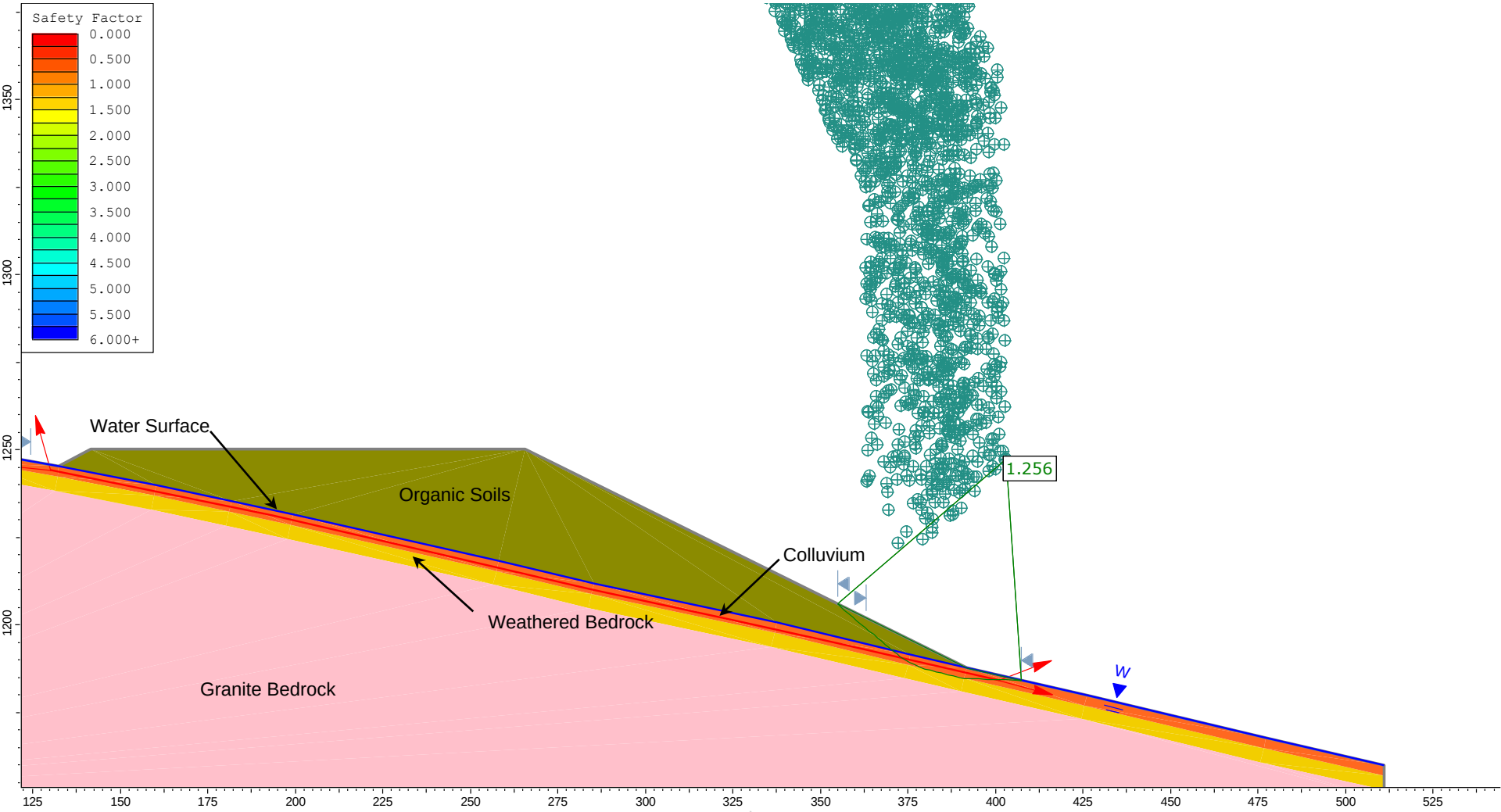


ROM Stockpile Results, Pseudostatic

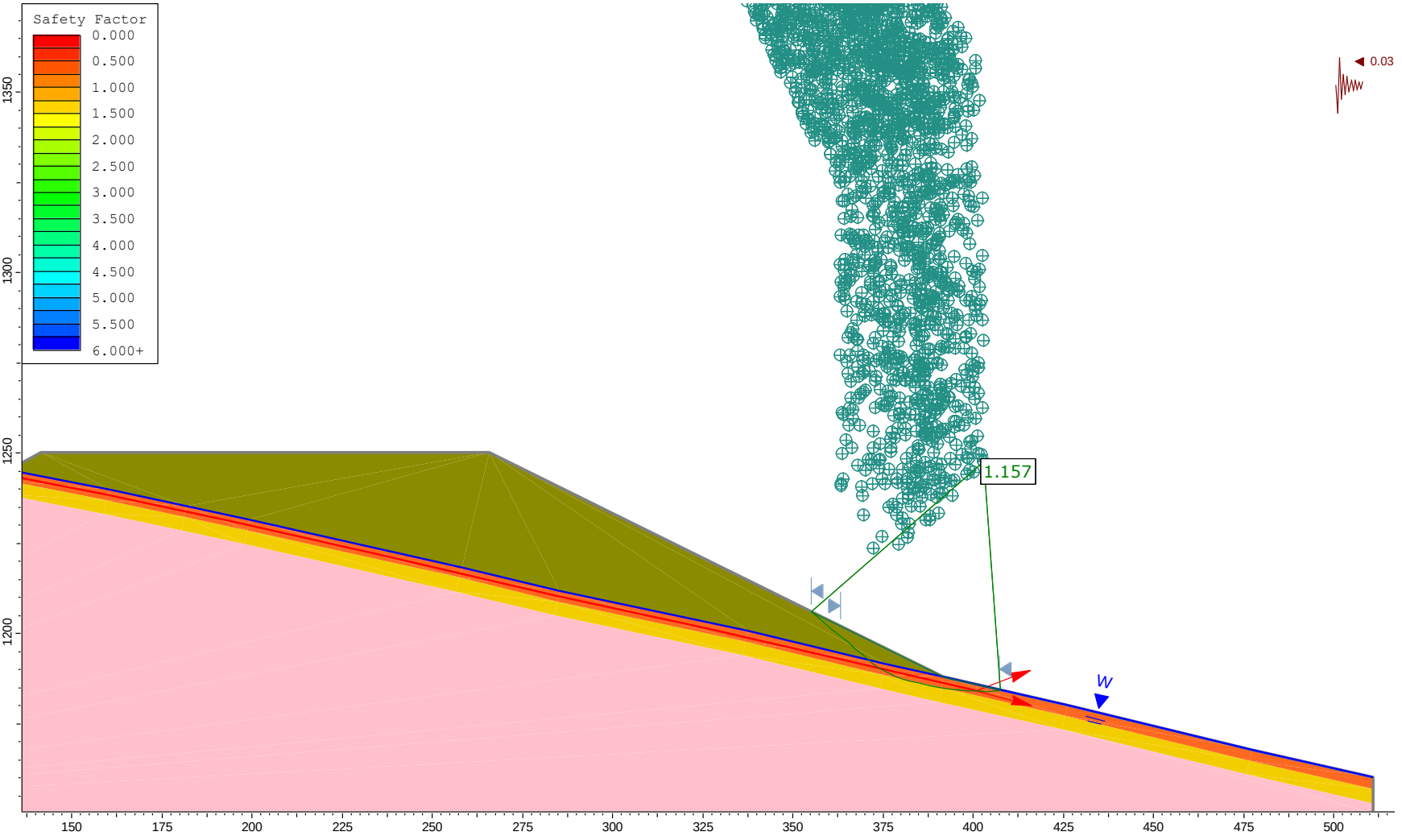


Temporary Organics Stockpile

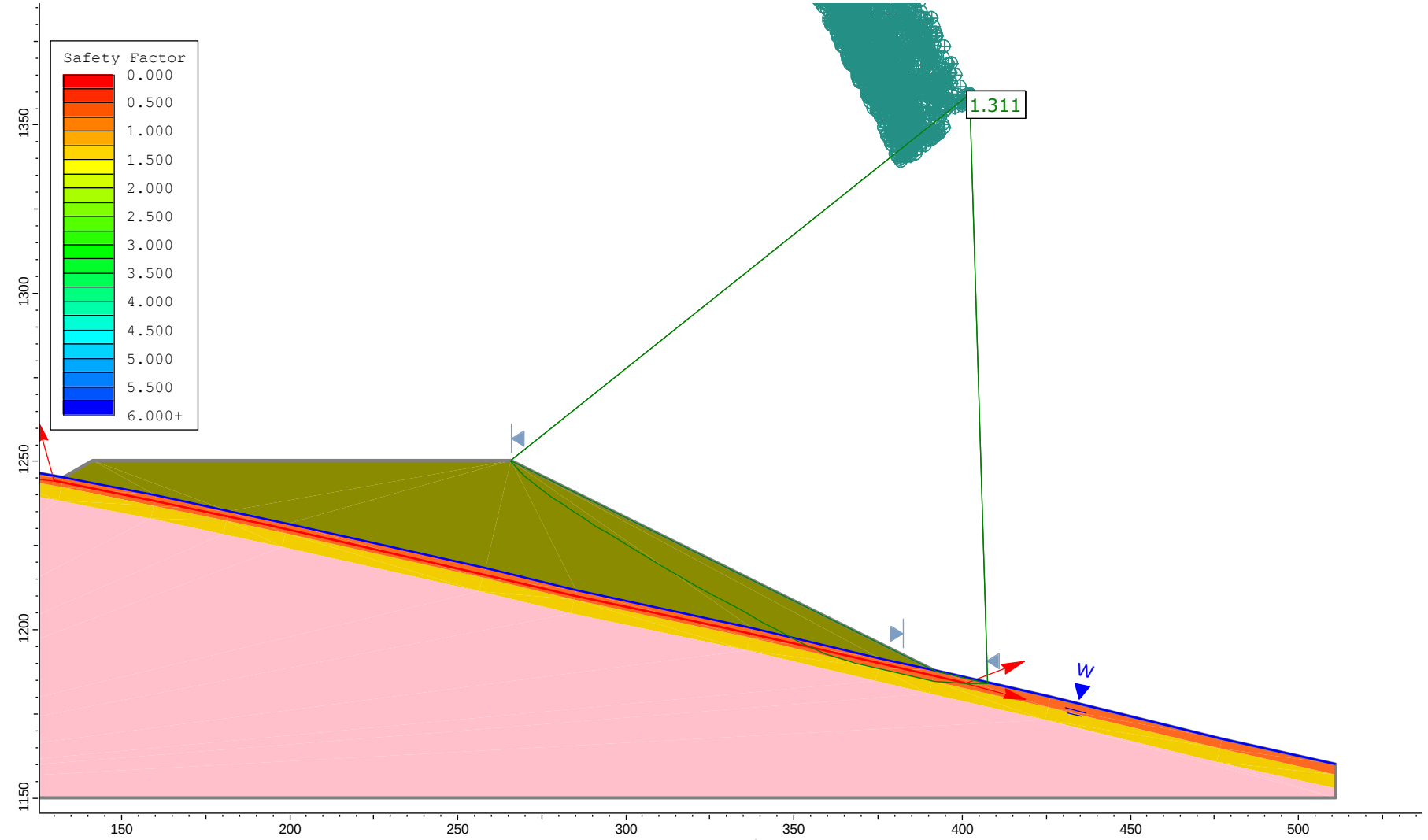
Temporary Organics Stockpile Results, Static (Toe)



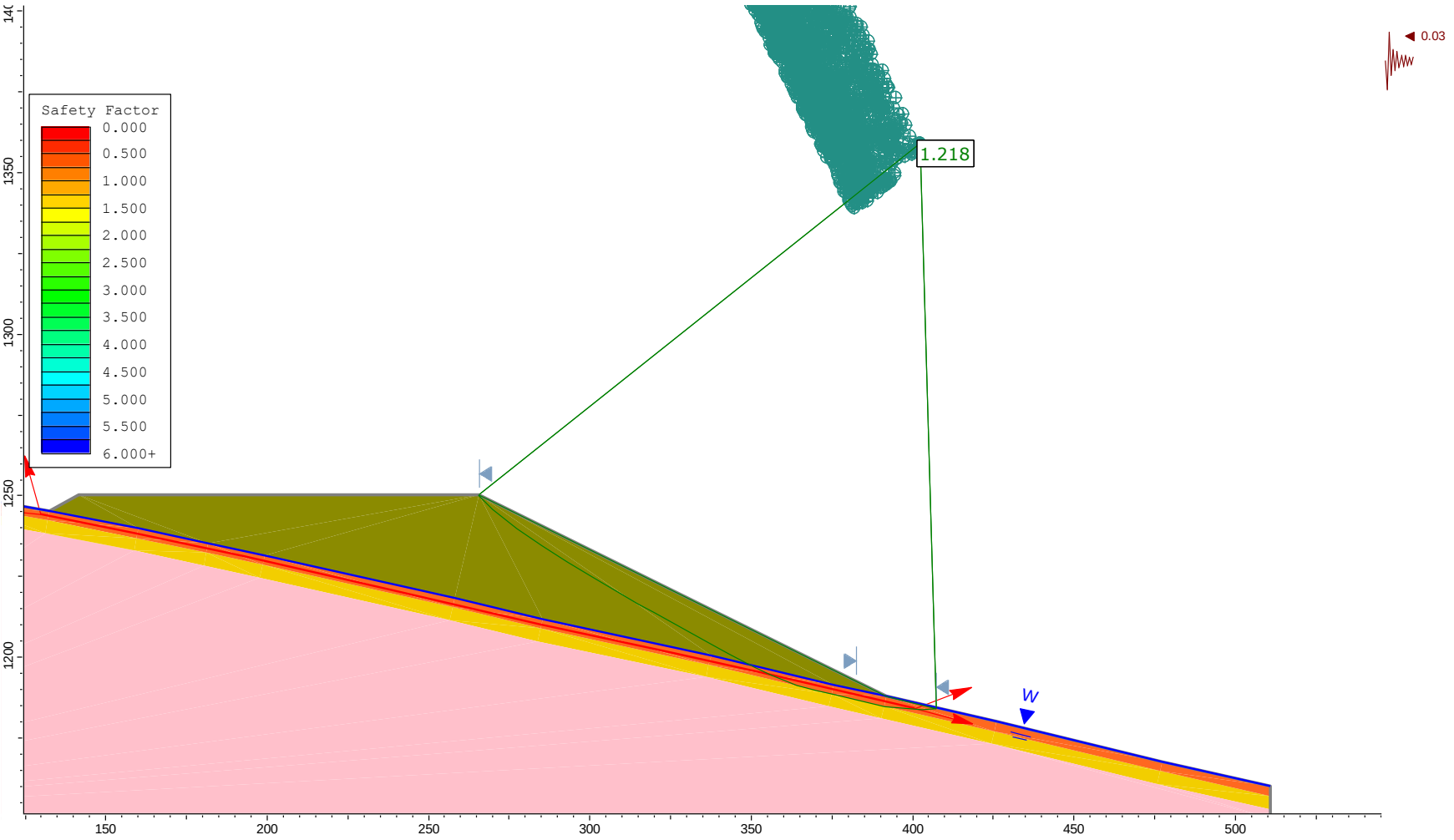
Temporary Organics Stockpile Results, Pseudostatic (Toe)



Temporary Organics Stockpile Results, Static

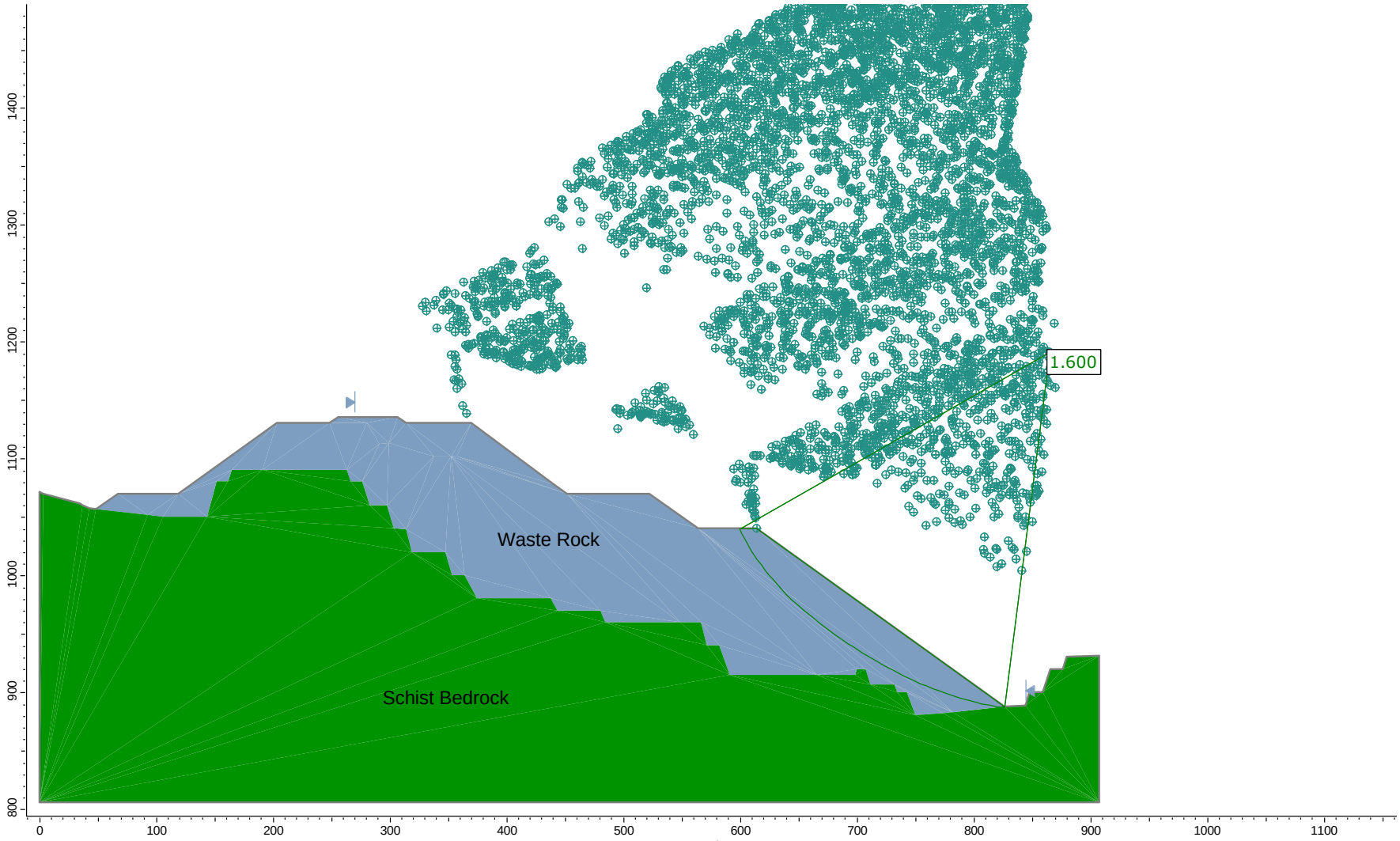


Temporary Organics Stockpile Results, Pseudostatic

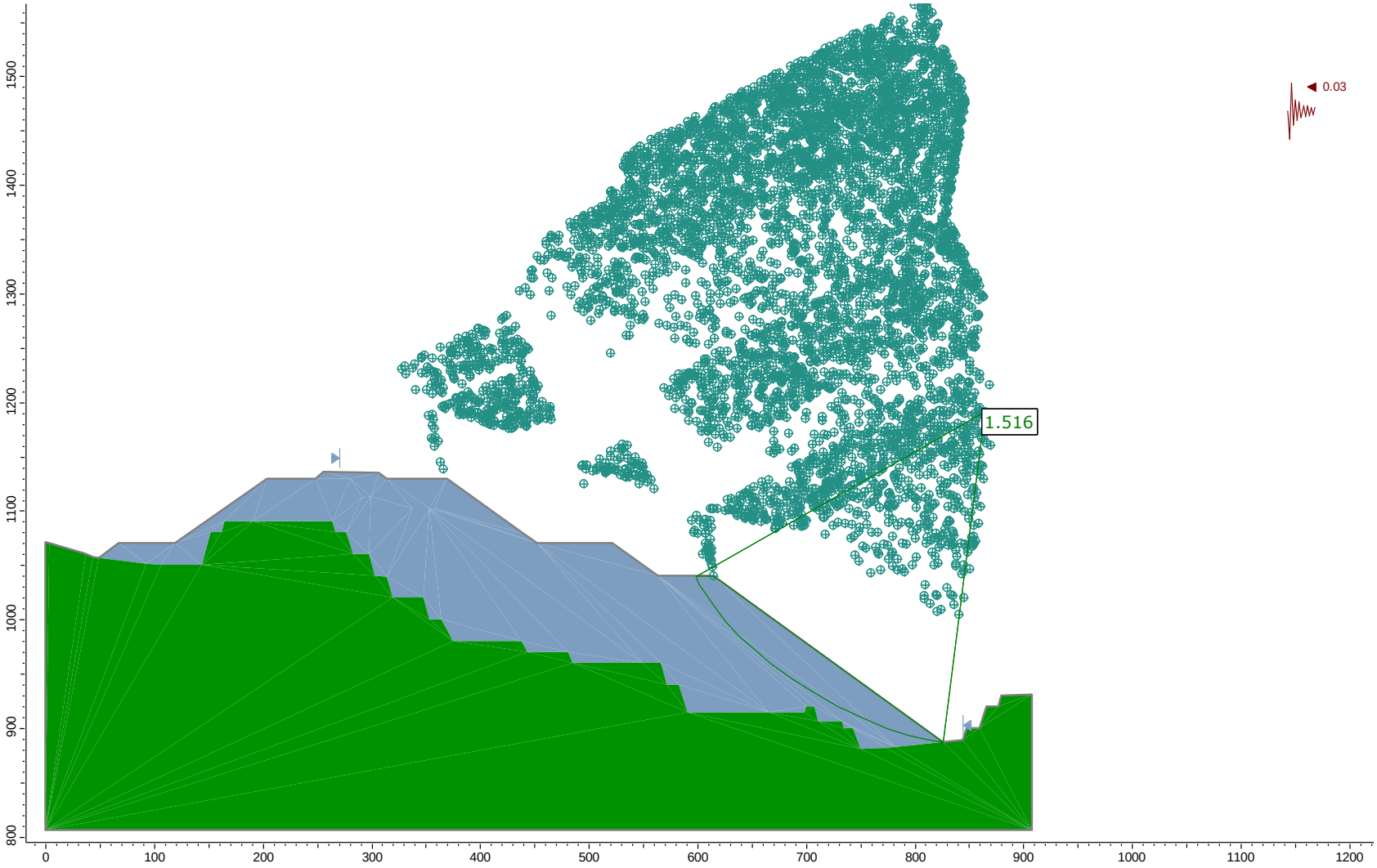


Supremo In-pit Backfill

Supremo In-pit Backfill Results, Static



Supremo In-pit Backfill Results, Pseudostatic









JDS Energy & Mining Inc.







APPENDIX 5-C

Coffee Mine Conceptual Water Treatment Design for Permitting



Coffee Mine Conceptual Water Treatment Design for Permitting

Coffee Gold Project

Yukon, Canada

Owner

Newmont™ COFFEE

Vancouver, Canada

Jennie Gjertsen
Jennie.Gjertsen@Newmont.com

Christian Roldan
christian.roldan@newmont.com

Prepared by

Brad Hansen
bhansen@westech-inc.com
(801) 290-1197

Ola Opara, PhD
oopara@westech-inc.com
(801) 230-6096

Reviewed by

Erik Donaldson
edonaldson@blumetric.ca
(519) 807-7301

Mark Somers, PE
msomers@blumetric.ca
(819) 360-8722

PROFESSIONAL ENGINEER
YUKON TERRITORY
MARK SOMERS
16/01/2025

WESTECH®

SYSTEM CERTIFICATION ISO 9001 SGS

Project #139648 Rev.5
Monday, December 2, 2024

Table of Contents

Background Information
- Summary of the Test Program: 2015 - 2024
- Water Treatment Plant Design Basis

Conceptual Treatment Design
- Design Overview
- Process Descriptions
- Conceptual Footprint and Site Layout
- System Controls
- Comparable WesTech Case Studies

Engineering and Design
- Project Delivery Options
- Next Steps: Advancing Design

Active Water Treatment Plant Work Plan
- Work Completed
- Work Required

Clarifications and Exceptions

Supplemental Information
- Comprehensive Testing Report
- Brochures
- Case Studies

Background Information

Summary of the Test Program: 2015 - 2024

WesTech Engineering (formerly Inotec) was contracted to develop a conceptual water treatment system for the Coffee Mine's waters. To increase confidence in the proposed treatment, reduce uncertainty and risks, and develop a site-specific approach for the treatment of the Coffee Gold waters, the testing was designed in three phases. Phase I feasibility and Phase II bench-scale laboratory testing and optimization have been completed to date. Along the way, the results were shared with the stakeholder (Newmont, Tr'ondek Hwech'in, and the Canadian regulatory agencies), and the obtained feedback was included in the testing program. Once the mine is operational and heap waters are available, the system design and expected performance will be demonstrated during the on-site optimization and demonstration testing.

Early testwork was performed on recirculated leach waters, mimicking site water chemistry in the later years of the mine's operation. Additional bench work was completed to tailor the design to the barren solution treatment and evolving water quality.

Phase I feasibility testing successfully demonstrated the removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. **The Phase II bench-scale testing and optimization removed all parameters of interest to below their respective discharge targets.**

Upon completing testing, WesTech and Newmont sought out feedback from the stakeholders through a series of water-treatment-focused workshops. The consultations yielded positive feedback, identified additional contaminants of interest, and resulted in the addition of several analytical parameters to the monitoring list, strengthening the testing design and outcomes. Sulfate and antimony were identified as potential additional contaminants of interest. Thiocyanate, sulfide, arsenic and selenium speciation, and radiochemistry were added to the analytical schedule.

The jar test optimization program tailored the treatment design to changing water quality expected during the mine lifecycle. The best approach for the Coffee Gold water treatment was confirmed to be a multi-stage treatment train, consisting of cyanide destruction, physico-chemical treatment for arsenic and sulfate precipitation, and biological denitrification. **All parameters of interest we removed to below their respective discharge target, except for cobalt.** Cobalt forms strong complexes with cyanide that are not broken in cyanide destruction steps, keeping the metal in solution throughout the phys-chem treatment. **To address the cobalt issue, the proposed water treatment flowsheet was modified to include the reverse osmosis (RO) membranes.**

Based on the results obtained from bench-scale testing, a set of preliminary design and operational parameters were developed. The testwork and analytical plan for optimization and demonstration tests will include, at the minimum, the same level of detail as the Phase II bench-scale program.

Please refer to the attached Comprehensive Report entitled "Coffee Project Water Treatment: From Feasibility Studies to a Conceptual System Design" for the detailed results of the completed testwork.

Water Treatment Plant Design Basis

Developing a conceptual water treatment design for a prospective mine is challenging. No heap leach waters exist for treatment evaluations without an operational mine. Predicting water quality generated by the heap leach facility (HLF) is crucial for identifying the parameters of concern and developing a treatment system with appropriate unit processes.

Water quality modeling was performed by Lorax Environmental Services (Table 1). The treatment targets were based on a back-calculation approach to arrive at allowable concentrations in the discharge to achieve Use-Protection water quality objectives in Halfway Creek.

The conceptual water treatment design described in this document is based on the water quality predictions and treatment targets presented in Table 1.

Table 1. Water quality predictions of the HLF solutions and the associated treatment targets.

Parameter [mg/L]	Early Phase	Post-Recirculation	Treatment Target	Treatment Required?
pH	9 - 10	8.4	<9.0	Probable
NH_3-N	72	0.06	16	Yes
NO_3-N	50	307	79	Yes
NO_2-N	1	1.9	0.15	Yes
Cl	300	123	1300	No
SO_4	1100	2516	1100	Yes
WAD-CN	130	0.2	0.046	Yes
Al	0.09	0.2	3.4	No
Ag	0.00045	0.00125	0.0027	No
As	5.0	2.0	0.043	Yes
Cd	0.0036	0.00013	0.002	Possibly
Cr	0.008	0.014	0.05	No
Cu	2.0	0.014	0.029	Yes
Co	0.5	0.25	0.03	Yes
Fe	2.3	0.5	10	No
Hg	0.005	0.00026	0.00019	Possibly
Mn	0.27	0.06	3.0	No
Mo	0.125	0.105	0.77	No
Ni	0.019	0.006	0.8	No
Pb	0.0002	0.0013	0.02	No
Sb	0.09	0.5	0.08	Yes
Se	0.007	0.005	0.021	No
U	0.1	0.685	0.7	Probable
Zn	0.7	0.052	0.2	Yes

Water Treatment Design for Permitting

Design Overview

Based on the additional design information obtained during the optimization jar testing, this revision supersedes information contained in the previous document, issued in March 2023.

The Coffee Gold Mine is projected to generate a positive water balance with variable water chemistry throughout the project lifecycle. Water generated through the infiltration of the heap will contain cyanide, metals, and other dissolved inorganics. **The mine water balance estimates the design flow to the water treatment facility as 25 to 35 L/s (396 to 555 gpm).**

Several water treatment approaches have been evaluated during feasibility, preliminary, and optimization lab testing. Based on the treatment results demonstrated during Phase II bench-scale testing, the full-scale treatment facility will consist of the following processes:

1. Flow Equilibration
2. Cyanide Destruction
3. Breakpoint Chlorination
4. Physico-Chemical Treatment
5. Membrane (UF/RO) Filtration
6. Solids Handling
7. Denitrification

Some of the reactions listed above have demonstrated synergies and were combined into one unit process. The conceptual process flow sheet is shown in Figure 1. Descriptions of unit processes, design criteria, and assumptions are provided below.

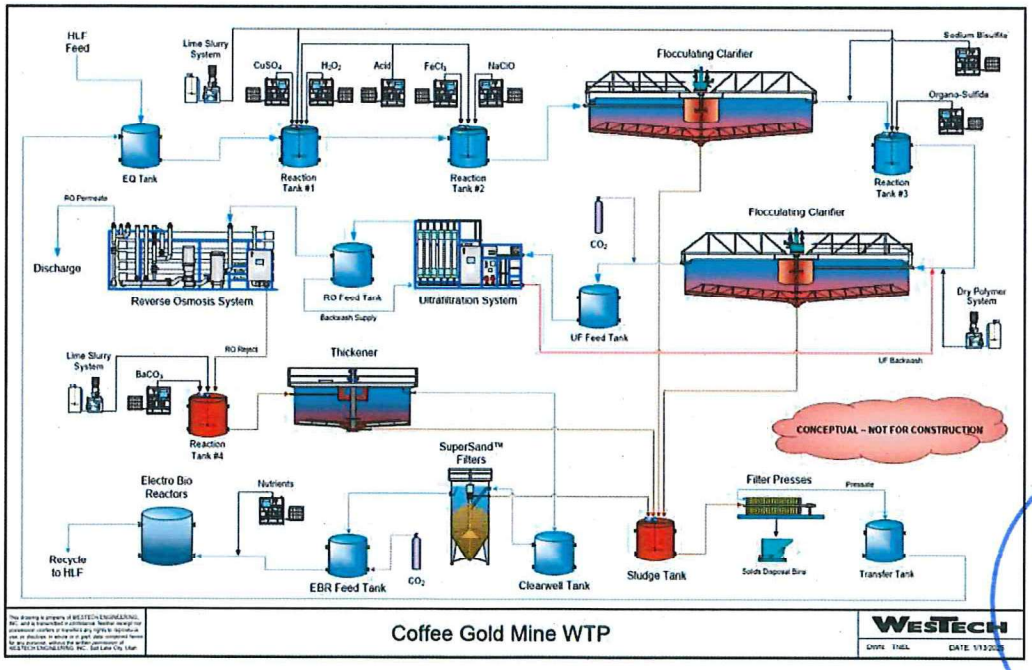


Figure 1. Coffee Gold Mine conceptual water treatment flow sheet.

PROFESSIONAL ENGINEER
YUKON
MARK SOMERS
TERRITORY
16/JAN/2025

WESTECH®

Process Descriptions

Flow Equilibration

The system will rely on flow equilibration (EQ) to improve efficiency, reliability, and control (Figure 2). **The goal of flow equilibration is to prevent wild swings in flowrates, temperatures, and water chemistry.** Depending on the final water quality modeling, the required volume of the EQ will be calculated, and the decision will be made on whether to use a tank or a basin.

Cyanide Destruction

The pH coming into the plant will be maintained between 9 – 9.5 to prevent hydrogen cyanide gas formation. The cyanide destruction step will be mixed and will rely on a chemical cyanide oxidation method to encourage the formation of oxidized metal species that will be removed in the following steps (e.g., arsenic).

Hydrogen peroxide oxidation has proven to be the most effective for cyanide destruction in barren solutions and post-recirculation waters from the Coffee Gold project. The ORP control was demonstrated to be a more reliable approach for controlling hydrogen peroxide dosing in a changing water chemistry than using set reagent:contaminant ratios. Copper is a required catalyst, and the process is pH-dependent.

Breakpoint Chlorination

Following the cyanide destruction step, breakpoint chlorination will be used for ammonia oxidation. pH will be lowered to 8.0 – 8.5.

The chemical ammonia oxidation step is an attractive approach for the Coffee Gold project because of the gradually decreasing ammonia loading in the HLF waters. The chlorine dose can be automatically adjusted to meet the treatment objective.

Chemical Conditioning

The group of water treatment processes, commonly referred to as the physical-chemical or “phys-chem” methods, relies on coagulation, flocculation, sedimentation, and filtration of precipitated constituents. It is one of the most widely used and accepted treatment methods, applied from drinking water to municipal wastewater to industrial and mining water treatments. **Likewise, the physico-chemical treatment at the Coffee Gold Mine will utilize chemical precipitation to remove certain constituents, followed by clarification and filtration to remove produced solids (Figure 2).**

Ferric chloride will be added to the mixed reaction tanks to aid arsenic coagulation and precipitation. Demonstrated during bench-scale testing with Coffee Gold Mine waters, this method is widely applied in the mining industry as well as in the drinking water treatment. Ferric chloride ($FeCl_3$) hydrolyzes in water to form positively charged ferric hydroxide ($Fe(OH)_3$). Dissolved arsenic oxyanions are negatively charged and readily sorb to the positively charged ferric hydroxide particles.

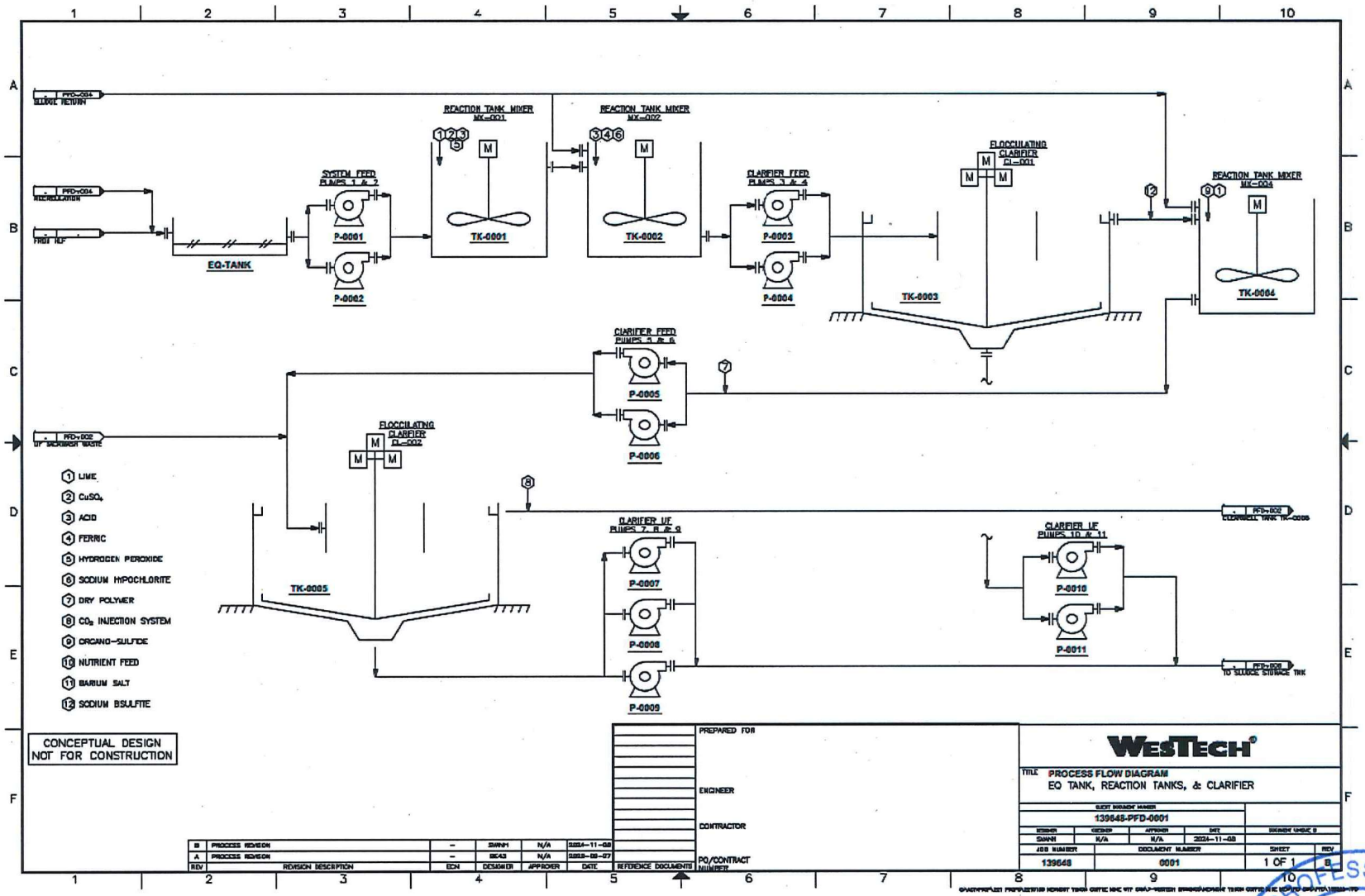


Figure 2. Coffee Gold conceptual water treatment. Process flow diagram depicting the equilibration, chemical reaction tanks, and the clarifiers.

PROFESSIONAL ENGINEER
YUKON TERRITORY
MARK SOMERS
16/JAN/2025

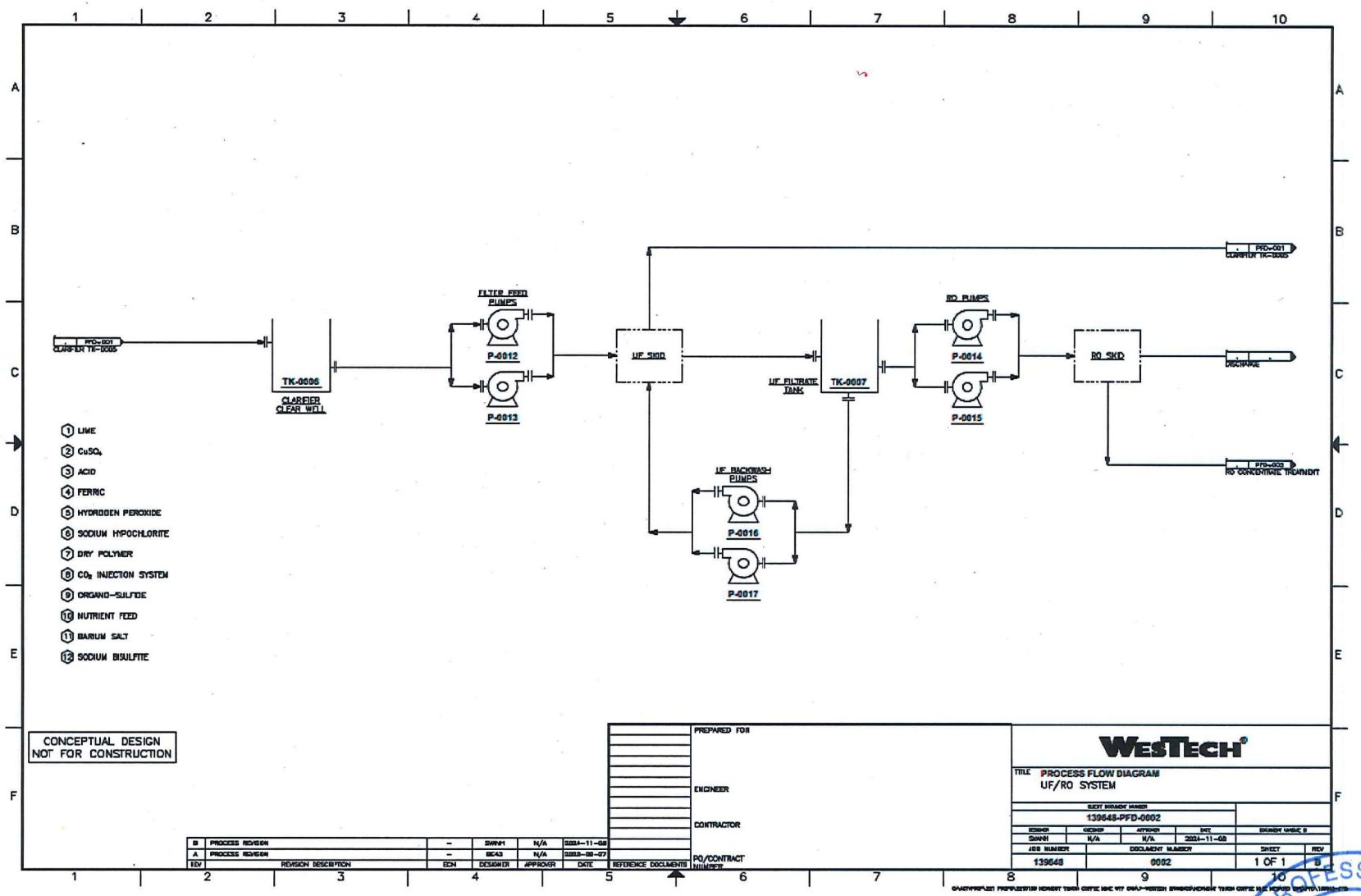


Figure 3. Coffee Gold conceptual water treatment. Process flow diagram depicting the UF and RO membrane filtration.

PROFESSIONAL ENGINEER
YUKON TERRITORY
MARK SOMERS
16/JAN/2025

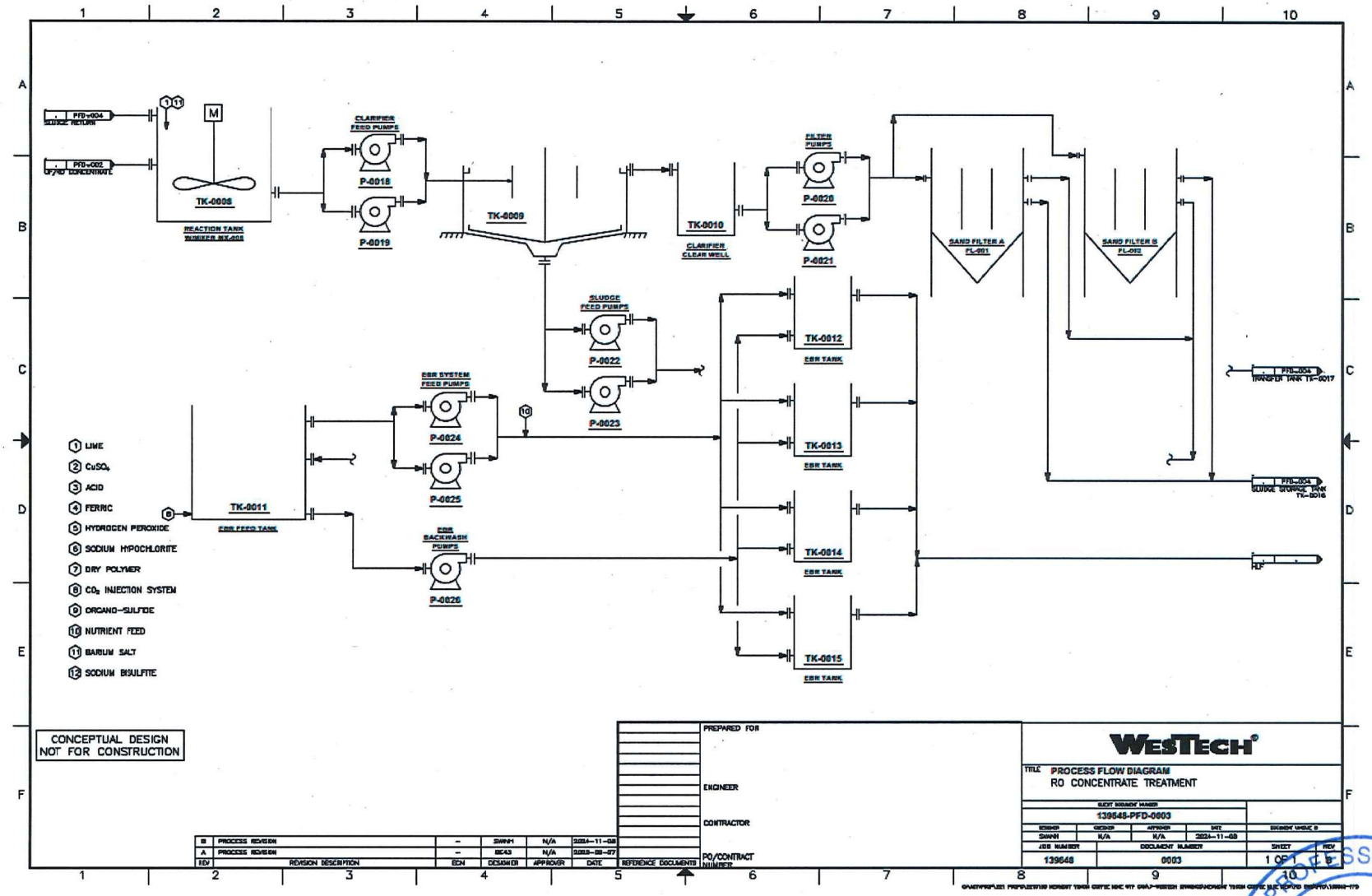


Figure 4. Coffee Gold conceptual water treatment. Process flow diagram depicting RO concentrate stream treatment.

PROFESSIONAL ENGINEER
YUKON TERRITORY
MARK SOMERS
16 JAN 2025

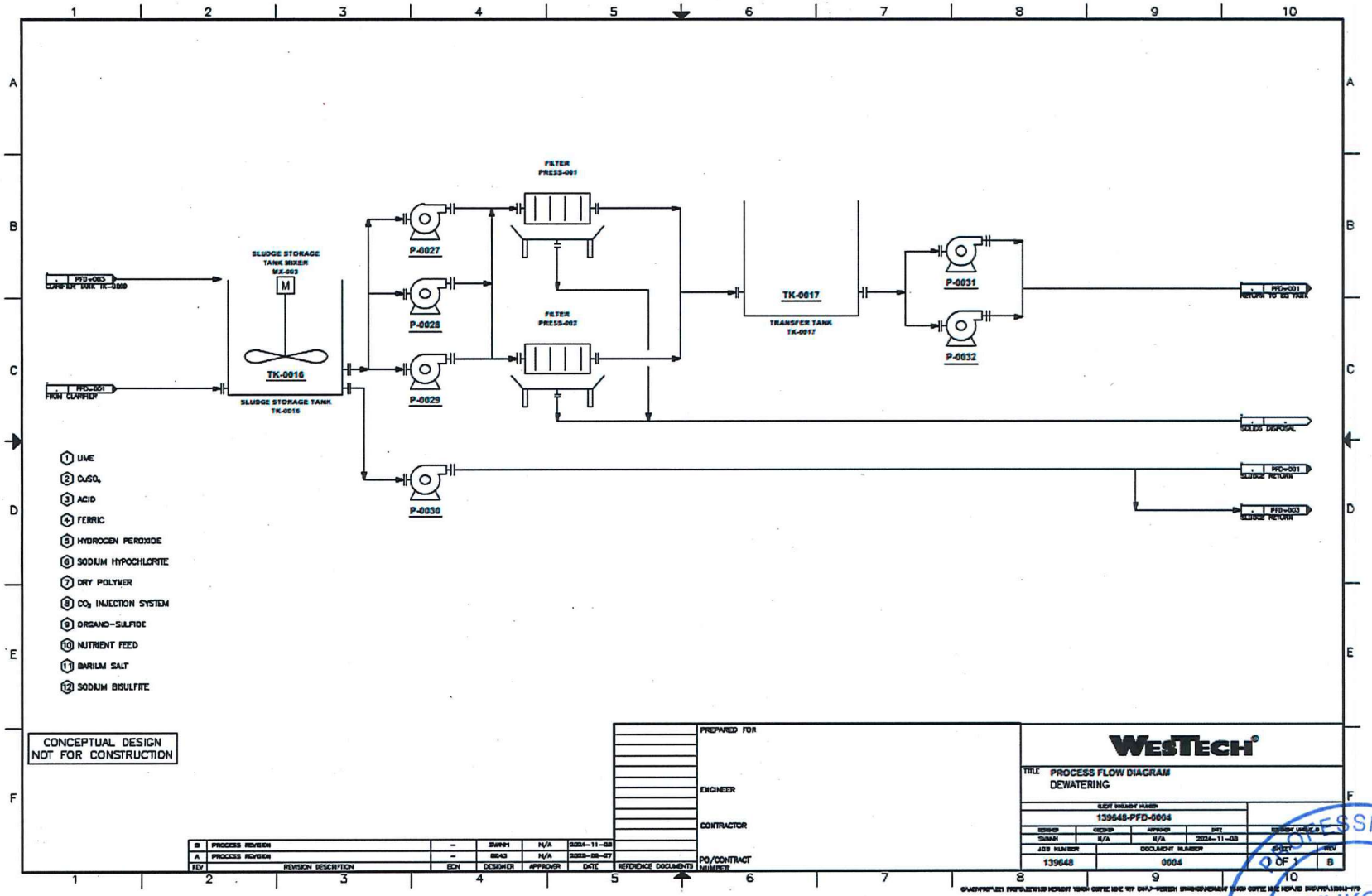


Figure 5. Coffee Gold conceptual water treatment. Process flow diagram depicting solids dewatering.

PROFESSIONAL ENGINEER YUKON MARK SOMERS TERRITORY

16/JAN/2025

The process is sensitive to the oxidative state of arsenic. If any reduced arsenic oxyanions, such as arsenite, are present, they must be oxidized to arsenate first for the ferric coagulation step to be effective. **WesTech approached the Coffee Gold system from a holistic perspective, and we looked for synergies between unit processes whenever possible.** The first step of the conceptual treatment design includes oxidation for cyanide detoxification, which will also ensure that all arsenic is present as arsenate (As(V)). Ferric chloride will act as a coagulant for any suspended solids present, which will improve the performance of the downstream clarifier.



Reaction tanks

Precipitation of some other metals, such as mercury, will need to be achieved with additional reagent dosing.

Because the water quality at the Coffee Gold mine will evolve with time, the treatment system must be flexible to handle varied contaminant loading. **The phys-chem system will be modular (multiple tanks), with some tanks taken offline or repurposed in later years. Additionally, any extra capacity required during the early years of operation can be supported by WesTech's rental fleet.**

Clarification

Following the mixed reaction tanks, water will be pumped into clarifiers. The most suitable clarification step will be selected during the Preliminary Engineering phase. As an example, the flocculating clarifier is similar to a conventional clarifier, except that the feedwell will be larger and contain an integral slow-moving mechanical flocculator to provide gentle mixing. This will allow solids that enter the tank to agglomerate, creating larger particles that will settle more rapidly. A flocculant will be required as a settling aid for the coagulated suspended solids. The flocculant is a long chain, high molecular weight polymer for coagulated particles to attach, creating much larger, faster settling particles.



Flocculating clarifier

The flocculating clarifier has a concentric dual drive and includes one motor each: for the rake and the flocculator drive. The rake mechanism consists of a shaft, rake arms, and cone scraper that rotates slowly and scrapes the settled solids into the center cone of the unit

The flocculator drive consists of a motor reducer to rotate the mixing impeller at a variable speed. The higher the impeller speed, the higher the mixing intensity in the reaction well. The VFD allows for balancing between mixing intensity and floc shear. Proper mixing intensity must be evaluated during start-up. Further adjustments will be infrequent once optimum impeller speed is determined through operation.

Settled sludge (~1% solids by weight) is then pumped out of the center cone to the sludge storage tank. A portion of the sludge will be recirculated back to the reaction mix tanks to aid with coagulation and precipitation. The clarified water will overflow the clarifier to a clearwell tank.

Neutralization

Treated water from the clarifier will have an elevated pH. **The pH must be lowered to prevent scaling and optimize the performance of the downstream membrane units.**

Several pH neutralization options were considered. With the Coffee Gold discharge standards for parameters such as chloride, nitrate, and sulfate, the use of conventional acids (e.g., hydrochloric, nitric, sulfuric) was dismissed. Carbon dioxide (CO_2) was selected as the neutralization option, leaving no detrimental dissolved species behind.

CO_2 will be injected into the pipe extending from the clarifier to the clearwell tank and will be primarily dispersed in the line. The CO_2 addition will be controlled using the pH meter located in the clearwell. Forwarding pumps will transfer the clarified water to the sand filters to remove residual solids.

Membrane Filtration

Ultrafiltration (UF)

Water in the clarifier overflow tank will feed the Ultrafiltration with VFD-controlled feed pumps. The water will first pass through a 200 µm pre-strainer for removal of larger debris. From the strainer, the feed will travel to the ultrafiltration system, which consists of membrane filtration units.

The filtration process is an outside/in, pressure-driven process to remove suspended solids and turbidity, and to achieve 4-log reduction of pathogens like Giardia and Cryptosporidium.

Filtrate is sent to the UF backwash tank. Backwashing is used to remove accumulated foulants by reversed inside/out flow at an interval of 20 - 60 minutes with air scour for increased agitation. A drain or filter-to-waste step is used to remove any additional accumulated material. Membrane integrity testing is conducted automatically once every 24 hours. The pressure decay test (PDT) is capable of detecting a single fiber break.

Maintenance cleans (MCs)/chemically enhanced backwashes (CEBs) and clean-in-place (CIP) procedures are automated chemical cleaning processes used to recover membrane permeability. MCs/CEBs are typically performed with NaOCl once per day to once per week. The automated clean-in-place procedure is designed to occur no more frequently than once per month, is conducted with either NaOCl or acid, and is initiated when membrane permeability decreases to a specified value.

Following chemical cleaning procedures, the membrane units are drained by gravity or a pressurized drain-to-waste, and waste is subsequently sent to the discharge location. A rinse step and backwashing are used to remove residual chemical prior to resuming production. If desired, chemical cleaning waste can be captured and neutralized prior to discharge.

Reverse Osmosis (RO)

Ultrafiltration permeate will be the feed to the RO. The feed goes to the reverse osmosis system. The single pass RO system is designed to remove dissolved contaminants from the inlet water source with a consistent silt density index (SDI) < 5 and a turbidity < 1 NTU.

The recovery of the system is preliminarily designed as 75% but may be improved or hampered by changes in the water quality and fluctuations in dissolved constituent concentrations, like TDS. The RO system has a nominal rejection rate of 95 – 99% of dissolved materials including hardness and TDS.

Reverse osmosis technology uses semi-permeable membranes for removal of dissolved contaminants. The basic principle of RO involves application of high pressure to counteract natural osmotic pressure to drive water from a more concentrated, feed solution to a pure water permeate. Dissolved impurities are removed during this process.

The process utilizes cross-flow filtration to remove dissolved contaminants from the feed stream, producing a purified water stream (permeate) and a high-solute waste stream (concentrate). The desired recovery level is typically determined by the scaling characteristics of the feed water. A high-pressure pump boosts the feed pressure provided by the feed pump(s) and drives water through the membranes.

The permeate stream will meet the treatment targets and will be discharged to the environment. Remineralization may be required prior to discharge.

Clean-in-place (CIP) procedures are chemical cleaning processes used to recover membrane permeability. The clean-in-place procedure is conducted with either a high pH/alkaline or low pH/acid solution, depending on the foulant. A CIP is initiated when normalized permeate flow decreases by ≥ 10%, normalized salt passage increases by ≥ 10%, or normalized differential pressure increases by ≥ 15%.

RO Concentrate Treatment

To ensure a zero-liquid discharge (ZLD) design, the reverse osmosis concentrate stream will be treated further and returned to the HLF (Figure 3). Cobalt will be recirculated through the treatment system until cyanide levels in the HLF drop, at which point, free cobalt will be readily precipitated in the phys-chem tanks. Some cobalt removal is also expected in the biological denitrification step (described below).

Sulfate Precipitation

Sulfate will be removed by gypsum precipitation. Since gypsum solubility is high (1,500 – 2,000 mg/L), the addition of barium salts might be needed to further enhance sulfate precipitation as $BaSO_4$. Barium sulfate has very low solubility in water (2.5 mg/L), with the final sulfate concentration limited only by the amount of barium added and reaction time.

Clarification and Filtration

The solids from the sulfate precipitation step will be captured in a thickener, with sand filters acting as a polishing step. The SuperSand™ is an up-flow, moving bed filter that is constructed with various media depths for different applications and configurations. The clarified and neutralized water will be pumped up to the top of the filter, where the feed pipe extends down the middle to near the bottom of the tank. The suspended solids will be filtered out as the water flows up through the filter media bed. As the filtrate reaches the top of the filter, it will pass over the effluent weir and will be discharged.

The Supersand filter employs a backwash rinse that is performed continuously while the tank is processing water. An airlift pump draws the media from the bottom of the filter up into the wash box. As the media is released into the wash box, it falls into the sand scrubber, where the filtered solids are separated from the sand. From there, the filtrate carries the solids out as waste (backwash). The washed sand falls down onto the media bed for continued use.

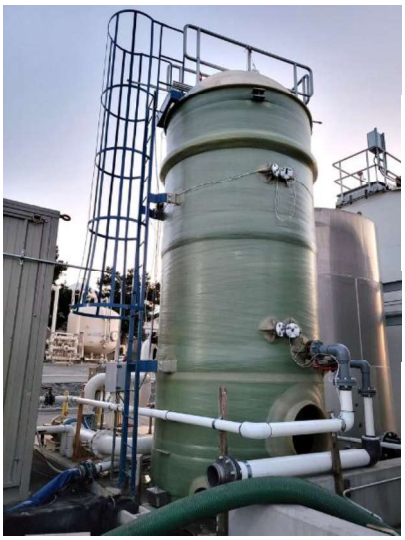
WesTech is an industry leader in continuous backwash sand filtration for tertiary treatment, total suspended solids reduction, and enhanced nutrient removal processes. With 35 years of experience, more than 25,000 filters are installed globally.

Denitrification

Biological denitrification is a process that relies on microorganisms to convert nitrate to nitrogen gas under anoxic conditions. It is commonly used in the tertiary treatment of wastewater, in mining and industrial water treatment, and – in recent years – even in drinking water applications.

In biological systems, microbes facilitate nitrate removal through electron transfer (redox processes). In conventional biological treatments, those electrons are supplied from excess organic carbo n. This typically results in excess biological growth and frequent backwashing.

Contrary to conventional biological systems, **the Electro-Biochemical Reactor (EBR) technology supplies the needed electrons directly to the reactor**. The electrons supplement those supplied from a carbon source, significantly reducing operating costs and lower biomass production. The directly supplied electrons are readily available to the microbes in a consistent, controllable manner, making the system less susceptible to low temperatures and changes in water conditions.



Denitrifying EBR

The EBRs will be supplied with organic carbon and supplemented with a direct current to maintain high electron availability. The by-product of denitrification is nitrogen gas, which is degassed to the atmosphere. Nitrogen is harmless and constitutes 78% of the air. Based on the preliminary bench-scale testing, the biological denitrification system is also expected to remove up to 60% of cobalt.

The size and number of the denitrifying bioreactors are sensitive to the nitrate loading rate (flowrate and nitrate concentration). Further, if the heat transfer inside the treatment building is not sufficient to keep a consistently warm water for the biological treatment, heaters will be required. Sizing for the denitrifying bioreactors will be adjusted based on the most current water quality information prior to detailed engineering.

WesTech has an extensive experience with denitrifying filters, with several dozen installations in the municipal wastewater and power markets over the past 12 years. The EBR process represents an improved process over our conventional denite filters.

Nitrate concentrations in the barren solutions are expected to be significantly lower than in the later years of the mine's life cycle. The EBR bioreactors will be designed and constructed in a modular fashion. The control philosophy will bring the reactors online based on nitrate load, as dictated by the flowrate and nitrate concentrations measured by an in-line nitrate analyzing instrument.

Solids Handling



Filter press

Solids generated from the physical-chemical treatment steps will be pumped to a sludge storage tank. The sludge holding tank is provided to collect the slurry prior to sending it to the filter press. Because dewatering with a filter press is a batch operation, sludge storage capacity is needed.

The sludge tank will feed filter presses, which will be used to separate solids from water (Figure 5). The filter press is comprised of a steel framework with a hydraulic closing cylinder that locks packs of membrane plates in place. The filter plates have an internal recess with a feed inlet and a filtrate drainage grid. Feed slurry is introduced under high pressure. As the chambers fill under pressure, filtrate moves through the membrane and exits via the plate drainage grid. The solids are trapped in the chamber and formed into a solid cake. At the end of the cycle, the membrane plates are inflated hydraulically to remove the cake.

Dewatered solids will be sent to an on-site lined pit for disposal. Water produced from the filter presses will be collected and pumped back to the front of the plant.

Conceptual Footprint and Site Layout

Based on the conceptual design, the approximate footprint of the plant is 36,000 ft^2 (3,350 m^2) (Figure 6). The maximum flowrate to the system was assumed as 15 L/s (238 gpm). Equipment sizing will be refined during the basic engineering design, possibly impacting the footprint and the layout.

We have also prepared a conceptual site 3D model to provide a visual representation of the Coffee Gold treatment plant's appearance (Figure 7). Because of the harsh environmental conditions in the Yukon, the facility will be enclosed. **A detailed site and building layout will be designed during preliminary engineering when site conditions are better understood.**

System Controls

The treatment facility will be equipped with a fully-automated control system. **The programmable logic controllers (PLC) will monitor and operate all unit processes based on flows, pressures, levels, and water quality parameters.** A local control panel will be provided with unit processes to give a local indication of motor status as well as limited motor controls. The status will also be transmitted to the distributed control system (DCS) along with a common alarm and common shutdown to give a remote indication of failure. All chemical dosing and transfer pumps will be pre-assembled on skids to ensure fast mobilization.

All chemical additions will be automated and controlled by the PLC. The skids for each reagent used will consist of one operating and one standby motorized diaphragm pump with automatic stroke control and local HOA switches. Only one pump will run at a time and will be selected at the DCS interface (Duty/Standby).



Dosing skid

The system will be equipped with instruments that will communicate with the PLC, including flow transmitters, flow control valves, level transmitters and switches, solenoid valves, pressure transmitters, etc. Each unit process will be equipped with relevant water quality analyzers. For instance, the clarifier unit will have an integrated turbidimeter and a pH probe, while the denitrifying bioreactors will be equipped with an in-line nitrate analyzer. The provided water quality monitoring will allow the operators to assess the plant's performance in real time. **The human-machine interface (HMI) will display the current plant conditions, trends, and alarms for the operators, notifying them of improper operations or out-of-spec conditions.**

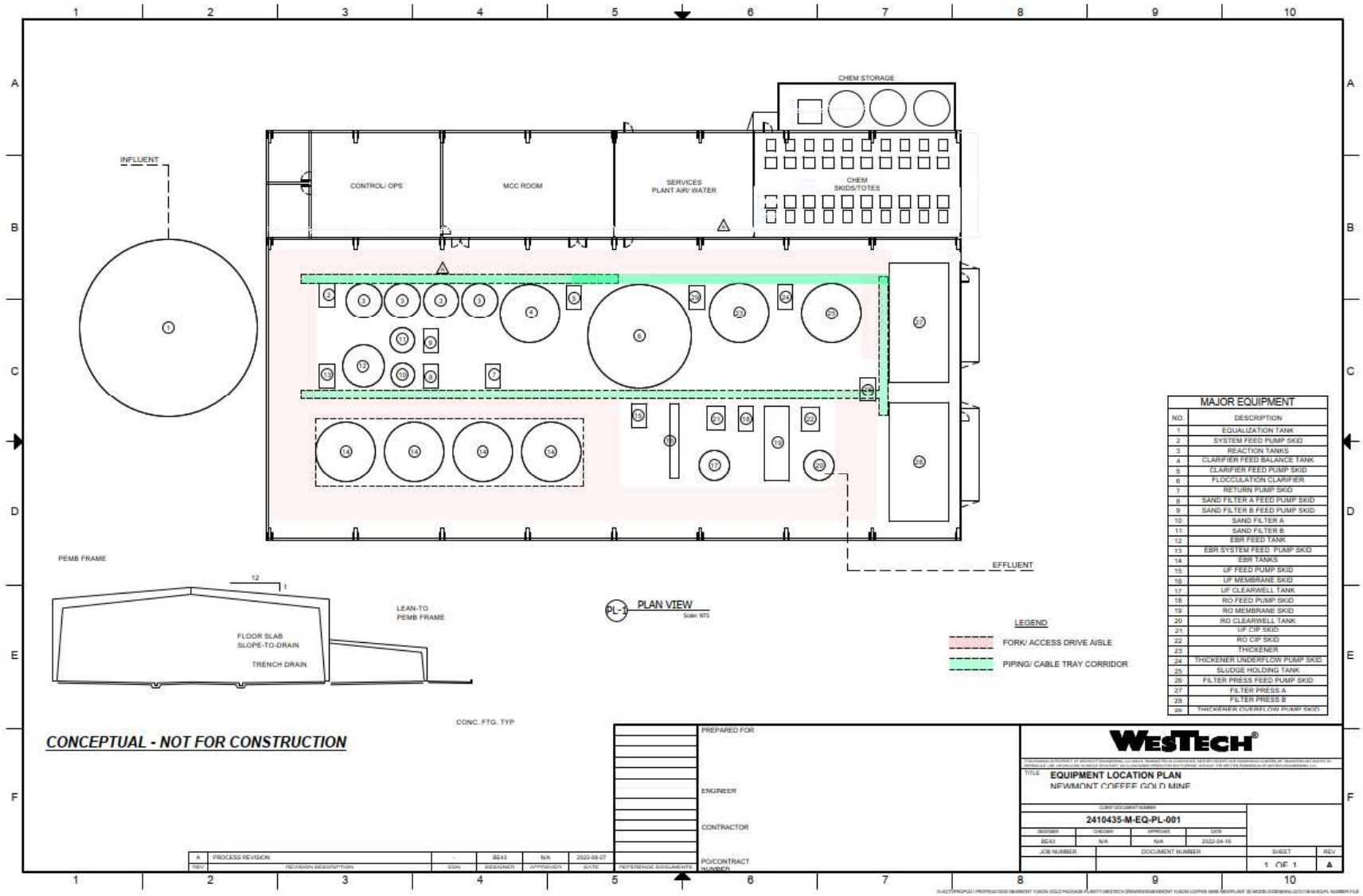


Figure 6. Coffee Gold conceptual water treatment. Plant layout.

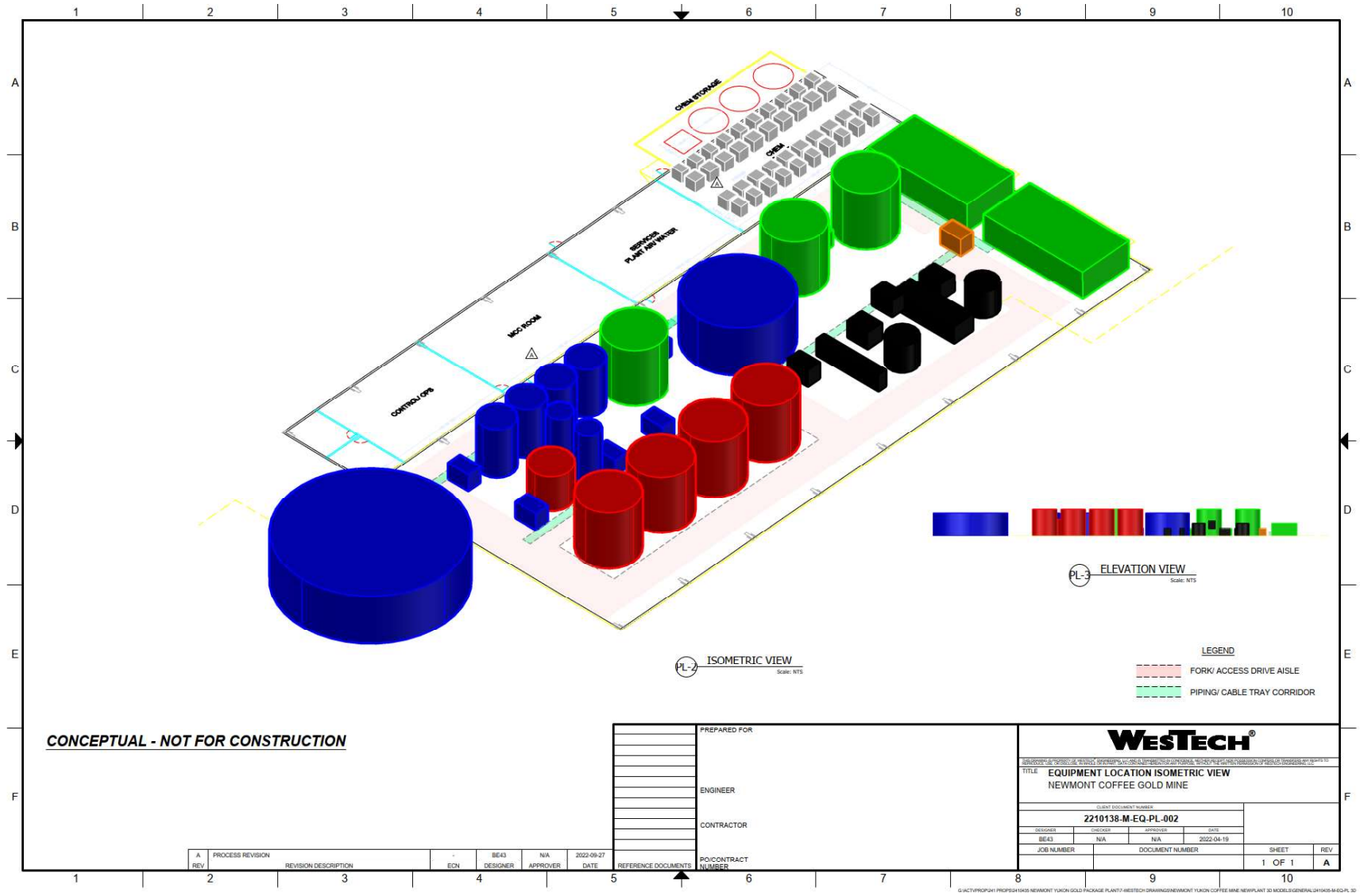


Figure 7. Coffee Gold conceptual water treatment. Plant 3D model.

Comparable WesTech Case Studies

WesTech has extensive experience designing mine water treatment systems with multiple unit processes, and we understand the nuanced differences in site chemistry and treatment needs. Although no two mine sites are the same, below are four case studies of our installations that include the same or similar processes and equipment proposed for the Coffee Gold site.

Newmont Pamour Water Treatment

Newmont has chosen WesTech to be the preferred technology provider for the Parmour pit dewatering project in Canada. WesTech recently designed the water treatment plant (WTP) for Newmont's Porcupine operation, where the Pamour pit is to be dewatered to extend the life of the mine. **The Pamour WTP flow sheet (Figure 8) closely resembles the conceptual design proposed for the Coffee Gold mine.** Two notable differences are 1) the use of the ultrafiltration membranes for solids polishing to trace levels instead of sand filters, and 2) the lack of biological denitrification system due to low nitrate levels. The plant is currently under construction.

The Pamour open pit contains over 32 million m^3 of water that must be treated prior to its utilization. The WTP is designed to treat the water and remove metal contaminants consisting primarily of arsenic, copper, cobalt, and nickel. The treatment method consists of various steps for the precipitation of the metals, followed by clarification. To meet the low effluent compliance standards, ultrafiltration is used to polish the clarified water and remove trace precipitants. Finally, the thickened precipitated solids are collected and further dewatered with a filter press.

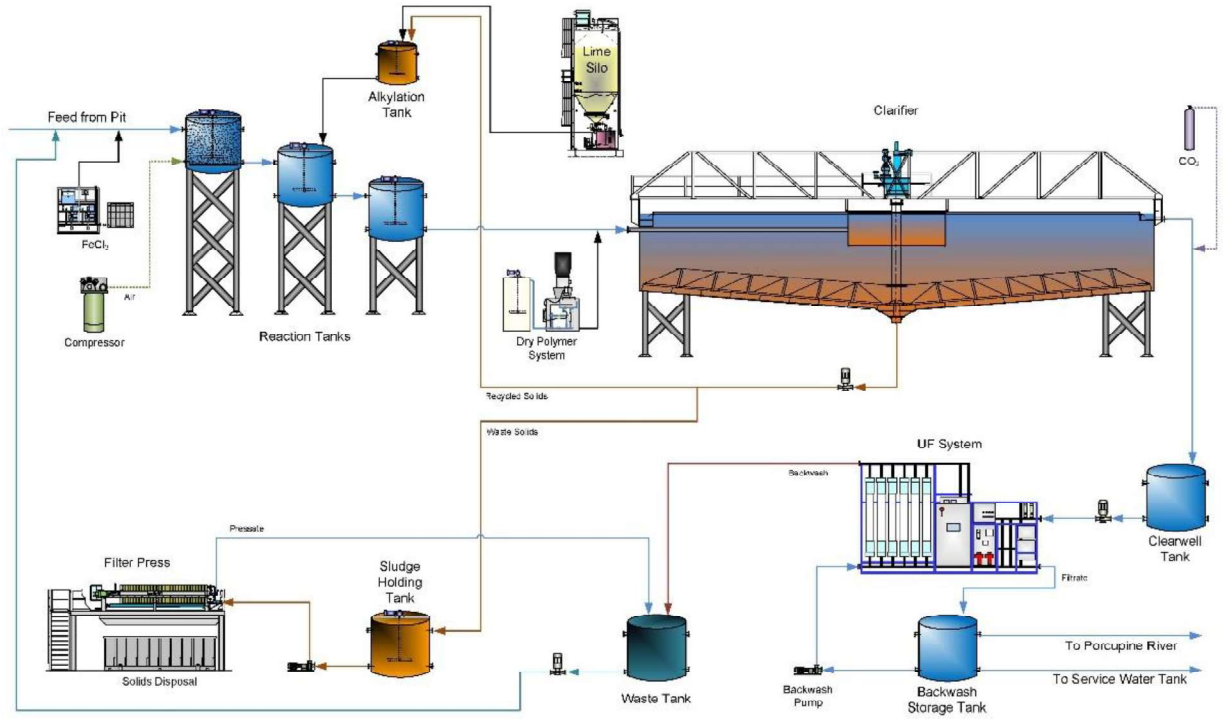


Figure 8. Newmont Pamour water treatment flow sheet.

Metals precipitation involves several treatment steps and reagent additions. First, oxidation is used to drive arsenic to its arsenate oxidation state. Ferric chloride is then added to allow for arsenic co-precipitation. The addition of the feed from the alkylation tank elevates the pH, causing calcium carbonate formation. After sufficient mixing and reaction time, a polymer is added before the clarifier.

The Pamour WTP is designed to collect and treat the ultrafiltration backwash, filter press filtrate, and filter press cloth wash so that the only waste disposal required is the dewatered filter cake from the filter press. The filter press cake consists of mainly calcium carbonate/calcium hydroxide with trace metal solids and some iron hydroxide solids generated with co-precipitated arsenic solids. Since there is no RO membrane or ion exchange in the treatment system, no offsite liquid disposal is required for concentrated brine or regenerant waste.

Combination of Phys-Chem and Biological Treatment

WesTech has extensive experience designing, installing, and operating water treatment systems for the FGD (flue gas desulfurization) streams at large coal-fired power plants. **A typical flow sheet, shown in Figure 9, resembles the treatment train proposed for the Coffee Gold project** and includes:

- Flow equilibration
- pH elevation
- Metals precipitation (e.g., mercury)
- Coagulation
- Arsenic co-precipitation
- Flocculated clarification
- pH neutralization
- Denite filtration
- Biological selenium removal

WesTech's FGD treatment relies on robust sedimentation and filtration equipment, supported by biological denitrification and metals removal steps, proven to treat complex wastewater streams successfully. Flue gas desulfurization removes sulfur dioxide from fossil fuel flue gases. Wet-scrubbing transfers the pollutants to a liquid which is treated before waterway discharge.

FGD wastewater can be a combination of multiple waste streams. An equalization tank allows for peak-flow attenuation and stream homogenization via mixing. Desaturation is performed by raising the wastewater stream pH to between 8.2-9.2 using lime ($Ca(OH)_2$) or sodium hydroxide (NaOH). Dissolved metals precipitate as hydroxides and sulfates, settling in the clarifier.

Reaction tanks are used to precipitate and coagulate metals, such as mercury and arsenic. Metal precipitates are removed from the waste stream by a flocculating clarifier. The pH of the clarified overflow is neutralized using hydrochloric acid prior to filtration and anaerobic biological treatment. WesTech's conventional denite filters are applied to reduce the nitrate loading to the biological selenium removal.

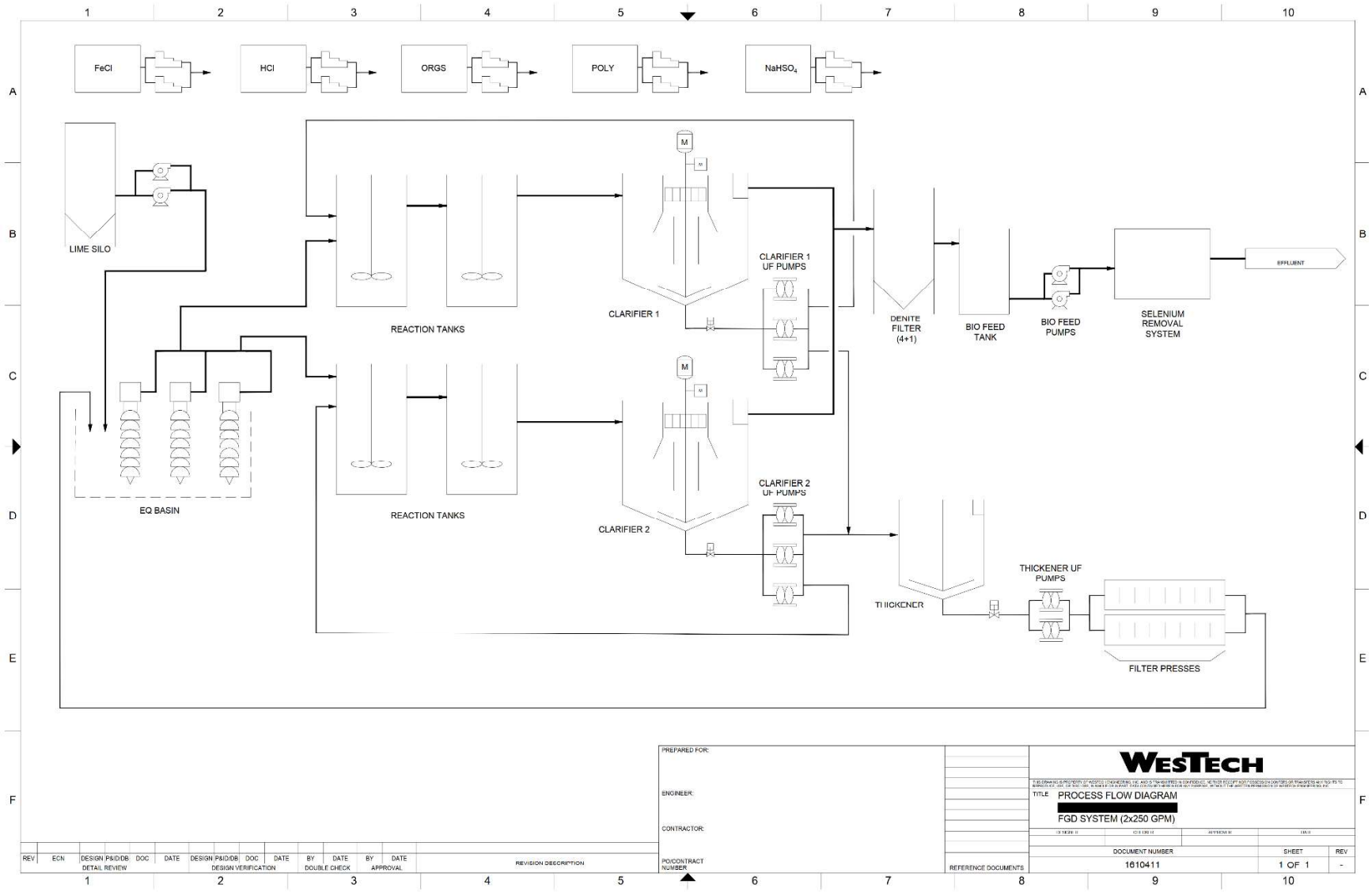


Figure 9. Typical WesTech FGD water treatment flow sheet.

Temporary Systems: Phys-Chem and Biological

In addition to the equipment-heavy large FGD projects, WesTech also has a breadth of experience supplying and operating mobile equipment for ash pond dewatering needs. One example is a 250-gpm (15.8 L/s) ash pond dewatering project, targeting solids (TSS), pH, arsenic, iron, mercury, selenium, and nitrates. The water is treated through a series of reaction tanks, clarifiers, filters, and bioreactors (Figure 10). WesTech was responsible for the engineering, procurement of equipment, construction, and operation.

Based on the similar flowrates and unit processes, WesTech's temporary ash-pond dewatering systems are a good example of how we can support a phased and modular installation of the Coffee Gold water treatment plant.



Figure 10. WesTech's temporary ash-pond dewatering system.

Drinking Water Denitrification

Two case studies for the application of WesTech's EBR technology for groundwater denitrification deserve mention. **Applying the biological denitrification process proposed for the Coffee Mine for the municipal drinking water emphasizes the confidence and regulatory approval the EBR process has passed.** Upon completion of successful field pilot-scale demonstrations, both municipalities have pre-selected the EBR equipment and are currently in the preliminary engineering phase.

The groundwater denitrification plant in Oakley, KS, is designed for a maximum flow of 510 gpm (32 L/s). A portion of the total flow (300 gpm or 19 L/s) will be treated with the EBR bioreactors to remove nitrate-N from approximately 17 mg/L to less than 2 mg/L. The EBR effluent will be blended with the rest of the plant flow to obtain nitrate-N concentrations less than 10 mg/L (the drinking water limit).

A second denitrification plant is currently designed for a rural water district in Oklahoma. With the maximum plant flow of 300 gpm (19 L/s), the system will remove nitrate-N from approximately 16 mg/L to below the drinking water limit.

Engineering and Design

Project Delivery Options

Modular Implementation Capabilities and Mobile Equipment Support

We understand that the operating flow rates and water quality parameters at the Coffee Gold Mine will change over the life of the project. The water treatment plant described within this document can be designed and built in full after the mine is commissioned. However, for the first several years of operation, the treatment plant would have excess capacity and consist of unit process targeting parameters that may not yet be present at substantial levels.

To address this discrepancy between the worse-case water quality projections and the early years of mine's lifecycle, WesTech can design the system in a modular fashion and support the phased installation with our mobile equipment fleet. To develop the Execution Plan and schedule, we will work closely with you to identify which parameters have to be treated each year of mine's operation. With mobile units, treatment requires a smaller commitment of resources and provides easier installation, fewer operating costs, and a reduced footprint. The systems can also include electrical, piping, asset management, and installation.

WesTech offers a variety of temporary treatment solutions, including aeration units, clarifiers, RO membranes, ultrafiltration, DAF units, pressure filters, Rapisand™ flocculating clarifiers, Superdisc™ filters, and chemical feed skids. Please see the attached brochure for details.

Scope Split

WesTech is proud to provide various project delivery options, including equipment supply, process and system design, and engineering. We have a good working relationship with several consulting engineering firms in the US and Canada and can work with an engineering partner preferred by Newmont. Our professional services portfolio includes:

- Water treatment process equipment
- Supporting water/wastewater needs for industrial, minerals, and municipal markets
- Civil and mechanical engineering design
- Process analysis and support
- Instrumentation design and supply
- Electrical panels and support
- Tankage, erection, and installation service
- Start-up and optimization

WesTech's design-build team can take responsibility for the full design, equipment supply, installation, and start-up of the most challenging turnkey projects. Coupling WesTech's proven treatment equipment with our in-house engineering and construction expertise allows facility owners and design engineers to focus on the bigger-picture challenges of the overall project. We look forward to working with you on defining the scope split for the design. The table below shows the scope we are able to supply.

Next Steps: Advancing Design

To progress the project into the Basic Design phase, we will require the client to provide and assist with the following:

1. The finalized mine water balance and water quality predictions
    a. The expected flowrate and water quality parameters each year of mine operation. This information is crucial to finalize the equipment supply and sizing for the full-scale facility.
    b. Water treatment targets and plan for each year of mine operation. Understanding that the water quality will change as the mine operation progresses, the system can be installed in a modular fashion and supported by rental equipment.
2. Newmont-specific project requirements

Once the information requested above is available, WesTech will develop a Basic Design document, equivalent to a 30% design. The document will contain:

- Updated design basis document
- Refined drawings, including:
    - Process flow diagrams (PFD) with input from Newmont
    - Equipment general arrangement (GA)
    - Site plan and layout
    - Piping and instrumentation (P&ID), which will set the scope of the project and define the level of controls
    - Electrical single-line drawings, supported by a load list
- Plant mass balance, based on the finalized design criteria and the approved PFD, to refine equipment sizing
- Other calculations, including:
    - Hydraulic profile
    - Chemical consumption
    - Pump hydraulics
    - Major equipment sizing refinement
    - Utility consumption
- Equipment list, including:
    - Major equipment list, including tankage sizing, pumps, mixers, blowers, drive units, based on the approved PFD
    - Chemical feed systems, including tankage, pumps, and mixers
- Scope of supply and equipment scope details, including detailed equipment description, datasheets, and other lists as required
- Execution plan and schedule
- Commercial proposal, including:

- Budget pricing
- Payment terms
- Schedule
- Warranty and process guarantees

With input from Newmont, the information developed in the Basic Design document will be used to generate the Final Engineering and Design package.

Active Water Treatment Plant Work Plan

The proposed water treatment plant (WTP) design for the Coffee Project will incorporate a design that has been tested and validated through a phased feasibility testing approach, including laboratory testing, on-site pilot testing, and optimizations. The objective of the phased testing approach is to develop fully vetted operational parameters and design criteria prior to implementation of a full-scale WTP facility.

Work Completed

Based on the water quality modelling, Phase I and Phase II testing programs were completed to develop and advance a conceptual design for the WTP. The Phase I treatability assessment and proof-of-concept was conducted in 2016 and consisted of laboratory assessment tests and evaluation of site water chemistry. The tests included column heap leach to generate water for treatment, site water chemistry evaluation, microbial screening tests, and treatment effectiveness assessment. The Phase II continuous flow laboratory column tests were conducted in 2020 and were used to develop an overall treatment approach for the Project heap leach rinse waters, as well as to develop operational parameters for on-site pilot-scale tests. Further optimization jar testing was performed in 2022 and 2024. An overview of the work completed to date is presented in Figure 11, and descriptions of the studies completed to date as well as outcomes of the testing programs are provided in the WesTech Report: From Feasibility Studies to a Conceptual System Design (WesTech 2021).

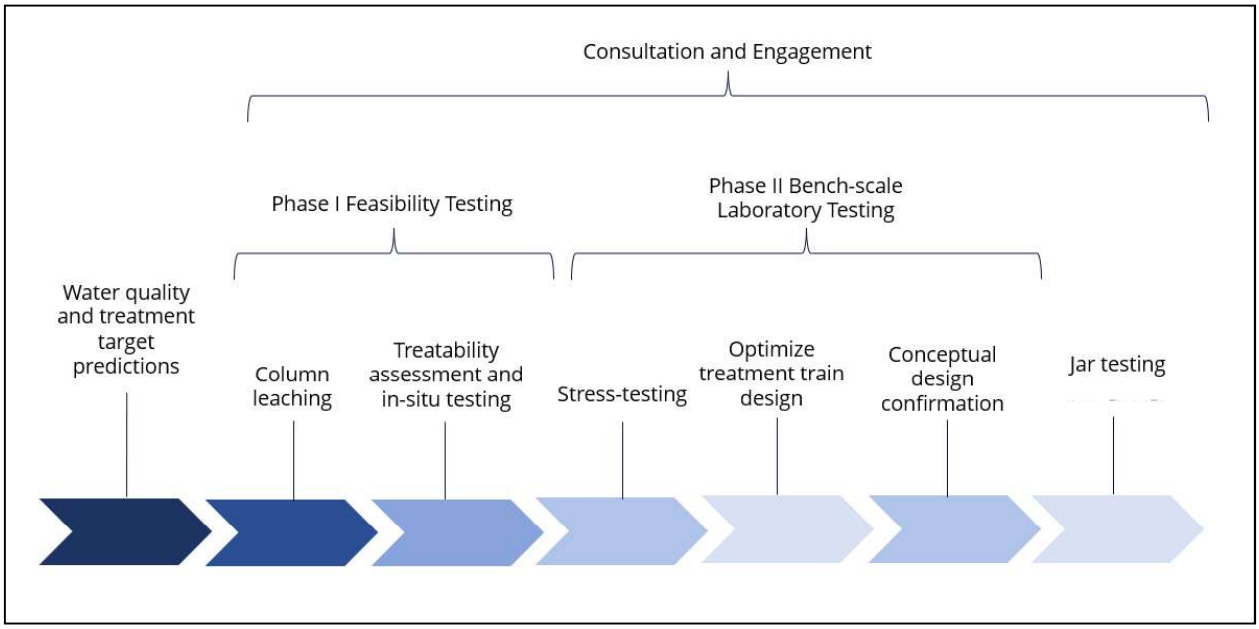


Figure 11. Water Treatment Plant Work Completed

Work Required

The work required prior to WTP operation includes development of the Preliminary and Detailed Engineering designs for the system, as well as Phase III pilot-scale testing. The designs will be based on outcomes of previous test work. An overview of the work that is required prior to full-scale implementation of the WTP, including Project milestones, is provided in Figure 12. A description of the work and associated milestones is provided below.

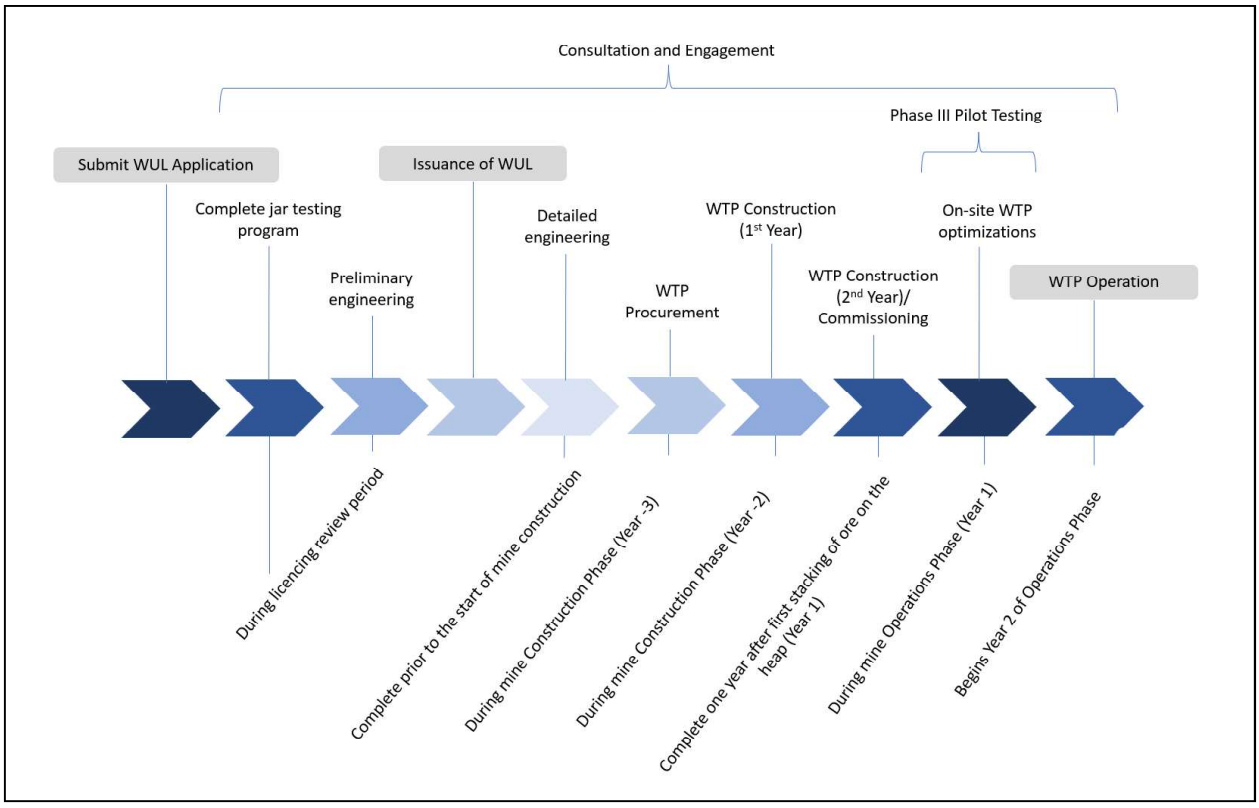


Figure 12. Water Treatment Plant Work Required

The WTP Preliminary Engineering will be completed during the licensing review period and will be based on the final jar testing results. The Preliminary Engineering document will contain refined process flow diagram drawings, plant mass balance, equipment list, scope of supply, execution plan and schedule, and commercial proposal. The development of this document is highly collaborative and typically requires three to six months to complete.

Detailed Engineering of the WTP will be completed to support the WTP procurement and construction processes. A Final Engineering and Design package will be produced and submitted prior to the initiation of mine site construction, which is scheduled to occur in Year -3 of mine life. The Final Engineering and Design package will build upon the Preliminary Design document and expand to include Piping and Instrumentation Diagram drawings, single-line electrical drawings, hydraulic and other calculations, plant layouts and 3D models, and mechanical design. The output will be an Issued for Construction package that

will be handed over to a construction contractor. The estimated time requirement for the Detailed Engineering is 12 months.

In order to ensure a functioning water treatment plant in Year 2 of operation, the WTP procurement process will occur within the first year of mine site construction (Year -3). The procurement period, scheduled for 12 months, starts with submitting design packages and equipment scope requirements to manufacturers and approving the fabricator drawings before releasing the purchase order or fabrication. Off-the-shelf components can be delivered quickly. However, fabrication of items such as skids and tanks takes months and hinges on the state of the global supply chain. While working in the procurement period, long-lead items are prioritized first.

Construction of the WTP is anticipated to be carried out over a two-year period, which will commence during Year -2 of the mine Construction Phase, and will continue into Year -1, which is the first year of the mine Operations Phase. Stacking and leaching ore on the leach pad is scheduled to start in the 2nd quarter of Year -1; therefore, commissioning of the WTP would occur during Year -1, and will be complete one year following the first stacking of ore on the heap. Commissioning will include wet testing, instrumentation and electrical testing, and programming testing.

Once the plant is commissioned, the full-scale equipment will be utilized to run a Demonstration Pilot (Phase III pilot testing program) in Year 1. The heap leach rinse waters will be treated through the plant in a recirculating mode for a period of six months. The objective of the Demonstration Pilot is to validate and optimize the system for treatment of the contaminants in the actual Project leach rinse waters. The two main goals of piloting will be to 1) demonstrate treatability under real-life conditions; and 2) optimize the performance in terms of reagent dosing rates.

Upon meeting the objectives of the Phase III pilot testing program, including validation of the treatment system for all parameters and process optimizations, the WTP will be operational by Year 2 of mine life, when the heap leach water balance model indicates solution removal will need to commence.

References

WesTech Engineering (WesTech). 2021. Coffee Project Water Treatment: From Feasibility Studies to a Conceptual System Design. Comprehensive Report. Prepared for Newmont Mining. Prepared by WesTech Engineering. September 2021.

Clarifications and Exceptions

General Clarifications

The process and system described herein is provided based on the current available information, including: water quality projections, laboratory test results, and site considerations currently understood by WesTech.

This document is not intended to be considered the basis of the final design (or purchase) of the system, and therefore is subject to modifications based on actual water quality that would be confirmed during mine development and after production/start-up of the mine. As such, we consider the plant design information conceptual, preliminary, and non-binding. WesTech is not liable for any costs associated with possible design changes, up to and including a complete system redesign.

Supplemental Information

Comprehensive Testing Report
Brochures
Case Studies

APPENDIX 7-A

2023 Geochemical Source Term Report

Coffee Mine Project
Geochemical Source Term Report

Prepared by:
Lorax Environmental Services Ltd.
2289 Burrard St.
Vancouver, BC, V6J 3H9

Prepared for:
Newmont Goldcorp
666 Burrard St #3400
Vancouver, BC V6C 2X8

1 January 2023

Table of Contents

TABLE OF CONTENTS I
1. INTRODUCTION 1-1
1.1 OVERVIEW 1-1
2. MINE FACILITIES 2-1
2.1 WASTE ROCK STORAGE FACILITIES 2-1
2.1.1 PIT WALL ROCK 2-4
2.1.2 ROM PAD AND STOCKPILE 2-5
2.1.3 HAUL ROADS 2-6
3. DATA SOURCES 3-1
3.1 HYDROLOGY 3-1
3.2 KINETIC TESTING 3-2
3.2.1 UNSATURATED TESTS 3-4
3.2.2 SATURATED TESTS 3-4
4. SOURCE TERM CALCULATIONS 4-1
4.1 APPROACH 4-1
4.2 WASTE ROCK STORAGE FACILITY 4-1
4.2.1 UNSATURATED SOURCE TERM 4-1
4.2.2 SATURATED SOURCE TERM 4-2
4.2.3 SOLUBILITY CONTROLS 4-3
4.2.3.1 URANIUM SOLUBILITY 4-3
4.2.3.2 ARSENIC SOLUBILITY 4-10
4.3 ROM STOCKPILE 4-11
4.3.1 UNSATURATED SOURCE TERM 4-11
4.3.2 SOLUBILITY CONTROLS 4-12
4.4 PIT WALL ROCK 4-13
4.4.1 UNSATURATED SOURCE TERM 4-13
4.4.2 SATURATED SOURCE TERM 4-14
4.4.3 SOLUBILITY CONTROLS 4-14
4.5 HAUL ROADS 4-15
4.5.1 UNSATURATED SOURCE TERM 4-15
4.5.2 SOLUBILITY CONTROLS 4-15
4.6 HEAP LEACH SOLUTION SOURCE TERMS 4-16
4.6.1 HLF BARREN SOLUTION CHEMISTRY – EARLY PHASE 4-17
4.6.2 HLF BARREN SOLUTION CHEMISTRY – LATE PHASE 4-18
4.6.2.1 ANALOGUE MINES 4-19
4.6.2.2 HLF RINSE SOLUTION ESTIMATE FOR MAJOR IONS AT COFFEE 4-20
4.6.2.3 HLF LATE PHASE AND RINSE SOLUTION ESTIMATE FOR TRACE ELEMENTS AT COFFEE 4-29
4.6.2.4 HLF LATE PHASE SOLUTION AND DRAINDOWN SEEPAGE CHEMISTRY ESTIMATE 4-32
4.6.3 SUMMARY OF HLF SOLUTION SOURCE TERM ESTIMATE 4-33
REFERENCES R-1

APPENDIX A SOURCE TERMS
APPENDIX B COFFEE GOLD PROJECT GEOCHEMICAL CHARACTERIZATION REPORT
APPENDIX C SATURATED COLUMN REPORT
APPENDIX D LOADING RATES
APPENDIX E ACTIVE TREATMENT TESTWORK REPORT

LIST OF FIGURES

FIGURE 2-1: MASS AND GEOLOGIC COMPOSITION OF ALPHA WRSF (TOP) AND BACKFILLED KONA PIT (BOTTOM) OVER THE LOM. 2-2

FIGURE 2-2: MASS AND GEOLOGIC COMPOSITION OF IN-PIT LATTE (TOP), IN-PIT SUPREMO (MIDDLE) AND IN-PIT DOUBLE DOUBLE (BOTTOM) WRSFS OVER THE LOM. 2-3

FIGURE 2-3: MASS AND COMPOSITION OF ROM ORE STOCKPILE AND WASTE ROCK USED IN PAD CONSTRUCTION..... 2-6

FIGURE 3-1: MEAN ANNUAL PRECIPITATION AS A FUNCTION OF MASL AT THE COFFEE SITE. 3-2

FIGURE 3-2: TIME-SERIES OF AS, U AND SO_4 FOR PHASE I SATURATED COLUMN STUDY 3-5

FIGURE 4-1: GENERALIZED U(VI) SORPTION BEHAVIOR ON FE-OXHYDROXIDE AS A FUNCTION OF PH, CA, AND ALKALINITY IN A PHREEQC SIMULATION. ALKALINITY IS FIXED BY pCO_2 REPRESENTATIVE OF TYPICAL ATMOSPHERIC ($10^{-3.5}$ ATM) AND GROUNDWATER ($10^{-3.5}$ ATM) CONCENTRATIONS. THE U SORPTION ENVELOPE DECREASES FROM PH ~6.5 TO 9 AS pCO_2 AND [CA] INCREASE, INDICATING GREATER U(VI) SOLUBILITY (FIGURE FROM LORAX, 2019). 4-4

FIGURE 4-2: PROBABILITY OF HAVING U CONCENTRATIONS ABOVE THE CCME GUIDELINE VALUE (15 µG/L) CALCULATED OVER DIFFERENT RANGES IN ALKALINITY, CA, ELECTRICAL CONDUCTIVITY, AND PH IN SURFACE WATER SAMPLES IN THE DAWSON RANGE. DATA LABELS IN GREY FONT CORRESPOND TO THE NUMBER OF WATER-SAMPLE ANALYSES USED TO CALCULATE EACH PROBABILITY VALUE 4-5

FIGURE 4-3: MODEL VALIDATION RESULTS COMPARED TO MEASURED RESULTS FOR HC3 AND COL 6. . 4-7

FIGURE 4-4: MODEL RESULTS FOR BASE CASE ALPHA WRSF FOR U, CA AND ALKALINITY. 4-10

FIGURE 4-5: CALCIUM CONCENTRATIONS *VERSUS* CALCITE SATURATION INDICES (SI) IN HLF DRAINAGE AT ANALOGUE MINES. 4-22

FIGURE 4-6: LOG pCO_2 VERSUS PH IN HLF DRAINAGE AT ANALOGUE MINES. DOTTED LINE INDICATES BEST FIT LINEAR REGRESSION. 4-22

FIGURE 4-7: MAGNESIUM CONCENTRATIONS VERSUS MAGNESITE SATURATION INDICES (SI) IN HLF DRAINAGE AT ANALOGUE MINES. 4-23

FIGURE 4-8: POTASSIUM CONCENTRATIONS *VERSUS* PH IN HLF DRAINAGE AT ANALOGUE MINES. DOTTED LINE INDICATES BEST FIT LINEAR REGRESSION. 4-24

LIST OF TABLES

TABLE 2-1: SURFACE AREA (HA) OF MINE FACILITIES IN EACH YEAR OF MINE LIFE 2-4

TABLE 2-2: PERCENTAGE OF FOOTPRINT AND MASS SUBMERGED ONCE PITS FLOOD TO SPILLWAY ELEVATION 2-4

TABLE 2-3: RELATIVE PROPORTIONS OF ROCK TYPES EXPOSED WITHIN MINE PITS UPON COMPLETION OF EXCAVATIONS 2-5

TABLE 2-4: LENGTH OF HAUL ROADS AT END OF OPERATIONS BY CATCHMENT 2-6

TABLE 3-1: MINE FACILITY RUNOFF COEFFICIENTS 3-2

TABLE 3-2: SUMMARY OF KINETIC TESTS INITIATED FOR THE COFFEE GOLD MINE 3-3

TABLE 3-3: ARSENIC CONCENTRATIONS PRODUCED DURING PHASE 1 OF THE SATURATED COLUMN EXPERIMENTS. 3-5

TABLE 4-1: OVERVIEW OF KINETIC TESTS USED FOR WRSF SOURCE TERM CALCULATION 4-2

TABLE 4-2: MODEL INPUTS USED TO RE-PRODUCE KINETIC TEST U CONCENTRATIONS. 4-6

TABLE 4-3: MEASURED AND MODELED U CONCENTRATIONS FROM KINETIC TESTS. 4-7

TABLE 4-4: TOTAL FE AND U CONTENT OF WASTE ROCK AND U SOLUBILITY MODEL INPUTS. 4-8

TABLE 4-5: KINETIC TESTS AND CYCLES USED FOR ORE STOCKPILE TERM CALCULATION 4-12

TABLE 4-6: TOTAL FE AND U CONTENT OF ORE LITHOLOGIES AND U SOLUBILITY MODEL INPUTS. 4-12

TABLE 4-7: EXAMPLE OF INFILTRATION CHEMISTRY CALCULATED FOR THE ORE STOCKPILE, WASTE ROCK PAD AND COMBINED SOURCE TERM FOR Y2 BASE CASE SCENARIO 4-13

TABLE 4-8: KINETIC TESTS AND CYCLES USED FOR PIT WALL SOURCE TERM CALCULATION 4-14

TABLE 4-9: EARLY PHASE HEAP LEACH SOLUTIONS SOURCE TERM ESTIMATE 4-18

TABLE 4-10: MAJOR ION CONCENTRATIONS MEASURED AT ANALOGUE MINES 4-21

TABLE 4-11: METALLURGICAL COLUMNS AND KINETIC TEST 4-26

TABLE 4-12: METALLURGICAL COLUMN RESULTS FOR SO_4 AND CL CONCENTRATIONS 4-27

TABLE 4-13: WATER-SOLUBLE LOAD OF SO_4, CL AND NA USED IN LOADING MODEL 4-28

TABLE 4-14: WEATHERING RATE OF SO_4, CL AND NA USED IN LOADING MODEL 4-28

TABLE 4-15: KINETIC TEST DATA USED IN HLF POST CLOSURE SOURCE TERM 4-30

TABLE 4-16: HEAP LEACH RINSE SOLUTION ESTIMATE SCALING FACTORS 4-30

TABLE 4-17: LATE PHASE HEAP WATER CHEMISTRY ESTIMATE PRIOR TO TREATMENT 4-33

TABLE 4-18: EARLY AND LATE PHASE HEAP WATER CHEMISTRY ESTIMATE SOURCE TERM 4-34

1. Introduction

1.1 Overview

This report describes the geochemical source terms developed and used in the Coffee Mine project water quality model (WQM). Geochemical source terms are water quality predictions for water in contact with geologic material disturbed by mining activities. Individual source terms are developed on an annual basis for each year of mine life and for post-closure. Specifically, the report describes the approach and resultant source terms for:

- WRSFs
- Pit Wall Rock
- Haul Roads
- ROM Stockpiles and
- Heap Leach Solutions

All source term inputs used in the Water Balance Water Quality Model (WBWQM), are presented in Appendix A. For each mine component, a base case and upper case source term has been calculated. The base case source term is meant to reflect the expected condition, while the upper case is meant to reflect a reasonably conservative upper estimate. These predictions become inputs to the WBWQM that is used to predict water quality in the receiving environment as a result of Project activity during operations and following reclamation and closure.

Source terms presented herein reflect the proposed mine plan and associated mine waste management and water management practices. The mine facilities and the assumed lithologic composition are described in Section 2. The geochemical data used to estimate loading rates and solubility controls is described in Section 3. Section 4 presents the approach, methodology and resultant source term determinations for the mine components. The scaling of loading rates and application of solubility controls to develop the source terms are an important discussion within Section 4.

2. Mine Facilities

In this section the footprints, mass and composition of mine waste facilities are presented. These mine facility details used as inputs to source term calculations.

2.1 Waste Rock Storage Facilities

Approximately 330 Mt of waste rock will be excavated from the Supremo Pit, Double Double Pit, Latte Pit and Kona Pit over the life of the Project. The majority of waste rock excavated (~246 Mt) will be stored in one out of pit waste rock facilities (Alpha WRSF) and four in-pit WRSFs (In-Pit Supremo, In-Pit Latte, In-Pit Double Double and In-Pit Kona). The lithologic composition of each waste rock facility is estimated by assuming; no re-handling of waste rock takes place, and waste rock is deposited in the WRSF nearest the origin of excavation; and the proportion of different weathering states is the same as what was anticipated in the Project Proposal geochemical characterization report (Appendix B). This assumption results in waste rock from the Latte Pit (schist) and Kona Pit (granite) being stored in the Alpha WRSF, while waste rock from the Supremo Pit and Double Double pits (gneiss) are placed in the Alpha WRSF and all four In-pit dumps. This results in the Alpha WRSF being the only facility which contains a mixture of different lithologies. The other In-pit waste rock dumps will be composed of exclusively gneiss waste rock. The tonnage and geologic composition of the five WRSFs are shown in Figure 2-1 and Figure 2-2. The annualized footprints of WRSFs are provided in Table 2-1.

At the end of mine life, the mine pits will begin to flood. The ultimate pit lake volume will be controlled by the spillway elevation of each backfilled pit. The percentage of each backfill dump below the spillway elevation, and the percentage of the dump footprint occupied by saturated waste rock, is provided in Table 2-2.

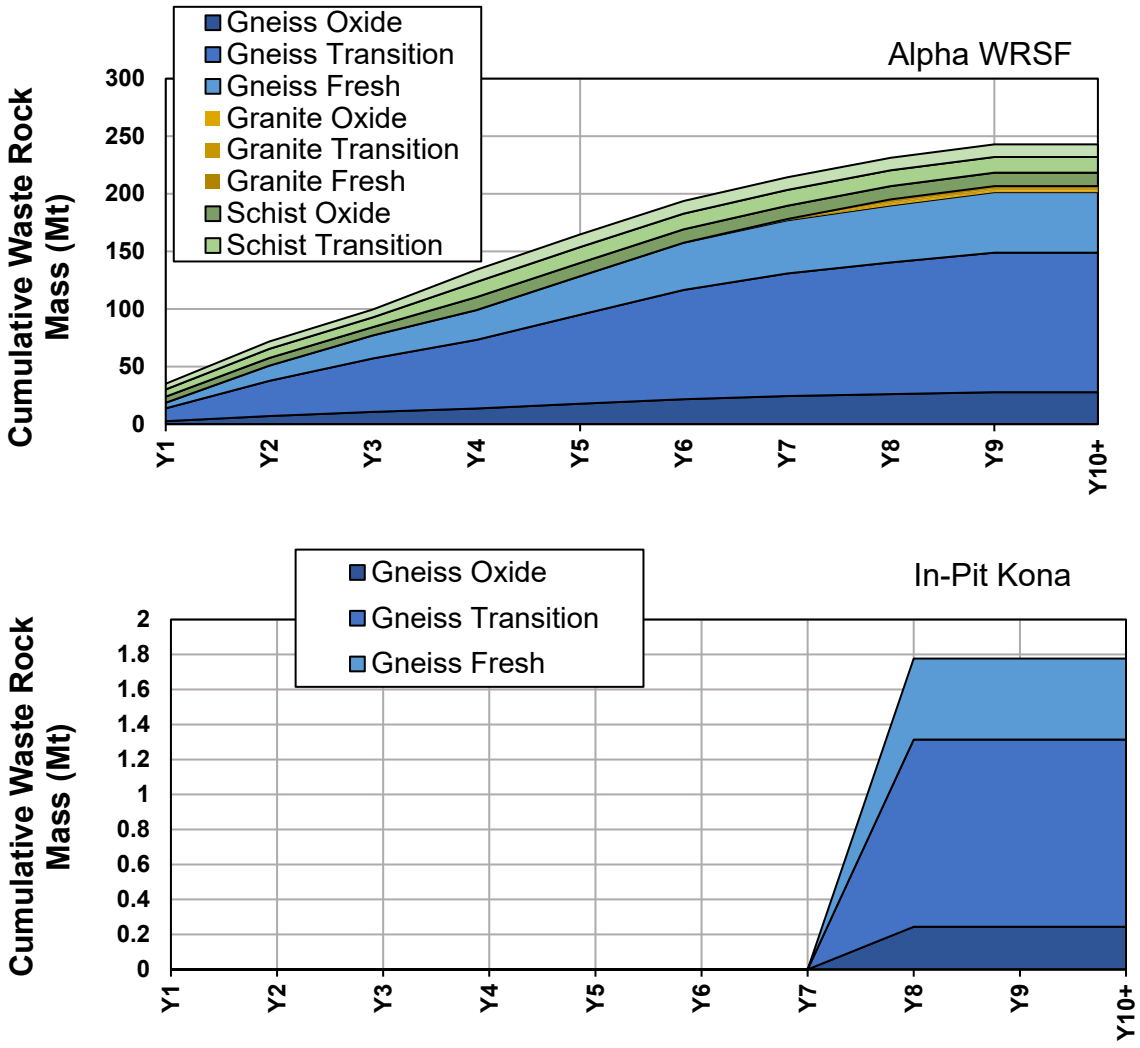


Figure 2-1: Mass and geologic composition of Alpha WRSF (top) and Backfilled Kona pit (bottom) over the LOM.

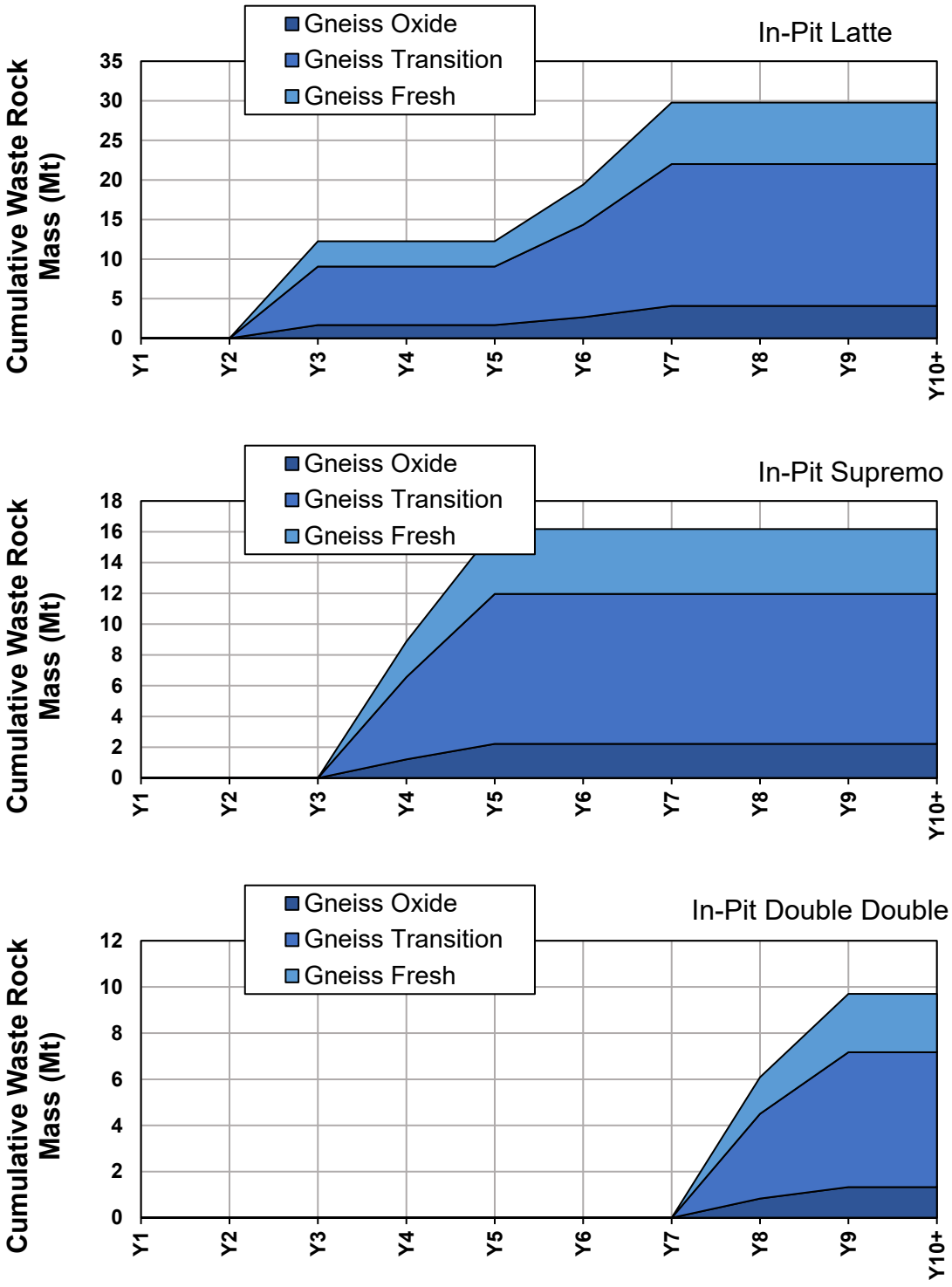


Figure 2-2: Mass and geologic composition of In-Pit Latte (top), In-pit Supremo (Middle) and In-Pit Double Double (bottom) WRSFs over the LOM.

Table 2-1:
Surface area (ha) of mine facilities in each year of mine life

Year	Alpha WRSF	In-Pit Kona	In-Pit Latte	In-Pit Supremo	In-Pit Double Double
Y1	57.4	-	-	-	-
Y2	96.8	-	-	-	-
Y3	109.7	-	10.1	-	-
Y4	145.4	-	10.1	10.1	-
Y5	161.4	-	10.1	19.7	-
Y6	170.8	-	17.3	19.7	-
Y7	179.0	-	25.6	19.7	-
Y8	179.8	3.2	25.6	19.7	8.4
Y9	187.9	3.2	25.6	19.7	11.9

Table 2-2:
Percentage of footprint and mass submerged once pits flood to spillway elevation

	Alpha WRSF	In-Pit Kona	Latte In-Pit	Supremo In-Pit	DD Backfill In-Pit
Footprint	0%	77%	37%	43%	45%
Mass	0%	39%	13%	17%	14%

2.1.1 Pit Wall Rock

Pit wall rock refers to rock exposures within the mining pit. This includes the pit floor, benches and blast damaged fractured rock. Fracturing and slope ravelling of the pit walls exposes a greater proportion of the wall rock to weathering. Assumptions regarding wall rock geochemical loading rates and solubility controls are described in detail in Section 5.2 of Appendix B.

During mine life, the composite loading from different mine pits will depend on the relative surface area of different wall rock geologies. The evolution of pit wall geology and surface area is incorporated into the Project Operations WQM. Annualized pit wall rock exposures are shown in Table 2-3 for the Supremo, Latte, Double Double and Kona pits. The runoff chemistry assigned to each of these wall rock units is provided in Appendix A.

Table 2-3:
Relative proportions of rock types exposed within mine pits upon completion of excavations

			Supremo Pit				Double Double Pit	Kona Pit	Latte Pit
			SU4-North	SU4-South	SU3-SU5	SU1-SU2			
Gneiss	Ore	Oxide	10%	15%	14%	7%	3%	0%	0%
		Transition	3%	1%	1%	3%	9%	0%	0%
	Waste Rock	Oxide	4%	12%	7%	4%	5%	0%	0%
		Transition	43%	37%	47%	54%	18%	0%	0%
		Fresh	41%	34%	30%	27%	66%	0%	0%
Schist	Ore	Oxide	0%	0%	0%	0%	0%	0%	4%
		Transition	0%	0%	0%	0%	0%	0%	21%
	Waste Rock	Oxide	0%	0%	0%	0%	0%	0%	12%
		Transition	0%	0%	0%	2%	0%	0%	21%
		Fresh	0%	0%	0%	0%	0%	0%	40%
Granite	Ore	Oxide	0%	0%	0%	0%	0%	10%	0%
		Transition	0%	0%	0%	0%	0%	11%	0%
	Waste Rock	Oxide	0%	0%	0%	0%	0%	16%	0%
		Transition	0%	0%	0%	0%	0%	21%	0%
		Fresh	0%	0%	0%	0%	0%	42%	0%

2.1.2 ROM Pad and Stockpile

Approximately 67 Mt of ore mined from the open pits will either be taken directly to the HLF or temporarily stockpiled on the ROM pad during the coldest winter months before stacking on the HLF. The maximum capacity of the ROM stockpile is 3 Mt, with the actual value fluctuating seasonally. The mass of ore on the ROM pad will fluctuate widely, with a mass ranging from 3.0 Mt to 0.33 Mt during Project Operations (Figure 2-3). Peak volumes occur during the winter months when ore is still being produced from the pits but no new material is stacked on the HLF, and minimum volumes occur during summer or fall months when ROM material is being removed to the HLF.

No granite ore from the Kona Pit will be placed in the ROM stockpile due to the elevated ML potential and mildly acidic pH associated with this ore type. The granite ore will be immediately directed to the HLF, where it will be mixed with lime and stored with other non-potentially acid generating ore types.

Stockpiled ore will be placed upon a pad constructed with waste rock. The pad will be constructed exclusively of schist waste rock to utilize the metal attenuating attributes of this rock type. The ability of schist waste rock to attenuate As and U is related to the

relatively high Fe content of this rock type and has been demonstrated in column experiments.

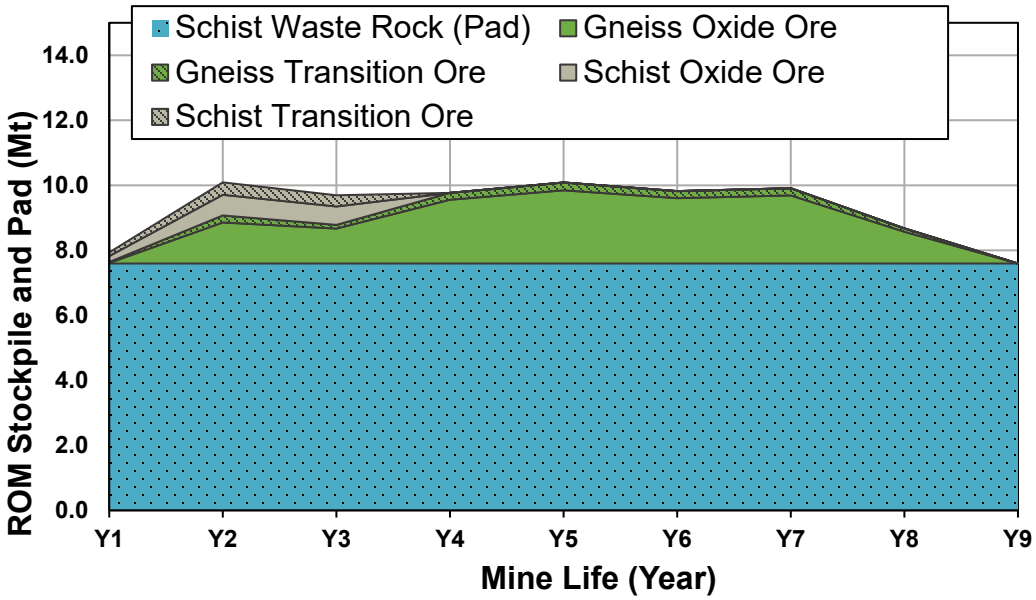


Figure 2-3: Mass and composition of ROM ore stockpile and waste rock used in pad construction.

2.1.3 Haul Roads

Haul roads will be constructed from ROM waste rock and represent a potential source of geochemical loading. The significance of the geochemical loading associated with haul roads will in large part depend on the ML/ARD screening criteria used to select construction material. For the purpose of source term calculation, it is assumed that no screening protocols are in place, and that the haul roads are constructed with gneiss waste rock, which represents the dominant waste rock type produced by the mine.

The length of out-of-pit haul roads connecting mine facilities is available for the end of mine life. The length of haul roads in the Halfway Creek, Latte Creek and YT24 catchments are shown in Table 2-4. It is assumed that the length and distribution of haul roads shown in Table 2-4 are present throughout the Project Operations. Haul roads are assumed to have an average fill thickness of 1.5 m and average width of 12 m.

Table 2-4:
Length of Haul Roads at end of operations by catchment

Scaling Factors	Haul Road Length (km)
Latte Catchment	0.89
Halfway Catchment	13.6
YT-24 Catchment	0.69

3. Data Sources

In this chapter geochemical and hydrological data sources used to develop source terms are presented. Kinetic test results are used to assign geochemical loading rates to different waste types that will be exposed by mining activity. The kinetic tests are also used to inform solubility constraints and upscaling behaviour of dissolved concentrations. Hydrology data is used to estimate the volume of runoff produced by a given mine waste facility. The flow volumes are required to convert geochemical loading rates into concentrations.

3.1 Hydrology

Surplus water produced from mine facilities is calculated by multiplying the mean annual precipitation (MAP) by estimated runoff coefficient. Precipitation amounts at the Coffee Gold site are influenced by orographic gradients that vary by season. The overall MAP orographic gradient is estimated to be 7% increase/100 m, based on analysis of long-term regional climate records and site climate data. The elevation dependent MAP developed for the Coffee site is presented in Figure 3-1. Using this elevation dependent estimate results in MAP range from 400 mm to 500 mm for mine facilities.

Runoff coefficients were developed for mine infrastructure (*i.e.*, pits and WRSFs) based on measured data from mine sites located in similar climatic zones, and professional experience (Table 3-1). The infiltration coefficient for the WRSFs averages 35% of MAP but varies from 21% in dry-years to roughly 50% in wet-years, consistent with published findings from comparable climates. A runoff coefficient of 0.7 is assigned to pit walls and haul roads, based on their low permeability and limited storage capacity.

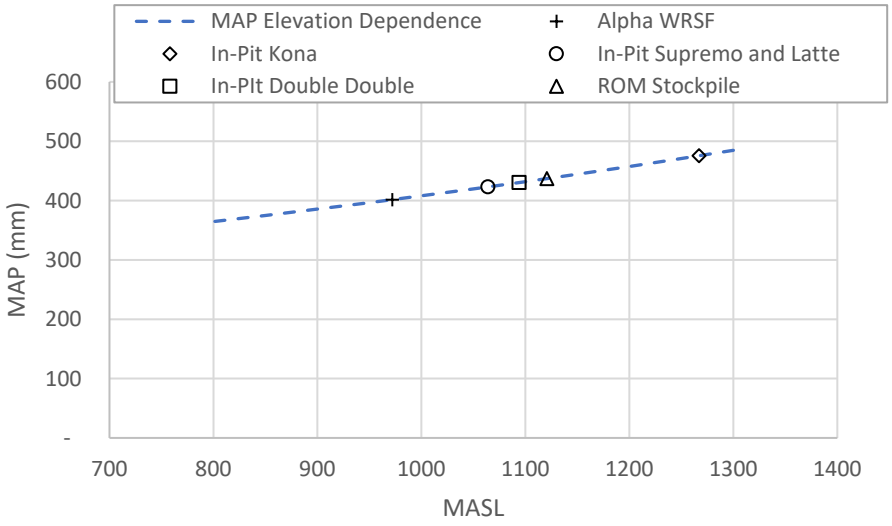


Figure 3-1: Mean annual precipitation as a function of MASL at the Coffee site.

Table 3-1:
Mine facility runoff coefficients

Facility	MAP (mm)	Runoff Coefficient
Alpha WRSF	402	0.35
In-Pit Kona	475	0.35
In-Pit Supremo	423	0.35
In-Pit Latte	423	0.35
In-Pit Double Double	430	0.35
ROM Stockpile	435	0.35
Haul Roads	485	0.70
Pit Wall	450	0.70

3.2 Kinetic Testing

Kinetic test data are used to assess long term drainage chemistry, develop source terms for water quality predictions and evaluate disposal strategies for waste rock that will be produced during the life of the Project. The kinetic tests developed for the Project include 8 humidity cells, 17 unsaturated columns, 11 field bins and 10 saturated columns. A summary of the kinetic tests developed for waste rock, ore and leach tailings for the Project is summarized in Table 3-2.

Table 3-2:
Summary of Kinetic Tests Initiated for the Coffee Gold Mine

Test ID	Duplicates	Material	Lithology	Weathering Facies	Start Date	Termination Date
Unsaturated Columns						
Col 1		Leach Tailings	Gneiss/Schist	Oxide/Transition	10-Apr-14	active
Col 2	Duplicate of Col 1	Leach Tailings	Gneiss/Schist	Oxide/Transition	10-Apr-14	active
Col 3		Waste Rock	Schist	Oxide	16-Jul-14	active
Col 4		Waste Rock	Schist	Transition	16-Jul-14	active
Col 5		Waste Rock	Gneiss	Oxide	16-Jul-14	active
Col 6		Waste Rock	Gneiss	Transition	30-Jul-14	active
Col 7		Ore	Granite	Oxide	22-Apr-15	19-Apr-17
Col 8		Ore	Granite	Transition	22-Apr-15	19-Apr-17
Col 9		Ore	Schist	Oxide	22-Apr-15	active
Col 10		Ore	Schist	Transition	22-Apr-15	active
Col 11		Ore	Gneiss	Oxide	22-Apr-15	active
Col 12		Ore	Gneiss	Transition	22-Apr-15	active
Col 13		Waste Rock	Granite	Transition	20-May-15	19-Apr-17
Col 14		Waste Rock	Granite	Fresh	20-May-15	19-Apr-17
Col 15		Leach Tailings	Schist	Oxide/Transition	3-Jun-15	active
Col 16		Leach Tailings	Gneiss	Oxide/Transition	3-Jun-15	active
Col 17		Leach Tailings	Gneiss/Granite	Oxide/Transition	3-Jun-15	active
Humidity Cells						
HC 1	Duplicate of Col 4	Waste Rock	Schist	Transition	25-Jun-14	24-Feb-16
HC 2		Waste Rock	Schist	Fresh	25-Jun-14	24-Feb-16
HC 3	Duplicate of Col 6	Waste Rock	Gneiss	Transition	25-Jun-14	24-Feb-16
HC 4		Waste Rock	Gneiss	Fresh	25-Jun-14	24-Feb-16
HC 5	Duplicate of Col 13	Waste Rock	Granite	Transition	6-May-15	24-Apr-17
HC 6	Duplicate of Col 14	Waste Rock	Granite	Fresh	6-May-15	24-Apr-17
HC 7		Waste Rock	Schist	Fresh	12-Aug-15	24-Apr-17
HC 8		Waste Rock	Gneiss	Fresh	12-Aug-15	24-Apr-17
Field Bins						
FB-GO	Duplicate of Col 5	Waste Rock	Gneiss	Oxide	17-Jun-14	active
FB-GT	Duplicate of Col 6 & HC 3	Waste Rock	Gneiss	Transition	17-Jun-14	active
FB-GS	Duplicate of HC 4	Waste Rock	Gneiss	Fresh	17-Jun-14	active
FB-SO	Duplicate of Col 3	Waste Rock	Schist	Oxide	17-Jun-14	active
FB-ST	Duplicate of Col 4 & HC 1	Waste Rock	Schist	Transition	17-Jun-14	active
FB-SS	Duplicate of HC 2	Waste Rock	Schist	Fresh	17-Jun-14	active
FB-GGT	Duplicate of Col 13 & HC 5	Waste Rock	Granite	Transition	17-Jun-15	active
FB-GGS	Duplicate of Col 14 & HC 6	Waste Rock	Granite	Fresh	17-Jun-15	active
FB-LT1	Duplicate of Col 1 & Col 2	Leach Tailings	Gneiss/Schist	Oxide/Transition	17-Jun-14	active
FB-LT2		Leach Tailings	Schist	Oxide	10-Aug-15	active
FB-LT3		Leach Tailings	Gneiss	Oxide	10-Aug-15	active
Saturated Columns						
Kona 1	Col 13,14 and 8 Residue	Waste rock/ore	Granite	Tran./Fresh	07-Jul-17	24-May-19
Kona 2	Col 13,14 and 7 Residue	Waste rock/ore	Granite	Oxide/Tran./Fresh	07-Jul-17	24-May-19
Kona 3	Col 13 Residue	Waste Rock	Granite	Transition	07-Jul-17	24-May-19
Kona 4	Col 14 Residue	Waste Rock	Granite	Fresh	07-Jul-17	24-May-19
Sat-GO	FB-GO Residue	Waste Rock	Gneiss	Oxide	29-Sept-17	24-May-19
Sat-GT	FB-GT Residue	Waste Rock	Gneiss	Transition	29-Sept-17	24-May-19
Sat-GS	FB-GS Residue	Waste Rock	Gneiss	Fresh	29-Sept-17	24-May-19
Sat-SO	FB-SO Residue	Waste Rock	Schist	Oxide	29-Sept-17	24-May-19
Sat-ST	FB-ST Residue	Waste Rock	Schist	Transition	29-Sept-17	24-May-19
Sat-SS	FB-SS Residue	Waste Rock	Schist	Fresh	29-Sept-17	24-May-19

Unsaturated kinetic tests (field bins, humidity cells, and columns) were initiated to evaluate the metal leaching potential of unsaturated mine waste at different scales and storage conditions. Geochemical loading rates used to estimate source terms for unsaturated mine waste are derived from field bins, humidity cells and unsaturated column experiments. Experimental setup, sample characteristics, and initial results of these experiments are presented in Appendix B. Most of these tests have continued since they were initiated in 2014 or 2015.

Saturated column tests provide a means to evaluate the metal leaching potential of saturated waste rock in backfilled pits. The saturated column results are used to inform metal leaching behaviour of backfilled waste rock which may become saturated upon mine closure. Experimental setup, sample characteristics and results of the saturated column testwork are provided in Appendix C.

3.2.1 Unsaturated Tests

Unsaturated kinetic tests (columns and field bins) generate information on long term metal leaching behaviour of mine waste. The loading rate statistics and kinetic test cycles used in source term development are provided in Appendix D.

3.2.2 Saturated Tests

Saturated column experiments were operated in several phases. In the first phase columns were operated independently and received an influent of DI water containing a low concentration of Na-Lactate to mimic DOC concentrations observed in the background groundwater at site (approx. 10 mg/L). In the second phase of the experiment saturated columns were operated in sequence, to investigate impact of mixed waste rock in a backfill facility.

Overall, results show that sulphide oxidation was curtailed and metal solubility and release was inhibited by saturated conditions. A significant exception to this general trend was for As. Leaching of As was enhanced by saturated columns, with granite columns producing the highest concentrations of this element. The second phase of the experiment, when columns were operated in sequence, demonstrated that As was not conservative under saturated conditions (Figure 3-2). Controls on As solubility under saturated conditions are more closely related to the availability of Fe-oxide mineral surfaces and concentration of Ca^{2+} and PO_4^{2-} which impact As sorption potential. The observation that saturated conditions enhance As mobility is consistent with groundwater monitoring at site, which often reveal elevated As concentrations, with the highest concentrations being associated with groundwater monitored screened in granite bedrock near the Kona Pit. The median and 90th percentile As values observed in Phase 1 of the saturated column experiments are shown in Table 3-3

Table 3-3:
Arsenic concentrations produced during Phase 1 of the saturated column experiments.

Column ID	Lithology	Weathering	As mg/L	
			P50	P90
GO	Gneiss	Oxide	0.0464	0.0518
GS	Gneiss	Fresh	0.0344	0.0506
GT	Gneiss	Transition	0.117	0.158
SO	Schist	Oxide	0.0218	0.0294
SS	Schist	Fresh	0.0121	0.0135
ST	Schist	Transition	0.0091	0.0125
GGT	Granite	Oxide	2.11	3.9515
GGS	Granite	Fresh	0.3765	0.48225

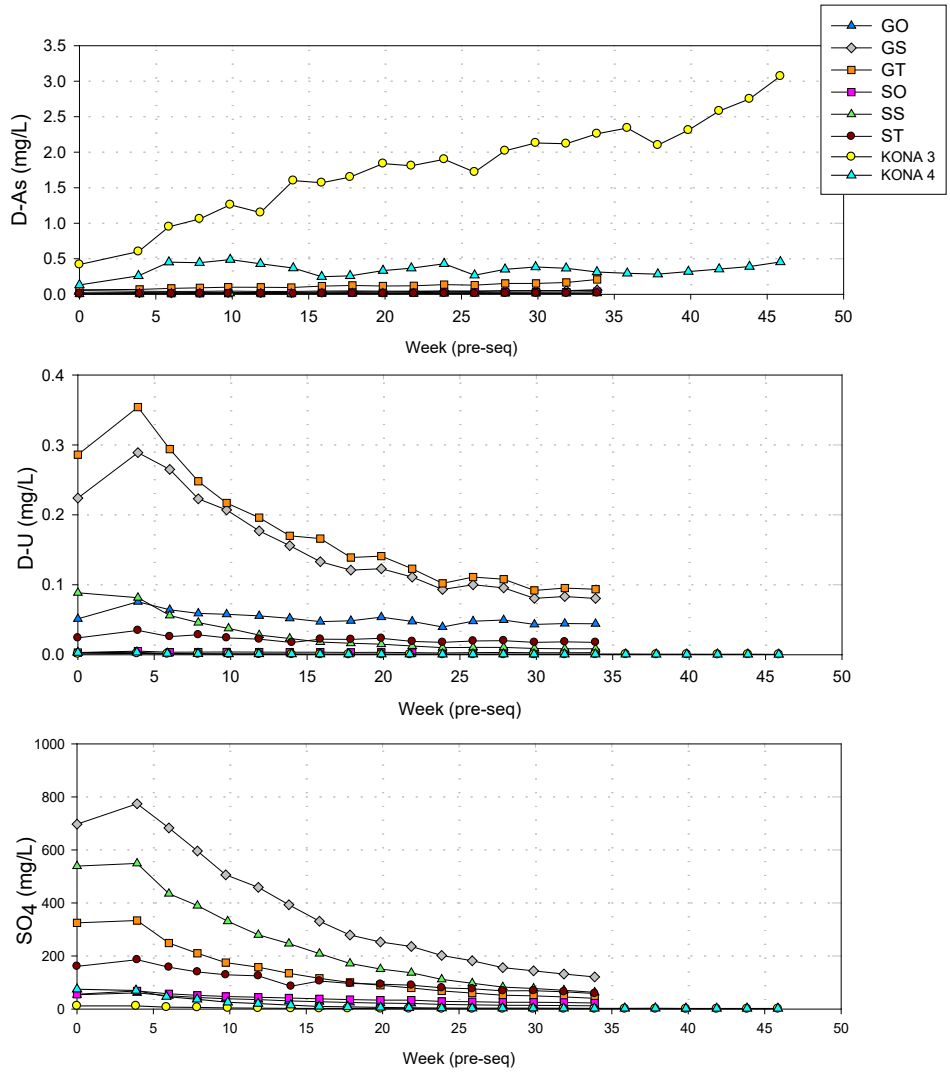


Figure 3-2: Time-series of As, U and SO_4 for Phase I Saturated Column Study

4. Source Term Calculations

4.1 Approach

Geochemical source terms are calculated by upscaling kinetic test geochemical loading rates to reflect site conditions. The scaled loading rates are then applied to incorporate the mass, footprint, hydrology and rock types present in a given mine facility. Solubility controls are then derived for certain parameters that are not expected to behave conservatively in the geochemical conditions of a given mine waste environment. These solubility controls are based on a combination of first principles, thermodynamic equilibrium, and experimental data or field monitoring data. Overall, the approach to source term calculation is consistent with what was completed for source term development in the Project Proposal for the Coffee Project as described in Appendix B.

A variety of updates have been made to source term model inputs in the current source term iteration relative to that presented in Appendix B. These updates include kinetic test results; solubility controls; and assumptions regarding release of a geochemical load from saturated waste rock and pit wall. Kinetic test results are used to calculate loading rates and estimate metal release from sub-aqueously stored mine rock. The updated kinetic test results are shown in Appendix D. Solubility calculations incorporate the geochemical modelling program PHREEQC to calculate solubility constraints for surface sorption of U to Fe-oxide mineral surfaces, and mineral solubility controls for certain major ions (Ca, Mg and P).

4.2 Waste Rock Storage Facility

Two types of loadings from waste rock are included in the WQM and described herein. During mine operations all waste rock will be stored in unsaturated conditions. The unsaturated waste rock source term represents the chemistry of water which infiltrates through unsaturated mine waste. Once a pit is completed mining and/or upon mine closure, meteoric water will accumulate in the mine pits, potentially submerging a portion of backfilled waste rock. Submergence of waste rock is modelled using a flushing source term. This source term reflects a one-time release of an accumulated load on waste rock surface solubilized by inundation by pit lake water.

4.2.1 Unsaturated Source Term

The unsaturated WRSF source terms are calculated by upscaling geochemical loading rates measured in waste rock field bin experiments. Field bins loading rates are applied to WRSF source term calculation using the same approach as that used in previous source term

iterations. The only update is the time period of data incorporated into the loading calculation. The date range and field bin data used in source term development is identified in Table 4-1. These loading rates are applied to the lithologic composition and mass of each WRSF shown in Figure 2-1 and Figure 2-2. Similar to previous source term iterations (Appendix B), the FB-GGT field bin is used to represent both granite oxide and granite transition waste rock. Field bin loading rates used in source term calculation are presented in Appendix D.

Table 4-1:
Overview of Kinetic Tests Used for WRSF Source Term Calculation

Kinetic Test ID	Mineralization	Lithology	Date Range
FB-GO	Oxide	Gneiss	June 2014-Oct 2018
FB-GT	Transition	Gneiss	June 2014-Oct 2018
FB-GS	Fresh	Gneiss	June 2014-Oct 2018
FB-SO	Oxide	Schist	June 2014-Oct 2018
FB-ST	Transition	Schist	June 2014-Oct 2018
FB-SS	Fresh	Schist	June 2014-Oct 2018
FB-GGT	Transition	Granite	June 2015-Oct 2018
FB-GGS	Fresh	Granite	June 2015-Oct 2018

Empirical scaling factors are developed based on a comparison between field bin data to a full-scale waste rock seepage data. Bulk scaling factors described in Section 5 of Appendix B are maintained herein.

The annual surplus water from WRSFs is used to convert loading rates to concentrations. The MAP and runoff coefficients used to calculate surplus water for WRSFs are shown in Section 3.1.

4.2.2 Saturated Source Term

Unsaturated waste rock will accumulate a geochemical load on mineral surfaces that are insufficiently flushed by infiltrating pore water. This load will become available when waste rock is inundated by a pit lake water. It is assumed that 50% of waste rock mineral surfaces are flushed by infiltrating meteoric water, leaving the other 50% of mineral surfaces to accumulate a geochemical load. The unflushed surfaces are assumed to accumulate an oxide load at the same weathering rate applied to the upscaled loading rate applied to the unsaturated source term described above. The rate at which a load accumulates on waste rock which is released upon pit lake inundation are shown in Appendix A. Note that Supremo Backfill, Latte Backfill and Double Double Backfill are all built from waste rock excavated from the Supremo Pit. As such, they are assumed to

have the same lithologic composition, hence, geochemical loading rate. No solubility controls are applied to this source term.

4.2.3 Solubility Controls

Upscaling kinetic test loading rates often results in concentrations that exceed solubility controls, particularly in neutral pH environments where a number of solubility limitations can exert an influence on drainage chemistry. Metal solubility can be affected by secondary mineral formation, sorption to mineral surfaces, and aqueous complexation reactions. The approach used to set solubility constraints is described in Appendix B and developed a method for calculating solubility of U, As and Ra, while concentration caps based on empirical data. For WRSFs, concentration caps based on empirical data were set for parameters which were frequently below detection limit (Hg and P) or parameters which are not expected to behave conservatively under aerobic, neutral pH conditions (Fe and Al).

In the current source term predictions, the model used to calculate U concentrations has been updated, and now incorporates the geochemical modelling program PHREEQC (Parkhurst and Apello, 1999). The PHREEQC model used to calculate U solubility also calculates solubility of P, Ca and alkalinity. Furthermore, enhancement of As solubility in backfilled waste rock dumps which have been partially flooded is also incorporated.

4.2.3.1 Uranium Solubility

Model Approach

A variety of factors influence U solubility in a mine waste environment. Solubility can be influenced by pH, redox conditions, availability of Fe-oxide mineral surfaces, and presence of ligands that can form aqueous complexes with U. Redox conditions can influence the oxidation state that U occurs in. Uranium(VI) and U(IV) are the two most common oxidations states of U; U(IV) being generally insoluble at pH > 3, while U(VI) forms the relatively soluble uranyl (UO_2^{2+}) aquocation (Cumberland *et al*., 2017). The oxidation state of U in Project mine rock has been directly measured using X-ray adsorption near edge spectroscopy (XANES) (Lorax, 2017). The analysis found that a significant portion of U (100% to 89% in oxide; 17% to 49% in transition; and, 27% to 67% in fresh). This shows that U can be mobilized to pore without post-depositional oxidation.

The uranyl aquocation (UO_2^{2+}) is generally insoluble in the presence of Fe-oxide minerals, and requires complexation with an anionic ligand before it can be released into pore water (Cumberland *et al.,* 2016). This effect is primarily because some UO_2^{2+} aqueous complexes can outcompete mineral surfaces for UO_2^{2+} binding, thus weakening U sorption (Stewart *et al.*, 2010). In most environmental settings, the most important complexes

which enhance UO_2^{2+} solubility are carbonate (CO_3^{2-}) and Ca (Stewart, 2008). The solubility of U(VI) in the presence of hydrous ferric oxide (HFO) and varying pH, Ca^{2+}, and CO_3^{2-} is illustrated in Figure 4-1 for reference. Overall, the figure illustrates that U mobility is strongly influenced by Ca and pCO_2 under a broad pH range (pH 3.5 to pH 10.5). The importance of Ca, alkalinity and pH on U mobility can also be observed in regional monitoring data.

A regional survey of over 3000 baseline water quality samples found that elevated U concentrations (>15 µg/L) were almost always associated with elevated pH, Ca, alkalinity (Figure 4-2) (Lorax, 2019). Overall, creeks with alkalinity >150 mg/L and Ca >80 mg/L have an 80 % probability of having U concentrations above 15 µg/L. Furthermore, the parabolic relationship of U and pH shows that U concentrations are maximal in circumneutral to alkaline pH and highly acidic surface waters, while U concentrations are lowest in the pH 4.5 to 6.5 range (Figure 4-2). This results show that the regional occurrence of U in Dawson Range creeks is consistent with what would be predicted with ligand-complexation surface-sorption model (Figure 4-1). This understanding, based on a first principles understanding and supported by baseline observations, forms the basis for U solubility modelling.

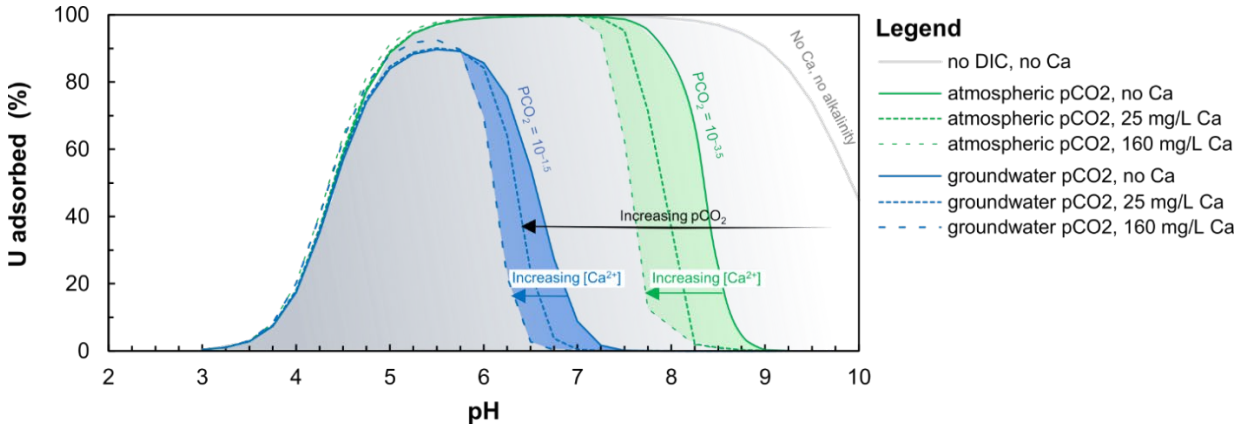


Figure 4-1: Generalized U(VI) sorption behavior on Fe-oxhydroxide as a function of pH, Ca, and alkalinity in a PHREEQC simulation. Alkalinity is fixed by pCO_2 representative of typical atmospheric ($10^{-3.5}$ atm) and groundwater ($10^{-3.5}$ atm) concentrations. The U sorption envelope decreases from pH ~6.5 to 9 as pCO_2 and [Ca] increase, indicating greater U(VI) solubility (Figure from Lorax, 2019).

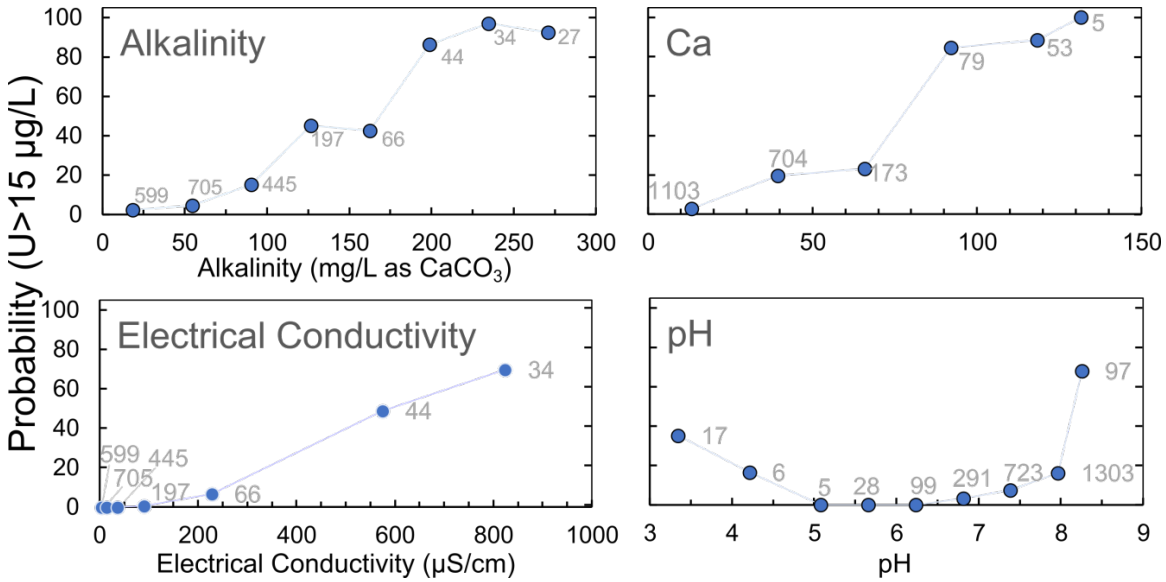


Figure 4-2: Probability of having U concentrations above the CCME guideline value (15 µg/L) calculated over different ranges in alkalinity, Ca, electrical conductivity, and pH in surface water samples in the Dawson Range. Data labels in grey font correspond to the number of water-sample analyses used to calculate each probability value

The first principles of uranium mobility and field observations illustrate the importance of alkalinity, Ca and pH on controlling U mobility. In order to translate this understanding into a geochemical source term prediction the surface sorption module in the geochemical modelling program PHREEQC is employed. This model uses the double layer surface model described by Dzombek and Morel (1990) with no explicit calculation of the diffuse-layer composition. The model is coupled to the llnl.dat database amended with thermodynamic data for Ca-UO_2 surface complexation from Bernhard *et al*., (2001) and $Ca_2UO_2(CO_3)_3$ and $Ca_2UO_2(CO_3)_2^{2-}$ phases from Payne, (1999).

Model Validation for Uranium Solubility

To validate the modelling approach, and calibrate poorly constrained inputs, the model is used to re-produce kinetic test U concentrations. Model inputs include solution chemistry (includes Ca, alkalinity and pH); water content; U(VI) availability; and, mineral surfaces available for sorption in the form of hydrous ferric oxide (HFO) (Table 4-2). The kinetic test leachate chemistry provides a direct measure of solution chemistry and is directly applied as a model input. The total U and Fe content is measured in each kinetic test sample prior to test setup. The proportion of total U present as U(VI) can be constrained with XANES data (Lorax, 2017). In the model it is assumed that 100% of U(VI) present in a sample is present on Fe-oxide mineral surfaces. This is a conservative assumption, in that most other potential reservoirs of U(VI) (uranophane, brannerite, *etc.*) would be less

available. The Fe-oxide content can be estimated based on mineralogical analysis; however, it is challenging to determine how a bulk measurement translates to reactive HFO surface area. Therefore, the availability of HFO mineral surfaces area is calibrated within the model. Note that this is the only calibrated model input.

The available HFO surface area is adjusted such that mean and maximum concentrations of kinetic tests are overpredicted in the model. This results an estimate of the % Fe as HFO ranging from 0.79% to 0.11% in most samples (Table 4-2). The amount of total Fe present as HFO correlates with weathering horizon, with greater %Fe as HFO in gneiss-oxide (0.62%) compared to gneiss-transition (0.30% to 0.34%) and gneiss-fresh (0.17%). This is consistent with the degree of weathering and expected Fe-oxide content of the different weathering facies.

Table 4-2:
Model inputs used to re-produce kinetic test U concentrations.

Test ID	Lithology	Weathering	Water Content (ml/kg)	Fe (g/kg)	% Fe as HFO	U ppm	% U as U(VI)	Solution Chemistry
Col 5	Gneiss	Oxide	125	15	0.62%	5.5	95%	Measured
HC3	Gneiss	Transition	100	12	0.30%	6.3	50%	Measured
Col 6	Gneiss	Transition	83	12	0.34%	6.3	50%	Measured
HC4	Gneiss	Fresh	165	18	0.17%	6.1	30%	Measured
Col 3	Schist	Oxide	106	29	0.79%	2.6	95%	Measured
HC1	Schist	Transition	165	26	0.15%	2.6	50%	Measured
Col 4	Schist	Transition	99	26	0.11%	2.7	50%	Measured
HC2	Schist	Fresh	170	29	0.07%	3.2	30%	Measured
Col 13	Granite	Transition	159	8.7	3.02%	7.6	50%	Measured
HC5	Granite	Transition	210	8.7	16.78%	7.6	50%	Measured
Col 14	Granite	Fresh	143	11	0.42%	6.2	30%	Measured
HC6	Granite	Fresh	180	11	0.78%	6.2	30%	Measured

The model significantly overestimates maximum concentrations of most kinetic tests, in some cases modeled maximums are over 500% of maximum measured values (Table 4-3). This provides some assurance that the modelled values will conservatively predict peak concentrations produced from mine waste facilities. The validation model results are plotted against measured results for two kinetic tests in Figure 4-3 to illustrate that the model also captures variations in U concentrations over time. The ability of the PHREEQC surface sorption model to re-produce U trends and conservatively predict U concentrations in kinetic test samples shows that this modelling approach can reasonably be applied to source term predictions.

Table 4-3:
Measured and modeled U concentrations from kinetic tests.

Test ID	Lithology	Weathering	Mean			Max		
			Measured (mg/L)	Model (mg/L)	% Diff	Measured (mg/L)	Model (mg/L)	% Diff
Col 5	Gneiss	Oxide	0.086	0.103	19%	0.168	1.074	539%
HC3	Gneiss	Transition	0.028	0.032	16%	0.065	0.089	36%
Col 6	Gneiss	Transition	0.211	0.242	15%	0.439	1.755	300%
HC4	Gneiss	Fresh	0.011	0.017	54%	0.060	0.061	0%
Col 3	Schist	Oxide	0.005	0.007	35%	0.025	0.167	570%
HC1	Schist	Transition	0.004	0.006	27%	0.018	0.020	14%
Col 4	Schist	Transition	0.036	0.048	33%	0.181	0.599	231%
HC2	Schist	Fresh	0.008	0.011	34%	0.024	0.036	52%
Col 13	Granite	Transition	0.001	0.002	34%	0.004	0.015	291%
HC5	Granite	Transition	0.001	0.001	84%	0.003	0.003	2%
Col 14	Granite	Fresh	0.093	0.094	0%	0.401	0.872	117%
HC6	Granite	Fresh	0.002	0.005	184%	0.026	0.032	26%

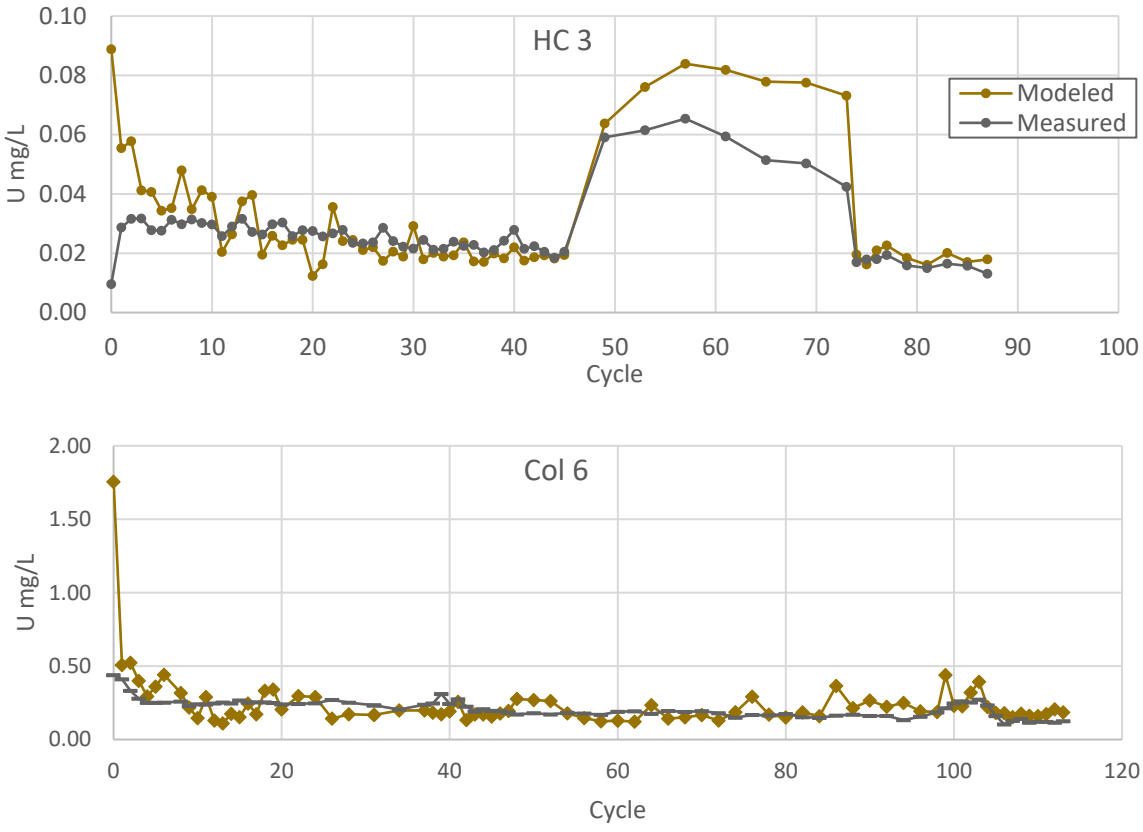


Figure 4-3: Model validation results compared to measured results for HC3 and Col 6.

Model Predictions for Uranium

Uranium source term concentrations are predicted using the PHREEQC surface sorption modelling approach described in the previous section. Model inputs are based on expected composition of various waste rock facilities, estimated pore water chemistry based on upscaled kinetic test data, and solubility constraints applied on certain mineral phases. The % of available U and Fe determined used in model validation are applied in the source term model (Table 4-3). The total Fe and U present in the waste facilities is calculated using the median Fe and U concentrations associated with each rock type (Table 4-4). An average water content of 11% is estimated based on the water content of other waste rock facilities in northern climates (Eriksson *et al.,* 1995; Nichol *et al*., 2005). The range of pH 8.0 to pH 8.3 is used for the base case and upper case scenarios, consistent with the pH assumptions used in previous source term iterations Lorax (2017).

Table 4-4:
Total Fe and U content of waste rock and U solubility model inputs.

Lithology	Weathering	Water content (ml/kg)	Fe (g/kg)	% Fe as HFO	U ppm[1]	% U as U(VI)	Solution Chemistry
Gneiss	Oxide	60	12.4	0.62%	7.0	95%	Source Term
Gneiss	Transition	60	12.8	0.32%	3.9	50%	Source Term
Gneiss	Fresh	60	17.5	0.17%	2.7	30%	Source Term
Granite	Oxide	60	12.2	0.60%	6.0	95%	Source Term
Granite	Transition	60	12.5	0.60%	6.3	50%	Source Term
Granite	Fresh	60	6.5	0.60%	6.7	30%	Source Term
Schist	Oxide	60	29.8	0.79%	2.1	95%	Source Term
Schist	Transition	60	29.4	0.13%	1.8	50%	Source Term
Schist	Fresh	60	29.8	0.07%	1.4	30%	Source Term

[1]Median values of mine waste assay data
[2]HFO and U(VI) availability assigned to each rock type in U solubility model.

The concentrations of P, Ca and alkalinity are predicted within the PHREEQC model. This is required as these parameters impact U mobility and have inter-related solubility constraints. That is, Ca solubility is generally controlled by calcite ($CaCO_3$), which CO_3^{2-} (alkalinity) is a constituent parameter. Similarly, P concentrations are generally controlled by apatite minerals [$Ca_5(PO_4)_3(Cl, F, OH)$], of which Ca is a constituent parameter. The concentration of PO_4^{3-} in pore water can influence surface sorption reactions and can compete with CO_3^{2-} for complexation with UO_2^{2+} ions. However, in neutral mine drainage P is generally limited by apatite mineral solubility. Therefore, the P concentration is predicted by assuming hydroxylapatite [$Ca_5(PO_4)_3OH$] SI of 0 (equilibrium) in both the upper case and base case model.

Calcite is often found to be supersaturated in mine drainage due to cation exchange processes and release of Ca from non-carbonate sources. Once calcite becomes supersaturated, precipitation can be kinetically inhibited by lack of free energy to create new surface areas, lack of nucleation sites, and the presence of competing species such as phosphate, Mg ions and organic ligands (Lorah and Herman, 1988; Lebron and Suarez, 1996). Consequently, supersaturation with respect to calcite can be maintained without calcite precipitation taking place. In fact, the precipitation of calcite directly from solution often requires water to be at least 5 times saturation with respect to calcite (log[SI] = 0.7) (Suarez, 1983; Chen *et al*., 2004). To account for this, the SI for calcite is set to 0.7 and 0.9 are used for the base case and upper case source terms, respectively. This is equivalent to Ca concentrations that are 5 to 8 times equilibrium values.

The alkalinity of mine drainage is controlled primarily by pH and the build-up of pore gas CO_2 within mine facilities. The gas permeability and flow through mine waste is difficult to predict; however, there is a significant volume of publicly available data on waste rock alkalinity. For instance, waste rock seeps at the Mt. Nansen mine are producing alkalinity values ranging from 16 mg$CaCO_3$/L to 48 mg$CaCO_3$/L. A much larger review of alkalinity values from 20 calcite buffered waste rock dumps at coal mines in the Elk Valley and Peace River region reported median and 90th percentile alkalinity values of 260 mg$CaCO_3$/L and 445 mg$CaCO_3$/L, respectively (MEND, 2015). For the purpose of source term prediction, a pCO_2 value is set to $10^{-2.7}$ is used both the upper case and base case scenarios. This is equivalent to pCO_2 concentrations that are 60 times atmospheric concentrations and results in mean alkalinity values of 266 mg$CaCO_3$/L in base case source terms and 579 mg$CaCO_3$/L in upper case predictions.

Using this approach and the model assumptions outlined herein, U solubility can be calculated for mine waste facilities. The final source terms are provided in Appendix A. An example of the U, Ca and alkalinity predicted for the base case Alpha WRSF over mine life is provided in Figure 4-4.

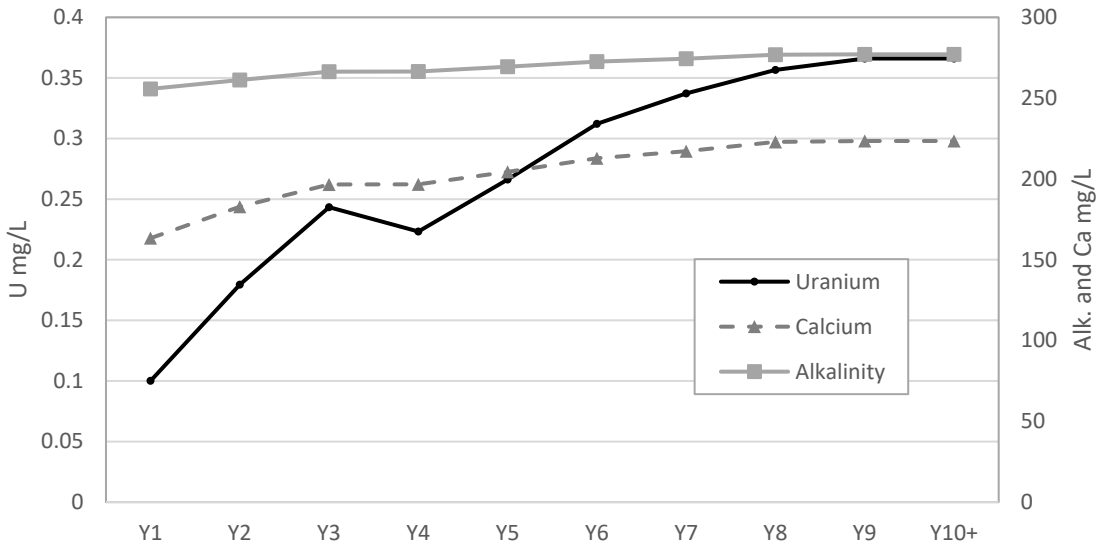


Figure 4-4: Model results for base case Alpha WRSF for U, Ca and Alkalinity.

4.2.3.2 Arsenic Solubility

Arsenic is released by a combination of sulphide mineral oxidation (*e.g.*, arsenopyrite, arsenianpyrite, and orpiment) and dissolution of oxide minerals (scorodite, yukonite, Fe-oxide mineral surfaces). Sorption is typically the most important control on As transport in natural waters, and occurs on the surface of various phases including organic matter, calcite, clays, and (oxyhydr)oxides of Al, Mn, and especially Fe (Smedley and Kinniburgh, 2002). The sorption potential of As is strongly related to oxidation state. In oxidizing aqueous environments, As forms the oxyanion arsenate [$As(V)O_4^{3-}$]. Under moderately reducing condition, As is found as arsenite [$As(III)O_3^{3-}$]. Arsenate sorption is generally stronger than that of arsenite (Goldberg, 2002; Grafe *et al.*, 2002; Dixit and Hering, 2003). The enhanced mobility of As under reducing environments can be observed in baseline monitoring data from the Dawson Range.

A survey of surface water in the Dawson Range found As concentrations to be consistently below 1 µg/L across the region (Lorax, 2019). The median and mean As concentrations of the 2,121 surface water samples that are available are both 0.5 µg/L. Only two As concentrations above the 5 µg/L were observed in surface water in the entire dataset (both were between 5 µg/L and 6 µg/L). Groundwater As concentrations are substantially higher than those of surface water. In 17 of the 46 groundwater wells at the Casino and Coffee project sites, median As concentrations exceed 5 µg/L. The most As-rich groundwater is found in the MW14-05A/B well cluster screened into granite bedrock below the Kona Pit; these wells have median As concentrations of 1,860 µg/L and 161 µg/L, respectively. They are also characterized by reducing conditions, as indicated by elevated Fe(II) and sulfide concentrations.

The solubility of As in unsaturated conditions can be related to pH, Fe-oxide content, and As concentration in host rock. These factors are considered in the existing As source term for unsaturated mine waste, as described in Appendix 31-D (Lorax 2017). No updates are made to the modelling approach for As solubility in unsaturated environments.

The solubility of As in saturated environments will be enhanced relative to unsaturated conditions due to occurrence of As predominantly as arsenite rather than arsenate. This is supported by both groundwater monitoring data and saturated column tests. In order to estimate the concentration of As produced from infiltration through saturated mine waste, the median and 90th percentile of concentrations observed in saturated column are applied to the base case and upper case source terms, respectively (Table 3-3). The saturated As source term is applied the proportion of each backfill WRSFs footprint which is flooded upon pit lake formation (Table 2-2).

Some management of waste rock to minimize As metal leaching is incorporated into development of this solubility control. It is assumed that material with high As leaching potential, based on As/Fe molar above 4.5 mmole/mole, will be excluded from portions of mine pits where waste rock will potentially become saturated. Therefore, the gneiss transition (GT) column is excluded from source term calculations, and this rock type is assigned As concentrations produced from the gneiss sulphide column (GS).

4.3 ROM Stockpile

4.3.1 Unsaturated Source Term

The ROM stockpile contains ore placed on a pad of schist waste rock. The ROM pad source terms are calculated by upscaling geochemical loading rates from ore unsaturated columns and waste rock field bins to estimate the loading generated from these two components of the facility. The loading rate from ore on the stockpile is calculated using the median and 75th percentile loading rates measured in unsaturated column work. The columns and cycles used to calculate these loading rates are presented in Table 4-5. Column loading rates are provided in Appendix D. These loading rates are applied to the lithologic composition of ore and waste rock which compose the ROM Pad, as shown in Figure 2-3. The ore column scaling approach is described in Appendix B. For the waste rock pad, the same scaled loading used for WRSF source terms are applied to ROM pad waste rock.

The annual surplus water of the ROM stockpile is used to convert loading rates to concentrations. The MAP and runoff coefficients used to calculate surplus water are shown in Section 3.1.

Table 4-5:
Kinetic Tests and Cycles Used for Ore Stockpile Term Calculation

Kinetic Test ID	Mineralization	Lithology	Material Type	Cycles/Weeks
Col 9	Oxide	Schist	Ore	2-78
Col 10	Transition	Schist	Ore	2-78
Col 11	Oxide	Gneiss	Ore	2-78
Col 12	Transition	Gneiss	Ore	2-50

4.3.2 Solubility Controls

The ROM stockpile source terms are calculated by upscaling kinetic test loading rates. A number of parameters are affected by thermodynamic solubility controls and scale-independent release mechanisms. Concentrations of As and ^{226}Ra are calculated using the same approach that was applied in Lorax (2018). The concentration prediction for U has been updated consistent with model updates described in section 4.2.3. The same assumptions regarding pH and pCO_2 and calcite SI values applied to waste rock are also applied to the ROM pad.

Table 4-6:
Total Fe and U content of ore lithologies and U solubility model inputs.

Lithology	Weathering	Water content (ml/kg)	Fe (g/kg)	% Fe as HFO	U ppm[1]	% U as U(VI)	Solution Chemistry
Gneiss	Oxide	60	16	0.62%	14	95%	Source Term
Gneiss	Transition	60	14	0.32%	11	50%	Source Term
Granite	Oxide	60	15	0.60%	14	95%	Source Term
Granite	Transition	60	12	0.60%	12	50%	Source Term
Schist	Oxide	60	31	0.79%	2.9	95%	Source Term
Schist	Transition	60	30	0.13%	2.6	50%	Source Term

Ore stockpiled on the ROM pad will be placed on a pad of schist waste rock. Infiltration of ore contact water through schist waste rock will attenuate a portion of the As and U load associated with the ore material. To quantify this effect, the solubility of As and U parameters is calculated assuming that ROM pad pore water is in contact with schist waste rock prior to discharge. That is, the inputs to the As and U solubility model assume that solid surfaces have the composition of schist waste rock. Some portion of water which contacts the ore stockpile may bypass the schist waste rock through preferential flow paths. To account for the potential for such behaviour, it is assumed that 10% to 20% of ore

contact water bypasses schist waste rock in the base case and upper case scenario. An example of calculated infiltration for the ore stockpile, waste rock pad, and Rom Pad which combines the two source terms is shown for two conservative parameters (SO_4 and Zn) and two non-conservative parameters (As and U) in Table 4-7 for Y2 of mine life.

Table 4-7:
Example of infiltration chemistry calculated for the ore stockpile, waste rock pad and combined source term for Y2 base case scenario

	SO_4	As	U	Zn
	mg/L	mg/L	mg/L	mg/L
Ore Stockpile Component	159	0.151	0.055	0.014
Waste Rock Component	146	0.002	0.021	0.015
Combined Source Term	305	0.018	0.024	0.029

4.4 Pit Wall Rock

Pit wall rock refers to rock exposures within the mining pit itself. This includes the pit floor, benches and blast damaged fractured rock. The WQM includes two types of geochemical loading released from pit wall rock: meteoric runoff from unsaturated pit wall rock exposures; and submergence of pit wall exposures. Pit wall runoff source term represents weathering from sub-aerially exposed pit wall. The second type of pit wall loading is from submergence of pit wall by pit lake formation. This source terms represents the flushing of oxidation products which may accumulate on mineral surfaces while the wall rock is unsaturated.

4.4.1 Unsaturated Source Term

Source terms for pit wall runoff are calculated by scaling laboratory columns representing waste rock and ore which will compose the wall exposures. The loading rates have been updated to incorporate recent column data. The column IDs and cycles used in source term development are shown in Table 4-8. The proportion of different rock types which make up pit walls at the end of mine life is shown in Table 2-3. It is assumed that the relative exposure of different lithologies shown in this figure is maintained throughout mine life. Pit wall upscaling is described in detail in Section 5.2 Appendix B.

The annual surplus water of pit wall rock is used to convert loading rates to concentrations. A constant pit wall elevation of 1170 masl is used to estimate MAP of all pit walls. The MAP and runoff coefficients used to calculate surplus water are shown in Section 3.1.

Table 4-8:
Kinetic Tests and Cycles Used for Pit Wall Source Term Calculation

Kinetic Test ID	Mineralization	Lithology	Material Type	Cycles/Weeks
Col 3	Oxide	Schist	Waste	2-98
Col 4	Transition	Schist	Waste	2-98
Col 5	Oxide	Gneiss	Waste	2-98
Col 6	Transition	Gneiss	Waste	2-98
Col 7	Oxide	Granite	Ore	2-52
Col 8	Transition	Granite	Ore	2-52
Col 9	Oxide	Schist	Ore	2-78
Col 10	Transition	Schist	Ore	2-78
Col 11	Oxide	Gneiss	Ore	2-78
Col 12	Transition	Gneiss	Ore	2-50
Col 13	Transition	Granite	Waste	2-50
HC6	Fresh	Granite	Waste	2-100
HC2	Fresh	Schist	Waste	2-87
HC4	Fresh	Gneiss	Waste	2-87

Note: Median loading rates used for base case, and 75th percentile loadings used for upper case source terms.

4.4.2 Saturated Source Term

The pit wall source term assumes that 75% of rock surfaces in the blast damaged zone and 50% of the blast fractured zone are flushed by meteoric water when subaerially exposed. When the pit wall becomes inundated by a pit lake, the blast-fractured and blast-influenced zone will be entirely flushed and the accumulated load will be released at that time. That is, 25% of the rock surface in the blast damaged zone and 50% of the surface in the blast fractured zone accumulates oxidation products, which are released once the pit wall is submerged. The unflushed surfaces are assumed to accumulate an oxide load at the same weathering rate applied to the unsaturated wall rock source terms. The accumulation rate is provided in Appendix A along with the other source terms. No solubility controls are applied to the saturated pit wall load.

4.4.3 Solubility Controls

Solubility controls for U are applied using the updated modelling approach described in Section 4.2.3 of this report. The one exception to this for mildly acidic granite transition ore exposures. The upscaled U concentration is directly applied to this rock type (*e.g.*, no solubility constraint). For all other rock types, the same pH assumptions applied to waste rock (base case pH 8.0; upper case pH 8.3) are applied. Alkalinity is determined by setting a pCO_2 value of $10^{-3.2}$. This is equivalent to 2x atmospheric pCO_2 concentration, and results in alkalinity values ranging from 70 mg/L to 180 mg/L. These alkalinity values are

similar or greater than background alkalinity concentrations observed in Halfway Creek at HC 2.5 (10th percentile 9.73 mg/L; median 72 mg/L; and, 90th percentile 132 mg/L).

Arsenic and ^{226}Ra solubility controls are calculated using the same approach described in Lorax (2017). Solubility caps for select other parameters not expected to upscale conservatively or present in detection limit values in kinetic tests are set to field bin results (Fe, Al, Cu, Hg, Se and Sb). The same parameters and solubility caps described in Lorax (2017) are applied to the current source term iteration.

4.5 Haul Roads

4.5.1 Unsaturated Source Term

Haul roads will be constructed primarily with waste rock. The lithology of waste rock that will be used in haul road construction is not yet defined. For the purpose of source term calculation, it is assumed that haul roads are constructed entirely of gneiss waste rock. This is the dominant rock type (~80%) of waste rock that will be produced over mine life. In the base case scenario, the loading rate assigned to haul road construction material is weighted based on the relative proportion of gneiss oxide, gneiss transition, and gneiss fresh waste rock that will be produced over mine life (13% oxide, 56% transition and 31% fresh). In the upper case scenario, the maximum loading rate for a given parameter from each of the three gneiss field bins is used for each parameter.

Geochemical loading rates are scaled to reflect differences in particle size surface area between field and kinetic test conditions. Roads will be constructed using gravel and sand particle size fraction of waste rock. Only the relatively fine grain size fraction will be used for road construction, with boulders and cobbles being excluded.

The annual surplus water of haul roads is used to convert loading rates to concentrations. A constant elevation of 1300 masl is used to estimate MAP of all haul roads. The MAP and runoff coefficients used to calculate surplus water are shown in Section 3.1.

4.5.2 Solubility Controls

Solubility controls are calculated for U, As and ^{226}Ra. Uranium solubility is calculated using the modelling approach described in section 4.1.3 of this report. The alkalinity is determined by setting a pCO_2 value of $10^{-3.2}$, which results in alkalinity values of 73 mg/L to 143mg/L for the base case and upper case scenario, respectively. The approach to calculating As and ^{226}Ra solubility controls is the same approach described WRSFs. Other model inputs (*e.g.*, pH and calcite SI) are consistent with what is described in section 4.1.3 for base case and upper case scenarios.

4.6 Heap Leach Solution Source Terms

A cyanide heap leaching facility is planned for extraction and recovery of Au from oxide and transition ore. Ore will be leached with lime buffered NaCN solution applied with drip emitters. The leach solution will drain into collection pipes that will direct the pregnant solution to the process plant where precious metals will be recovered. The resulting barren solution will be amended with additional lime and NaCN as required and then recirculated to the heap to continue the leaching cycle.

The HLF will be constructed in stages and gold recovery from certain areas of the pad will be completed while other areas are undergoing leaching. For those areas where leaching is completed, progressive reclamation will be able to commence. Upon completion of economic gold recovery of heap leach ore, progressive reclamation will be initiated which involves the following steps:

- Rinsing of leached ore with barren solution to export and volatilize cyanide and free cyanide;
- Capping of the HLF with geosynthetic clay liner (GCL) protected by 0.5 m of coarse waste rock for the flat surfaces, and 0.5 m of coarse waste rock over the slopes;
- If necessary, passive treatment of post-reclamation HLF seepage to serve as a final polishing step as contingency (*e.g.,* zero valent iron, coarse organic composted wood chips from tree clearing, suitable geologic material).

During operations and early closure, discharge of any excess HLF solution will undergo active treatment prior to release to the Alpha Pond and ultimately, Halfway Creek. Active treatment will include cyanide destruction, physico-chemical treatment and nitrate removal and final metal polishing using a biological system termed the Electrochemical Biological Reactor (EBR) system. Once active treatment is terminated and closure of the HLF is completed and stabilized, it may be necessary to direct residual HLF seepage waters through the events ponds converted to passive systems prior to discharge to Halfway Creek.

The development of a heap leach solution source term for use in the water quality model for parameters of interest involved a multi-step approach:

- Develop an estimate of early phase heap leach process barren solution coincident with water treatment requirements commencing in year 2
- Develop an estimate of heap leach recycled solution later in the mine life prior for parameters of concern as well as major ion concentrations that could accumulate over time. The concentrations of several major ions (*e.g.* SO_4, Na, Ca, Mg, K,

alkalinity) are anticipated to behave conservatively and accumulate in recycled heap rinse solutions.

- For parameters of interest that are targeted in the water treatment process, a back-calculation approach was used to develop estimates of effluent discharge concentrations for both active and passive treatment based on assimilative capacity in Halfway Creek. Calculated effluent discharge concentrations were used as the active or passive treated effluent concentration in the water quality model.

4.6.1 HLF Barren Solution Chemistry – Early Phase

During mine operations, HLF solutions will be dominantly pregnant/barren solution with some amount of meteoric water. Later in the mine life the HLF pore water will be a combination of pregnant solution and rinse water from areas where recirculation rinsing has been initiated. For the operations source term, it is assumed that all HLF pore water is barren solution during operations. The processing of heap leach ore for the Project will entail the use of cyanide solutions under pH conditions ranging between pH 10.0 and 11.0. While the dissolution of gold is the primary objective during cyanide leaching, other metals are liberated during the leaching process, both as a result of complexation reactions with cyanide (*e.g.* Cu-CN, Cd-CN, Zn-CN) and increased solubility under elevated pH conditions (*e.g.* As and U).

In Appendix B, the chemistry of Coffee barren solutions was estimated based on the final water quality measured in metallurgical cyanide leach columns (see Table 4-56 in Appendix B). This water quality estimate was updated to account for potentially higher concentrations of nitrate-nitrogen in the solutions as compared to measured in metallurgical columns and the inclusion of estimates for Cl, Ca and Na in the solutions based on measured concentrations in early phase Eagle Gold heap leach process solutions and charge balancing of solution chemistry. A summary of the early phase source term prediction is provided in Table 4-9.

Table 4-9:
Early Phase Heap Leach Solutions Source Term Estimate

Parameter	Units	Early Phase HLF Solution
pH	s.u.	9 to 10
$N\text{-}NH_3$	mg/L	72
$N\text{-}NO_3$	mg/L	50
$N\text{-}NO_2$	mg/L	1
Cl	mg/L	300
Sulphate	mg/L	1100
Total Alk	$mg/CaCO_3/L$	600
WAD-CN	mg/L	130
TDS	mg/L	2750
Al	mg/L	0.09
Ag	mg/L	0.00045
As	mg/L	5.0
Ca	mg/L	300
Cd	mg/L	0.0036
Cr	mg/L	0.008
Cu	mg/L	2
Co	mg/L	0.5
Fe	mg/L	2.3
Hg	mg/L	0.005
Mg	mg/L	2
Mn	mg/L	0.27
Mo	mg/L	0.125
Na	mg/L	580
K	mg/L	8
Ni	mg/L	0.019
Pb	mg/L	0.0002
Sb	mg/L	0.09
Se	mg/L	0.007
U	mg/L	0.1
Zn	mg/L	0.7

4.6.2 HLF Barren Solution Chemistry – Late Phase

The chemistry of the Coffee HLF solutions will evolve over the mine life as ore stacking and solution recycling progresses. A conceptual understanding of the chemical evolution of process solution can be informed by other HLF operations where Au has been recovered using sodium cyanide (NaCN) and lime (CaO) additives. In this section three analogue mine sites are described. The rinsed draindown chemistry of these sites is subsequently used to inform the behaviour of major ions and trace metals in HLF drainage for the Coffee Project for the later stages of heap leach operation.

4.6.2.1 Analogue Mines

Brewery Creek Mine

The Brewery Creek Mine is located 55 km east of Dawson City, Yukon and operated a gold heap leach facility from 1997 to 2001. The ore was primarily hosted in quartz monzonite sills and to a lesser extent in the Earn Group clastic sediments. A total of 9.5 Mt of ore was stacked in 7 cells encompassing an area of 31 ha. The heap was amended with cyanide, caustic and lime. The heap leach process recycled nearly all of the water used in processing. Thus, little or no water was released to the environment during operations. Mining ceased in September 2000, but processing and gold recovery continued uninterrupted until December 2001. Detoxification in the form of nutrient addition to promote in-situ biodegradation of cyanide species began in May 2002. Analytical results of solution chemistry from the Brewery Creek Mine is available from the end of operations (December, 2001), to May 2002 when detoxification using nutrient additives was initiated.

Daisy Mine

The Daisy Mine is located 8.9 km east of Beatty, Nevada and operated as a gold heap leach facility from 1996 to 2000. The ore consists of silicified and argillic altered limestone, with gold occurring in goethite and arseniosiderite minerals. During operations cyanide, lime and caustic were amended to the ore. By the end of operations, the HLF contained approximately 16 Mt of ore on a 17 ha pad. Owing to the arid climate, the site operated under a water deficit throughout mine life. No rinsing of the HLF occurred at the end of operations. Cover installation was complete in February 2002, at which point the HLF draindown commenced. Quarterly water quality monitoring is available from 2002 to 2008.

Marigold Mine

The Marigold Mine is located 4.8 km south of Valmy, Nevada. As of 2014, a total of 18 cells were operated, with cells 1, 2,7 and 8 inactive and in draindown. The ore is hosted in the Valmy Formation quartzite and argillites, with gold being hosted in iron oxide minerals contained in fractures. During operations cyanide, lime and caustic were amended to the ore, and process solution was circulated through all active cells. Cell 7, specifically, was operated from 1992 to 2001, and contained 2.4 Mt of ore at the end of operations. Owing to the arid climate, the site operated under a water deficit throughout mine life. No rinsing of the HLF occurred at the end of operations. Quarterly water quality monitoring is available for the first two years of draindown (2002 to 2003).

4.6.2.2 HLF Rinse Solution Estimate for Major Ions at Coffee

Recirculation of HLF process solution and progressive rinsing of the heap will lead to the accumulation of dissolved parameters in process solution. The rate and degree to which parameters will accumulate in solution depends on the source, release mechanism, and geochemical controls on mobility. Most trace elements are expected to stabilize in heap leach solutions relatively quickly, with the primary controls being related to the availability of cyanide and the highly alkaline pH produced by lime addition. Major ions are generally more soluble than trace metals in the HLF environment and may accumulate in process solution over time.

In order to accurately predict TDS, the accumulation of major ions in re-circulated process solution needs to be estimated. The eight major ions which mostly compose TDS at the three analogue mine sites are Na, Mg, Ca, SO_4, Cl, NO_3, K and HCO_3. Accurate prediction of the accumulation of TDS in the Coffee HLF requires a conceptual understanding of the sources and geochemical behavior of these elements in the Coffee HLF.

Major ion loadings in the Coffee HLF originate from reagents amended in support of Au extraction and weathering of primary minerals. Reagents which contribute to major ion loading include NaCN and lime (CaO). Irrigating NaCN solution into the heap leach contributes to Na and N loadings in the re-circulated process solution. A small portion of N is lost to CN off-gassing and denitrification, with the majority of residual N occurring as NO_3 in heap rinse solutions. Considering the non-conservative behaviour and lack of thermodynamic solubility constraints impacting N concentrations, the observed concentrations of N species at analogue mines are considered a reasonable approach to estimating N concentrations in the Coffee HLF.

The high Na concentrations observed in analogue HLF operations is primarily due to Na released from NaCN addition (Table 4-10). Sodium is highly soluble, and Na amended in the form of NaCN can be expected to eventually be rinsed from the heap. However, a portion of the Na amended in the form of NaCN will be trapped in dead-end pore space or retained on cation exchange sites within the heap. This Na retained in the heap will form a reservoir that will be gradually leached after draindown and closure. In order to calculate Na concentrations in the Coffee HLF, a loading model is used which incorporates the NaCN addition rate and an estimate of the mass of Na which will be retained within the HLF.

Calcium is present in lime and in carbonate minerals (calcite and dolomite) within the heap. The high pH produced by lime dissolution will limit dissolution of Ca bearing carbonates, and a portion of Ca from the lime additive will re-precipitation as secondary calcite. The concentration of Ca in re-circulated process solution will be controlled by thermodynamic

solubility constraints effecting Ca-carbonate formation and dissolution. Speciation of water quality data from the three analogue mines using the geochemical modelling program PHREEQC coupled to the Lawrence Livermore National Labs Database (llnl.dat) can be used to predict the degree of calcite saturation in these heaps (Parkhurst and Appelo, 1996). The results show that calcite is supersaturated at all three analogue mines (Figure 4-5), with similar median calcite SI values of 0.63 at Brewery Creek Mine, 0.53 at Daisy Mine, and 0.44 at Marigold Mine. These results show that Ca concentrations will be controlled by calcite precipitation with SI values ranging from 0.44 to 0.63.

Table 4-10:
Major Ion Concentrations Measured at Analogue Mines

		Analogue Sites								
		Brewery Creek Mine			**Daisy Mine**			**Marigold Mine**		
Parameter	*units*	*Min*	*P50*	*Max*	*Min*	*P50*	*Max*	*Min*	*P50*	*Max*
pH	mg/L	8.14	8.74	9.31	6.89	7.68	8.01	7.43	8.26	8.75
N-NO_3	mg/L	263	276	307	48	170	230	161	233	275
SO_4	mg/L	439	499	539	2160	2400	3100	560	650	726
Alkalinity	mg$CaCO_3$/L	13.9	41.1	82.5	95	130.5	160	21.4	47.5	77.2
Ca	mg/L	139	177	184	360	394	450	95.9	115	138
Mg	mg/L	7.8	9.31	10.3	93	110	140	28.2	32	37.8
Na	mg/L	338	434	455	720	780	940	754	840	946
Cl	mg/L	37	41.5	51.7	82	93.5	120	418	565	682
K	mg/L	3.7	5.4	51.5	9.9	15	27	7.8	8.25	10.8
TDS	mg/L	2290	2430	2624	3500	4485	5400	2810	3280	3620

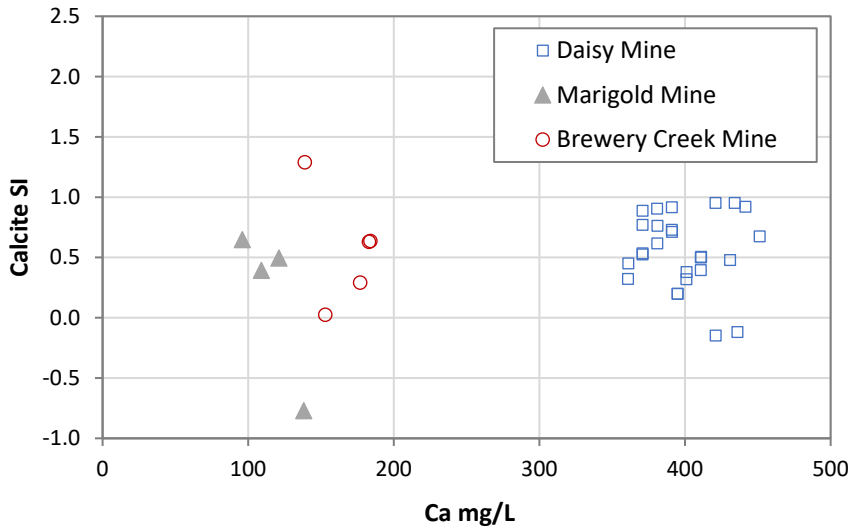


Figure 4-5: Calcium concentrations *versus* calcite saturation indices (SI) in HLF drainage at analogue mines.

The concentration of HCO_3 is determined by the interaction between carbonate dissolution/precipitation, biodegradation of CN, and ingress of atmospheric CO_2 into the heap. Assuming that calcite precipitates to achieve the range of SI values observed shown in Figure 4-5, the HCO_3 concentration can be predicted based on solution pH and pCO_2 concentrations. The relationship between these two parameters in the analogue dataset is shown in Figure 4-6.

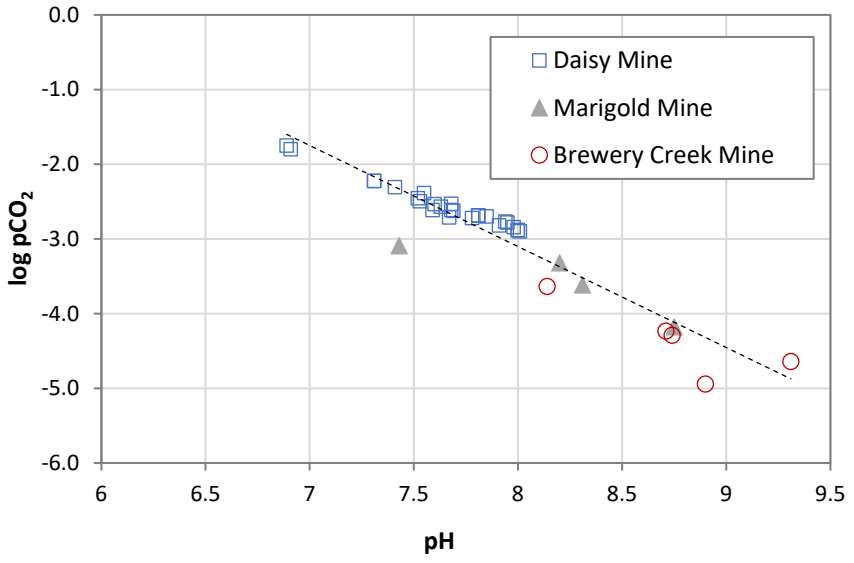


Figure 4-6: Log pCO_2 versus pH in HLF drainage at analogue mines. Dotted line indicates best fit linear regression.

The analogue mine data shows pCO_2 is undersaturated with respect to atmospheric concentrations when pH > 8.2 (atmospheric log pCO_2 = -3.4). This indicates that residual CaO remains in the HLF and is providing a source alkalinity that is not associated with carbonate mineral dissolution. As lime is rinsed or re-precipitated as calcite in the heap, the pH declines to <8.2 and pCO_2 becomes supersaturated with respect to atmospheric concentrations. Drainage from unsaturated mine rock facilities is typically elevated in pCO_2 relative to atmospheric values due to limitations on gas exchange between the interior of the facility and the atmosphere. Collectively, the analogue mines show a consistent relationship between pCO_2 and drainage pH. Once a pH estimate is established, the relationship between pCO_2 and pH shown in Figure 4-6 can be used to estimate HCO_3 concentrations at the Coffee HLF.

The primary source of Mg in the ore is dolomite and to a lesser extent silicate minerals (*e.g.,* phengite and biotite). Any Mg that enters process solution from weathering of silicates or dolomite is likely to be re-precipitated in the high pH environment of the active HLF facility as magnesite ($MgCO_3$). As lime is rinsed from the HLF and the pH declines, Mg concentrations will increase from increasing solubility of primary Mg minerals and dissolution of any secondary magnesite which may have formed in the heap. The SI of magnesite is plotted against Mg concentrations for the three analogue mines in Figure 4-7.

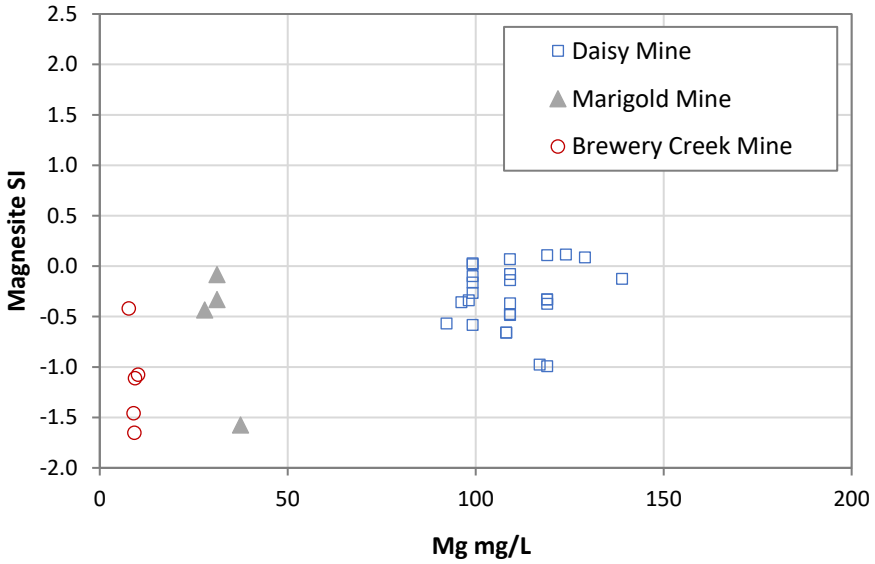


Figure 4-7: Magnesium concentrations versus magnesite saturation indices (SI) in HLF drainage at analogue mines.

The results show that Mg concentrations are often near equilibrium with magnesite at the Daisy Mine and Marigold Mine, which generally have higher Mg concentrations compared to Brewery Creek Mine. This shows that magnesite equilibrium (SI=0) is an effective

upper solubility limit on Mg concentrations and can be used to conservatively predict Mg concentrations in the Coffee HLF. Potassium is released from weathering of mica and K-feldspar minerals which are relatively abundant in Coffee ore. The solubility of potassium is controlled mainly by cation exchange in porous media, with clay minerals generally providing the most abundant exchange sites. The degree to which K concentrations will be controlled by cation exchange depends on solution chemistry, competing ion effects, and the availability and mineralogy of clay mineral surfaces. An empirical relationship can be observed between K and pH in the three analogue mines that is consistent with results from the Coffee Project leach tailings field bins (Figure 4-8). Given the relatively consistent relationship between K and pH from these data sources, it is assumed that K concentrations in the Coffee HLF can be reasonably predicted based on the empirical relationship shown in Figure 4-8.

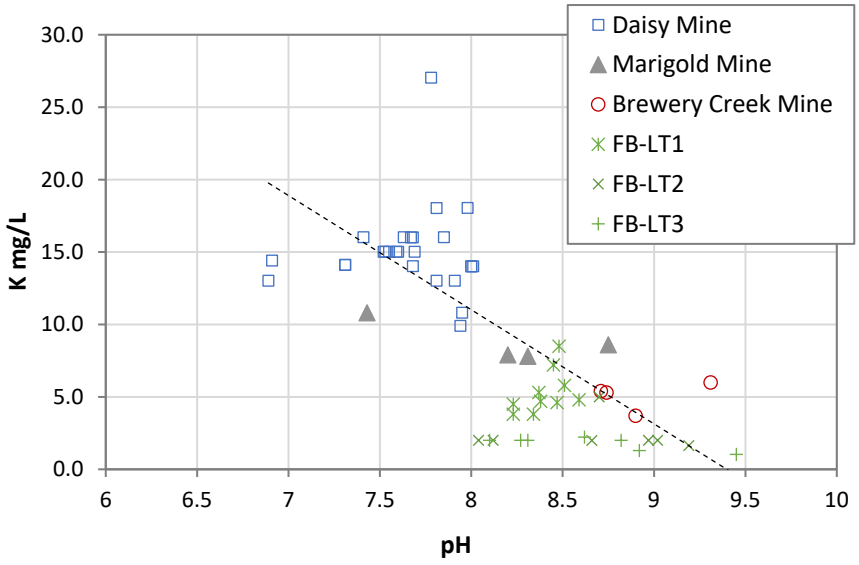


Figure 4-8: Potassium concentrations *versus* pH in HLF drainage at analogue mines. Dotted line indicates best fit linear regression.

Chloride is a major ion in HLF drainage that has not been identified in any distinct mineral phase. This element is often present as an impurity in apatite minerals and can be associated with clay minerals in mine rock. Chloride is highly soluble and any Cl released from mine rock is expected to be retained in the process solution. Considering the conservative behaviour of Cl, prediction of Cl will require a conservative loading model using site specific geochemical characterization data for the Coffee Project.

Sulphate will be released from dissolution of sulphate minerals and oxidation of residual sulphides present in the ore. The sulphur content varies considerably in different ore types, with schist generally having significantly higher sulphate and sulphide compared to gneiss

and granite. Sulphate is expected to remain relatively soluble during heap leach operations. This is due to elevated pH values generated by lime addition limiting Ca solubility. After irrigation of barren solution is complete, pH values will decline allowing for increased Ca solubility, which may potentially lead to gypsum precipitation. Sulphate concentrations can be predicted using a conservative loading model, similar to Cl, with the final concentrations potentially being limited by gypsum solubility.

Modeling Approach for Major Ions for Coffee

In addition to evaluating analogue sites, there are two general approaches used to predicting concentrations of major ions:

- Loading calculations for conservative parameters (Na, Cl and SO_4); and,
- assigned concentrations for non-conservative parameters based on the thermodynamics of mineral precipitation/dissolution or empirical observations (K, Ca, Mg, NO_3 and HCO_3).

Note that solubility constraints for SO_4 are considered in the final solution but are ultimately not applied as predicted concentrations remain below gypsum saturation. An upper case and base case prediction for major ions has been developed, consistent with previous source term development for the Coffee Project.

Major ion loading rates are predicted based on geochemical test results for metallurgical columns and leach tailings kinetic tests. Metallurgical column and leach tailings kinetic testing samples used in source term development are shown in Table 4-11. Data for solubility constraints are generated from empirical observations of analogue mines described above or using the geochemical modelling program PHREEQC coupled to the llnl.dat database.

Table 4-11:
Metallurgical Columns and Kinetic Test

Lithology	Weathering	Met Columns	Kinetic Tests
		Head ID (*Column IDs*)	**Column ID (*Composition*)**
Schist	Oxide	72133 (*73001*), 72136 (*72153, 72156*)	Column 15 (*100% Schist*)
Schist	Transition	72137 (*72759, 72162*), 72138 (*72165, 72168*)	
Granite	Oxide	72139 (*72717, 72174*)	Column 17 (*90% Gneiss, 10% Granite*)
Granite	Transition	72177 (*72177, 72180*)	
Gneiss	Oxide	72134 (*73004*), 72142 (*73010*, *73013*, *73007*), 72143 (*73019*, *73022, 73016*), 72144 (*73025*, *73028*), 72145 (*73031, 73034*)	
Gneiss	Transition	72146 (*73037, 73040*)	

The major ions SO_4, Na and Cl are modeled to behave conservatively and accumulate in the process solution during operations. Two types of loading are used to predict these concentrations; a water-soluble load that will be released shortly after ore is stacked on the heap and irrigated with process solution; and, a kinetic weathering rate representing gradual release of major ions from primary minerals in the spent leach tailings. The calculations of loading rates for conservative parameters are described below.

The water-soluble load for SO_4 and Cl is estimated using results from the metallurgical column tests. The columns were irrigated with NaCN solution which was recirculated over a 32-day period. The concentration of SO_4 and Cl in the column water at the end of the experiment can be used to calculate the water-soluble load of these parameters associated with different ore types. Details of columns used to calculate the water-soluble load from the metallurgical columns are shown in Table 4-12. The loading is calculated by multiplying the concentration by the total water added to the column during testing and divided by the column mass. When multiple columns are constructed from the same head sample, the columns are averaged to produce a loading associated with the head sample. The loading released each year of mine life is scaled based on the quantity and lithology of ore that will be stacked on the HLF in a given year.

Table 4-12:
Metallurgical column results for SO_4 and Cl concentrations

Lithology	Weathering	Head ID	Column ID	Mass (kg)	Water Added (L)	SO_4 (mg/L)	Cl (mg/L)
Schist	Oxide	72133 A	73001	48	18.4	43.1	19.4
		72136 A	72153	101	32.6	725	26.0
			72156	50	19.7	547	23.0
	Tran.	72137 A	72159	94	30.4	2980	27.0
			72162	50	16.5	2370	<25
		72138 A	72165	84	28.6	2570	<25
			72168	49	19.3	2670	<25
Granite	Oxide	72139 A	72171	104	33.0	57.4	27.0
			72174	50	20.3	37.9	20.6
	Tran.	72140 A	72177	98	29.9	666	23.0
			72180	50	18.5	424	22.0
Gneiss	Oxide	72134 A	73004	46	16.4	8.8	17.9
		72142 A	73010	83	29.8	9.6	21.0
			73013	43	19.6	11.8	21.8
			73007	718	143.7	6.9	15.0
		72143A	73019	86	28.5	10.6	22.0
			73022	44	22.4	12.3	19.2
			73016	741	147.8	8.1	16.0
		72144 A	73025	99	29.2	44.5	22.0
			73028	50	18.4	41.9	24.0
		72145 A	73031	95	28.2	58.2	25.0
			73034	49	17.3	62.8	24.7
	Tran.	72146 A	73037	94	25.8	444	27.0
			73040	50	22.5	744	30.0

The water-soluble load of Na is estimated based on the expected NaCN amendment rate and an estimate of Na that will retained within the HLF. Amending NaCN at a dossage of 0.2 kg/t would equate to a Na amendment of 93.8 mg/kg. It is assumed that 70% of the Na amendment will be available to process solution, resulting in 65.7 mg/kg Na being immediately water-soluble. The water-soluble load associated with each lithology and weathering zone is presented in Table 4-13. These rates are applied to the base case and upper case loading model.

Table 4-13:
Water-soluble load of SO_4, Cl and Na used in loading model

Lithology	Weathering	SO_4	Cl	Na
		kg/t	kg/t	kg/t
Schist	Oxide	121	8.1	65.7
Schist	Transition	918	5.5	65.7
Granite	Oxide	16.8	8.5	65.7
Granite	Transition	180	7.6	65.7
Gneiss	Oxide	8.9	7.1	65.7
Gneiss	Transition	228	10.5	65.7

After the initial water-soluble load is released to process water in the HLF, primary minerals in the ore will continue to weather. Weathering of the ore over time is measured using kinetic tests conducted on leach tailings samples built from metallurgical column residues (Table 4-11). Major ion weathering rates used in the model are presented in Table 4-14.

Table 4-14:
Weathering rate of SO_4, Cl and Na used in loading model

Lithology	Weathering	SO_4		Cl		Na	
		Upper Case	Base Case	Upper Case	Base Case	Upper Case	Base Case
		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
Schist	Oxide	0.107	0.0279	0.0024	0.000945	0.0124	0.00187
Schist	Transition	0.107	0.0279	0.0024	0.000945	0.0124	0.00187
Granite	Oxide	0.0118	0.0038	0.00235	0.00093	0.0642	0.00881
Granite	Transition	0.0118	0.0038	0.00235	0.00093	0.0642	0.00881
Gneiss	Oxide	0.0118	0.0038	0.00235	0.00093	0.0642	0.00881
Gneiss	Transition	0.0118	0.0038	0.00235	0.00093	0.0642	0.00881

The upscaled loadings are converted to a concentration using the HLF water balance. All loadings of Na, Cl and SO_4 are modeled to accumulate within HLF process water (pore water + barren/pregnant tanks) between Y-1 and Y6. Starting in Y6, a portion of the load in the HLF is exported to treatment with surplus water. Surplus water continues to be generated for the remainder of HLF operations and rinsing. After Y6 concentrations are predicted to decline in the heap leach solution. This is due to: export of TDS with discharge solution; and, the type of ore stacked is primarily gneiss oxide which produces relatively low quantities of SO_4 compared to other ore types.

Non-conservative parameters are estimated based on empirical relationships described above (Figure 4-5 to Figure 4-8) combined with thermodynamic solubility constraints imposed using the geochemical modelling program PHREEQC. In order to employ thermodynamic solubility constraints a prediction of pH is required. The pH of the drain HLF solution is set to the range of pH values observed in Coffee leach tailings field bins (min= pH 8.0; median = pH 8.4; max = pH 9.4). Lower pH estimates result in more conservative TDS estimates. Therefore, the upper case estimate uses the minimum pH observed in field bins of pH 8.0, and the base case source term uses the median pH observed in field bins of pH 8.4.

The concentration of Ca and Mg are predicted based on thermodynamic solubility constraints. Data from analogue mines show that magnesite equilibrium provides a conservative estimate of Mg concentrations (Figure 4-7). Therefore, Mg concentrations set to equilibrium with magnesite (SI=0) in both the upper case and base case scenarios. Calcium concentrations tend to be super saturated with respect to calcite, with median SI values of 0.44, 0.53 and 0.63 (Figure 4-5). For the base case and upper case scenario calcite is set to an SI of 0.53 and 0.63, respectively. Alkalinity is predicted based on the relationship observed between pCO_2 and pH in the analogue mines (Figure 4-6). Based on this relationship log pCO_2 is set at -3.78 in the base case scenario which assumes pH 8.0, and log pCO_2 is set at -3.10 in the upper case scenario which assumes a pH of 8.4.

Nitrate and K concentrations are assigned values based on analogue data. The K concentration is estimated based on the empirical relationship between K and pH shown in Figure 4-8. Nitrate concentrations are set to the maximum and median concentrations observed at the Brewery Creek Mine, which has the highest NO_3 concentrations of the three analogue sites (see Table 4-10).

4.6.2.3 HLF Late Phase and Rinse Solution Estimate for Trace Elements at Coffee

The water quality estimate for late phase rinsed HLF ore for trace elements is based on upscaling kinetic test results on leach tailings samples. The concentration prediction for U in HLF rinse solutions has been updated to be consistent with model updates described in section 4.2.3.1 of this report. Model inputs are modified to reflect the material composition, pore water chemistry, and water content of the HLF. The availability of U and Fe-oxides are updated using median total Fe and U content of the various ore lithologies (Table 4-6). The HLF water content will be elevated compared to waste rock owing to irrigation of detoxified rinse solution at the end of mine life, and a water content of 18% is applied (*i.e.*, 90 ml/kg). The concentration of As has been estimated using the same approach described in section 4.2.3.2. Residual CN in HLF drainage is taken from monitoring data from the Brewery Creek closed heap leach operation in Yukon.

Data Sources

Kinetic test loading rates for leach tailings are upscaled to produce the rinsed HLF chemistry estimate for trace elements. During the rinsing phase, it is expected that 4 pore volumes will be rinsed through the HLF. Therefore, loading rates were calculated from leach tailings kinetic tests after this volume of pore water has been rinsed. The kinetic test ID's and cycles used are presented in Table 4-15; note that the cycles vary with the size of the columns, with a greater number of cycles required to rinse the equivalent of 4 pore volumes in larger columns. Median loading rates are used for base case rinse chemistry estimates and 75th percentile loading rates are used for upper case rinse estimates calculations.

Table 4-15:
Kinetic Test Data used in HLF Post Closure Source Term

Kinetic Test ID	Metallurgic Sample ID	Mineralization	Lithology	Material Type	Cycles
Col 1	70340	90% Oxide 10% Transition	82% Gneiss 23% Schist	Leach Tailings	23-87
Col 2	70340	90% Oxide 10% Transition	82% Gneiss 23% Schist	Leach Tailings	51-87
Col 16	20%72162, 20% 72168, 30% 72150, 30% 72156	40% Oxide, 60% Transition	Schist	Leach Tailings	9-57
Col 17	35% 73028, 35% 73034, 18% 73040, 7% 72174, 3% 72180	80% Oxide 20% Transition	90% Gneiss, 10% Granite	Leach Tailings	8-57

The HLF rinse chemistry estimate is calculated by upscaling kinetic test loading rates and weighting the scaled results proportional to the different ore types contained in the HLF. Scaling factors used in HLF rinse chemistry calculation are summarized in Table 4-16.

Table 4-16:
Heap Leach Rinse Solution Estimate Scaling Factors

Scaling Factors	Unit	Base Case	Upper Case
Mean Annual Precipitation	mm	485	485
Runoff Coefficient	-	30%	30%
Grain size correction	-	20%	20%
% of material flushed	-	10%	25%
Bulk Scaling	-	2%	5%

Physical scaling factors considered in development of the HLF rinse estimate include grain size correction and flushing rate. Note that kinetic testing was carried out in a cold room which maintained a temperature of 4°C. The HLF will approach mean annual temperatures of ambient air, which is near 0°C, and may become partially frozen during winter months. No consideration is given to freezing of the HLF during winter months or re-establishment of permafrost. The geochemical loading rates measured at 4°C is expected to produce a conservative approximation of field loading rates, and no temperature scaling factor is applied.

There are differences in the grain size used in kinetic test samples, and the grain size specified in the design criteria of the HLF. Metallurgical leach columns were conducted on a variety of grain sizes to examine Au recovery. Laboratory kinetic test samples were collected from the smallest grain size samples of 80% -12.2 mm to ensure conservative results. The design criteria for the HLF is 80% - 50 mm. The grain size distribution on metallurgical leach column samples crushed to 80% - 50 mm found that on average 20% of the sample is -12.2 mm. Therefore, a grain size scaling factor of 0.2 is applied.

Unsaturated rock piles are known to develop preferential water pathways with variable moisture content. As a result, the entire mass of the reactive grain size fraction will not be equally rinsed by infiltrating water. Laboratory kinetic tests will experience a greater degree of flushing of mineral surfaces due to their small size and high flushing rate. In uncovered waster rock environments, an average contact water factor of 10% to 50% has been estimated (Elboushi, 1975; Kempton, 2012). Over 50% of the HLF will be covered with either raincoats during operations or a geosynthetic clay liner at the end of mine life. At closure, much of the infiltration will only occur through uncovered slopes, limiting the contact with reactive mineral surfaces. Therefore, a contact water factor of 10% to 25% was applied to the base case and upper case source term calculations. The physical scaling factors used in the upper case and base case source term predictions are presented in Table 4-16.

Kinetic tests representing various ore types are weighted to reflect the expected composition of the HLF at the end of mine life. The relative proportions of Col 1, Col 2, Col 15 and Col 17 is 0.35, 0.35, 0.10, and 0.20, respectively.

Solubility Controls

The HLF rinse estimate is calculated by upscaling kinetic test loading rates. This approach to source term calculation frequently results in predicted concentrations that exceed thermodynamic solubility controls, particularly in neutral pH environments where numerous controls on dissolved concentrations influence drainage chemistry. Solubility

controls for As, U and ^{226}Ra are calculated using the approach described in Section 4.2.3 of this report.

Nitrogen Species

As introduced above, elevated concentrations of nitrogen species are expected to be present in HLF drainage in post closure. Unlike other sources of nitrogen loading at the mine site, the primary source of nitrogen species in the HLF is from degradation of CN. Hence, nitrogen concentrations cannot be calculated based on an estimate of explosive use. Nitrogen loadings in the HLF will depend in large part on the rate of CN degradation during mine life and the effectiveness of rinsing closed sections of the heap during progressive reclamation. For the purposes of source term prediction, NO_3, NH_4, and WAD-CN concentrations produced at the closed heap leach facility at an analogue mine site, Brewery Creek are applied. The median and maximum concentrations observed 4 to 11 years after closure are used as the Base Case and Upper source term concentrations for nitrogen species.

For CN-WAD, the maximum and median concentrations measured at Brewery Creek were 0.196 mg/L and 0.086 mg/L. Nitrite was not regularly monitored in HLF drainage at the Brewery Creek site. Therefore, the ratio of NO_2/NO_3 in available Brewery Creek data was used to predict NO_2 concentrations based on the maximum and median NO_3 concentration.

4.6.2.4 HLF Late Phase Solution and Draindown Seepage Chemistry Estimate

The rinse and seepage water quality estimate for the HLF is presented in Table 4-17 for base case and upper case. This water quality estimate represents drainage chemistry from the HLF during late phase operations and rinsing.

The nature of loading calculations and source term calculations often results in solution chemistries that are not in charge balance. Charge balance refers to the fact that in all waters the valence concentration (eq/L) of positively charged cations must always equal the valence concentration of negatively charged anions. The charge balance of the predicted solutions has % error ranging from of -6.9% to +9.6%. Correcting this charge balance error would require manipulation of the solution chemistry. The predicted concentrations have been developed as reasonably conservative approximations of Coffee HLF chemistry. While they are not precisely charge balanced, the predictions are considered reasonable for the purpose of water quality modelling and guiding potential treatment testwork. Therefore, no further adjustments are made to correct the charge balance.

Table 4-17:
Late Phase Heap Water Chemistry Estimate prior to Treatment

		HLF Late Phase Chemistry	
		Upper Case	**Base Case**
pH	s.u.	8.4	8.0
N-NH_4	mg/L	0.06	0.025
N-NO_3	mg/L	307	275
N-NO_2	mg/L	1.9	1.6
Cl	mg/L	123	115
Sulphate	mg/L	2516	2300
Total Alk	mg/$CaCO_3$/L	87	47
WAD-CN	mg/L	0.2	0.09
TDS	mg/L	4100	3000
Al	mg/L	0.2	0.06
Ag	mg/L	0.00125	0.00009
As	mg/L	2.0	0.66
Ca	mg/L	350	204
Cd	mg/L	0.00013	0.00004
Cr	mg/L	0.014	0.004
Cu	mg/L	0.014	0.004
Fe	mg/L	0.5	0.15
Hg	mg/L	0.00026	0.0001
Mg	mg/L	155	117
Mn	mg/L	0.06	0.016
Mo	mg/L	0.105	0.0330
Na	mg/L	1168	890
K	mg/L	11	8
Ni	mg/L	0.006	0.002
Pb	mg/L	0.0013	0.00032
Sb	mg/L	0.5	0.17
Se	mg/L	0.005	0.0015
Tl	mg/L	0.004	0.0015
U	mg/L	0.685	0.300
Zn	mg/L	0.052	0.02
Ra-226	Bq/L	0.07	0.05

4.6.3 Summary of HLF Solution Source Term Estimate

Table 4-18 provides a summary of the source term estimate for the HLF solution during operations and later in the mine life and into closure (e.g., as draindown seepage chemistry).

Table 4-18:
Early and Late Phase Heap Water Chemistry Estimate Source Term

Parameter	Units	Early Phase HLF Solution	Later Phase HLF Solution
pH	s.u.	9 to 10	8.4
$N\text{-}NH_3$	mg/L	72	0.06
$N\text{-}NO_3$	mg/L	50	307
$N\text{-}NO_2$	mg/L	1	1.9
Cl	mg/L	300	123
Sulphate	mg/L	1100	2516
Total Alk	$mg/CaCO_3/L$	600	87
WAD-CN	mg/L	130	0.2
TDS	mg/L	2750	4100
Al	mg/L	0.09	0.2
Ag	mg/L	0.00045	0.00125
As	mg/L	5.0	2.0
Ca	mg/L	300	350
Cd	mg/L	0.0036	0.00013
Cr	mg/L	0.008	0.014
Cu	mg/L	2	0.014
Co	mg/L	0.5	0.25
Fe	mg/L	2.3	0.5
Hg	mg/L	0.005	0.00026
Mg	mg/L	2	155
Mn	mg/L	0.27	0.06
Mo	mg/L	0.125	0.105
Na	mg/L	580	1168
K	mg/L	8	11
Ni	mg/L	0.019	0.006
Pb	mg/L	0.0002	0.0013
Sb	mg/L	0.09	0.5
Se	mg/L	0.007	0.005
U	mg/L	0.1	0.685
Zn	mg/L	0.7	0.052

References

Bernhard, G., Geipel, G., Reich, T., Brendler, V., Amayri, S., & Nitsche, H. (2001). Uranyl (VI) carbonate complex formation: Validation of the Ca2UO2 (CO3) 3 (aq.) species. *Radiochimica Acta*, *89*(8), 511-518.)

Chen, J., Zhang, D.D., Wang, S., Xiao, T., Huang, R., 2004. Factors controlling tufa deposition in natural waters at waterfall sites. *Sedimentary Geology*. 166, 353–366.

Cumberland S. A., Douglas G., Grice K. and Moreau J. W. (2016) Uranium mobility in organic matter-rich sediments: A review of geological and geochemical processes. *Earth-Science Rev.* 159, 160–185.

Dixit S. and Hering J. G. (2003) Comparison of arsenic(V) and arsenic(III) sorption onto iron oxide minerals: Implications for arsenic mobility. *Environ. Sci. Technol.* 37, 4182–4189.

Dzombak, D. A., & Morel, F. (1990). *Surface complexation modeling: hydrous ferric oxide*. John Wiley & Sons.Bernhard *et al*., (2001)

Eriksson, N., Gupta, A., & Destouni, G. (1997). Comparative analysis of laboratory and field tracer tests for investigating preferential flow and transport in mining waste rock. *Journal of Hydrology*, *194*(1-4), 143-163.

Goldberg S. (2002) Competitive Adsorption of Arsenate and Arsenite on Oxides and Clay Minerals. *Soil Sci. Soc. Am. J.* 66, 413–421.

Grafe M., Eick M. J., Grossl P. R. and Saunders A. M. (2002) Adsorption of arsenate and arsenite on ferrihydrite in the presence and absence of dissolved organic carbon. *J. Environ. Qual.* 31, 1115–1123.

Lebron, I., Suarez, D.L., 1996. Calcite nucleation and precipitation kinetics as affected by dissolved organic matter at 25 °C and pH>7.5. *Geochimica et Cosmochimica Acta* 60, 2276–2765.

Lorah, M., Herman, J., 1988. The chemical evolution of a travertine-depositing stream: geochemical processes and mass transfer reactions. *Water Resources Research* 24, 1541-1552

Lorax (2019). Uranium and arsenic in the baseline environment-Draft, Dawson Range, Yukon. Prepared for Government of Yukon by Lorax Environmental Services Ltd. in partnership with University of British Columbia. June 2019.

MEND (2015). Role of Nitrate in the Remobilization and Attenuation of Selenium in Coal Mine Waste Environments. In *MEND Report 10.3*. The Mine Environment Neutral Drainage Program.

Nichol, C., Smith, L., & Beckie, R. (2005). Field-scale experiments of unsaturated flow and solute transport in a heterogeneous porous medium. *Water Resources Research*, *41*(5).

Parkhurst, D. L., & Appelo, C. A. J. (1999). User's guide to PHREEQC (Version 2): A computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations. *Water-resources investigations report*, *99* (4259), 312.

Payne, T. E. (1999). *Uranium (VI) interactions with mineral surfaces: controlling factors and surface complexation modelling* (Doctoral dissertation, University of New South Wales).

Smedley P. L. and Kinniburgh D. G. (2002) A review of the source, behaviour and distribution of arsenic in natural waters. *Appl. Geochemistry* 17, 517–568.

Stewart B. D. (2008) The dominating influence of calcium on the biogeochemical fate of uranium. PhD Thesis, Stanford University. 135 p.

Stewart B. D., Mayes M. A. and Fendorf S. S. (2010) Impact of Complexes on Uranium (VI) Adsorption to Synthetic and Natural Sediments. *Environ. Sci. Technol.* 44, 928–934.

Suarez, D.L., 1983. Calcite supersaturation and precipitation kinetics in the lower Colorado River, All-American Canal, and East Highland Canal. *Water Resource Research.* 19, 653– 661.

Appendix A: Source Terms

Newmont™ COFFEE

			Alkalinity	Sulphate	P	Al	Ag	As	Ca	Cd	Cl	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn	Ra226
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Alpha WRSF																													
Base Case																													
Y1			2.56E+02	842.0794378	9.69E-04	0.008228957	1.95196E-05	0.004437896	1.63E+02	1.59452E-05	5.175228	0.000484378	0.001185598	0.001546028	0.025610154	5.41713E-06	25.09858	9.93E+01	0.011256683	0.041563093	63.00021	0.005100522	0.002429059	0.012724604	0.000915041	0.000175655	0.1001028	0.048571521	0.01030844
Y2			2.61E+02	1098.919711	8.12E-04	0.008228957	2.3628E-05	0.005403955	1.83E+02	2.1261E-05	6.441121	0.000568156	0.001451841	0.001968891	0.030979054	5.41713E-06	29.70646	1.12E+02	0.011323323	0.06034412	70.91733	0.005053573	0.002953354	0.014774196	0.001042446	0.00021649	0.1794877	0.051573505	0.009086412
Y3			2.66E+02	1381.298493	6.84E-04	0.008228957	2.890848E-05	0.005768261	1.97E+02	2.69181E-05	7.962226	0.00068673	0.001784019	0.002453946	0.037892378	5.41713E-06	36.03341	1.21E+02	0.012789631	0.07846698	97.95048	0.005665078	0.003619398	0.017785402	0.001245284	0.000266658	0.243355	0.059761683	0.008152935
Y4			2.68E+02	1383.742682	6.74E-04	0.008228957	2.938186E-05	0.005571746	1.97E+02	2.68622E-05	8.047844	0.000702581	0.001809	0.002469429	0.03851832	5.41713E-06	36.7945	1.21E+02	0.013582673	0.077209048	98.85569	0.006041836	0.003675364	0.018235977	0.001282198	0.000270045	0.2333444	0.062570533	0.008146106
Y5			2.69E+02	1556.034004	6.19E-04	0.008228957	3.249666E-05	0.005797182	2.04E+02	3.03401E-05	8.957808	0.000771219	0.002006146	0.002762558	0.042598801	5.41713E-06	40.47814	1.26E+02	0.014282095	0.088620543	110.2221	0.006322005	0.004069186	0.019967035	0.001397162	0.000299916	0.2662268	0.066881481	0.007705366
Y6			2.73E+02	1752.939006	5.67E-04	0.008228957	3.61396E-05	0.005975239	2.13E+02	3.42947E-05	10.01176	0.000852525	0.002235725	0.003099744	0.047362976	5.41713E-06	44.82442	1.31E+02	0.015232135	0.101389074	123.3556	0.006713935	0.004528964	0.022027372	0.001535339	0.000334624	0.3121846	0.072337704	0.007282237
Y7			2.74E+02	1860.928681	5.43E-04	0.008228957	3.86082E-05	0.006094669	2.17E+02	3.99781E-05	10.58701	0.001526558	0.002362429	0.003675025	0.050203119	5.41713E-06	47.44509	1.34E+02	0.408756918	0.107996874	130.7595	0.007143648	0.004761618	0.023127905	0.001604908	0.0003561	0.3371746	0.078605697	0.00707878
Y8			2.77E+02	2005.959855	5.09E-04	0.008228957	4.319444E-05	0.006236087	2.23E+02	5.53812E-05	11.39067	0.003840637	0.002545741	0.005322423	0.054809935	5.41713E-06	51.85586	1.37E+02	1.812541325	0.115263924	141.5322	0.008390037	0.005056492	0.024758903	0.001702605	0.000392077	0.3566192	0.095727926	0.006831397
Y9			2.77E+02	2021.510409	5.08E-04	0.008228957	4.329211E-05	0.006271858	2.23E+02	5.50216E-05	11.45808	0.003719137	0.002558719	0.005269248	0.05501403	5.41713E-06	51.99259	1.38E+02	1.734661644	0.116670172	142.3621	0.008294547	0.005085319	0.024831517	0.001706803	0.00039366	0.3660202	0.094891616	0.006806438
Closure			2.77E+02	2021.510409	5.08E-04	0.008228957	4.329211E-05	0.006271858	2.23E+02	5.50216E-05	11.45808	0.003719137	0.002558719	0.005269248	0.05501403	5.41713E-06	51.99259	1.38E+02	1.734661644	0.116670172	142.3621	0.008294547	0.005085319	0.024831517	0.001706803	0.00039366	0.3660202	0.094891616	0.006806438
Alpha WRSF																													
Upper Case																													
Y1			5.24E+02	1231.632708	3.30E-04	0.012513423	2.85495E-05	0.020813814	8.09E+01	2.33216E-05	7.569333	0.000708455	0.001734065	0.002261234	0.037457635	8.50822E-06	36.70939	3.12E+01	0.016464123	0.060790541	92.14465	0.007460068	0.003552762	0.018611116	0.001338346	0.000256914	0.14143626	0.071041129	0.017826755
Y2			5.38E+02	1607.289525	2.74E-04	0.012513423	3.455855E-05	0.024860363	8.79E+01	3.10965E-05	9.42084	0.00083099	0.002123475	0.002879717	0.045310233	8.50822E-06	43.44892	3.40E+01	0.016561591	0.088259834	115.5714	0.0073914	0.004319602	0.021608868	0.001524691	0.000316641	0.2443784	0.075431856	0.015713458
Y3			5.52E+02	2020.299187	2.30E-04	0.012513423	4.228176E-05	0.026386337	9.48E+01	3.93707E-05	11.64562	0.001004417	0.002609322	0.003589163	0.055421721	8.50822E-06	52.70278	3.67E+01	0.021706225	0.114756488	143.2632	0.008285792	0.005293763	0.026913084	0.001821363	0.000390016	0.332129	0.087407958	0.014099163
Y4			5.52E+02	2023.87408	2.26E-04	0.012513423	4.297411E-05	0.025563192	9.48E+01	3.9289E-05	11.77085	0.001027601	0.00264586	0.003611808	0.056337259	8.50822E-06	53.81596	3.67E+01	0.019866135	0.112926625	144.5872	0.008836842	0.005375619	0.026672099	0.001875355	0.000394497	0.303926	0.091516206	0.014087353
Y5			5.59E+02	2275.868864	2.07E-04	0.012513423	4.75298E-05	0.026507476	9.86E+01	4.43758E-05	13.10177	0.001127991	0.002934207	0.004004542	0.062299527	8.50822E-06	59.20367	3.82E+01	0.020889117	0.129617176	161.2119	0.009246619	0.005951627	0.029203959	0.002043502	0.000438659	0.3647112	0.097821436	0.013325165
Y6			5.68E+02	2563.863831	1.90E-04	0.012513423	5.285727E-05	0.027253305	1.03E+02	5.01597E-05	14.64329	0.00124691	0.003269991	0.004533712	0.0692735	8.50822E-06	65.56058	3.98E+01	0.022278654	0.148292541	180.4209	0.009819859	0.006624102	0.032217426	0.002245601	0.000489424	0.4320176	0.105800783	0.012593434
Y7			5.72E+02	2721.810471	1.81E-04	0.012513423	5.646874E-05	0.030818762	1.05E+02	5.84723E-05	15.48465	0.002232757	0.00345531	0.005375123	0.073427518	8.50822E-06	69.39361	4.07E+01	0.597851423	0.157957167	191.25	0.010448362	0.006964384	0.033827075	0.002347353	0.000520893	0.4686458	0.114969375	0.012241588
Y8			5.78E+02	2931.934327	1.68E-04	0.012513423	6.317666E-05	0.0413761	1.08E+02	8.1001E-05	16.66009	0.005617349	0.003723422	0.007784622	0.080165487	8.50822E-06	75.84483	4.17E+01	2.651038703	0.168586017	207.0063	0.012271341	0.007395669	0.036212587	0.002490245	0.000573456	0.4951114	0.140012497	0.011813781
Y9			5.79E+02	2956.678703	1.68E-04	0.012513423	6.33194E-05	0.040902143	1.08E+02	8.04751E-05	16.75869	0.005439642	0.003742405	0.007706848	0.080463999	8.50822E-06	76.04482	4.19E+01	2.537131205	0.170642808	208.2201	0.012131676	0.007437832	0.036318792	0.002496384	0.000575771	0.5092724	0.138789302	0.011770617
Closure			5.79E+02	2956.678703	1.68E-04	0.012513423	6.33194E-05	0.040902143	1.08E+02	8.04751E-05	16.75869	0.005439642	0.003742405	0.007706848	0.080463999	8.50822E-06	76.04482	4.19E+01	2.537131205	0.170642808	208.2201	0.012131676	0.007437832	0.036318792	0.002496384	0.000575771	0.5092724	0.138789302	0.011770617
In-Pit Kona																													
Base Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y4			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y6			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y7			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y8			2.54E+02	772.1407579	1.31E-03	0.022879125	1.483888E-05	0.006983296	1.53E+02	1.53709E-05	4.227084	0.000338092	0.000928986	0.001136894	0.019433283	0.000005	17.96104	8.80E+01	0.004739232	0.048232383	52.46434	0.00201948	0.001868185	0.008630865	0.000587521	0.00013994	0.3213	0.024950275	0.013416376
Y9			2.54E+02	772.1407579	1.31E-03	0.022879125	1.483888E-05	0.006983296	1.53E+02	1.53709E-05	4.227084	0.000338092	0.000928986	0.001136894	0.019433283	0.000005	17.96104	8.80E+01	0.004739232	0.048232383	52.46434	0.00201948	0.001868185	0.008630865	0.000587521	0.00013994	0.3213	0.024950275	0.013416376
Closure			2.29E+02	168.5872449	7.02E-03	0.022879125	3.239866E-06	0.029381213	3.27E+01	3.35605E-06	0.922931	7.38183E-05	0.000202832	0.000291894	0.004243014	0.000005	3.921568	1.68E+01	0.001034752	0.010530936	11.45493	0.000440928	0.000407895	0.001884441	0.000128278	3.05542E-05	0.09686362	0.005447579	0.027598687
In-Pit Kona																													
Upper Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y4			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y6			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y7			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y8			5.20E+02	1129.339787	4.58E-04	0.028135436	2.170333E-05	0.031475772	7.87E+01	2.24817E-05	6.182569	0.000494497	0.001358743	0.001955353	0.028423289	0.000005	26.26998	3.03E+01	0.006931642	0.070545103	76.7348	0.009253709	0.002732423	0.012623578	0.000859313	0.000204678	0.4715732	0.036492489	0.022888616
Y9			5.20E+02	1129.339787	4.58E-04	0.028135436	2.170333E-05	0.031475772	7.87E+01	2.24817E-05	6.182569	0.000494497	0.001358743	0.001955353	0.028423289	0.000005	26.26998	3.03E+01	0.006931642	0.070545103	76.7348	0.009253709	0.002732423	0.012623578	0.000859313	0.000204678	0.4715732	0.036492489	0.022888616
Closure			4.74E+02	246.5771703	1.95E-03	0.028135436	4.73865E-06	0.04633986	4.78E+01	4.90859E-06	1.349886	0.000107967	0.000296665	0.000426927	0.006205869	0.000005	5.73572	2.06E+01	0.001513437	0.015402638	16.75408	0.000644905	0.00059659	0.0027562	0.00018762	4.46888E-05	0.23584134	0.007967677	0.047083935
In-pit Latte WRSF																													
Base Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			2.75E+02	1914.082579	5.89E-04	0.008250873	3.67843E-05	0.006983296	2.19E+02	3.81035E-05	10.47864	0.000838107	0.002302891	0.003314066	0.048173741	5.44404E-06	44.52416	1.35E+02	0.011748222	0.119564681	130.0554	0.005006149	0.004631098	0.021395307	0.001456423	0.000346902	0.5640124	0.061849975	0.009380879
Y4			2.75E+02	1914.082579	5.89E-04	0.008250873	3.67843E-05	0.006983296	2.19E+02	3.81035E-05	10.47864	0.000838107	0.002302891	0.003314066	0.048173741	5.44404E-06	44.52416	1.35E+02	0.011748222	0.119564681	130.0554	0.005006149	0.004631098	0.021395307	0.001456423	0.000346902	0.5640124	0.061849975	0.009380879
Y5			2.75E+02	1914.082579	5.89E-04	0.008250873	3.67843E-05	0.006983296	2.19E+02	3.81035E-05	10.47864	0.000838107	0.002302891	0.003314066	0.048173741	5.44404E-06	44.52416	1.35E+02	0.011748222	0.119564681	130.0554	0.005006149	0.004631098	0.021395307	0.001456423	0.000346902	0.5640124	0.061849975	0.009380879
Y6			2.73E+02	1764.390016	6.32E-04	0.008250873	3.39075E-05	0.006983296	2.13E+02	3.51236E-05	9.659151	0.000772563	0.002122792	0.003054886	0.04440627	5.44404E-06	41.04211	1.31E+02	0.010829442	0.110214017	119.8843	0.004614639	0.004268919	0.019722067	0.001342522	0.000319772	0.5358332	0.057012942	0.009750055
Y7			2.74E+02	1825.398899	6.14E-04	0.008250873	3.508E-05	0.006983296	2.16E+02	3.63381E-05	9.993144	0.000799276	0.002196193	0.003160518	0.045941745	5.44404E-06	42.46126	1.33E+02	0.011203901	0.114024985	124.0297	0.004774203	0.004416529	0.020404015	0.001388944	0.000330829	0.5473762	0.058984329	0.009594212
Y8			2.74E+02	1825.398899	6.14E-04	0.008250873	3.508E-05	0.006983296	2.16E+02	3.63381E-05	9.993144	0.000799276	0.002196193	0.003160518	0.045941745	5.44404E-06	42.46126	1.33E+02	0.011203901	0.114024985	124.0297	0.004774203	0.004416529	0.020404015	0.001388944	0.000330829	0.5473762	0.058984329	0.009594212
Y9			2.74E+02	1825.398899	6.14E-04	0.008250873	3.508E-05	0.006983296	2.16E+02	3.63381E-05	9.993144	0.000799276	0.002196193	0.003160518	0.045941745	5.44404E-06	42.46126	1.33E+02	0.011203901	0.114024985	124.0297	0.004774203	0.004416529	0.020404015	0.001388944	0.000330829	0.5473762	0.058984329	0.009594212
Closure			2.66E+02	1351.879931	7.97E-04	0.008250873	2.598E-05	0.017861899	1.95E+02	2.69118E-05	7.440865	0.000591939	0.001626488	0.002340661	0.034024192	5.44404E-06	31.44656	1.20E+02	0.008297545	0.084446249	91.85565	0.003535748	0.003270856	0.015111096	0.001028644	0.00024501	0.4546752	0.043683455	0.011061862
In-pit Latte WRSF																													
Upper Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			5.74E+02	2799.553824	2.00E-04	0.012250909	5.3801E-05	0.031475772	1.06E+02	5.57305E-05	15.32615	0.001225823	0.003368229	0.004847181	0.070459333	7.99078E-06	65.12142	4.11E+01	0.017183052	0.174876343	190.2202	0.007322038	0.006773485	0.031292962	0.002130177	0.000507382	0.8017744	0.090462311	0.015942562
Y4			5.74E+02	2799.553824	2.00E-04	0.012250909	5.3801E-05	0.031475772	1.06E+02	5.57305E-05	15.32615	0.001225823	0.003368229	0.004847181	0.070459333	7.99078E-06	65.12142	4.11E+01	0.017183052	0.174876343	190.2202	0.007322038	0.006773485	0.031292962	0.002130177	0.000507382	0.8017744	0.090462311	0.015942562
Y5			5.74E+02	2799.553824	2.00E-04	0.012250909	5.3801E-05	0.031475772	1.06E+02	5.57305E-05	15.32615	0.001225823	0.003368229	0.004847181	0.070459333	7.99078E-06	65.12142	4.11E+01	0.017183052	0.174876343	190.2202	0.007322038	0.006773485	0.031292962	0.002130177	0.000507382	0.8017744	0.090462311	0.015942562
Y6			5.68E+02	2580.61218	2.15E-04	0.012250909	4.95935E-05	0.031475772	1.03E+02	5.13721E-05	14.12756	0.001129957	0.003104814	0.004468103	0.064948997	7.99078E-06	60.02854	3.99E+01	0.015839236	0.16119998	175.3438	0.006749411	0.006243758	0.028845667	0.001963585	0.000467702	0.7561498	0.083387624	0.015569967
Y7			5.71E+02	2669.844302	2.08E-04	0.012250909	5.130383E-05	0.031475772	1.04E+02	5.31484E-05	14.61606	0.001169028	0.003212171	0.004622601	0.067194796	7.99078E-06	62.1042	4.04E+01	0.016386923	0.166773935	181.4069	0.006982791	0.006459654	0.029843089	0.002031481	0.000483874	0.7746186	0.086270992	0.016305116
Y8			5.71E+02	2669.844302	2.08E-04	0.012250909	5.130383E-05	0.031475772	1.04E+02	5.31484E-05	14.61606	0.001169028	0.003212171	0.004622601	0.067194796	7.99078E-06	62.1042	4.04E+01	0.016386923	0.166773935	181.4069	0.006982791	0.006459654	0.029843089	0.002031481	0.000483874	0.7746186	0.086270992	0.016305116
Y9			5.71E+02	2669.844302	2.08E-04	0.012250909	5.130383E-05	0.031475772	1.04E+02	5.31484E-05	14.61606	0.001169028	0.003212171	0.004622601	0.067194796	7.99078E-06	62.1042	4.04E+01	0.016386923	0.166773935	181.4069	0.006982791	0.006459654	0.029843089	0.002031481	0.000483874	0.7746186	0.086270992	0.016305116
Closure			5.50E+02	1977.271343	2.73E-04	0.012250909	3.799866E-05	0.038695216	9.41E+01	3.93614E-05	10.82457	0.000865776	0.002378916	0.003423472	0.04976408	7.99078E-06	45.99402	3.64E+01	0.012136061	0.123511818	134.3489	0.005171415	0.004783983	0.02210162	0.001504503	0.000358354	0.6350316	0.063891801	0.018799349
In-pit Supremo WRSF																													
Base Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y4			2.66E+02	1375.774372	7.85E-04	0.008457944	2.64392E-05	0.006983296	1.96E+02	2.73874E-05	7.531675	0.000602402	0.001655236	0.002382032	0.034625569	5.48274E-06	32.00238	1.21E+02	0.008444204	0.085938834	93.4792	0.003598242	0.003328668	0.015378184	0.001046825	0.000249341	0.4595304	0.044455559	0.010556488
Y5			2.65E+02	1290.850182	8.30E-04	0.008457944	2.480725E-05	0.006983296	1.92E+02	2.56969E-05	7.066758	0.000565217	0.001553061	0.002234994	0.032488192	5.48274E-06	30.02693	1.18E+02	0.007922958	0.080633977	87.70888	0.003376129	0.003123195	0.014428915	0.000982206	0.00023349	0.442204	0.041711393	0.01088017
Y6			2.65E+02	1290.522741	8.30E-04	0.008457944	2.480095E-05	0.006983296	1.92E+02	2.56903E-05	7.064965	0.000565073	0.001552667	0.002234427	0.032479951	5.48274E-06	30.01931	1.18E+02	0.007920948	0.080613523	87.68664	0.003375272	0.003122403	0.014425255	0.000981957	0.00023389	0.4421326	0.041700813	0.010881478
Y7			2.65E+02	1287.254271	8.32E-04	0.008457944	2.473811E-05	0.006983296	1.92E+02	2.56253E-05	7.047072	0.000563642	0.001548735	0.002228768	0.03239769	5.48274E-06	29.94328	1.18E+02	0.007900887	0.080409356	87.46455	0.003366724	0.003114495	0.014388721	0.00097947	0.00023298	0.4414424	0.041595198	0.010894566
Y8			2.65E+02	1287.254271	8.32E-04	0.008457944	2.473811E-05	0.006983296	1.92E+02	2.56253E-05	7.047072	0.000563642	0.001548735	0.002228768	0.03239769	5.48274E-06	29.94328	1.18E+02	0.007900887	0.080409356	87.46455	0.003366724	0.003114495	0.014388721	0.00097947	0.00023298	0.4414424	0.041595198	0.010894566
Y9			2.65E+02	1287.254271	8.32E-04	0.008457944	2.473811E-05	0.006983296	1.92E+02	2.56253E-05	7.047072	0.000563642	0.001548735	0.002228768	0.03239769	5.48274E-06	29.94328	1.18E+02	0.007900887	0.080409356	87.46455	0.003366724	0.003114495	0.014388721	0.00097947	0.00023298	0.4414424	0.041595198	0.010894566
Closure			2.56E+02	857.2615126	1.20E-03	0.008457944	1.647466E-05	0.019558186	1.70E+02	1.70654E-05	4.693077	0.000375364	0.001031398	0.001484273	0.021575607	5.48274E-06	19.94107	9.80E+01	0.005261685	0.053549518	58.24801	0.002242108	0.002074133	0.009582331	0.000652289	0.00015367	0.3657822	0.027700792	0.013209765
In-pit Supremo WRSF																													
Upper Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y4			5.51E+02	2012.21956	2.69E-04	0.012675547	3.867036E-05	0.031475772	9.47E+01	4.00571E-05	11.01589	0.000881078	0.002420963	0.003483981	0.050643658	8.06761E-06	46.80696	3.66E+01	0.012350566	0.125694885	136.7235	0.00526282	0.004868539	0.022492266	0.001531095	0.000364688	0.641886	0.065021087	0.017976509
Y5			5.47E+02	1888.008701	2.85E-04	0.012675547	3.628326E-05	0.031475772	9.27E+01	3.75844E-05	10.3359	0.000826691	0.002271521	0.003268921	0.047517512	8.06761E-06	43.91765	3.58E+01	0.011588187	0.117935956	128.2838	0.004937955	0.004568013	0.021103857	0.001436583	0.000342176	0.6175624	0.061007447	0.018527704
Y6			5.47E+02	1887.529783	2.85E-04	0.012675547	3.627E-05	0.031475772	9.27E+01	3.7549E-05	10.33328	0.000826481	0.002270945	0.003268092	0.047505459	8.06761E-06	43.90651	3.58E+01	0.011585247	0.11790604	128.2512	0.004936702	0.004566854	0.021098504	0.001436219	0.00034209	0.617491	0.060991971	0.018529932
Y7			5.47E+02	1882.74929	2.85E-04	0.012675547	3.618216E-05	0.031475772	9.26E+01	3.74798E-05	10.30711	0.000824388	0.002265193	0.003259815	0.

Haul Road	Alkalinity	Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Cl	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn	Ra226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Upper Case	145.305	247.3713	0.002264	0	0.013289	5.55E-06	0.029981	32.7968	5.6E-06	1.116154	0.00011	0.000757	0.00074	0.009311	2.55E-06	4.820933	30.29286	0.001252	0.034844	16.30951	0.000625	0.001281	0.002289	0.000178	4.62E-05	0.044506	0.008228	0.06057
Base Case	73.415	165.3674	0.003748	0	0.002452	3.25E-06	0.006673	48.556	3.39E-06	0.921176	7.37E-05	0.0002	0.000297	0.004258	1.31E-06	3.930555	19.56948	0.001022	0.010643	11.45291	0.000429	0.000394	0.001883	0.000126	3.11E-05	0.029698	0.005721	0.035641

	Years	Alkalinity	Sulphate	P	Al	Ag	As	Ca	Cd	Cl	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn	Ra226
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case																												
Schist Oxide Waste	All Years	68.73	6.245327	4.83E-03	0.002077	3E-06	0.003508	17.7884	3.14E-06	3.82	2.29E-05	0.001077	0.000603	0.007048	1.01E-05	3.476297	7.352424	0.000229	0.003973	0.259826	0.000184	2.84E-05	0.004521	0.000178	7.41E-05	0.001079	0.001951	0.000655
Schist Transition Waste	All Years	70.07	51.84251	4.92E-03	0.002504	4.78E-06	0.001078	24.9316	5.95E-06	4.4	2.82E-05	0.000952	0.000948	0.007598	1.07E-05	10.2286	12.64439	0.000212	0.013564	0.902071	0.000816	2.13E-05	0.001851	0.000248	1.09E-05	0.006639	0.002139	0.000147
Schist Sulphide Waste	All Years	70.66	62.92521	2.54E-03	0.005	6.23E-05	0.000854	36.1664	9.34E-05	6.9	0.001447	0.000934	0.00096	0.01	2.5E-06	6.794115	10.98076	0.367546	0.009033	0.445196	0.015102	0.000315	0.0433	0.001869	0.000218	0.005344	0.031148	0.000727
Schist Oxide Ore	All Years	70.105	40.64969	1.18E-02	0.004656	3.23E-05	0.163476	27.0948	8.35E-06	3.82	7.08E-05	0.000309	0.001038	0.016738	2.38E-05	2.660521	10.32519	0.003168	0.004857	0.218754	0.001608	4.72E-05	0.007268	0.000955	0.000102	0.001315	0.004719	0.000227
Schist Transition Ore	All Years	77.34	132.7093	1.74E-02	0.004719	1.72E-05	0.181843	58.236	7.08E-06	4.4	0.000482	0.000151	0.001001	0.016298	2.33E-05	4.720346	16.25796	0.043771	0.005239	0.368863	0.004134	7.55E-05	0.034219	0.001793	0.000208	0.004796	0.004594	0.000397
Gneiss Oxide Waste	All Years	68.79	8.176345	1.73E-02	0.002124	2.94E-06	0.054146	17.3968	8.56E-06	2.37	3.02E-05	0.000715	0.00078	0.006938	9.99E-06	5.12207	6.461816	0.000195	0.018472	0.802494	0.000201	1.89E-05	0.00251	6.38E-05	2.52E-05	0.081735	0.001982	0.034723
Gneiss Transition Waste	All Years	69.055	9.887124	8.77E-03	0.004153	2.41E-06	0.003489	19.8636	5.19E-06	5.4	2.16E-05	0.000139	0.000625	0.00691	9.91E-06	4.524299	7.916024	0.000134	0.011605	0.3776	0.000208	1.55E-05	0.009155	0.000129	0.000131	0.021884	0.001959	0.018126
Gneiss Sulphide Waste	All Years	70.635	62.29596	3.50E-03	0.0091	6.17E-05	0.000887	34.8476	9.25E-05	6.2	0.000493	0.000934	0.001354	0.012	5.5E-06	6.18252	11.42853	0.262156	0.023194	0.663514	0.003083	0.000311	0.01176	0.001573	0.000186	0.013575	0.030833	0.01252
Gneiss Oxide Ore	All Years	78.37	9.753408	1.20E-01	0.004483	1.82E-05	0.137143	21.9452	9.44E-06	2.37	6.49E-05	0.000454	0.000824	0.016738	2.39E-05	3.409384	6.376412	0.001133	0.015574	0.262681	0.000239	5.18E-05	0.011256	0.000133	0.000206	0.049355	0.004719	0.056763
Gneiss Transition Ore	All Years	91.04	66.01334	7.08E-02	0.00574	1.45E-05	0.15998	42.416	1.13E-05	5.4	9.88E-05	0.000172	0.001231	0.019837	2.83E-05	5.22453	12.17721	0.011325	0.02121	0.30284	0.000405	4.25E-05	0.112077	0.000635	0.000259	0.029234	0.005595	0.005088
Granite Transition Waste	All Years	68.65	22.02382	4.24E-02	0.003436	3.16E-06	0.001807	6.3448	3.34E-06	6	0.000665	5.19E-05	0.000441	0.005781	8.26E-06	14.36081	1.800652	0.353931	0.002319	26.63434	0.000227	4.72E-05	0.005978	5.73E-05	3.73E-05	0.000753	0.002548	0.001234
granite Sulphide Waste	All Years	70.905	62.29596	4.45E-03	0.006	9.34E-05	0.050305	36.7836	9.34E-05	5	0.0019	0.000934	0.006982	0.007	0.00001	12.59921	6.210239	2.399	0.010291	3.915268	0.003091	0.001828	0.01176	0.001246	0.000216	0.017025	0.060408	0.053334
Granite Oxide Ore	All Years	0	3.633931	7.54E-02	0.138042	4.85E-06	0.069928	20.8452	3.68E-06	6	4.18E-05	8.37E-05	0.000865	0.023912	1.2E-05	12.43643	6.01866	0.012878	0.001144	30.24792	0.000121	0.000103	0.019381	7.55E-05	3.26E-05	0.000512	0.002328	0.00373
Granite Transition Ore	All Years	0	63.3185	4.24E-02	0.196012	2.53E-06	8.8	68.376	8.54E-05	6	0.067673	8.89E-05	0.017582	0.119991	1.23E-05	18.14638	16.71032	2.867423	0.000167	1.247365	0.018022	8.95E-05	0.008168	0.000438	0.000294	0.001452	0.124081	0.00345
Granite Oxide Waste	All Years	68.78	22.02382	7.54E-02	0.003436	3.16E-06	0.001807	6.1984	3.34E-06	6	0.000665	5.19E-05	0.000441	0.005781	8.26E-06	14.36081	1.800652	0.353931	0.002319	26.63434	0.000227	4.72E-05	0.005978	5.73E-05	3.73E-05	0.000753	0.002548	0.002647
Upper Case																												
Schist Oxide Waste	All Years	142.625	9.537103	0.000998	0.003893	5.11E-05	0.012711	35.49661	5.72E-06	4.88	4.59E-05	0.001311	0.000975	0.007433	1.06E-05	6.885405	14.15619	0.000523	0.004224	1.369803	0.00031	5.55E-05	0.005093	0.000391	7.91E-05	0.003617	0.002077	0.003205
Schist Transition Waste	All Years	144.865	60.34921	0.007995	0.003973	5.29E-05	0.003843	42.98838	9.98E-06	4.95	7.53E-05	0.001196	0.001427	0.007887	1.12E-05	14.69314	17.94416	0.001758	0.020159	6.313286	0.001095	3.89E-05	0.002078	0.000569	1.53E-05	0.022084	0.002234	0.001036
Schist Sulphide Waste	All Years	149.97	153.3802	0.034439	0.0037	6.29E-05	0.001739	74.26649	0.000125	15.45	0.001925	0.001542	0.00096	0.01	0.000005	19.37227	28.33901	0.419491	0.013721	1.48616	0.018878	0.000934	0.0411	0.000935	0.000315	0.022266	0.031227	0.002654
Schist Oxide Ore	All Years	147.605	99.67354	0.00285	0.006255	0.00012	0.239028	60.26539	1.43E-05	4.88	0.000135	0.00059	0.001606	0.018736	2.42E-05	5.859479	23.23286	0.006216	0.006032	1.574947	0.002039	9.69E-05	0.007954	0.001296	0.000144	0.002738	0.004845	0.000301
Schist Transition Ore	All Years	161.28	248.0512	0.037088	0.008265	0.000116	0.310504	113.4551	9.06E-06	4.95	0.000716	0.000375	0.001392	0.016518	2.36E-05	8.051655	31.16966	0.063161	0.006592	1.335843	0.005588	0.000103	0.039643	0.002256	0.000261	0.009945	0.004719	0.011064
Gneiss Oxide Waste	All Years	142.665	12.74826	0.067875	0.003825	4.88E-05	0.018824	35.47367	1.36E-05	7.935	5.83E-05	0.000969	0.001167	0.007268	1.05E-05	10.08389	12.51258	0.000454	0.023001	6.224795	0.000326	3.09E-05	0.002709	0.000146	2.85E-05	0.085592	0.002092	0.073839
Gneiss Transition Waste	All Years	143.39	18.34663	0.01926	0.005541	4.96E-05	0.013158	38.04801	8.35E-06	9.1	4.86E-05	0.0003	0.000944	0.007268	1.04E-05	9.562216	15.63394	0.000308	0.017694	1.370976	0.000327	3.09E-05	0.01045	0.000209	0.000141	0.05141	0.002065	0.052797
Gneiss Sulphide Waste	All Years	147.32	92.972	0.05751	0.00541	6.23E-05	0.000944	57.55757	9.44E-05	11	0.000704	0.001096	0.001354	0.012	5.5E-06	12.9019	22.8093	0.296181	0.029584	2.027009	0.003146	0.000617	0.0123	0.001886	0.000315	0.038744	0.031148	0.066037
Gneiss Oxide Ore	All Years	177.48	14.34695	0.140929	0.006695	0.000118	0.245418	52.36821	1.57E-05	7.935	0.000102	0.000802	0.001251	0.017179	2.49E-05	7.658684	13.8359	0.002454	0.020851	2.470888	0.000245	9.34E-05	0.012598	0.000191	0.000235	0.064322	0.004782	0.103936
Gneiss Transition Ore	All Years	184.18	120.5461	0.062401	0.009017	0.000142	0.295255	82.08347	1.85E-05	9.1	0.000213	0.000616	0.00136	0.020472	2.87E-05	11.19631	24.15068	0.041962	0.03385	1.176725	0.000839	8.61E-05	0.129444	0.000775	0.000326	0.056226	0.005668	0.00718
Granite Transition Waste	All Years	140.735	32.37502	0.002422	0.005309	3.62E-05	0.01595	11.63002	5.73E-06	6	0.000933	0.000151	0.000689	0.006167	8.81E-06	23.84097	3.011491	0.437959	0.002787	50.98738	0.000315	6.54E-05	0.00689	8.48E-05	4.85E-05	0.000897	0.003461	0.005398
granite Sulphide Waste	All Years	147.09	67.01535	0.044827	0.008	0.00037	0.06048	57.63411	0.000154	5	0.002314	0.001598	0.009561	0.007	0.00003	20.05223	9.607	2.934706	0.026316	6.540321	0.003115	0.00309	0.02333	0.002171	0.000328	0.025681	0.061981	0.101351
Granite Oxide Ore	All Years	0	6.056552	1.25E-02	0.199512	1.58E-05	0.327112	36.49832	6.1E-06	6	0.000119	0.00013	0.001477	0.031868	1.93E-05	20.359	10.14677	0.022877	0.002656	80.47012	0.000253	0.000146	0.026746	0.000118	4.8E-05	0.000858	0.002655	0.010583
Granite Transition Ore	All Years	0	79.88749	2.42E-03	0.262268	9.51E-06	11.45	100.2225	9.81E-05	6	0.09579	0.000111	0.019355	0.191175	1.43E-05	25.50854	24.15362	3.306287	0.000504	3.612391	0.024619	0.000173	0.009081	0.000718	0.000485	0.001654	0.13337	0.045602
Granite Oxide Waste	All Years	140.79	32.37502	0.012532	0.005309	3.62E-05	0.082737	11.63002	5.73E-06	6	0.000933	0.000151	0.000689	0.006167	8.81E-06	23.84097	3.011491	0.437959	0.002787	50.98738	0.000315	6.54E-05	0.00689	8.48E-05	4.85E-05	0.000897	0.003461	0.010313
Wall Rock Submergence Loading (Accumulation Rate of Load Released Upon Inundation)																												
		mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	Bq/m2/wk
Base Case																												
Schist Oxide Waste	All Years	21.37824	0.016538	0.007108	1.03E-05	0.012007	60.89106	1.07E-05	13.07615	7.84E-05	0.003686	0.002063	0.024125	3.45E-05	11.89963	25.16791	0.000784	0.013599	0.889404	0.00063	9.73E-05	0.015475	0.000609	0.000253	0.003695	0.006677	0.002241
Schist Transition Waste	All Years	177.4609	0.016839	0.00857	1.64E-05	0.003689	85.34278	2.04E-05	15.06154	9.65E-05	0.00326	0.003246	0.026009	3.66E-05	35.0133	43.28271	0.000726	0.046432	3.087859	0.002795	7.28E-05	0.006335	0.000849	3.74E-05	0.022727	0.007324	0.000503
Schist Sulphide Waste	All Years	215.3978	0.008705	0.017115	0.000213	0.002924	123.8004	0.00032	23.61923	0.004954	0.003199	0.003286	0.034231	8.56E-06	23.25678	37.58798	1.258139	0.03092	1.523941	0.051695	0.001077	0.148219	0.006397	0.000746	0.018294	0.106622	0.00249
Schist Oxide Ore	All Years	139.147	0.040533	0.015939	0.00011	0.559589	92.74758	2.86E-05	13.07615	0.000242	0.001058	0.003554	0.057296	8.13E-05	9.107168	35.34391	0.010843	0.016625	0.748812	0.005503	0.000162	0.024878	0.003268	0.000351	0.004502	0.016155	0.000778
Schist Transition Ore	All Years	454.2741	0.059707	0.016155	5.88E-05	0.622461	199.3463	2.42E-05	15.06154	0.00165	0.000518	0.003427	0.055788	7.97E-05	16.15811	55.65225	0.149831	0.017932	1.262647	0.014152	0.000258	0.117133	0.006139	0.000712	0.016418	0.015724	0.001359
Gneiss Oxide Waste	All Years	27.98826	0.059389	0.00727	1.01E-05	0.185346	59.55058	2.93E-05	8.112692	0.000103	0.002449	0.002669	0.023748	3.42E-05	17.53324	22.11929	0.000669	0.063233	2.746998	0.000689	6.46E-05	0.008592	0.000218	8.63E-05	0.279784	0.006785	0.118858
Gneiss Transition Waste	All Years	33.84439	0.03002	0.014216	8.24E-06	0.011943	67.99463	1.78E-05	18.48462	7.39E-05	0.000476	0.00214	0.023653	3.39E-05	15.48702	27.09716	0.000459	0.039723	1.292553	0.000711	5.32E-05	0.031338	0.000443	0.000447	0.074909	0.006704	0.062047
Gneiss Sulphide Waste	All Years	213.2439	0.011979	0.03115	0.000211	0.003036	119.286	0.000317	21.22308	0.001689	0.003199	0.004635	0.041077	1.88E-05	21.16324	39.12072	0.89738	0.079396	2.271259	0.010554	0.001066	0.040255	0.005385	0.000637	0.046468	0.105545	0.042858
Gneiss Oxide Ore	All Years	33.38667	0.410613	0.015347	6.25E-05	0.46945	75.12011	3.23E-05	8.112692	0.000222	0.001554	0.00282	0.057296	8.19E-05	11.67058	21.82695	0.003877	0.053311	0.899177	0.000819	0.000177	0.038529	0.000457	0.000707	0.168947	0.016155	0.194304
Gneiss Transition Ore	All Years	225.9688	0.242219	0.019649	4.97E-05	0.547625	145.1932	3.88E-05	18.48462	0.000338	0.000589	0.004214	0.067903	9.7E-05	17.88397	41.68353	0.038766	0.072605	1.036646	0.001387	0.000146	0.383649	0.002174	0.000888	0.100069	0.019152	0.017417
Granite Transition Waste	All Years	75.38925	0.145283	0.011761	1.08E-05	0.006185	21.71874	1.14E-05	20.53846	0.002278	0.000178	0.001511	0.01979	2.83E-05	49.15816	6.16377	1.211532	0.007937	91.1714	0.000775	0.000162	0.020463	0.000196	0.000128	0.002577	0.008724	0.004224
granite Sulphide Waste	All Years	213.2439	0.015239	0.020538	0.00032	0.172197	125.9131	0.00032	17.11538	0.006504	0.003199	0.023898	0.023962	3.42E-05	43.12807	21.25813	8.211962	0.035228	13.40226	0.010581	0.006257	0.040255	0.004265	0.000738	0.058279	0.206782	0.182567
Granite Oxide Ore	All Years	12.43923	0.258073	0.472529	1.66E-05	0.23937	71.35472	1.26E-05	20.53846	0.000143	0.000286	0.002962	0.081851	4.09E-05	42.57085	20.60234	0.044083	0.003918	103.541	0.000415	0.000354	0.066343	0.000258	0.000112	0.001753	0.00797	0.012769
Granite Transition Ore	All Years	216.7441	0.145283	0.670964	8.67E-06	30.12308	234.0563	0.000292	20.53846	0.23165	0.000304	0.060185	0.410737	4.21E-05	62.11647	57.20071	9.815411	0.000572	4.269825	0.06169	0.000306	0.027961	0.001499	0.001007	0.00497	0.424738	0.011811
Granite Oxide Waste	All Years	75.38925	0.258073	0.011761	1.08E-05	0.006185	21.2176	1.14E-05	20.53846	0.002278	0.000178	0.001511	0.01979	2.83E-05	49.15816	6.16377	1.211532	0.007937	91.1714	0.000775	0.000162	0.020463	0.000196	0.000128	0.002577	0.008724	0.00906
Upper Case																												
Schist Oxide Waste	All Years	32.64624	0.003415	0.013325	0.000175	0.04351	121.5076	1.96E-05	16.70462	0.000157	0.004488	0.003339	0.025444	3.61E-05	23.56927	48.45772	0.001791	0.014459	4.688941	0.001061	0.00019	0.017435	0.00134	0.000271	0.012381	0.007108	0.01097
Schist Transition Waste	All Years	206.58	0.027368	0.013601	0.000181	0.013155	147.1525	3.42E-05	16.94423	0.000258	0.004093	0.004884	0.026999	3.82E-05	50.29574	61.42425	0.006019	0.069005	21.61087	0.003748	0.000133	0.007112	0.001947	5.24E-05	0.075596	0.007647	0.003547
Schist Sulphide Waste	All Years	525.0323	0.117886	0.012665	0.000215	0.005951	254.2199	0.000426	52.88654	0.006589	0.005277	0.003286	0.034231	1.71E-05	66.31279	97.00662	1.43595	0.046968	5.087238	0.064619	0.003199	0.140688	0.003201	0.001077	0.076218	0.106891	0.009086
Schist Oxide Ore	All Years	341.1902	0.009755	0.021411	0.000409	0.81821	206.2931	4.88E-05	16.70462	0.000462	0.002019	0.005499	0.064135	8.29E-05	20.05745	79.52788	0.021279	0.020649	5.391163	0.006979	0.000332	0.027226	0.004437	0.000493	0.009371	0.016586	0.001031
Schist Transition Ore	All Years	849.0983	0.126954	0.028293	0.000398	1.062881	388.3657	3.1E-05	16.94423	0.00245	0.001285	0.004766	0.056542	8.08E-05	27.56143	106.6962	0.216206	0.022564	4.572693	0.019127	0.000352	0.135701	0.007723	0.000892	0.034043	0.016155	0.037874
Gneiss Oxide Waste	All Years	43.63826	0.232342	0.013094	0.000167	0.064437	121.4291	4.66E-05	27.16212	0.0002	0.003317	0.003995	0.024878	3.58E-05	34.51793	42.83152	0.001555	0.078733	21.30795	0.001115	0.000106	0.009273	0.000498	9.74E-05	0.292988	0.007162	0.252755
Gneiss Transition Waste	All Years	62.80193	0.06593	0.018968	0.00017	0.045039	130.2413	2.86E-05	31.15	0.000166	0.001026	0.003233	0.024878	3.55E-05	32.7322	53.51617	0.001054	0.060569	4.692957	0.001119	0.000106	0.035772	0.000717	0.000484	0.175982	0.007068	0.180729
Gneiss Sulphide Waste	All Years	318.2503	0.196862	0.018519	0.000213	0.00323	197.024	0.000323	37.65385	0.00241	0.003751	0.004635	0.041077	1.88E-05	44.1642	78.078	1.013851	0.101269	6.938609	0.01077	0.002111	0.042104	0.006456	0.001077	0.132624	0.106622	0.226049
Gneiss Oxide Ore	All Years	49.11071	0.482412	0.022918	0.000404	0.840086	179.2604	5.37E-05	27.16212	0.000349	0.002746	0.004281	0.058804	8.51E-05	26.21626	47.36137	0.008401	0.071374	8.45804	0.00084	0.00032	0.043123	0.000655	0.000804	0.22018	0.01637	0.35578
Gneiss Transition Ore	All Years	412.6386	0.213604	0.030867	0.000485	1.01068	280.978	6.32E-05	31.15	0.000728	0.002108	0.004656	0.070079	9.82E-05	38.32584	82.66965	0.14364	0.11587	4.028021	0.002873	0.000295	0.443095	0.002653	0.001116	0.192465	0.019401	0.024578
Granite Transition Waste	All Years	110.8222	0.008292	0.018174	0.000124	0.054598	39.81047	1.96E-05	20.53846	0.003193	0.000516	0.002359	0.021109	3.02E-05	81.60947	10.30857	1.499169	0.009542	174.5337	0.001077	0.000224	0.023586	0.00029	0.000166	0.003072	0.011847	0.018478
granite Sulphide Waste	All Years	229.3987	0.153447	0.027385	0.001267	0.207026	197.286	0.000526	17.11538	0.007922	0.005468	0.03273	0.023962	0.000103	68.64033	32.8855	10.04572	0.090082	22.38802	0.010662	0.010577	0.079859	0.007431	0.001122	0.087907	0.212167	0.346932
Granite Oxide Ore	All Years	20.73204	0.042899	0.682946	5.42E-05	1.119731	124.9366	2.09E-05	20.53846	0.000409	0.000444	0.005055	0.109086	6.62E-05	69.69041	34.73318	0.078311	0.00909	275.4554	0.000867	0.000501	0.091555	0.000402	0.000164	0.002938	0.009087	0.036226
Granite Transition Ore	All Years	273.461	0.008292	0.897765	3.26E-05	39.19423	343.0693	0.000336	20.53846	0.327897	0.00038	0.066255	0.654406	4.91E-05	87.31769	82.67969	11.31768	0.001726	12.36549	0.084272	0.000592	0.031086	0.002457	0.001659	0.005662	0.456536	0.156099
Granite Oxide Waste	All Years	110.8222	0.042899	0.018174	0.000124	0.283214	39.81047	1.96E-05	20.53846	0.003193	0.000516	0.002359	0.021109	3.02E-05	81.60947	10.30857	1.499169	0.009542	174.5337	0.001077	0.000224	0.023586	0.00029	0.000166	0.003072	0.011847	0.035301

Year	Alkalinity	Sulphate	P	Al	Ag	As	Ca	Cd	Cl	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn	Ra226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
ROM Stockpile (Ore+PAD)																											
Base Case Concentratoins																											
Y1	234.355	188.023	0.001395	0.004856	1.92E-05	0.020932	68.984	6.62E-06	1.141215	0.000271	0.000416	0.000877	0.015472	1.5855E-05	9.408768	31.987	0.015272	0.005417	11.13555	0.003956	0.000506	0.016508	0.000878	0.000124	0.011418	0.01761	0.024157
Y2	251.755	304.9187	0.000359	0.015866	7.27E-05	0.018318	140.436	2.71E-05	1.141215	0.00064	0.001179	0.003139	0.055174	7.2443E-05	27.17632	83.3923	0.042121	0.029075	12.51027	0.007588	0.000635	0.065163	0.002754	0.000534	0.023525	0.028804	0.032308
Y3	249.49	283.9906	0.000414	0.013908	6.39E-05	0.018386	137.952	2.34E-05	1.141215	0.00058	0.001055	0.002735	0.048156	6.2437E-05	23.94072	74.37932	0.037523	0.02437	12.27101	0.007026	0.000613	0.051895	0.002441	0.000458	0.023532	0.026825	0.03286
Y4	239.66	169.6422	0.000779	0.00944	3.26E-05	0.016017	110.916	1.72E-05	1.141215	0.000253	0.000947	0.001653	0.032862	4.075E-05	17.46985	40.45471	0.008326	0.027639	11.71531	0.002954	0.000554	0.037982	0.00046	0.000374	0.02674	0.022514	0.057888
Y5	241.45	173.1911	0.000692	0.010517	3.68E-05	0.016017	124.084	1.95E-05	1.141215	0.000269	0.001047	0.001855	0.036847	4.6444E-05	19.28643	43.96267	0.008821	0.031409	11.85069	0.003014	0.000565	0.042886	0.000502	0.000424	0.030347	0.023638	0.057323
Y6	239.96	170.2314	0.000763	0.009619	3.33E-05	0.016017	113.104	1.76E-05	1.141215	0.000256	0.000964	0.001686	0.033523	4.1696E-05	17.77146	41.03714	0.008408	0.028265	11.73778	0.002964	0.000556	0.038796	0.000467	0.000382	0.027338	0.0227	0.057793
Y7	240.465	171.2271	0.000737	0.009921	3.45E-05	0.016017	116.796	1.83E-05	1.141215	0.00026	0.000992	0.001743	0.034642	4.3293E-05	18.28113	42.02134	0.008547	0.029323	11.77577	0.002981	0.000559	0.040172	0.000479	0.000396	0.02835	0.023016	0.057634
Y8	233.225	157.5749	0.001401	0.005777	1.84E-05	0.016017	66.156	9.59E-06	1.141215	0.000199	0.000608	0.000966	0.019309	2.1389E-05	11.29296	28.52659	0.006645	0.014818	11.25497	0.002752	0.000513	0.021307	0.000315	0.000206	0.01463	0.018692	0.059949
Y9	226.2	145.5853	0.001401	0.002137	4.22E-06	0.001589	21.7056	1.99E-06	1.141215	0.000145	0.000271	0.000284	0.005843	2.1523E-06	5.155798	16.67521	0.004974	0.002079	10.79759	0.00255	0.000473	0.00474	0.000172	3.85E-05	0.004146	0.014896	0.06224
Upper Case Concentratoins																											
Y1	487.7	300.1846	0.000553	0.007208	7.49E-05	0.104265	87.644	1.02E-05	1.66915	0.000411	0.000695	0.001289	0.018916	1.7095E-05	12.42752	42.9025	0.023189	0.007366	16.88654	0.005588	0.000749	0.020394	0.001172	0.000168	0.02805	0.024572	0.008608
Y2	519.6	534.1037	0.000148	0.023743	0.000357	0.090015	103.244	4.31E-05	1.66915	0.000997	0.002178	0.004616	0.060847	7.5133E-05	32.54065	102.9959	0.067576	0.039205	21.94318	0.010358	0.000976	0.075924	0.003628	0.000673	0.035013	0.035998	0.016596
Y3	514.55	492.862	0.000169	0.020781	0.000307	0.090124	101.264	3.72E-05	1.66915	0.000899	0.001922	0.004045	0.053463	6.4889E-05	28.81229	92.48293	0.058728	0.03259	21.10807	0.009604	0.000937	0.0607	0.003221	0.00058	0.032871	0.03398	0.01666
Y4	492.125	251.9	0.000324	0.014099	0.000197	0.077467	89.448	2.82E-05	1.66915	0.000391	0.00164	0.002416	0.036293	4.3154E-05	21.19624	49.77056	0.017198	0.038093	19.75626	0.004209	0.000839	0.044749	0.000644	0.000443	0.043273	0.029506	0.036327
Y5	494.33	257.6482	0.000285	0.015718	0.000225	0.077467	90.072	3.19E-05	1.66915	0.000417	0.001823	0.002711	0.040386	4.9056E-05	23.21068	53.51481	0.018662	0.043264	20.34097	0.00428	0.00086	0.050328	0.000702	0.0005	0.045087	0.030645	0.03594
Y6	492.495	252.8544	0.000317	0.014368	0.000202	0.077467	89.552	2.88E-05	1.66915	0.000395	0.00167	0.002465	0.036973	4.4134E-05	21.5307	50.39222	0.017441	0.038952	19.85334	0.004221	0.000842	0.045675	0.000653	0.000452	0.043563	0.029695	0.036262
Y7	493.115	254.4671	0.000305	0.014822	0.000209	0.077467	89.728	2.99E-05	1.66915	0.000403	0.001722	0.002548	0.038121	4.579E-05	22.09587	51.44272	0.017852	0.040403	20.01739	0.004241	0.000848	0.047241	0.00067	0.000468	0.044062	0.030015	0.036153
Y8	483.17	232.3542	0.000589	0.008595	0.000101	0.077467	78.724	1.55E-05	1.66915	0.000301	0.001016	0.001412	0.022375	2.3087E-05	14.34654	37.03898	0.01222	0.020511	17.76806	0.003969	0.000765	0.02578	0.000447	0.000249	0.03398	0.025634	0.037745
Y9	468.22	212.9343	0.000589	0.003126	6.17E-06	0.003622	31.7736	2.91E-06	1.66915	0.000212	0.000396	0.000416	0.008546	3.148E-06	7.540915	24.38931	0.007275	0.003041	15.79265	0.003729	0.000692	0.006932	0.000251	5.63E-05	0.00936	0.021786	0.037745
ROM PAD (Slopes composed of waste rock only)																											
Base Case																											
All Years	226.2	145.5853	0.001401	0.002137	4.22E-06	0.001589	21.7056	1.99E-06	1.141215	0.000145	0.000271	0.000284	0.005843	2.1523E-06	5.155798	16.67521	0.004974	0.002079	10.79759	0.00255	0.000473	0.00474	0.000172	3.85E-05	0.004146	0.014896	0.06224
Upper Case																											
All Years	468.22	212.9343	0.000589	0.003126	6.17E-06	0.003622	31.7736	2.91E-06	1.66915	0.000212	0.000396	0.000416	0.008546	3.148E-06	7.540915	24.38931	0.007275	0.003041	15.79265	0.003729	0.000692	0.006932	0.000251	5.63E-05	0.00936	0.021786	0.037745

Appendix B: Coffee Gold Project Geochemical Characterization Report

Newmont™
COFFEE

GOLDCORP



Coffee Gold Project

Geochemical Characterization Report

Project No. A362-2
March 2017

LORAX ENVIRONMENTAL

2289 Burrard Street
Vancouver, BC, V6J 3H9
Canada
1-604-688-7173

Table of Contents

TABLE OF CONTENTS I
1. INTRODUCTION 1-1
1.1 PROJECT BACKGROUND 1-1
1.2 SCOPE AND PURPOSE 1-1
1.3 REPORT STRUCTURE 1-1
2. GEOLOGY 2-1
2.1 REGIONAL GEOLOGY 2-1
2.2 LOCAL GEOLOGY 2-1
2.3 WEATHERING FACIES 2-2
3. METHODOLOGY 3-1
3.1 SAMPLE SELECTION 3-1
3.2 ANALYTICAL METHODS 3-5
3.2.1 MINERALOGY 3-5
3.2.1.1 QUANTITATIVE X-RAY DIFFRACTION 3-5
3.2.1.2 μ-X-RAY FLORESCENCE (XRF) MAPPING 3-5
3.2.1.3 X-RAY ABSORPTION NEAR-EDGE SPECTROSCOPY (XANES) 3-5
3.2.2 STATIC TESTS 3-6
3.2.3 ACID-BASE ACCOUNTING 3-6
3.2.4 METAL ABUNDANCE 3-6
3.2.5 SFE 3-6
3.2.6 KINETIC TESTS 3-7
3.2.6.1 HUMIDITY CELLS 3-7
3.2.6.2 UNSATURATED COLUMNS 3-9
3.2.6.3 FIELD BINS 3-10
3.2.7 METALLURGICAL COLUMNS 3-11
3.2.8 RADIOISOTOPES 3-12
3.3 QUALITY ASSURANCE AND QUALITY CONTROL 3-12
3.3.1 STATIC TESTWORK 3-12
3.3.2 KINETIC PROGRAM 3-13
4. GEOCHEMICAL CHARACTERIZATION RESULTS 4-1
4.1 WASTE ROCK 4-1
4.1.1 OVERVIEW OF TEST RESULTS 4-1
4.1.2 MINERALOGY 4-2
4.1.2.1 GNEISS WASTE ROCK 4-2
4.1.2.2 SCHIST WASTE ROCK 4-5
4.1.2.3 GRANITE WASTE ROCK 4-5
4.1.2.4 OTHER WASTE ROCK LITHOLOGIES 4-6
4.1.2.5 SUMMARY OF SULPHUR AND CARBONATE MINERALOGY 4-9
4.1.2.6 TRACE ELEMENT OCCURRENCE 4-10
4.1.3 ACID BASE ACCOUNTING 4-15
4.1.3.1 RINSE AND PASTE PH 4-15
4.1.3.2 ACID POTENTIAL 4-19
4.1.3.3 NEUTRALIZATION POTENTIAL 4-24
4.1.3.4 NET POTENTIAL RATIO 4-30
4.1.4 SHAKE FLASK EXTRACTIONS 4-33
4.1.5 SOLID-PHASE ELEMENTAL ABUNDANCE 4-39
4.1.6 KINETIC TEST SAMPLES 4-45
4.1.6.1 SAMPLE SELECTION CRITERIA AND RATIONALE 4-45
4.1.6.2 STATIC TESTS 4-49
4.1.6.3 LABORATORY KINETIC TEST RESULTS 4-53
4.1.6.4 FIELD KINETIC TEST RESULTS 4-68
4.1.6.5 COMPARISON OF DUPLICATE KINETIC TESTS 4-76

4.1.7 RADIOISOTOPES 4-80
4.1.7.1 OCCURRENCE 4-80
4.1.7.2 KINETIC TEST LEACHATE 4-80
4.2 ORE 4-81
4.2.1 OVERVIEW OF TEST RESULTS 4-81
4.2.2 MINERAL IDENTIFICATION 4-82
4.2.2.1 GNEISS ORE 4-82
4.2.2.2 SCHIST ORE 4-82
4.2.2.3 GRANITE ORE 4-82
4.2.2.4 TRACE METAL OCCURRENCE 4-83
4.2.3 ACID BASE ACCOUNTING 4-83
4.2.3.1 RINSE pH 4-84
4.2.3.2 ACID POTENTIAL 4-84
4.2.3.3 NEUTRALIZATION POTENTIAL 4-87
4.2.3.4 NET POTENTIAL RATIO 4-89
4.2.4 SHAKE FLASK EXTRACTIONS 4-90
4.2.5 SOLID PHASE ELEMENTAL ABUNDANCE 4-93
4.2.6 KINETIC TESTS 4-96
4.2.6.1 SAMPLE SELECTION CRITERIA AND RATIONALE 4-96
4.2.6.2 STATIC TESTS 4-99
4.2.6.3 COLUMN RESULTS 4-101
4.2.7 RADIOISOTOPES 4-106
4.2.7.1 OCCURRENCE 4-106
4.2.7.2 KINETIC TEST LEACHATE 4-107
4.3 LEACH TAILINGS 4-107
4.3.1 OVERVIEW OF TEST RESULTS 4-108
4.3.2 MINERALOGY 4-108
4.3.3 ACID BASE ACCOUNTING 4-109
4.3.4 TRACE METAL ENRICHMENT 4-109
4.3.5 METALLURGICAL COLUMN LEACH SOLUTION 4-112
4.3.6 KINETIC TESTS 4-114
4.3.6.1 SAMPLE SELECTION AND RATIONALE 4-114
4.3.6.2 STATIC TESTS 4-117
4.3.6.3 UNSATURATED COLUMN RESULTS 4-119
4.3.6.4 FIELD KINETIC TESTS 4-129
4.3.6.5 COMPARISON OF DUPLICATES KINETIC TESTS 4-131
4.3.7 RADIOISOTOPES 4-132
4.3.7.1 OCCURRENCE 4-132
4.3.7.2 KINETIC TEST LEACHATE 4-132
4.4 OVERBURDEN AND BORROW MATERIAL 4-133
4.4.1 OVERVIEW OF TEST RESULTS 4-133
4.4.2 ACID BASE ACCOUNTING 4-133
4.4.3 SHAKE FLASK EXTRACTIONS 4-135
4.4.4 TRACE METAL ENRICHMENT 4-136
4.4.5 RADIOISOTOPES 4-139
5. SOURCE TERM PREDICTIONS 5-1
5.1 WASTE ROCK STORAGE FACILITIES 5-3
5.1.1 APPROACH 5-4
5.1.2 DATA SOURCES 5-5
5.1.3 DATA SCALING 5-5
5.1.3.1 WASTE ROCK 5-5
5.1.3.2 UNDERDRAIN 5-9
5.1.4 SOLUBILITY CONTROLS 5-9
5.1.4.1 ARSENIC 5-9
5.1.4.2 URANIUM 5-14
5.1.4.3 RADIUM-226 5-17

5.1.4.4 OTHER PARAMETERS 5-23
5.1.5 SOURCE TERM 5-23
5.2 PIT WALLS 5-25
5.2.1 DATA SOURCES 5-26
5.2.2 DATA SCALING 5-27
5.2.3 SOLUBILITY CONTROLS 5-28
5.2.4 SOURCE TERM 5-30
5.3 HEAP LEACH FACILITY 5-33
5.3.1 PROCESS WATER 5-34
5.3.1.1 APPROACH 5-34
5.3.1.2 DATA SOURCES 5-35
5.3.1.3 DATA SCALING 5-35
5.3.1.4 SOLUBILITY CONTROLS 5-35
5.3.2 SOURCE TERM 5-36
5.4 MINE FACILITIES AREA 5-39
5.4.1 APPROACH 5-39
5.4.2 DATA SOURCES 5-39
5.4.3 SOLUBILITY CONTROLS 5-39
5.4.4 SOURCE TERM 5-40
6. CLOSURE 6-1
REFERENCES R-1

LIST OF APPENDICES

APPENDIX A GEOLOGICAL CROSS SECTIONS
APPENDIX B MINERALOGY REPORTS
APPENDIX C STATIC TEST RESULTS
APPENDIX D KINETIC TEST RESULTS

LIST OF FIGURES

FIGURE 3-1: OVERBURDEN ACID BASE ACCOUNTING SAMPLE LOCATIONS 3-3

FIGURE 3-2: COLLAR LOCATIONS OF DRILL CORE SAMPLES COLLECTED FOR ABA AND ICP-OES ANALYSIS 3-4

FIGURE 3-3: PICTURE OF FIELD KINETIC TESTS 3-11

FIGURE 4-1: RINSE PH VS PASTE PH FOR COFFEE GOLD MINE WASTE ROCK AND ORE SAMPLES AS PRESENTED BY LITHOLOGY AND WEATHERING FACIES. WASTE ROCK SAMPLES ARE REPRESENTED BY HOLLOW SAMPLES AND ORE SAMPLES ARE REPRESENTED BY FILLED SYMBOLS 4-19

FIGURE 4-2: TOTAL-S VERSUS SULPHIDE-S FOR WASTE ROCK AND ORE SAMPLES AS PRESENTED BY LITHOLOGY AND WEATHERING FACIES. ORE SAMPLES ARE REPRESENTED BY FILLED SYMBOLS, WASTE ROCK SAMPLES ARE REPRESENTED BY HOLLOW SYMBOLS. 4-21

FIGURE 4-3: TOTAL-S BY LECO FURNACE VS TOTAL-S BY AQUA REGIA DIGESTION FOR COFFEE GOLD MINE WASTE ROCK SAMPLES AS PRESENTED BY LITHOLOGY AND WEATHERING FACIES. ORE SAMPLES ARE REPRESENTED BY FILLED SYMBOLS 4-22

FIGURE 4-4: RELATIONSHIP BETWEEN SOBEK NP AND SIDERITE NP (TOP) AND SOBEK NP AND CANP (BOTTOM) WASTE ROCK SAMPLES AS PRESENTED BY LITHOLOGY AND WEATHERING FACIES. ORE SAMPLES ARE REPRESENTED BY FILLED SYMBOLS. 4-26

FIGURE 4-5: TOTAL-C (LECO) PLOTTED AGAINST CANP FOR WASTE ROCK SAMPLES AS PRESENTED BY LITHOLOGY AND WEATHERING FACIES. ORE SAMPLES ARE REPRESENTED BY FILLED SYMBOLS. DOTTED LINE SHOWS THE LINEAR REGRESSION AS PER THE EQUATION SHOWN ON THE FIGURE. 4-27

FIGURE 4-6: SOBEK NP VERSUS SURROGATE NP CALCULATED USING CA FROM AQUA REGIA DIGESTION (ABA DATABASE) FOR STATIC TEST SAMPLES. WASTE ROCK SAMPLES ARE HOLLOW SYMBOLS, ORE SAMPLES ARE REPRESENTED BY FILLED SYMBOLS. 4-28

FIGURE 4-7: SOBEK NP (TOP), CANP (MIDDLE) AND T-C NP* (BOTTOM) *VS* T-AP FOR COFFEE GOLD MINE WASTE ROCK AND ORE AS PRESENTED BY LITHOLOGY AND WEATHERING FACIES. ORE SAMPLES ARE REPRESENTED BY FILLED SYMBOLS WHILE WASTE ROCK IS SHOWN AS HOLLOW SYMBOLS. 4-32

FIGURE 4-8: BOX PLOTS SHOWING THE RANGES OF TOTAL-S FOR THE EXPLORATION DATABASE WITH TOTAL-S FOR THE KINETIC TEST SUB-SAMPLES SUPERIMPOSED. 4-47

FIGURE 4-9: BOX PLOTS SHOWING THE RANGES OF AS AND SB FOR THE EXPLORATION DATABASE AND U FOR THE ABA DATABASE WITH CONCENTRATIONS FOR THE KINETIC TEST SUB-SAMPLES SUPERIMPOSED 4-48

FIGURE 4-10: LEACHATE PH FROM GNEISS, SCHIST AND GRANITE WASTE ROCK UNSATURATED COLUMNS AND HUMIDITY CELLS. 4-58

FIGURE 4-11: ALKALINITY LOADING RATES FROM GNEISS, SCHIST AND GRANITE WASTE ROCK UNSATURATED COLUMNS AND HUMIDITY CELLS. 4-59

FIGURE 4-12: SULPHATE LOADING RATES FROM GNEISS, SCHIST AND GRANITE WASTE ROCK UNSATURATED COLUMNS AND HUMIDITY CELLS 4-60

FIGURE 4-13: METAL (AS, SB, CR AND U) LOADING RATES FROM GNEISS, SCHIST AND GRANITE WASTE ROCK UNSATURATED COLUMNS 4-62

FIGURE 4-14: METAL (AS, SB, CR AND U) LOADING RATES FROM GNEISS, SCHIST AND GRANITE WASTE ROCK HUMIDITY CELLS 4-63

FIGURE 4-15: ARSENIC VERSUS PH MEASURED IN DUPLICATE KINETIC TEST SAMPLES CONTAINING DIFFERENT MASSES AND OPERATED UNDER DIFFERENT PROCEDURES 4-78

FIGURE 4-16: URANIUM VERSUS ALKALINITY MEASURED IN DUPLICATE KINETIC TEST SAMPLES CONTAINING DIFFERENT MASSES AND OPERATED UNDER DIFFERENT PROCEDURES 4-79

FIGURE 4-17: BOX PLOTS SHOWING THE CONCENTRATION RANGES FOR TOTAL-S FOR THE EXPLORATION DATABASE ORE SAMPLES WITH TOTAL-S FOR THE KINETIC TEST SUB-SAMPLES SUPERIMPOSED 4-97

FIGURE 4-18: BOX PLOTS SHOWING THE CONCENTRATION RANGES FOR SOLID PHASE AS AND SB FOR THE EXPLORATION DATABASE ORE SAMPLES AND U FOR THE ABA DATABASE ORE SAMPLES WITH THE KINETIC TEST SUB-SAMPLES SUPERIMPOSED. 4-98

FIGURE 4-19: TIME SERIES PLOTS FOR LEACHATE PH, TOTAL ALKALINITY AND WEEKLY SULPHATE LOADINGS FOR ORE COLUMNS. 4-105

FIGURE 4-20: WEEKLY LEACHING RATES FOR SB, AS AND U IN LEACHATE FROM ORE COLUMNS 4-106

FIGURE 4-21: BOX PLOTS SHOWING THE CONCENTRATION RANGES FOR TOTAL-S FROM THE EXPLORATION DATABASE ORE SAMPLES WITH TOTAL-S FOR LEACH TAILINGS KINETIC TEST SUB-SAMPLES SUPERIMPOSED 4-115

FIGURE 4-22: BOX PLOTS SHOWING THE CONCENTRATION RANGES FOR SOLID PHASE AS AND SB FROM THE EXPLORATION DATABASE ORE SAMPLES AND U FROM THE ABA DATABASE ORE SAMPLES WITH THE LEACH TAILINGS KINETIC TEST SUB-SAMPLES SUPERIMPOSED. 4-116

FIGURE 4-23: LEACHATE PH AND WEEKLY LOADING RATES FOR TOTAL ALKALINITY AND SULPHATE FROM LEACH TAILINGS COLUMNS 4-122

FIGURE 4-24: LOADING RATES FOR CYANIDE FROM LEACH TAILINGS COLUMNS 4-124

FIGURE 4-25: LOADING RATES FOR AS, SB AND U FROM LEACH TAILINGS COLUMNS 4-126

FIGURE 4-26: COMPARISON OF AS VERSUS PH (LEFT) AND U VERSUS ALKALINITY (RIGHT) IN DUPLICATE LEACH TAILINGS KINETIC TEST SAMPLES. 4-131

FIGURE 5-1: MINESITE LAYOUT AT END OF MINE LIFE. 5-2

FIGURE 5-2: GYPSUM SATURATION INDICES (SI) CALCULATED FOR ANALOGUE SITE 5-7

FIGURE 5-3: CALCITE SATURATION INDICES (SI) CALCULATED FOR ANALOGUE SITE 5-7

FIGURE 5-4: COMPARISON OF THE RELATIONSHIP BETWEEN AS AND PH IN TWO HUMIDITY CELLS CONTAINING DIFFERENT SAMPLES OF THE SAME LITHOLOGY AND WEATHERING FACIES. FRESH GNEISS WASTE ROCK HUMIDITY CELLS ARE SHOWN ON THE LEFT AND FRESH SCHIST WASTE ROCK SHOWN ON THE RIGHT 5-11

FIGURE 5-5: OBSERVED ARSENIC CONCENTRATIONS AT PH 8 PLOTTED AGAINST AS/FE MOLAR RATIOS MEASURED BY AQUA REGIA ANALYSIS OF KINETIC TEST SOLIDS. EACH DATA POINT REPRESENTS AN INDIVIDUAL KINETIC TEST SAMPLE. 5-12

FIGURE 5-6: RELATIONSHIP BETWEEN U AND ALKALINITY IN GROUNDWATER MONITORING WELLS AND LABORATORY KINETIC TESTS CONTAINING WASTE ROCK AND ORE. DATA SHOWN FOR KINETIC TESTS CONTAINING, AND GROUNDWATER WELLS SCREENED IN SCHIST (UPPER LEFT), GNEISS (UPPER RIGHT) AND GRANITE (BOTTOM LEFT). LINES SHOW RELATIONSHIP BETWEEN ALKALINITY AND U USED TO DEFINE BASE CASE SOLUBILITY (DOTTED) AND UPPER CASE (SOLID) 5-15

FIGURE 5-7: RELATIONSHIP BETWEEN PH AND PORE GAS CO_2 AT CALCITE EQUILIBRIUM AND VARYING TEMPERATURES AND TDS. 5-17

FIGURE 5-8: BARIUM CONCENTRATION VERSUS ^{226}RA ACTIVITY MEASURED IN FIELD BINS, LABORATORY KINETIC TEST COLUMNS, AND METALLURGICAL CYANIDE LEACH COLUMNS. BLACK LINE SHOWS DETECTION LIMIT, DOTTED LINE SHOWS 10X DETECTION LIMITS FOR ^{226}RA, DATA BELOW THIS LINE CAN BE CONSIDERED SEMI-QUANTITATIVE AS THE ANALYTICAL PRECISION IS +/- 50 TO 100% 5-18

FIGURE 5-9: RELATIONSHIP BETWEEN BARIUM AND SO_4 IN FIELD BIN AND METALLURGICAL LEACH COLUMN (MET COLUMN) SAMPLES. THE GREY LINE INDICATES BARITE SOLUBILITY AT EQUILIBRIUM (SI=0). THE BLACK LINE INDICATES BARITE AT SUPERSATURATION (SI=0.55). 5-20

FIGURE 5-10: BASE CASE SOLUBILITY CONTROL OF RA-226 AS A FUNCTION OF SO_4 CONCENTRATIONS. PLOTS SHOW RA-226 SOLUBILITY FOR VARIOUS GNEISS (TOP), SCHIST (MIDDLE), AND GRANITE (BOTTOM) ORE AND WASTE ROCK UNITS 5-21

FIGURE 5-11: UPPER CASE SOURCE TERM SOLUBILITY OF RA-226 AS A FUNCTION OF SO_4 CONCENTRATIONS. PLOTS SHOW RA-226 SOLUBILITY FOR VARIOUS GNEISS (TOP), SCHIST (MIDDLE), AND GRANITE (BOTTOM) ORE AND WASTE ROCK UNITS..... 5-22

FIGURE 5-12: MASS AND GEOLOGIC COMPOSITION OF HLF OVER MINE LIFE..... 5-35

LIST OF TABLES

TABLE 2-1: ROCK UNITS IN THE PROJECT AREA 2-2

TABLE 3-1: SUMMARY OF GEOCHEMICAL CHARACTERIZATION TESTWORK FOR THE COFFEE GOLD MINE AS A FUNCTION OF MATERIAL TYPE..... 3-1

TABLE 3-2: SUMMARY OF WASTE ROCK AND ORE PROPORTIONS FOR THE COFFEE GOLD MINE AND NUMBER OF SAMPLES SUBMITTED FOR STATIC TESTWORK 3-2

TABLE 3-3: SUMMARY OF KINETIC TESTS INITIATED FOR THE COFFEE GOLD MINE 3-8

TABLE 4-1: XRD RESULTS FOR GNEISS WASTE ROCK SAMPLES 4-4

TABLE 4-2: XRD RESULTS FOR SCHIST WASTE ROCK SAMPLES 4-7

TABLE 4-3: XRD RESULTS FOR GRANITE WASTE ROCK SAMPLES 4-8

TABLE 4-4: XRD RESULTS FOR DYKE (KAM02939 AND KAM037975) AND BRECCIA (KAM036549) WASTE ROCK SAMPLES 4-9

TABLE 4-5: SUMMARY OF AS AND U μ-XRF RESULTS FOR COFFEE GOLD MINE SAMPLES 4-13

TABLE 4-6: RELATIVE ABUNDANCE OF AS SPECIES ESTIMATED FROM THE LINEAR COMBINATION FITS OF XANES DATA..... 4-14

TABLE 4-7: RELATIVE ABUNDANCE OF U SPECIES ESTIMATED FROM THE LINEAR COMBINATION FITS OF XANES DATA..... 4-14

TABLE 4-8: STATISTICAL DISTRIBUTION OF ABA RESULTS BY WEATHERING FACIES FOR GNEISS WASTE ROCK..... 4-16

TABLE 4-9: STATISTICAL DISTRIBUTION OF ABA RESULTS BY WEATHERING FACIES FOR SCHIST WASTE ROCK..... 4-17

TABLE 4-10: STATISTICAL DISTRIBUTION OF ABA RESULTS BY WEATHERING FACIES FOR GRANITE WASTE ROCK..... 4-18

TABLE 4-11: STATISTICAL DISTRIBUTION OF SULPHUR (WT.%) MEASURED IN ASSAY DATABASE USED FOR SURROGATE ACID POTENTIAL VALUES FOR WASTE ROCK LITHOLOGIES 4-23

TABLE 4-12: STATISTICAL DISTRIBUTION OF NEUTRALIZATION POTENTIAL (KG $CaCO_3$/T) VALUES CALCULATED FROM CA MEASURED IN ASSAY DATABASE FOR WASTE ROCK LITHOLOGIES . 4-29

TABLE 4-13: ARD DISTRIBUTIONS FOR COFFEE GOLD MINE WASTE ROCK LITHOLOGIES BASED ON VARIOUS ESTIMATES OF NEUTRALIZATION POTENTIAL..... 4-33

TABLE 4-14: SUMMARY OF CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE AND METAL MINING EFFLUENT REGULATIONS (MMER) WATER QUALITY GUIDELINES 4-34

TABLE 4-15: SHAKE FLASK EXTRACTION RESULTS FOR GNEISS WASTE ROCK BY WEATHERING FACIES . 4-36

TABLE 4-16: SHAKE FLASK EXTRACTION RESULTS FOR SCHIST WASTE ROCK BY WEATHERING FACIES . 4-37

TABLE 4-17: SHAKE FLASK EXTRACTION RESULTS FOR GRANITE WASTE ROCK WEATHERING FACIES ... 4-38

TABLE 4-18: SOLID PHASE ELEMENTS BY AQUA REGIA DIGESTION FOR GNEISS WASTE ROCK BY WEATHERING FACIES 4-40

TABLE 4-19: SOLID PHASE ELEMENTS BY AQUA REGIA DIGESTION FOR SCHIST WASTE ROCK BY WEATHERING FACIES 4-41

TABLE 4-20: SOLID PHASE ELEMENTS BY AQUA REGIA DIGESTION FOR GRANITE WASTE ROCK BY WEATHERING FACIES 4-42

TABLE 4-21: COMPARISON OF MEDIAN SOLID PHASE VALUES FOR ENRICHED ELEMENTS IN WASTE ROCK BY WEATHERING FACIES AND LITHOLOGIES 4-43

TABLE 4-22: SOLID PHASE AS AND SB CONCENTRATIONS IN WASTE ROCK FROM THE EXPLORATION DATABASE..... 4-44

TABLE 4-23: WASTE ROCK KINETIC TEST SUMMARY..... 4-46

TABLE 4-24: X-RAY DIFFRACTION RESULTS FOR WASTE ROCK KINETIC TEST SUB-SAMPLES 4-50

TABLE 4-25: ACID-BASE ACCOUNTING FOR WASTE ROCK KINETIC TEST SUB-SAMPLES 4-52

TABLE 4-26: PARTICLE SIZE DISTRIBUTION FOR WASTE ROCK KINETIC TEST SUB-SAMPLES 4-53

TABLE 4-27: LOADING RATES FOR GNEISS WASTE ROCK LABORATORY KINETIC TESTS 4-55

TABLE 4-28: LOADING RATES FOR SCHIST WASTE ROCK LABORATORY KINETIC TESTS 4-56

TABLE 4-29: LOADING RATES FOR GRANITE WASTE ROCK LABORATORY KINETIC TESTS 4-57

TABLE 4-30: LOADING RATE AND PERCENT DIFFERENCES FOR RECIRCULATION EXPERIMENT FOR GNEISS AND SCHIST WASTE ROCK KINETIC TESTS..... 4-66

TABLE 4-31: CONCENTRATIONS AND PERCENT DIFFERENCES FOR RECIRCULATION EXPERIMENT FOR GNEISS AND SCHIST WASTE ROCK KINETIC TESTS..... 4-67

TABLE 4-32: LEACHATE CONCENTRATIONS FOR OXIDE AND TRANSITION GNEISS WASTE ROCK FIELD BINS 4-70

TABLE 4-33: LEACHATE CONCENTRATIONS FOR FRESH GNEISS WASTE ROCK FIELD BINS..... 4-71

TABLE 4-34: LEACHATE CONCENTRATIONS FOR OXIDE AND TRANSITION SCHIST WASTE ROCK FIELD BINS 4-72

TABLE 4-35: LEACHATE CONCENTRATIONS FOR FRESH SCHIST WASTE ROCK FIELD BINS 4-73

TABLE 4-36: LEACHATE CONCENTRATIONS FOR GRANITE WASTE ROCK FIELD BINS 4-74

TABLE 4-37: LOADING RATES FOR WASTE ROCK FIELD KINETIC TESTS 4-75

TABLE 4-38: COMPARISON OF LOADING RATES FROM DUPLICATE SAMPLES OPERATED IN KINETIC TESTS WITH DIFFERENT MASSES AND OPERATING PROCEDURE 4-77

TABLE 4-39: XRD RESULTS FOR GNEISS, GRANITE AND SCHIST ORE SAMPLES..... 4-83

TABLE 4-40: STATISTICAL DISTRIBUTION OF ABA RESULTS BY WEATHERING FACIES FOR ORE LITHOLOGIES 4-85

TABLE 4-41: STATISTICAL DISTRIBUTION OF SULPHUR (WT.%) MEASURED IN ASSAY DATABASE USED FOR SURROGATE ACID POTENTIAL VALUES FOR ORE LITHOLOGIES AND WEATHERING FACIES... 4-86

TABLE 4-42: STATISTICAL DISTRIBUTION OF NEUTRALIZATION POTENTIAL VALUES CALCULATED FROM CA MEASURED IN ASSAY DATABASE FOR ORE LITHOLOGIES 4-88

TABLE 4-43: ARD DISTRIBUTIONS FOR COFFEE GOLD MINE ORE LITHOLOGIES 4-90

TABLE 4-44: SHAKE FLASK EXTRACTION RESULTS FOR ORE SAMPLES BY LITHOLOGY BY WEATHERING FACIES 4-92

TABLE 4-45: SOLID PHASE ELEMENTS BY AQUA REGIA DIGESTION FOR ORE LITHOLOGIES BY WEATHERING FACIES 4-94

TABLE 4-46: SOLID PHASE AS AND SB CONCENTRATIONS IN ORE FROM THE EXPLORATION DATABASE .. 4-95

TABLE 4-47: ORE KINETIC TEST DETAILS 4-97

TABLE 4-48: ACID BASE ACCOUNTING AND SOLID PHASE ELEMENTS FOR ORE COLUMN SUB-SAMPLES 4-100

TABLE 4-49: PARTICLE SIZE DISTRIBUTION FOR ORE COLUMN SUB-SAMPLES 4-100

TABLE 4-50: LOADING RATES FOR GNEISS ORE COLUMNS 4-102

TABLE 4-51: LOADING RATES FOR SCHIST ORE COLUMNS 4-103

TABLE 4-52: LOADING RATES FOR GRANITE ORE COLUMNS 4-104

TABLE 4-53: ACTIVITY OF ^{226}RA IN ORE COLUMN KINETIC TEST LEACHATE 4-107

TABLE 4-54: ACID BASE ACCOUNTING RESULTS FOR LEACH TAILINGS 4-110

TABLE 4-55: SOLID PHASE ELEMENT RESULTS FOR LEACH TAILINGS 4-111

TABLE 4-56: FINAL LEACH SOLUTION FROM METALLURGICAL CYANIDE COLUMNS 4-113

TABLE 4-57: LEACH TAILINGS KINETIC TEST DETAILS, SAMPLE SELECTION CRITERIA AND RATIONALE 4-115

TABLE 4-58: XRD RESULTS FOR LEACH TAILINGS KINETIC TEST SUB-SAMPLES 4-117

TABLE 4-59: ACID-BASE ACCOUNTING RESULTS AND SOLID PHASE ELEMENTS IN LEACH TAILINGS KINETIC TEST SUB-SAMPLES 4-118

TABLE 4-60: PARTICLE SIZE DISTRIBUTION FOR LEACH TAILINGS KINETIC SAMPLE 4-120

TABLE 4-61: LOADING RATES FOR LEACH TAILINGS UNSATURATED COLUMNS FOR 10 CYCLES AFTER RINSING. 4-121

TABLE 4-62: LOADING RATES AND PERCENT DIFFERENCE OF RECIRCULATION EXPERIMENT FOR GNEISS/SCHIST OXIDE/TRANSITION FACIES LEACH TAILINGS COLUMNS 4-127

TABLE 4-63: CONCENTRATIONS AND PERCENT DIFFERENCES FOR RECIRCULATION EXPERIMENT FOR LEACH TAILINGS COLUMNS 4-128

TABLE 4-64: LEACHATE RESULTS FROM LEACH TAILINGS FIELD KINETIC TESTS 4-130

TABLE 4-65: STATISTICAL DISTRIBUTION OF ACID BASE ACCOUNTING RESULTS FOR MINE SITE OVERBURDEN 4-135

TABLE 4-66: STATISTICAL SUMMARY OF SHAKE FLASK EXTRACTION RESULTS FOR MINE SITE OVERBURDEN 4-137

TABLE 4-67: STATISTICAL DISTRIBUTION OF SOLID PHASE ELEMENT RESULTS FOR MINE SITE OVERBURDEN SAMPLES 4-138

TABLE 5-1: MASS, LITHOLOGY AND OXIDATION OF WASTE ROCK PRODUCED FROM THE FOUR MINE PITS. ... 5-3

TABLE 5-2: MASS, LITHOLOGY AND OXIDATION OF WASTE ROCK STORED WASTE ROCK STORAGE AREAS. .. 5-4

TABLE 5-3: SURFACE AREA OF MINE FACILITIES IN EACH YEAR OF MINE LIFE 5-4

TABLE 5-4: LOADING RATES FROM FIELD BIN AND FULL SCALE WRSF AT ANALOGUE MINE SITE 5-8

TABLE 5-5: ARSENIC TO FE MOLAR RATIOS IN WASTE ROCK AND ORE LITHOLOGIES AND WEATHERING ZONES 5-13

TABLE 5-6: URANIUM TO ALKALINITY RATIO USED TO PREDICT UPPER CASE AND BASE CASE U SOLUBILITY 5-16

TABLE 5-7: RATIO OF RA-226 TO BA MEASURED IN ICP-MS DATABASE FOR VARIOUS LITHOLOGIES, WEATHERING TYPES AND ORE/WASTE TYPES. 5-19

TABLE 5-8: BASE CASE SOURCE TERMS FOR WRSF FOR THE FINAL YEAR OF MINE LIFE, TABLE 5-8CLOSURE AND POST-CLOSURE 5-23

TABLE 5-9: UPPER CASE SOURCE TERMS FOR WRSF IN FINAL YEAR OF MINE LIFE AND CLOSURE..... 5-24

TABLE 5-10: SOURCE TERM FOR ALPHA WRSF UNDERDRAIN APPLIED IN BOTH BASE CASE AND UPPER CASE. 5-25

TABLE 5-11: PLAN VIEW SURFACE AREAS OF WALL ROCK EXPOSED IN MINE PIT. MAXIMUM VALUES SHOW PEAK WALL ROCK SURFACE AREAS EXPOSED DURING MINE LIFE, FINAL VALUES ARE WALL ROCK EXPOSURES AT THE END OF MINE LIFE 5-26

TABLE 5-12: OVERVIEW OF KINETIC TESTS USED FOR PIT WALL SOURCE TERM CALCULATION 5-26

TABLE 5-13: PIT WALL PHYSICAL SCALING FACTORS 5-27

TABLE 5-14: ESTIMATES OF WALL ROCK RUNOFF PH AND ALKALINITY USED TO CALCULATE ARSENIC AND URANIUM SOLUBILITY..... 5-29

TABLE 5-15: BASE CASE ESTIMATES FOR PIT WALL ROCK SOURCE TERMS 5-31

TABLE 5-16: UPPER CASE ESTIMATES FOR PIT WALL ROCK SOURCE TERMS 5-32

TABLE 5-17: LITHOLOGY, OXIDATION AND SOURCE OF ORE STOCKPILED IN THE HEAP LEACH FACILITY. 5-33

TABLE 5-18: BASE CASE SOURCE TERM PREDICTIONS FOR HLF DURING OPERATIONS 5-37

TABLE 5-19: UPPER CASE SOURCE TERM PREDICTIONS FOR HLF DURING OPERATIONS 5-38

TABLE 5-20: BASE CASE AND UPPER CASE SOURCE TERM PREDICTIONS FOR MINE FACILITIES AREA 5-40

1. Introduction

1.1 Project Background

The proposed Coffee Gold Mine (the Project) is an advanced exploration gold project located in the White Gold District of west-central Yukon, approximately 130 km south of Dawson City. The Project contains several gold occurrences within an exploration concession covering an area of more than 600 km^2.

The Project will mine 60 MT of ore and 300 MT of waste rock from four open pits during an 11 ½ year mine life. The ore will be crushed and placed onto a heap leach facility by truck for nine months of the year. During the three coldest months of winter, run-of-mine (ROM) ore will be stockpiled. Gold will be extracted from pregnant leach solution by an adsorption, desorption, recovery (ADR) carbon plant with mercury retorting to produce a final gold doré product. Waste rock will either be stored in a waste rock storage facility (Alpha WRSF) adjacent to mine pits or backfilled into other completed mine pits.

1.2 Scope and Purpose

The purpose of the geochemical characterization program is to determine the metal leaching and acid rock drainage (ML/ARD) potential of geologic material that will be disturbed by mining activities. Techniques used to assess ML/ARD potential include static tests, which examine the intrinsic ML/ARD potential of a sample, and kinetic tests, which expose the material to various weathering conditions. These results are used to predict the geochemical evolution of drainage produced from mine waste facilities that will exist during mine operations and closure, and inform mine waste management, water quality predictions, aquatic resources effects assessments and mitigation/contingency measures.

1.3 Report Structure

The geochemical characterization program relates the ML/ARD characteristics of various rock units present at site. The site geology and rock units defined in the geologic block model are described in Chapter 2. Analytical methods of the various field and laboratory testwork are described in Chapter 3, and the results are presented and discussed in Chapter 4. In Chapter 4 the intrinsic ML/ARD potential from different rock units is described. This information is then combined with site specific information on climate, hydrology and the mine plan to produce geochemical source terms in Chapter 5.

2. Geology

This chapter provides a description of site geology and an overview of the volume of various geologic materials that will be excavated during mine life. The information presented in this section has largely been drawn from the Feasibility Study (JDS, 2016) for the Project. Geologic information most relevant to the geochemical characterization of materials to be disturbed as part of the Project is summarized below.

2.1 Regional Geology

The Project is located in the Yukon-Tanana Terrane (YTT), an accreted pericratonic rock sequence that extends from southeast Alaska into northern British Columbia. The YTT consists of schists and gneisses that were deformed and metamorphosed in the late Paleozoic era, and subjected to a number of intrusive events in the Mesozoic. The YTT hosts a number of gold deposits related to these Mesozoic intrusions. The Paleozoic rocks are pervasively foliated and contain at least two overprinting rock fabrics. During the Early Jurassic period, the rocks were tectonically stacked along foliation parallel thrust faults.

2.2 Local Geology

The Project area consists of felsic to mafic gneisses and schists of Paleozoic age which were intruded by a large granitic body in the late Cretaceous. A number of intermediate to felsic dikes have cut granitic and metamorphic country rock. Mineralization at the Project is divided into two main west-northwest trending, south to southwest dipping panels bordering a third intrusive rock panel to the south. From north to south, these are divided into an augen gneiss-mafic schist sequence overlain by a package of interbanded biotite-feldspar-quartz-muscovite schist, mafic metavolcanic rocks and metacarbonate rocks. To the south, the sequences are butted against a Cretaceous granite along a west-northwest trending contact. The Paleozoic metamorphic rocks and the Cretaceous granite rock sequence are cut by intermediate to felsic dykes. The major rock units present at the Project site are shown in Table 2-1. A vast majority of the rock that will be mined from mine pits are the felsic gneiss (Supremo and Double Double pits), biotite schist (Latte pit) and granite (Kona pit).

Gold mineralization at the site is hydrothermal in origin and structurally controlled. The gold mineralization is associated with brecciation, pyrite and silica sericite alteration, and minor quartz veins. Main groupings of rock types at the Project site are described below. Note that there is some variability within these main rock types, and multiple lithology codes have been used in drill core logging.

Table 2-1:
Rock Units in the Project Area

Rock Unit	Description
Felsic Gneiss	Variable quartz + feldspar augen + biotite +muscovite. Typical Mg# 2-28. Low in potassium. Host to gold mineralized zones at Supremo.
Biotite Schist	Biotite+/-feldspar+/-quartz+/-muscovite+/- amphibole. Commonly carbonate-rich. High in potassium. Typical Mg# 20 - 40. Locally mylonitic. Host to gold mineralized zones at Latte.
Muscovite Schist	Mainly quartz + muscovite. Typical Mg# 10 - 20. Locally mylonitic.
Biotite Amphibolite	Amphibole + feldspar + biotite. Typical Mg# 20 - 40. Biotite and amphibole both Fe-rich. Contains up to 20% biotite.
Amphibolite	Found within the lower mafic footwall. Amphibole + feldspar ± biotite. Typical Mg# 30-50, biotite and amphibole more Mg-rich than biotite amphibolite. Contains up to 15% biotite.
Metagabbro/Amphibolite	Interleaved metagabbro with coarse magnesiohornblende + feldspar, and fine-grained, massive amphibolite with >95% magnesiohornblende. Moderate to strong retrogression to actinolite. High Mg content of biotite, amphibole.
Ultramafics	Serpentinite, pyroxenite or listwaenite. Typical Mg# 50 - 73, higher than all amphibolites and metagabbro. Very high in chromium and nickel.
Granite	Coffee Creek granite and Dawson Range batholith. Both are phases of the Whitehorse Plutonic suite and are uranium-rich. Dawson Range batholith higher in Thorium. Both are identifiable using airborne radiometrics.
Dacite Dykes	Quartz + feldspar phenocryst porphyry. Generally strongly silicified and sericitized. Strong spatial association with mineralized gold zones.
Andesite Dykes	Feldspar phenocrystic. Aphanitic in gold-bearing structures where all original textures are destroyed by intense silicification and sericitization. Strong spatial association with mineralized gold zones.

Source: Kaminak 2016

2.3 Weathering Facies

Structural weaknesses associated with gold mineralization have led to extensive weathering and oxidation along structurally controlled corridors at the Project. The extent of oxidation is directly related to the amount of fracturing and the presence of sulphide mineralization and clay alteration. The surrounding country rock outside of these corridors is typically fresh (unoxidized) from surface. Weathering facies have been grouped according to the following nomenclature: oxide, upper transition, lower transition, fresh (unweathered). Brief summaries of these divisions are described in turn below.

Oxide

Oxide materials are defined as materials which show greater than 95% of rock surfaces being oxidized. The oxide facies is characterized by the presence of cubic vugs or limonite/hematite stains after pyrite. Rock surfaces show a pale orange-brown to dark red discoloration.

Upper Transition

The upper transition materials are defined by between 50% to 95% visible oxidation on rock faces. Outside of the ore zones, this material typically shows oxidized intervals or stronger limonite veining with associated limonite halos separated by fresh (unweathered) intervals. In mineralized zones, upper transition materials also typically show unoxidized windows. In support of the geologic block model used to develop the mine plan, the upper transition unit is further broken down into upper and middle transition units. For the purpose of the geochemical evaluation, the upper and middle transition materials are treated as a single weathering facies.

Lower Transition

The lower transition facies describes materials showing between 5% and 50% oxidation. Fresh (unweathered) materials are more pervasive. In mineralized zones, the lower transition facies show <50% oxidization of pyrite around veins/fractures.

Fresh (unweathered)

The fresh (unweathered) facies describes materials showing ≤5% oxidation. These materials are characterized by an absence of oxidation of brassy metamorphic pyrite and the presence of weak to absent fracture-controlled limonite-hematite. Very minor joint-controlled oxidation on unmineralized joint/fracture surfaces can also be present, although oxidation does not extend into adjacent country rock

3. Methodology

In this section, the rational for sample selection is discussed and a brief overview of analytical methods is provided.

3.1 Sample Selection

A key objective of the geochemical program was to produce a dataset that is representative of all types of materials to be disturbed or exposed during the Project. In this regard, appropriate sample selection is critical for adequately describing the variability in mine waste geochemical characteristics. The sampling program was specifically designed to characterize geochemical properties giving consideration to the following variables:

- Material type (*e.g.,* ore, waste rock, leach tailings, borrow material, overburden)
- Lithology (*e.g.,* gneiss, schist, granite, other)
- Weathering (*e.g*., oxide, transition, fresh)

The geochemical program included a variety of static testwork and kinetic testwork, in addition to detailed mineralogical analysis. A summary of the of number of samples and type of tests (by material type) is provided in Table 3-1. Test procedures are described below.

Table 3-1:
Summary of Geochemical Characterization Testwork for the Coffee Gold Mine as a Function of Material Type

Analytical Test	Ore	Waste Rock	Leach Tailings	Overburden and Borrow Material
Static Tests				
Acid base accounting (ABA)	38	348	16	105
Shake Flask Extraction (SFE)	18	102	*NS*	31
Aqua Regia (ICP-MS) Trace Metals	38	348	16	105
Aqua Regia (ICP-OES) Metals*	3,545	26,549	*NS*	*NS*
Kinetic Tests				
Humidity Cells	*NS*	8	*NS*	*NS*
Unsaturated Columns	6	6	7	*NS*
Field Bins	*NS*	8	3	*NS*
Cyanide column effluent	*NS*	*NS*	26	*NS*
Mineralogy				
XANES	6	5	*NS*	*NS*
XRD	7	41	8	*NS*
µXRF	6	7	*NS*	*NS*

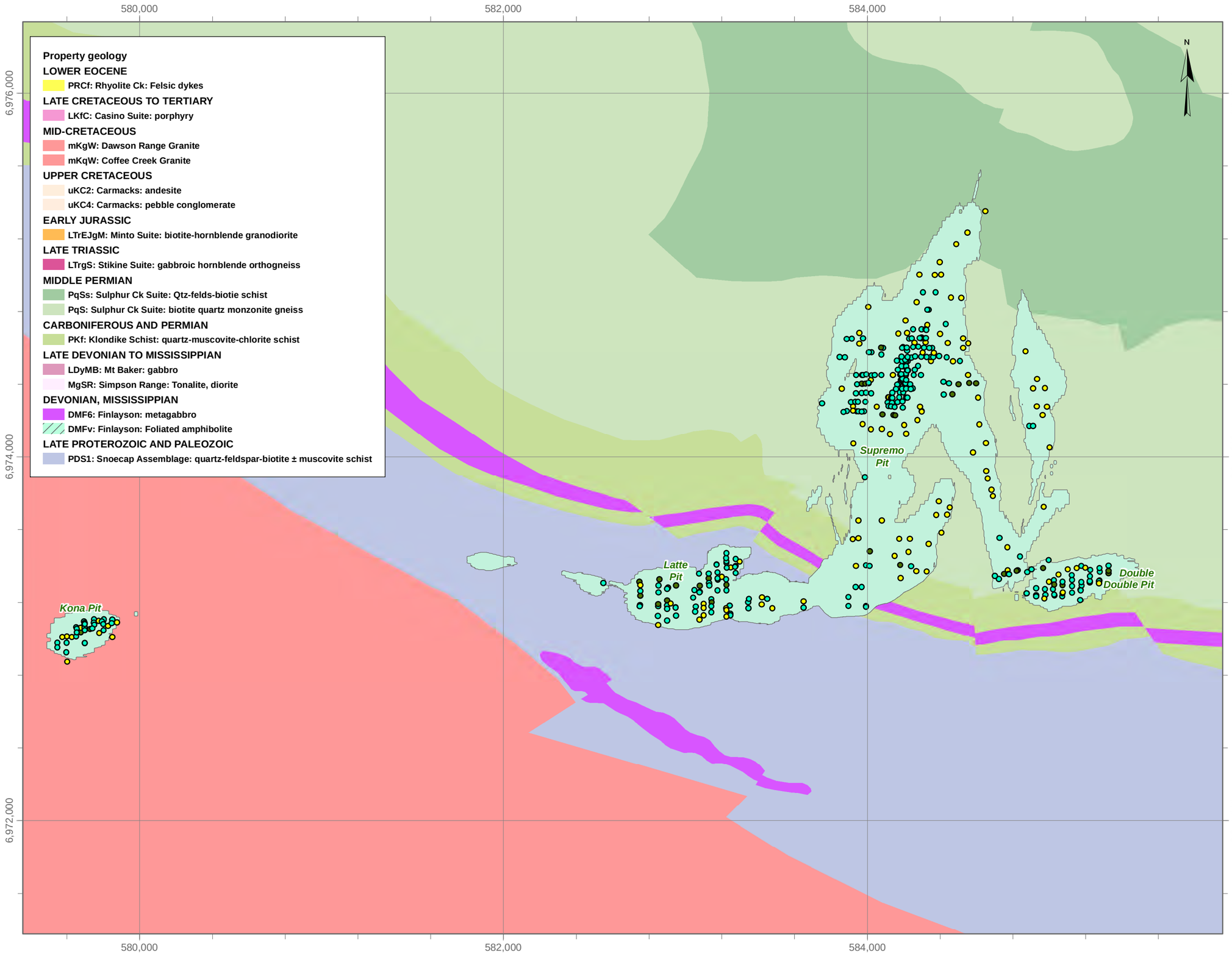
Notes:
NS = no sample
*Analyses completed in support of the exploration assay database
XANES = x-ray absorption near-edge spectroscopy
XRD = x-ray diffraction
µXRF = micro x-ray fluorescence

One of the primary objectives of static testing was to assign ML/ARD characteristics by rock type. As described in Chapter 2 (Geology), the Coffee Gold Mine deposit consists of several mineralized lithologies overprinted by an in-situ weathering profile; therefore, the geochemistry of site mine rock (waste rock and ore) was assessed by lithology (gneiss, granite, schist and other) and weathering facies (oxide, upper and lower transition and fresh). A summary of the sample distribution for waste rock and ore as a function of lithologic unit and weathering facies is provided in Table 3-2 along with the percentage of waste rock and ore to be disturbed during the life of the Project. Plan view maps showing sampling locations for surficial samples (overburden and borrow) are shown in Figure 3-1. Drill core collar locations for waste rock and ore sampled from drill core is shown in Figure 3-2. Cross sections show sample locations with respect to pit shells are provided in Appendix A.

Table 3-2:
Summary of Waste Rock and Ore Proportions for the Coffee Gold Mine and Number of Samples Submitted for Static Testwork

Lithologic Unit	Weathering Facies	Waste Rock		Ore	
		% of total	*n* of samples	% of total	*n of* samples
Gneiss	Oxide	85.8%	34	72.5%	5
	Upper Transition		26		5
	Lower Transition		79		
	Fresh		49	*NA*	*NA*
Schist	Oxide	11.3%	15	24.2%	6
	Upper Transition		14		5
	Lower Transition		19		
	Fresh		31	*NA*	*NA*
Granite	Oxide	1.8%	6	2.7%	6
	Upper Transition		17		8
	Lower Transition		14		
	Fresh		20	*NA*	*NA*
Other	Oxide	0.1%	4	0.4%	1
	Upper Transition		7		2
	Lower Transition		6		
	Fresh		7	*NA*	*NA*
Total		*100%*	*348*	*100%*	*38*

Notes:
NA = not applicable,
NS = no samples*other lithologies not included in ore block model



Property geology

LOWER EOCENE
- PRCf: Rhyolite Ck: Felsic dykes

LATE CRETACEOUS TO TERTIARY
- LKfC: Casino Suite: porphyry

MID-CRETACEOUS
- mKgW: Dawson Range Granite
- mKqW: Coffee Creek Granite

UPPER CRETACEOUS
- uKC2: Carmacks: andesite
- uKC4: Carmacks: pebble conglomerate

EARLY JURASSIC
- LTrEJgM: Minto Suite: biotite-hornblende granodiorite

LATE TRIASSIC
- LTrgS: Stikine Suite: gabbroic hornblende orthogneiss

MIDDLE PERMIAN
- PqSs: Sulphur Ck Suite: Qtz-felds-biotie schist
- PqS: Sulphur Ck Suite: biotite quartz monzonite gneiss

CARBONIFEROUS AND PERMIAN
- PKf: Klondike Schist: quartz-muscovite-chlorite schist

LATE DEVONIAN TO MISSISSIPPIAN
- LDyMB: Mt Baker: gabbro
- MgSR: Simpson Range: Tonalite, diorite

DEVONIAN, MISSISSIPPIAN
- DMF6: Finlayson: metagabbro
- DMFv: Finlayson: Foliated amphibolite

LATE PROTEROZOIC AND PALEOZOIC
- PDS1: Snoecap Assemblage: quartz-feldspar-biotite ± muscovite schist

LEGEND

Drill Collars
- ABA Samples
- ICP Samples
- ABA and ICP Samples

Pits

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:20,000

0 200 400 Meters

DATE SAVED:	Mar 21, 2017
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

GOLDCORP

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Collar Locations of Drill Core Samples Collected for ABA and ICP-OES Analysis

PROJECT #: A362-1 *FIGURE:* 3-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\DDH Collar Locations\Fig 3-1_ABA and ICP Samples_20170321.mxd

580,000 582,000 584,000

6,976,000 6,974,000 6,972,000

Property geology

LOWER EOCENE
- PRCf: Rhyolite Ck: Felsic dykes

LATE CRETACEOUS TO TERTIARY
- LKfC: Casino Suite: porphyry

MID-CRETACEOUS
- mKgW: Dawson Range Granite
- mKqW: Coffee Creek Granite

UPPER CRETACEOUS
- uKC2: Carmacks: andesite
- uKC4: Carmacks: pebble conglomerate

EARLY JURASSIC
- LTrEJgM: Minto Suite: biotite-hornblende granodiorite

LATE TRIASSIC
- LTrgS: Stikine Suite: gabbroic hornblende orthogneiss

MIDDLE PERMIAN
- PqSs: Sulphur Ck Suite: Qtz-felds-biotie schist
- PqS: Sulphur Ck Suite: biotite quartz monzonite gneiss

CARBONIFEROUS AND PERMIAN
- PKf: Klondike Schist: quartz-muscovite-chlorite schist

LATE DEVONIAN TO MISSISSIPPIAN
- LDyMB: Mt Baker: gabbro
- MgSR: Simpson Range: Tonalite, diorite

DEVONIAN, MISSISSIPPIAN
- DMF6: Finlayson: metagabbro
- DMFv: Finlayson: Foliated amphibolite

LATE PROTEROZOIC AND PALEOZOIC
- PDS1: Snoecap Assemblage: quartz-feldspar-biotite ± muscovite schist

Halfway Creek

Alpha WRSF

Beta WRSF

Kona Pit

Supremo Pit

Latte Pit

Double Double Pit

Latte Creek

CFR0818 CFR0925 CFR0985 CFR0984 CFR0816 CFR0676 CFR0981 CFR0910 CFR0805 CFR0288 CFR0802 CFR0911 CFR0933 CFR0923 CFR0804 CFR0102 CFR0909 CFR0797 CFR0905 CFR0908 CFR0864 CFR0866 CFR0614 CFR0937 CFR0884 CFR0872 CFR0867 CFR0978 CFR0881 CFR0877 CFR0860 CFR0599 CFR0924 CFR0776 CFR0846 CFR0612 CFR0786 CFR0783 CFR0782 CFR0757 CFR0839 CFR0686 CFR0944 CFR0841 CFR0836 CFR0624 CFR0761 CFR0759 CFR0825 CFR0694 CFR0752 CFR0737 CFR0320 CFR0713 CFR0680 CFR0746 CFR0716 CFR0693 CFR0957 CFB035 CFR0055 CFR0666 CFR0633 CFR0651 CFR0956 CFB030 CFR0698 CFR0695 CFR0939 CFR0663 CFR0665 SRK-15TP-24 SRK-15TP-23 SRK-15TP-47 CFB027 SRK-15TP-46 SRK-15TP-22 SRK-15TP-45 SRK-15TP-02 SRK-15TP-03 SRK-15TP-04 SRK-15TP-05 SRK-15TP-06 SRK-15TP-07 SRK-15TP-15 SRK-15TP-17 SRK-15TP-43 KNB-1 KNB-2 SRK-15TP-18 SRK-15TP-44 SRK-15TP-08 SRK-15TP-16 SRK-15TP-41 KNB-3 SRK-15TP-14 SRK-15TP-42 SRK-15TP-12 SRK-15TP-10 SRK-15TP-09 SRK-15TP-11 SRK-15TP-13

LEGEND
- Test Pits
- Overburden Drill Collars with ABA Samples
- Pits
- Waste Rock Dumps
- Leach pad
- Organics Stockpile
- ROM Stockpile
- Event Pond
- Heap Leach Access Disturbance Footprint
- Frozen Soil Storage Area
- Support Infrastructure
- Haul Road

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:20,000

0 200 400 Meters

DATE SAVED:	Mar 21, 2017
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

GOLDCORP

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Overburden Drill Core Locations with ABA Samples

PROJECT #: A362-1 *FIGURE:* 3-2

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\DDH Collar Locations\Overburden ABA Sample Locations_20170321.mxd

3.2 Analytical Methods

3.2.1 Mineralogy

3.2.1.1 Quantitative X-ray Diffraction

X-ray diffraction (XRD) is a powerful tool used to characterize the crystal structures of materials. Each mineral possesses a characteristic X-ray diffraction pattern that can be matched against a database of recorded phases. XRD data are produced when a monochromatic beam is projected onto a sample at an angle; this produces diffraction pattern peaks, which can be used as "fingerprints" to identify the mineral phases present. XRD was conducted at SGS and the University of British Columbia (UBC) Earth & Ocean Sciences Department. Select samples were submitted to the Canadian Light Source (CLS) for x-ray absorption near-edge spectroscopy (XANES) analysis in order to achieve higher resolution and identify minerals present in trace quantities.

3.2.1.2 µ-X-ray Florescence (XRF) Mapping

Synchrotron X-ray florescence (XRF) is a powerful approach for probing and mapping the distribution of elements in a given sample, with the data output used to define phase associations for parameters of concern (*e.g.,* arsenic (As) and uranium (U)). The principle of XRF is based on the detection of X-ray photons emitted from elements irradiated with X-rays. The emitted X-ray photon energies are element specific providing a unique identification for each element. µ-XRF maps were collected on the Very Sensitive Elemental and Structural Probe Employing Radiation from a Synchrotron (VESPERS) beamline at the CLS using a pink beam (meaning the photon beam consists of a wide range of energies, at a maximum of 20 KeV).

3.2.1.3 X-ray Absorption Near-Edge Spectroscopy (XANES)

Each element has a characteristic energy at which it absorbs X-rays, termed the X-ray absorption edge. Features of this edge and the absorption features of the elements on either side of the edge can provide information about the oxidation state and coordination environment of the element of study. XANES is part of the x-ray absorption spectrum and generally ranges from -50 eV to +100 eV relative to the absorption edge. In this regard, XANES analysis (performed at the CLS) was conducted to acquire phase association information for As and U, both of which represent parameters of potential concern in mine waste materials.

3.2.2 Static Tests

3.2.3 Acid-Base Accounting

Acid-base accounting (ABA) consists of a suite of tests used to estimate the acid generating potential (AP) and acid neutralizing potential (NP) of a sample. An accounting technique is then used to compare the AP and NP with standard criteria thereby indicating the theoretical acid generation potential of a sample. ABA was conducted by ALS in North Vancouver, B.C. Neutralization potential was measured using the standard sobek method (sobek NP) (Sobek et al. 1978) and the siderite peroxide correction sobek method (siderite NP) (Skousen *et al*., 1997). Carbonate NP (CaNP) was quantified from the total inorganic carbon (TIC) content by treating the sample with $HClO_4$ to evolve inorganic carbon (C) as CO_2, which was then measured by coulometery. A surrogate NP is developed by correlating NP values measured in ABA testwork to elemental abundances measured in the ICP-OES database, as discussed in Chapter 4. Total sulphur (S) was determined using a Leco furnace analyzer. Sulphate-S was determined via HCl extraction and measured gravimetrically after precipitation of barium chloride ($BaCl_2$). Sulphide-S was determined by first leaching the sulphate-S with sodium carbonate ($NaCO_3$) and then measuring the remaining sulphide-S with a Leco furnace. The oxidized sulphide was then determined gravimetrically after precipitation with $BaCl_2$.

3.2.4 Metal Abundance

Metal abundance in mine rock was measured as part of the ML/ARD characterization program and as part of the exploration program. Metal analysis conducted in support of the exploration program used a two acid (aqua regia) digestion followed by a 35 element (including S) inductively coupled plasma optical emission spectrometry (ICP-OES) scan (exploration database). Metal analysis conducted as part of the geochemical characterization program also used a two acid (aqua regia) digestion; however, this was followed by a 51 element inductively coupled plasma mass spectrometry (ICP-MS) scan (ABA database). The exploration database is considerably larger than the ABA database, with approximately 80,000 exploration samples versus a few hundred ABA samples. Both data sets were used in the analysis of acid-generating potential. All metal assays were conducted at ALS in North Vancouver, B.C.

3.2.5 SFE

Shake flask extractions (SFE) were conducted as described by Price (1997) in *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia*, using a 24-hour NanoPure water leach

extraction test at a 3:1 liquid to solid ratio. The leachate was filtered and submitted for analysis including pH, conductivity, sulphate and dissolved metals.

3.2.6 Kinetic Tests

Kinetic test data are used to assess long term drainage chemistry, develop source terms for water quality predictions and evaluate disposal strategies for waste rock that will be produced during the life of the Project. The kinetic tests developed for the Project include eight humidity cells, 17 unsaturated columns and 11 field bins. A brief overview of these kinetic test programs is provided below. A summary of the kinetic tests developed for waste rock, ore and leach tailings for the Project is summarized in Table 3-3.

Most waste rock kinetic tests used composite samples each constructed from approximately 80 m of split drill core collected from three to six drill holes from across the site. Drill core samples were selected by comparing metal assay results to statistics on metal abundance in non-mineralized (Au < 0.3 ppm) material of the respective lithologies/weathering zones. Composite samples were produced for the three main weathering zones (oxide, transition and fresh) and the three dominant lithologies (gneiss, schist and granite). Note that a granite oxide composite was not constructed due to it's relatively low abundance in the deposit (approx. 0.5% of waste rock). In addition to these composite samples, humidity cells were initiated on two individual drill core samples (HC7 and HC8) to examine metal leaching from schist and gneiss fresh facies that has As and U concentrations in the upper 90th percentile of the respective material types. Laboratory and field kinetic test results are provided in Appendix D.

3.2.6.1 Humidity Cells

Humidity cell tests measure the weathering rates of geological materials that are exposed to air and water under controlled laboratory conditions. The tests are designed to mimic weathering conditions by exposing samples to alternating cycles of dry and moist air, with regular flushings of the samples. The leachate is collected and analyzed at regular intervals to assess primary reaction rates for acid generation, neutralization, and metal release under controlled laboratory conditions. The reaction rates can be used to estimate the time to NP depletion and onset of acid generation.

Humidity cells are composed of Plexiglas cylinders (10.2 cm inner diameter, 25.5 cm length) filled with 1 kg of sample crushed to approximately minus 6 mm. The sample material is placed on a perforated acrylic disk covered in a nylon mesh. The contents of the cell are subjected to three days of dry air permeation followed by three days of humid air permeation (<10% relative humidity). On the seventh day, at the end of each wet/dry cycle, the contents of the cell are leached with 500 mL of distilled de-ionized water (Price,

1997). The purpose of the leaching step is to recover any readily soluble reaction products that have formed due to mineral dissolution or sulphide oxidation. The leachate is then analyzed for pH, conductivity, hardness, anions and dissolved metals, including mercury (Hg).

Table 3-3:
Summary of Kinetic Tests Initiated for the Coffee Gold Mine

Test ID	Duplicates	Material	Lithology	Weathering Facies	Start Date	Test Status
Unsaturated Columns						
Col 1		Leach Tailings	Gneiss/Schist	Oxide/Transition	10-Apr-14	active
Col 2	Duplicate of Col 1	Leach Tailings	Gneiss/Schist	Oxide/Transition	10-Apr-14	active
Col 3		Waste Rock	Schist	Oxide	16-Jul-14	active
Col 4		Waste Rock	Schist	Transition	16-Jul-14	active
Col 5		Waste Rock	Gneiss	Oxide	16-Jul-14	active
Col 6		Waste Rock	Gneiss	Transition	30-Jul-14	active
Col 7		Ore	Granite	Oxide	22-Apr-15	active
Col 8		Ore	Granite	Transition	22-Apr-15	active
Col 9		Ore	Schist	Oxide	22-Apr-15	active
Col 10		Ore	Schist	Transition	22-Apr-15	active
Col 11		Ore	Gneiss	Oxide	22-Apr-15	active
Col 12		Ore	Gneiss	Transition	22-Apr-15	active
Col 13		Waste Rock	Granite	Transition	20-May-15	active
Col 14		Waste Rock	Granite	Fresh	20-May-15	active
Col 15		Leach Tailings	Schist	Oxide/Transition	3-Jun-15	active
Col 16		Leach Tailings	Gneiss	Oxide/Transition	3-Jun-15	active
Col 17		Leach Tailings	Gneiss/Granite	Oxide/Transition	3-Jun-15	active
Humidity Cells						
HC 1	Duplicate of Col 4	Waste Rock	Schist	Transition	25-Jun-14	terminated
HC 2		Waste Rock	Schist	Fresh	25-Jun-14	terminated
HC 3	Duplicate of Col 6	Waste Rock	Gneiss	Transition	25-Jun-14	terminated
HC 4		Waste Rock	Gneiss	Fresh	25-Jun-14	terminated
HC 5	Duplicate of Col 13	Waste Rock	Granite	Transition	6-May-15	active
HC 6	Duplicate of Col 14	Waste Rock	Granite	Fresh	6-May-15	active
HC 7		Waste Rock	Schist	Fresh	12-Aug-15	active
HC 8		Waste Rock	Gneiss	Fresh	12-Aug-15	active
Field Bins						
FB-GO	Duplicate of Col 5	Waste Rock	Gneiss	Oxide	17-Jun-14	active
FB-GT	Duplicate of Col 6 & HC 3	Waste Rock	Gneiss	Transition	17-Jun-14	active
FB-GS	Duplicate of HC 4	Waste Rock	Gneiss	Fresh	17-Jun-14	active
FB-SO	Duplicate of Col 3	Waste Rock	Schist	Oxide	17-Jun-14	active
FB-ST	Duplicate of Col 4 & HC 1	Waste Rock	Schist	Transition	17-Jun-14	active
FB-SS	Duplicate of HC 2	Waste Rock	Schist	Fresh	17-Jun-14	active
FB-GGT	Duplicate of Col 13 & HC 5	Waste Rock	Granite	Transition	17-Jun-15	active
FB-GGS	Duplicate of Col 14 & HC 6	Waste Rock	Granite	Fresh	17-Jun-15	active
FB-LT1	Duplicate of Col 1 & Col 2	Leach Tailings	Gneiss/Schist	Oxide/Transition	17-Jun-14	active
FB-LT2		Leach Tailings	Schist	Oxide	10-Aug-15	active
FB-LT3		Leach Tailings	Gneiss	Oxide	10-Aug-15	active

Notes:
All columns and humidity cells are constructed of Plexiglas with acrylic perforated disk & nylon mesh;
All unsaturated columns are operated as trickle leach and all humidity cells as flood leach according to the MEND method (Price, 1997);
No sample preparation was conducted prior to flushings;
All columns and humidity cells were operated in a cold room at SGS and maintained at 4°C.

The humidity cell experiments were operated in a 4°C cold room to mimic the subarctic environment of the Project site. Although seasonally warmer temperatures can be expected in the near-surface waste materials, the bulk of the waste rock mass can be expected to remain at near-freezing temperatures throughout the year. In this regard, cool (4°C) experiment conditions are more representative of conditions to be expected at site. A summary of the humidity cell tests for the Project are provided in Table 3-3.

Humidity cell tests were subjected to recirculation experiment that involved recirculating the weekly effluent as influent to the tests. Effluent was re-circulated for three consecutive cycles, and then on the fourth cycle the leachate chemistry was analyzed. The objective of the recirculation experiment was to simulate increased pore water residence time to allow for assessment of whether the leachate chemistry produced by the kinetic tests are controlled primarily by the kinetic loading rates or by pH related solubility influences.

3.2.6.2 Unsaturated Columns

The unsaturated column test work is used to determine the kinetic behaviour of waste rock and ore stored on the surface and exposed to atmospheric weathering (sub-aerial storage). Unsaturated columns permit more flexibility than humidity cells with respect to test scale, particle size and range, sample mass, water infiltration or flow rate, degree of oxygenation and monitoring (cycle length).

The unsaturated columns are composed of Plexiglas cylinders (21.0 cm inside diameter, 20.5 cm length) filled with 4.4 kg to 20 kg of sample. The sample material is placed on a perforated Plexiglas disk covered in a nylon mesh. Columns containing waste rock or ore have the sample crushed to approximately minus 6 mm while the grain size distribution of leach tailings samples were not modified. The unsaturated columns are subjected to a trickle leach, whereby 400 mL of distilled de-ionized water is sprinkled on a bi-weekly basis. This is equivalent to 4.35 mm of rainfall per week. As per the rationale described above for the humidity cells, the unsaturated columns were operated in a 4°C cold room to mimic the subarctic environment of the Project site. Leachate collected from the unsaturated columns is analyzed for the same parameters as the humidity cells (pH, conductivity, hardness, anions and dissolved metals, including Hg).

Column tests were subjected to recirculation experiment that involved recirculating the weekly effluent as influent to the tests. Initially, effluent was re-circulated for one cycle, and then on the second cycle the leachate chemistry was analyzed. After a period of 8 cycles little change in solution chemistry was observed. Therefore, the re-circulation period was extended to two cycles, with the leachate being analyzed on the third cycle. The objective of the recirculation experiment was to simulate a slower an increased residence time to allow for assessment of whether the leachate chemistry produced by the

kinetic tests are controlled primarily by the kinetic loading rates or by pH related solubility influences.

3.2.6.3 Field Bins

Field bins are utilized to characterize the weathering characteristics of larger-scale samples under ambient climate conditions. Loading measurements from field bins can be utilized to develop scaling factors for laboratory-based tests when developing water quality predictions. The field bin leachate results can also be used to estimate drainage quality and give an indication of the timescale over which acidic conditions may develop.

The field bins for the Project were erected in Small's Expediting yard adjacent to the Whitehorse airport. Six barrels were loaded with crushed drill core and one barrel was filled with cyanide column leach residue on May 7th, 2014 (Table 3-3). Five additional barrels were developed the following year on June 6th, 2015, including one empty rain test barrel which was established to assess the chemistry of infiltrating water.

The field bins consist of 119L HDPE colorless barrels (80 cm high x 45 cm diameter) mounted in wooden cribs that are supported on a slight incline to improve the flow of leachate towards the drainage tap and collection containers (Table 3-3). A hole is drilled and threaded in the bottom of each barrel. This is where the acid-washed tubing and fittings are securely fit to allow leachate to drain to the collection system attached to the base of the cribs below the field bins. Two pieces of nylon mesh are placed over the hole at the bottom of the bin to prevent fines from clogging the drain. As well, elbow taps (positioned with the opening facing down) are threaded into holes drilled along the sides of each of the barrels to ensure adequate air flow through the interior of the bin.

Prior to placing the test material in a barrel, the samples were weighed, mixed and split using the cone and quarter technique. The split sample, comprising roughly 12.5% of the original material, was sent to the analytical laboratory for physical sediment characteristics, geochemical static testwork and additional laboratory kinetic testing. The quartering process is performed in order to ensure that each sample is properly mixed and that a representative sample is obtained for further analyses and duplicate laboratory kinetic testwork.

The initial leachate sample was achieved by irrigating the field bins with approximately 8L of distilled-deionized water. Subsequent sampling is conducted when sufficient volumes of natural precipitation have collected in the leachate collection jugs. Precipitation percolates through, and reacts with, the mine rock stored in the field bins and then flows through tubing attached to the bottom of each bin into collection jugs located in Rubbermaid totes (Figure 3-3). Leachate is collected and analyzed for pH, conductivity,

anions and dissolved metals, including Hg. Leachate collected from the leach tailings field bins are also analyzed for cyanide forms and compounds, including total, weak acid dissociable (WAD), cyanate (CNO^z) and thiocyanate (SCN^-).



Figure 3-3: Picture of Field Kinetic Tests

3.2.7 Metallurgical Columns

Metallurgical testwork for the Project was carried out by Kappes, Cassiday & Associates (KCA) in Reno, Nevada in 2014 and 2015. Ore (head) sample preparation and cyanide column leach testwork procedures are detailed in the report *Coffee Project Report of Metallurgical Test Work* (KCA, 2015).

In total, 17 columns were established during this phase of metallurgical testing to account for variations in scale, grain size, lithology and weathering facies. Three different scales and particle size distributions were established for testwork:

- Large scale columns, which measured 45.7 cm in diameter and contained 730 kg of sample composed of 80% particles passing 150 mm;
- Intermediate scale columns, which measured 20.3 cm in diameter and contained approximately 90 kg of sample composed of 80% particles passing 80 mm; and
- Small scale columns, which measured 15 cm in diameter and contained approximately 50 kg of sample composed of 80% particles passing 12.5 mm.

Lime buffered cyanide solution (NaCN) was continuously distributed onto the material through Tygon tubing at a flow rate of 10 to 12 L/hr/m^2 of column surface area. The column tests were run as continuously drained drip leach tests to more accurately reflect the actual conditions of a full scale heap leach. Following the stripping of Au from the effluent, the

barren solution was recirculated through the column with makeup NaCN amended as required to maintain a target level of 0.6 g NaCN /L and hydrated lime ($Ca(OH)_2$) added as needed for pH control. At the end of the cyanide leach experiments, samples of spent ore (leach tailings) were collected from the metallurgical columns for geochemical characterization. The final leach solution from the columns were collected to provide an indication of heap leach process water chemistry during Operations. No steps were taken to rinse remaining pore water or detoxify cyanide in leach tailings samples before samples were collected for geochemical testwork.

3.2.8 Radioisotopes

Solid samples of waste rock, ore and overburden were analyzed for naturally occurring radioactive material (NORM) by the Saskatchewan Research Council (SRC) Environmental Analytical Laboratories. The samples were analyzed for the major components of NORM, namely, natural U (principally ^{238}U) and thorium (^{232}Th) and their major radioactive decay products, and ^{40}K, the naturally occurring radionuclide of potassium. The results for ^{238}U and ^{232}Th were based on the analysis by the ICP-MS method of U and Th concentrations on a mass basis. Conversion to radioactivity concentrations by SRC was done using standard conversion factors for natural U and Th (0.01235 Bq/g per ppm of U; 0.00406 Bq/g per ppm of Th). The concentrations of other radionuclides were determined by gamma radiation spectrometry.

The activity of ^{226}Ra was measured in kinetic test leachate and in process solution from metallurgical columns. Kinetic test leachate samples included leach tailings field bins, waste rock field bins and laboratory ore columns. Field bin samples were not filtered while ore columns and metallurgical column samples were filtered prior to analysis. The activity of ^{226}Ra was determined at ALS Environmental or SRC Environmental Analytical Laboratories by alpha radiation spectrometry.

3.3 Quality Assurance and Quality Control

3.3.1 Static Testwork

The quality assurance and quality control (QA/QC) program for the static test program involved the analysis of laboratory duplicates. Approximately one duplicate was measured for every 20 samples. The analytical laboratory adheres to a precision specification of $\pm$10% for internal geochemical laboratory duplicates. Precision can be expressed as a function of concentration:

$$P_c = ((Detection\ Limit / c) + P) \times 100\%$$

where *Pc* is the precision at concentration c; *c* is concentration of the element; and *P* is the "Precision Factor" of the element. This is the precision of the method at very high concentrations. Any laboratory duplicate result that does not adhere to the precision specifications would trigger a re-analysis.

3.3.2 Kinetic Program

QA/QC samples for the laboratory kinetic test programs (humidity cells and columns) include the collection of a blank sample during each sampling event to monitor any contamination that may occur during sample collection and handling. Each set of samples submitted for analyses is also subjected to a rigorous internal laboratory QC program.

A field QA/QC program was established to evaluate the quality of the field bin data set, including field duplicates and field blanks. The field duplicate sample is intended to monitor the variability in sub-sampling and analysis, while the field blank is used to quantify any contamination that may occur during sample collection, handling and transportation. Field QA/QC data for all the field bins are presented in Appendix D.1-6, and includes data for field duplicate and field blank samples collected in 2014 and 2015.

For the purpose of evaluating the field duplicate samples, acceptable precision and accuracy was defined to be within 20% relative percent difference (RPD) at concentrations greater than 10 times (10×) the detection limit (DL); where,

$$RPD = [(result - duplicate\ result) * 100] / [(result + duplicate\ result) / 2]$$

All field duplicates were within the data quality objectives, with nearly all (98%) of RPD values < 20% (for concentrations greater than 10 times the detection limit). Field blanks show all but one parameter to be at concentrations below their respective detection limits. Only the sulphate value for the field blank sample collected June 4, 2014 is at the detection limit (0.3 mg/L). Overall, results of the QA/QC program demonstrate very good quality control on limiting contamination during sampling activities.

4. Geochemical Characterization Results

The following sections provide data collected for the geochemical characterization of geologic waste materials for the Project. The chapter has been divided by waste material, including waste rock, ore, leach tailings and overburden/borrow materials. Within each section, data are provided with respect to mineralogy, ABA, SFE, solid phase elements and kinetic testwork. As well, variations in geochemical properties as a function of lithology and weathering facies within each waste type are discussed. The results from these components are ultimately used to define acid generating potential, metal leaching potential and drainage chemistry predictions (source terms) for mine waste facilities.

4.1 Waste Rock

4.1.1 Overview of Test Results

Geochemical testwork indicates that all lithologies and weathering facies of waste rock have little or no potential for acid generation. The low potential for acid generation is, in part, related to the lack of sulphur (S) mineralization, with median total S values in gneiss, granite and schist being 0.01, <0.01 and 0.03 wt.%, respectively. There is some variation in sulphur content between weathering facies within each lithology, with the fresh weathering facies typically showing greater S content then the transition and oxide facies. However, the S content remains relatively low even in unweathered (fresh) waste rock, with median values ranging from <0.01 to 0.11 wt.%. Due to the low S concentrations and the presence of carbonate minerals, all waste rock is classified as non-reactive or non-PAG.

Mineralogical investigations indicate that the most frequently detected sulphur mineral waste rock is pyrite (<1 wt.%). Calcite represents the dominant carbonate mineral (<29 wt.%), indicating that these materials are capable of buffering acid generating reactions. However, carbonate minerals that are less effective at neutralizing acid are also present in appreciable amounts in the gneiss and schist (<11 wt.%). The oxide gneiss and granite waste rock have limited buffering capacity, owing to the undetectable to very low abundance of carbonate minerals.

Solid phase metal analysis found that As, Sb, Bi and Se were enriched in all rock types, while U enrichment was limited to the granite and gneiss lithologies. Elemental enrichment is related to both lithology and weathering facies, with Sb and As concentrations being most enriched in the oxide weathering facies, and in the granite lithology. Schist waste rock is also elevated with respect to Se and Cr. Granite and gneiss waste rock show U enrichment.

Results of the SFE indicate that As and Sb are metals of potential concern from all waste rock lithologies, most notably granite. Elevated concentrations of Cr were also observed in the gneiss and schist lithologies. It is interesting to note that U was not found to be elevated in SFE testwork, which is in contrast to metal enrichment and metal leaching results from kinetic testwork. This result is attributed to the low alkalinity produced during SFE experiments.

Field and laboratory kinetic tests are consistent with static testwork results, with the highest As concentrations produced by granite waste rock, the highest Sb concentrations produced by schist fresh facies and the overall highest U concentrations produced by gneiss waste rock. Uranium was similarly enriched in the granite waste rock, however, the concentrations in granite leachate were highly variable, and can be related to the low alkalinity produced in some granite samples which inhibits U solubility. The gneiss and schist oxide facies produced the highest Cr concentrations and the lowest As and Sb concentrations. Note that this is contrary to elemental enrichment testing which showed that oxide facies generally had the greatest As and Sb. This result is attributed to the relative abundance of Fe in the oxide kinetic test samples.

4.1.2 Mineralogy

The following section provides an overview of the mineralogical results for waste rock samples. Mineralogical laboratory reports for XRD and assessments completed at the CLS are presented in Appendix B.1 and Appendix B.2, respectively.

4.1.2.1 Gneiss Waste Rock

Gneiss materials are typically characterized by quartz, plagioclase, K-feldspar, kaolinite, +/- illite/muscovite, +/- phlogopite, and, with exception of the oxide weathering facies, carbonate minerals including calcite +/- ankerite +/- dolomite (Table 4-1). Of these, quartz, plagioclase, and K-feldspar comprise the major rock forming minerals. Sheet silicates such as illite/muscovite, kaolinite, phlogopite, and bioite, also contribute significantly to the total mineral make up. Kaolinite, a secondary clay mineral that generally forms from the weathering of aluminium feldspars, is typically present in the greatest amounts in the oxide facies and, to a lesser extent, the upper transition facies. The fresh facies has the lowest occurrence of kaolinite. Illite/muscovite is variable within each facies and does not show any discernible trend.

Calcite represents the dominant carbonate mineral for each of the upper transition, lower transition and fresh facies. Dolomite is rare, present in only a single upper transition sample (KAM091516, Table 4-1), a single lower transition sample (KAM079117), and two fresh samples (KAM078808 and KAM092488) Ankerite is typically present in the upper

transition samples, is present in a single lower transition sample (KAM051451) and notably absent from samples associated with oxide and fresh weathering facies. The presence of carbonate minerals in gneiss samples from the upper transition, lower transition, and fresh materials in appreciable abundances, indicates that these weathering facies are capable of buffering acid generating reactions. In contrast, the oxide gneiss has limited buffering capacity, owing to the absence of carbonate minerals detectable by XRD. However, ABA results discussed in subsequent sections show that some carbonate content is associated with oxide weathering facies.

Sulphide minerals are present in each of the gneiss weathering facies (oxide, upper transition, lower transition, and fresh), although not all samples show detectable sulphide minerals irrespective of weathering facies. With respect to gneiss waste rock, the major sulphide species is pyrite, with pyrrhotite present in a single fresh sample (KAM145241, Table 4-1).

In addition to sulphide minerals, XRD identified the presence of sulphate minerals in the gneiss samples including gypsum (lower transition facies), hydronium-jarosite (oxide facies) and natroalunite (fresh facies). These minerals are present in very low abundances (Table 4-1). Since natroalunite is typically a secondary mineral formed through weathering processes, it is unexpected to see detectable quantities associated with the fresh (unweathered) material. In this regard, the presence of natroalunite in this sample should be viewed with some uncertainty. Similarly, the very low abundance of gypsum in a lower transition sample should also be viewed as being uncertain.

Table 4-1:
XRD Results for Gneiss Waste Rock Samples

		Oxide			Upper Transition						Lower Transition					Fresh				
Sample ID		KAM144308	KAM139298	KAM137583	KAM152499	KAM084288	KAM097065	KAM097065	KAM029087	KAM091516	KAM050812	KAM079117	KAM143923	KAM051451	N839989	KAM145241	KAM153051	N837976	KAM078808	KAM092488
Mineral	**Ideal Formula**	**wt. %**																		
Ankerite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2$				0.75	8.1	0.50			2.4				1.6						
Calcite	$CaCO_3$				0.63	2.7	2.9	2.4	5.1	6.7	7.3	0.22	7.8	7.3	0.64	9.6	0.68	10	0.50	
Dolomite	$(Ca,Mg)CO_3$									13		5.1							4.9	4.1
Siderite	$Fe^{2+}CO_3$																			
Dawsonite	$NaAlCO_3(OH)_2$												0.16							
Pyrite	FeS_2			0.35		0.38	0.20					0.69			0.59		0.31		0.70	0.46
Pyrrhotite	$Fe_{1-x}S$															0.33				
Gypsum	CaSO4 2H2O												0.29							
Goethite	$a\text{-}Fe^{3+}O(OH)$					0.90														
Hydroniumjarosite	$H_2Fe_6^{3+}(SO_4)_4(OH)_{12}$			0.54																
Natroalunite	$NaAl_3(SO4)_2(OH)_6$																	0.39		
Diaspore	AlO(OH)							0.7												
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)_2$													8.1						
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$			1.9	2.5					14	9.5		1.6		3.5	6.3		16		
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	10						12			7.3		25	14					7.2	14
Illite/Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$/ $K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$		6.1	14	6.7	4.0	9.0		6.0			8.7			26		5.1			
Kaolinite	$Al_2Si_2O_5(OH)_4$	9.6	16	12	2.6	17	14	7.8	15	13		8.3	7.6		6.9		3.8		1.7	9.6
K-feldspar	$KAlSi_3O_8$	24	31	20	20	17	14	14	22	28	25	33	1.7	11	11	33	18	4.6		23
Plagioclase	$NaAlSi_3O_8 - CaAl_2Si_2O_8$			13	28	1.39	3.8	3.1		7.3	13	7.1	9.0	25	7.8	24	32	20	56	
Quartz	SiO_2	56	48	38	37	48	55	60	51	16	27	37	47	26	33	14	40	19	29	49
Anatase	TiO_2			0.41					0.50						0.49					
Clinozoisite	$Ca_2Al_3(SiO_4)_3(OH)$				1.8		0.46				9.8				6.0			11		
Grossular	$Ca_3Al_2(SiO_4)_3$													1.0				0.57		
Actinolite	$Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$															1.6		15		
Augite	$(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$															11	1.0			
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$										1.2			6.1	4.3			3.5		
Barite	$BaSO_4$	0.20																		
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

4.1.2.2 Schist Waste Rock

The schist oxide, upper transition, lower transition, and fresh materials are composed of quartz, K-feldspar, +/- plagioclase, kaolinite, +/- illite/muscovite, +/- phlogopite, +/- biotite, carbonate minerals, including calcite +/- ankerite +/- dolomite, +/- siderite, and +/- dawsonite, and sulphide minerals, including +/- pyrite, +/- arsenopyrite, +/- galena, and +/- manganese sulphide (Table 4-2). Of these, quartz, plagioclase, K-feldspar, kaolinite and illite/muscovite represent the bulk of the mineral assemblage irrespective of weathering facies. The schist unit exhibits the greatest abundances of sheet silicates. As with the gneiss unit, kaolinite is typically present in the greatest abundance in the oxide facies, followed by the upper transition.

Calcite and dolomite comprise the major carbonate minerals for each of the oxide, upper transition, lower transition, and fresh materials. Ankerite is also present in appreciable amounts in each of the upper transition, lower transition, and fresh weathering facies. Siderite is present in two samples, from the upper transition (KAM022156, Table 4-2) and fresh (KAM036824) facies. Appreciable quantities of Fe/Mn-bearing carbonates in the upper transition, lower transition, and fresh weathering facies indicate that CaNP may overestimate the NP derived from carbonate minerals for the schist unit from these facies.

Pyrite is present in each of the upper transition, lower transition, and fresh weathering facies. In contrast, sulphide minerals (including pyrite) were not detected in the oxide schist facies. No sulphate minerals were detected in any of the schist samples.

4.1.2.3 Granite Waste Rock

The granite unit is generally characterized as being composed of quartz, +/- plagioclase, +/- K-feldspar, kaolinite, +/- illite/muscovite, +/- phlogopite, and +/- trace carbonate minerals (Table 4-3). Quartz, +/- plagioclase, an +/- K-feldspar comprise the major minerals for the granite material. The granite oxide facies is primarily quartz (55 to 66 wt.%) with trace amounts of K-feldspar (< 2 wt.%), while the upper transition, lower transition, and fresh facies granite material is comprised of quartz (31 to 62 wt.%), K-feldspar (0 to 31 wt.%), +/- plagioclase (0 to 35 wt.%). Sheet silicates such as kaolinite and illite/muscovite are generally most abundant in the oxide facies, with a combined contribution of 33% to 42 % of the granite composition. The lower transition facies exhibit slightly lower abundances of kaolinite and illite/muscovite (23 to 24 wt.%), with the exception of R305815 which shows much lower abundances.

The granite samples showed undetectable to very low abundances of carbonate minerals. Hydrocalumite was observed in a single oxide sample (R305826, Table 4-3) and a single

fresh sample (R305832). Calcite and dolomite were only observed in fresh granite samples (KAM025798 and R305825). Iron bearing carbonates were also observed in two samples at very low abundances, including upper transition (R305818) and fresh (KAM025798) weathering facies.

Pyrite was the only sulphide mineral observed for the granite, and only present in two samples. These included a single upper transition sample (KAM025898, Table 4-3) and a single fresh sample (R305825), both showing abundances of <1 wt.%.

In addition to sulphide minerals being present, XRD identified the presence of acidic sulphate minerals (hydronium-jarosite) in a single upper transition sample. This material is present in very low abundance and therefore there is some uncertainty as to the validity of this identification.

4.1.2.4 Other Waste Rock Lithologies

Mineral assemblages for other waste rock materials, including two dyke samples (KAM029393 and KAM03975) and a single breccia sample (KAM036549) (Table 4-4). For the oxide dyke, the major minerals include quartz, kaolinite, and illite/muscovite. Neither carbonate nor sulphide minerals were present in the XRD scans. With respect to lower transition dyke material, dominant minerals included quartz, K-feldspar, plagioclase, kaolinite, illite/muscovite, biotite, and carbonate minerals (calcite, ankerite, and siderite). Sulphide minerals were not detectable in XRD scans of the lower transition dyke sample. The fresh breccia material exhibits quartz, K-feldspar, kaolinite, muscovite, and carbonate minerals, such as dolomite, ankerite, and siderite. The only sulphide mineral present in these samples was pyrite (0.5 wt.%) in the fresh breccia sample.

Table 4-2:
XRD Results for Schist Waste Rock Samples

		Oxide		Upper Transition				Lower Transition				Fresh			
Sample ID		KAM029385	J957606	KAM147059	KAM037928	KAM079346	KAM022156	KAM043465	KAM081312	KAM047995	KAM039252	KAM149916	KAM151027	KAM036824	KAM149916
Mineral	**Ideal Formula**	**wt. %**													
Ankerite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2$			10		9.8	11	9.7	0.089	3.9	5.4	0.90		5.5	11
Calcite	$CaCO_3$		29		13			1.7	0.28	5.6	3.8	4.8			2.0
Dolomite	$(Ca, Mg)CO_3$			11		12							22	9.3	7.9
Siderite	$Fe^{2+}CO_3$						0.49							4.5	
Dawsonite	$NaAlCO_3(OH)_2$			0.19									0.21		
Hydrocalumite	$Ca_4Al_2(OH)_{12}(Cl,CO_3,OH)_2 \cdot 4H_2O$														
Galena	PbS			0.048											
Pyrite	FeS_2			1.0			0.52	0.94		0.50	0.70	1.4	0.91	1.3	0.60
Pyrite, arsenian	$Fe(As, S)_2$														0.80
Manganese sulfide	MnS_2														0.40
Hematite	$a\text{-}Fe_2O_3$		0.28		0.70										
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)2$				2.0					10	9.0				
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$											12			
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	21				12		17	9.0	0.00	9.7	8.6		14	25
Illite/Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2/ K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$		12	9.6	11		22			6.3			20		
Kaolinite	$Al_2Si_2O_5(OH)_4$	20	13	21	13	21	21	10	0.93	4.2	9.7	4.1	4.9	15	11
K-feldspar	$KAlSi_3O_8$	6.5	10		15	10		3.2	15	12	16	6.1	1.8	1.6	
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$								35	20	8.6	10			
Quartz	SiO_2	50	35	46	43	35	44	57	40	34	36	42	41	49	41
Cristobalite	SiO_2														
Anatase	TiO_2		0.91		1.0		0.66	0.44		0.40	0.40	0.48	0.14		
Rutile	TiO_2			0.42									0.43		
Clinozoisite	$Ca_2Al_3(SiO_4)_3(OH)$											6.0			
Grossular	$Ca_3Al_2(SiO_4)_3$												8.0		
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$									2.1		3.8			
Analcime	$Na_2(Al_2Si_4O_{12}) \cdot 2H_2O$														
Diopside	$CaMgSi_2O_6$	2.2													
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Table 4-3:
XRD Results for Granite Waste Rock Samples

		Oxide		Upper Transition					Lower Transition			Fresh		
Sample ID		R305826	R305808	R305824	KAM025898	KAM025898	R305818	R305821	R305817	R305803	R305815	R305832	KAM025798	R305825
Mineral	**Ideal Formula**	**wt. %**												
Ankerite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2$						0.20							
Calcite	$CaCO_3$												0.93	
Dolomite	$(Ca,Mg)CO_3$													0.10
Siderite	$Fe^{2+}CO_3$												0.50	
Hydrocalumite	$Ca_4Al_2(OH)_{12}(Cl,CO_3,OH)_2 \cdot 4H_2O$	0.10										0.40		
Pyrite	FeS_2					0.20								0.087
Gorceixite	$BaAl_3(PO_4)_2(OH)_5 \cdot H_2O$		0.11											
Iron-alpha	a-Fe				0.28								0.22	
Hematite	$a\text{-}Fe_2O_3$							0.20			0.2?	0.18	0.28	
Hydroniumjarosite	$H_2Fe_6^{3+}(SO_4)_4(OH)_{12}$							0.27						
Jarosite	$KFe_3^{+3}(SO_4)_2(OH)_6$						0.40							
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)_2$					1.0			1.4		2.0	2.6		
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$				1.1								1.7	
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$												1.1	
Illite/Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$/ $K0.65Al2.0Al0.65Si3.35O_{10}(OH)_2$	35	1.8	0.55		1.7	12	4.8	3.1	1.4		2.7		
Kaolinite	$Al_2Si_2O_5(OH)_4$	7.6	32	37	10	8.4	8.5	4.1	21	22	0.61	7.1	0.87	19
K-feldspar	$KAlSi_3O_8$	1.6			30	30	21	31	30	31	28	29	28	31
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$				21	18		25			34	19	35	
Quartz	SiO_2	55	66	62	37	37	54	31	45	38	35	39	31	49
Cristobalite	SiO_2					2.9	4.1	2.5		7.4				
Anatase	TiO_2		0.18	0.28										
Rutile	TiO_2							0.70						
Clinochlore	$(Mg,Fe^{2+})5Al(Si_3Al)O_{10}(OH)_8$												0.81	
Analcime	$Na_2(Al_2Si_4O_{12}) \cdot 2H_2O$	0.24												
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Table 4-4:
XRD Results for Dyke (KAM02939 and KAM037975) and Breccia (KAM036549) Waste Rock Samples

		Oxide	Lower Transition	Fresh
Sample ID		KAM029393	KAM037975	KAM036549
Mineral	**Ideal Formula**	**wt. %**		
Ankerite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2$		2.4	12
Calcite	$CaCO_3$		8.5	
Dolomite	$(Ca,Mg)CO_3$			6.5
Siderite	$Fe^{2+}CO_3$		0.80	0.60
Pyrite	FeS_2			0.50
Hematite	$a\text{-}Fe_2O_3$		1.1	
Diaspore	AlO(OH)			1.10
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)_2$		14	
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$			18
Illite/Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$/ $K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$	15	5.9	
Kaolinite	$Al_2Si_2O_5(OH)_4$	30	6.9	8.2
K-feldspar	$KAlSi_3O_8$		8.3	3.6
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$		25	
Quartz	SiO_2	54	26	49
Anatase	TiO_2	0.70	0.90	0.40
	Total	*100*	*100*	*100*

4.1.2.5 Summary of Sulphur and Carbonate Mineralogy

Regardless of the lithotype or weathering facies, pyrite is the primary sulphide mineral. In general, the schist unit shows the greatest sulphide mineral abundance (Table 4-2), followed by the gneiss and the granite units. Typically, the oxide samples are depleted with respect to sulphide minerals. Other sulphide minerals identified in trace abundances include pyrrhotite in both the gneiss and schist lithology; and arsenopyrite, galena, and manganese-sulphide in the schist lithology. However, due to the low abundances of these sulphide minerals, their presence cannot be stated with certainty based on the XRD data. Sulphate minerals were identified in gneiss and granite lithologies. These minerals were generally, but not always, found in the oxide and transition weathering facies. The two

sulphate minerals, hydroniumjarosite and K-jarosite, identified in the granite lithology (Table 4-3) are both acid generating, while sulphate minerals identified in the gneiss lithology were a combination of acid generating (hydroniumjarosite, Table 4-1) and non-acid generating (gypsum and barite). No sulphate minerals were identified by XRD in schist waste rock; however, ABA analysis shows that minor quantities of sulphate are present in this rock type (75th percentile of 0.01 wt.%) and barite was identified in schist ore.

Carbonate mineral phases identified by XRD include calcite, dolomite, ankerite, siderite, and in rare instances dawsonite. Of these, NP is strongly associated with more readily soluble carbonate minerals including calcite and dolomite. When available, these carbonates buffer acid generating reactions such that a neutral pH is maintained. Within a given lithology, carbonate abundance shows a general pattern of decreasing abundance with increased degree of weathering. In this regard, oxide facies samples show the lowest carbonate mineral abundance, with many samples exhibiting undetectable levels. Similarly, a number of upper transition samples exhibit carbonate-depleted characteristics. Highest carbonate abundances are exhibited by unweathered (fresh) schist materials (Table 4-2), followed by the gneiss and granite units. The Fe- and Mn-bearing carbonates, ankerite and siderite, were identified in approximately half the samples. Typically, the Fe-carbonates are in much lower concentrations than calcite and dolomite and are associated with the gneiss and schist samples (predominantly upper and lower transition samples).

4.1.2.6 Trace Element Occurrence

For the purposes of identifying mineral associations for trace elements of interest, mine waste rock and ore samples were analyzed at the CLS using high resolution microscopy methods. Specific trace elements examined were As and U owing to elevated concentrations observed in site water quality and in kinetic test results. The analysis included µXRF and XANES testing to determine elemental-phase associations and valence state. Note that µXRF could not detect elements with emission energies that fall below Ar, meaning that elements lighter than Ar are not detectable. The complete results of this analysis are provided in Appendix B.2.

Arsenic

The XANES results are presented in Table 4-6. A total of 10 samples were compared with As K-edge XANES spectra and five standards. The results show that arsenate (As(V)) is the only oxidation state identified within the oxide weathering facies and is the dominant speciation in most samples from the transition and fresh weathering facies. Reduced forms

of As (As(-I) and As(III)) were less abundant than As(V) in all but one unweathered (fresh) gneiss waste rock sample.

For all samples where As was detected, a co-association with Fe was observed. This is consistent with XRD results which have identified the presence of arsenopyrite (FeAsS), arsenian-pyrite[$Fe(As,S)_2$] and scorodite ($FeAsO_4*H_2O$), but may also be a result of As being present on Fe-oxide mineral surfaces. In one schist transition sample, As was associated with both Fe and Ca, indicating the presence of yukonite [$Ca_3Fe(AsO_4)_2(OH)_3*5H_2O$]. Although it was not identified by µXRD, XANES data indicated the presence of As(I) suggesting that the sulphide minerals realgar (As_4S_4) or orpiment (As_2S_3) may also be present.

Uranium

For quantifying U oxidation states, XANES spectra were collected for nine samples (Table 4-7). Analysis of the gneiss oxide composite sample was attempted (5.5 ppm U); however, the concentration was below the detection capabilities of the beamline. The oxidation state of U in most of the samples is a mixture of U(IV) and U(VI) with the only exception being a single gneiss oxide sample where U(VI) was the only oxidation state detected. In general, oxide samples are dominated by U(VI) while transition and fresh samples show a wide range of U(VI) and U(IV) proportions. It is interesting to note that in all samples, including fresh unweathered material, U(VI) is present. This has implications for U release to pore water as U(VI) is more soluble than in the reduced oxidation state.

Associations of U with other elements was examined with µXRF data collected from 18 samples. Results are summarized in Table 4-5. Despite the high resolution of the µXRF technique, U minerals were only identified in 8 of the samples analyzed due to its low abundance. Uranium minerals are chemically diverse, and a range of minerals may be present that incorporate elements which overlap with spots identified by µXRF. For the purpose of identifying the most likely U host phases, only relatively common minerals were considered.

Uranium minerals can be classified as reduced or oxidized species. Reduced uranium minerals incorporate U in the tetravalent oxidation state [U(IV)] while oxidized uranium minerals incorporate U in the hexavalent oxidation state [U(VI)]. XANES data, described below, indicates that U is present in both oxidation states in most samples. The most abundant U(IV) bearing minerals in decreasing prevalence are uraninite (UO_2), coffinite ($USiO_4 \cdot nH_2O$) and brannerite [$(U,Ca,Y,Ce)(Ti,Fe)_2O_6$] (Gilligan *et al.*, 2015). In gneiss waste rock samples, U was found to be associated with Fe, Ti, Ca, As, Cu and Th. The association of U with Ca, Fe and Ti in three out of six gneiss samples suggests that brannerite is present (Table 4-5), although the presence of the uraninite and coffinite cannot

be precluded. Note that in one gneiss sample (72146B) no elemental overlap was found with U. This indicates that U is occurring with elements lighter than Ar, which includes Si and O.

Minerals containing U(VI) can occur in a diverse group of minerals that can be broadly classified as hydrated uranyl oxides, phosphates, vanadates, silicates and carbonates. Uranyl carbonate minerals generally form in evaporate deposits, which is a class of minerals not expected to occur in the Project waste rock or ore. No association between U and V was identified, indicating that vanadates are not present. Silicon, P and O have emission energies below the range that was detectable by this analysis. Associations of U with Cu and/or As in gneiss waste rock and ore suggest the presence of uranyl phosphate minerals. That is, Cu occurs in tobernite ($Cu(UO_2)_2(PO_4)_8 \cdot 12H_2O$) and AsO_4 can commonly substitute for PO_4 in the autunite series minerals ($Ca(UO_2)_2(AsO_4,PO_4)_8 \cdot 8H_2O$. The association between U and Fe could be related to a variety of oxidized or reduced minerals, but may also reflect adsorption of the positively charged uranyl ion onto negatively charged surfaces of sulfides, clays and organic matter, as well as Fe, Mn and Al oxyhydroxide particles (Lottermoser, 2007).

In schist waste rock, U was found to be associated with Fe, Ca and As (Table 4-5). In a single sample, 72146B, no detectable elements (i.e., elements heavier than Ar) overlapped with a U spot, indicating the presence of a U oxide or silicate mineral. The association of U with As and Ca suggests the presence of an autunite series mineral, as described above.

Table 4-5:
Summary of As and U µ-XRF Results for Coffee Gold Mine Samples

Sample Description	Drill Core /Head ID	Lithology	Weathering	Ore/ Waste	Verified U Spots[1]	Verified As Spots	U Spatial Overlap						As Spatial Overlap	
							Fe	As	Ca	Cu	Ti	Th	Fe	Ca
Kinetic Test Sample (FB-GO, Col 5)	Composite	Gneiss	Oxide	Waste	X	X	✓	✓	✓	✓	✓	✓	✓	-
High U Drill Core	KAM144308	Gneiss	Oxide	Waste	X^2	X	✓	-	✓	✓	-	✓	✓	-
Kinetic Test Sample (FB-GT, HC3, Col 6)	Composite	Gneiss	Transition	Waste	-	X	-	-	-	-	-	-	✓	-
High U Drill Core	KAM091516	Gneiss	Transition	Waste	X^2	X	✓	-	✓	✓	✓	-	✓	-
Kinetic Test Sample (FB-GS, HC4)	Composite	Gneiss	Fresh	Waste	X	X	✓	-	-	✓	✓	-	✓	-
High U Drill Core	KAM078808	Gneiss	Fresh	Waste	X^2	X	✓	-	-	✓	-	-	✓	-
Kinetic Test Sample (FB-SO, Col 3)	Composite	Schist	Oxide	Waste	-	X	-	-	-	-	-	-	✓	-
High U Drill Core	KAM029385	Schist	Oxide	Waste	-	X	-	-	-	-	-	-	✓	-
Kinetic Test Sample (FB-ST, HC1, Col 4)	Composite	Schist	Transition	Waste	-	X	-	-	-	-	-	-	✓	-
High U Drill Core	KAM079346	Schist	Transition	Waste	X	X	✓	-	✓	-	-	-	✓	-
Kinetic Test Sample (FB-SS, HC2)	Composite	Schist	Fresh	Waste	-	X	-	-	-	-	-	-	✓	-
High U Drill Core	KAM047252	Schist	Fresh	Waste	X^2	X	✓	✓	✓	-	-	-	✓	-
Met Head Sample	72146B	Gneiss	Transition	Ore	X	X	-	-	-	-	-	-	✓	-
Met Head Sample	50% 72144B 50% 72145B	Gneiss	Oxide	Ore	-	X	-	-	-	-	-	-	✓	-
Met Head Sample	72139B	Granite	Oxide	Ore	-	X	-	-	-	-	-	-	✓	-
Met Head Sample	72140B	Granite	Transition	Ore	-	X	-	-	-	-	-	-	✓	-
Met Head Sample	50% 72138B 50% 72137B	Schist	Oxide	Ore	-	X	-	-	-	-	-	-	✓	-
Met Head Sample	50% 72135B 50% 72136B	Schist	Transition	Ore	-	X	-	-	-	-	-	-	✓	✓

Notes: [1] Single spot indicated by X, two spots indicated by X^2.

Table 4-6:
Relative Abundance of As Species Estimated from the Linear Combination Fits of XANES Data

Sample Description	Drill Core /Head ID	Lithology	Weathering Facies	Ore/ Waste	As(V)	As(-I)	As(III)
					%	%	%
Met Head Sample	72144B	Gneiss	Oxide	Ore	100	-	-
High U Drill Core Sample	KAM144308	Gneiss	Oxide	Waste	100	-	-
Kinetic Test Sample (GS)	Composite	Gneiss	Fresh	Waste	59	19	22
High U Drill Core Sample	KAM078808	Gneiss	Fresh	Waste	20	61	20
Met Head Sample	72139B*	Granite	Oxide	Ore	100	-	-
High U Drill Core Sample	KAM029385	Schist	Oxide	Waste	100	-	-
Met Head Sample	72135B	Schist	Oxide	Ore	100	-	-
Met Head Sample	72137B	Schist	Transition	Ore	91	9.3	-
Met Head Sample	72146B	Gneiss	Transition	Ore	95	5.7	-
Met Head Sample	72140B	Granite	Transition	Ore	100	-	-

Table 4-7:
Relative Abundance of U Species Estimated from the Linear Combination Fits of XANES Data

Sample Description	Sample ID	Lithology	Weathering Facies	Ore/ Waste	U(IV)	U(VI)
					%	%
High U Drill Core Sample	KAM144308	Gneiss	Oxide	Waste	0	100
High U Drill Core Sample	KAM091516	Gneiss	Transition	Waste	83	17
High U Drill Core Sample	KAM078808	Gneiss	Fresh	Waste	73	27
Kinetic Test Sample (GS)	Composite	Gneiss	Fresh	Waste	33	67
High U Drill Core Sample	KAM029385	Schist	Oxide	Waste	11	89
High U Drill Core Sample	KAM079346	Schist	Transition	Waste	53	47
SS Waste	KAM047252	Schist	Fresh	Waste	72	28
Met Head Sample	72146B	Gneiss	Transition	Ore	51	49

4.1.3 Acid Base Accounting

This section discusses the ABA results for the Project waste rock lithologies. Nearly 350 waste rock samples were submitted for ABA testwork. The statistical distributions for the major waste rock lithologies (gneiss, schist and granite) are presented by weathering facies in Table 4-8 and Table 4-9, respectively. The complete set of ABA results and data for the minor waste rock lithologies are provided in Appendix C.1-1.

4.1.3.1 Rinse and Paste pH

Paste and rinse pH values provide information on the pH of a rock type immediately after excavation. Paste pH is the standard test conducted as part of most ABA testwork, however, it often produces an unreliably high estimate of pH. This is because the sample is pulverized to 100 µm size or smaller to produce a paste, resulting in an extremely high number of new surfaces and the exposure (and abrasion) of minerals not previously subjected to weathering. Rinse pH provides a more representative indication of the present drainage pH of a sample as it is conducted on a sample that is crushed to <2 mm (i.e., grain size of sand). Figure 4-1 shows paste pH against rinse pH with a 1:1 line superimposed, illustrating lower rinse pH values compared to paste pH.

Rinse pH for the two dominant lithologies (gneiss and schist) are circum-neutral to alkaline ($6.6 \leq pH \leq 9.9$, weather facies medians ranging from 7.2 - 8.8) (Table 4-8 and Table 4-9). The granite samples show slightly lower pH values ($6.0 \leq pH \leq 9.2$) (Table 4-10). In general, rinse pH decreases with increased weathering, whereby the oxide facies samples show the lowest pH values and the fresh facies samples show the highest pH values. However, rinse pHs even for the most weathered samples (oxide) typically remain above pH 7. Overall, the rinse pH values demonstrate that the in-situ pH of the waste rock types at the Project site are circum-neutral to alkaline.

Table 4-8:
Statistical Distribution of ABA Results by Weathering Facies for Gneiss Waste Rock

Parameter	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	T-C NP*	CaNP	Sobek NP	Siderite NP	T-C NNP*	Sobek NNP	NPR	NPR	NPR
Unit	s.u.	s.u.	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	T-C NP*/ T-AP	CaNP/ T-AP	SobekNP/ T-AP
Gneiss (Oxide)														
n	21	34	34	22	22	34	22	18	18	34	18	34	22	18
Min	6.6	6.4	*<0.01*	0.005	*<0.005*	*<0.8*	*<4.5*	3.0	4.0	0.5	2.7	2.5	7.2	8.0
25th PCTL	7.2	7.3	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	4.3	5.0	1.2	4.0	5.0	15	13
Median	7.3	7.7	0.01	0.01	0.01	3.9	4.5	6.5	7.5	3.6	6.2	9.1	15	20
75th PCTL	7.5	8.4	0.01	0.01	0.01	7.8	15	17	18	7.5	15	18	18	28
Max	8.7	9.3	0.10	0.10	0.02	40	36	25	25	38	25	78	76	83
Gneiss (Upper Transition)														
n	16	25	26	17	17	26	17	10	10	26	10	26	17	10
Min	7.1	6.6	*<0.01*	0.005	*<0.01*	0.8	2.3	2.0	3.0	-27.0	1.7	0.1	0.2	1.4
25th PCTL	7.3	7.2	*<0.01*	*<0.01*	*<0.01*	1.0	*<4.5*	10.0	5.3	0.5	6.9	2.6	14	11
Median	7.5	7.5	0.01	0.01	0.01	1.9	*<4.5*	28	25	1.2	23	5.1	15	24
75th PCTL	7.7	7.9	0.01	0.03	0.01	18	25	33	31	18	30	23	25	63
Max	9.2	9.4	0.94	0.90	0.02	50	48	52	53	49	52	159	153	166
Gneiss (Lower Transition)														
n	44	79	79	44	44	79	44	13	13	79	13	79	44	13
Min	6.8	6.8	*<0.01*	0.005	*<0.01*	*<0.8*	*<4.5*	4.0	5.0	-0.2	3.7	0.8	6.2	5.7
25th PCTL	7.9	8.1	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	13	15	1.2	13	5.0	15	20
Median	8.8	8.6	0.01	0.01	0.01	3.9	8.0	20	20	3.6	19	7.8	15	32
75th PCTL	9.2	9.1	0.02	0.01	0.01	19	35	48	50	17	40	23	39	61
Max	9.8	9.7	0.30	0.25	0.03	86	91	127	121	85	125	173	159	100
Gneiss (Fresh)														
n	34	49	49	34	34	49	34	10	10	49	10	49	34	10
Min	7.2	7.6	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	6.0	6.0	0.5	5.7	1.1	1.1	5.5
25th PCTL	8.6	8.7	*<0.01*	*<0.01*	*<0.01*	3.1	*<4.5*	9.0	10	1.3	8.7	5.2	15	21
Median	9.0	9.0	0.01	0.01	0.01	13	8.0	18	20	11	16	17	15	26
75th PCTL	9.5	9.3	0.04	0.04	0.01	32	35	38	39	31	34	35	27	41
Max	9.9	9.8	0.43	0.16	0.03	98	98	128	140	94	127	316	311	390
Gneiss (All Weathering Facies)														
n	115	187	188	117	117	188	117	51	51	188	51	188	117	51
Min	6.6	6.4	*<0.01*	*<0.01*	*<0.01*	*<0.8*	2.3	2.0	3.0	-27	1.7	0.08	0.15	1.4
25th PCTL	7.4	7.7	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	6.0	6.5	1.2	5.7	5.0	14	13
Median	8.4	8.5	0.01	0.01	0.01	4.7	4.5	15	15	4.4	13	10	15	27
75th PCTL	9.2	9.1	0.02	0.02	0.01	21	23	29	26	20	26	26	29	42
Max	9.9	9.8	0.94	0.90	0.03	98	98	128	140	94	127	303	298	390

Notes: Values in grey italics are below the analytical detection limit; *n* = number of analyses included in statistical distribution; * adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.2.3 for discussion); NNP = net neutralization potential, derived by subtracting AP from NP.

Table 4-9:
Statistical Distribution of ABA Results by Weathering Facies for Schist Waste Rock

Parameter	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	T-C NP*	CaNP	Sobek NP	Siderite NP	T-C NNP*	Sobek NNP	NPR	NPR	NPR
Unit	s.u.	s.u.	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	T-C NP*/ T-AP	CaNP/ T-AP	SobekNP/ T-AP
Schist (Oxide)														
n	13	15	15	13	13	15	13	12	12	15	12	15	13	12
Min	6.8	6.6	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	4.0	4.0	1.3	3.7	4.6	4.0	3.4
25th PCTL	7.0	7.4	0.01	*<0.01*	*<0.01*	7.8	4.5	18	21	6.8	17	9.6	14	15
Median	7.2	7.6	0.01	0.01	*<0.01*	63	116	127	137	49	121	20	19	43
75th PCTL	7.3	8.0	0.07	0.05	0.01	155	157	161	167	144	161	155	236	258
Max	7.8	8.5	0.44	0.34	0.06	250	268	268	271	250	268	800	858	858
Schist (Upper Transition)														
n	11	14	14	11	11	14	11	6	6	14	6	14	11	6
Min	7.2	7.7	*<0.01*	*<0.01*	*<0.005*	2.3	*<4.5*	6.0	7.0	2.0	5.7	5.4	5.7	6.6
25th PCTL	7.7	8.1	0.02	0.01	*<0.01*	76	72	94	97	75	92	18	16	13
Median	8.2	8.2	0.04	0.02	*<0.01*	107	93	118	119	103	114	51	37	17
75th PCTL	8.3	8.4	0.08	0.14	0.01	168	155	188	182	160	167	137	127	115
Max	8.5	8.6	1.02	0.97	0.03	209	223	209	202	193	189	539	393	432
Schist (Lower Transition)														
n	15	19	19	15	15	19	15	7	7	19	7	19	15	7
Min	7.2	7.5	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	7.0	7.0	0.5	6.7	2.6	8.3	13
25th PCTL	7.3	8.1	0.01	*<0.01*	*<0.01*	34	30	53	74	31	49	11	15	18
Median	8.1	8.3	0.03	0.01	0.01	61	57	60	96	61	55	32	33	26
75th PCTL	8.7	8.5	0.11	0.06	0.01	84	78	105	110	77	104	194	131	50
Max	9.4	9.3	0.32	0.13	0.02	230	216	115	123	229	112	350	230	320
Schist (Fresh)														
n	19	31	31	19	19	31	19	8	8	31	8	31	19	8
Min	7.3	8.1	*<0.01*	*<0.01*	*<0.01*	*<0.8*	*<4.5*	11	12	0.5	11	2.3	2.2	3.3
25th PCTL	8.3	8.4	0.01	*<0.01*	*<0.01*	33	35	86	87	33	63	9.4	12	5.6
Median	8.6	8.6	0.06	0.03	0.01	57	59	108	107	51	89	23	24	42
75th PCTL	8.9	8.9	0.16	0.17	0.01	87	91	112	117	85	110	93	100	75
Max	9.3	9.3	0.97	0.80	0.03	376	141	147	149	375	147	345	356	470
Schist (All Weathering Facies)														
n	58	79	79	58	58	79	58	33	33	79	33	79	58	33
Min	6.8	6.6	*<0.01*	*<0.01*	*<0.01*	*<0.8*	*<4.5*	4.0	4.0	0.46	3.7	2.3	2.2	3.3
25th PCTL	7.3	8.1	*<0.01*	*<0.01*	*<0.01*	33	32	47	51	31	46	11	14	13
Median	8.2	8.3	0.03	0.01	*<0.01*	63	65	108	106	59.4	93	28	25	26
75th PCTL	8.6	8.6	0.14	0.10	0.01	110	121	135	144	108	126	131	131	147
Max	9.4	9.3	1.0	0.97	0.06	376	268	268	271	375	268	800	858	858

Notes: Values in grey italics are below the analytical detection limit; *n* = number of analyses included in statistical distribution; * adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.2.3 for discussion); NNP = net neutralization potential, derived by subtracting AP from NP.

Table 4-10:
Statistical Distribution of ABA Results by Weathering Facies for Granite Waste Rock

Parameter	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	T-C NP*	CaNP	Sobek NP	SideriteNP	T-C NNP*	Sobek NNP	NPR	NPR	NPR
Unit	s.u.	s.u.	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	T-C NP* /T-AP	CaNP /T-AP	SobekNP /T-AP
Granite (oxide)														
n	6	6	6	6	6	6	6	6	3	6	6	6	6	6
Min	6.0	5.9	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	1.0	3.0	0.5	0.7	2.5	14	3.2
25th PCTL	6.2	6.0	*<0.01*	*<0.01*	0.01	1.0	*<4.5*	2.0	3.5	0.7	1.7	3.1	14	6.4
Median	6.4	6.4	0.01	0.01	0.01	1.9	*<4.5*	2.0	4.0	1.6	1.7	6.2	14	6.4
75th PCTL	6.6	6.8	0.01	0.01	0.02	2.9	*<4.5*	2.0	4.0	2.6	1.7	9.6	15	7
Max	7.5	7.8	0.01	0.01	0.02	3.1	*<4.5*	4.0	4.0	2.8	3.7	10	15	13
Granite (Upper Transition)														
n	11	17	17	17	17	11	11	17	7	17	17	11	11	17
Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	0.8	2.3	1.0	2.0	-3.8	-2.8	0.4	1.1	0.3
25th PCTL	6.9	6.5	*<0.01*	*<0.01*	*<0.01*	1.2	*<4.5*	1.0	3.0	-0.3	0.7	2.5	11	3.2
Median	7.0	6.9	0.01	*<0.01*	0.01	1.6	*<4.5*	2.0	4.0	0.5	1.7	5.2	14	6.7
75th PCTL	7.3	7.2	0.01	0.01	0.01	2.3	*<4.5*	3.0	4.5	1.3	2.7	7.4	15	9.6
Max	8.9	8.8	0.13	0.11	0.05	5.4	6.8	6.0	6.0	5.1	5.7	17	22	20
Granite (Lower Transition)														
n	12	14	14	14	14	12	12	14	7	14	14	12	12	14
Min	6.3	5.9	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	1.0	4.0	-0.3	0.4	1.5	2.9	1.3
25th PCTL	6.8	6.7	*<0.01*	*<0.01*	0.01	2.3	*<4.5*	2.3	5.0	0.9	1.9	4.9	14	7.4
Median	8.0	7.8	0.01	*<0.01*	0.01	2.7	*<4.5*	3.5	6.0	2.0	3.2	7.8	15	11
75th PCTL	8.7	8.6	0.01	0.01	0.01	4.5	5.1	5.0	6.5	3.4	4.7	15	17	17
Max	9.0	9.0	0.05	0.01	0.02	8.5	9.1	7.0	7.0	8.2	6.7	28	30	23
Granite (Fresh)														
n	13	20	20	20	20	13	13	20	6	20	20	13	13	20
Min	6.8	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.8*	*<4.5*	2.0	3.0	-4.4	1.6	0.5	2.9	1.4
25th PCTL	8.0	7.6	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	3.0	4.3	-0.7	2.1	2.5	14	4.0
Median	8.5	8.5	0.01	0.01	0.01	3.1	4.5	4.0	5.0	0.5	3.1	10	15	8.2
75th PCTL	9.0	8.8	0.03	0.01	0.01	5.4	4.5	5.3	5.8	3.0	4.7	18	15	17
Max	9.2	9.3	0.14	0.14	0.02	20	18	18	19	20	18	65	58	58
Granite (All Weathering Facies)														
n	42	57	57	38	57	42	42	57	23	42	57	42	42	57
Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	0.8	2.3	1.0	2.0	-2	-2.8	0.41	1.1	0.3
25th PCTL	6.8	6.7	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	2.0	4.0	0.5	1.7	2.5	14	3.2
Median	7.4	7.3	0.01	0.01	0.01	2.3	*<4.5*	3.0	5.0	2.0	2.7	7.4	14	6.7
75th PCTL	8.7	8.6	0.01	0.01	0.01	3.7	4.5	5.0	6.0	2.9	3.7	10	15	13
Max	9.2	9.3	0.14	0.14	0.05	20	18	18	19	20	18	65	58	58

Notes: Values in grey italics are below the analytical detection limit; *n* = number of analyses included in statistical distribution; * adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.2.3 for discussion); NNP = net neutralization potential, derived by subtracting AP from NP.

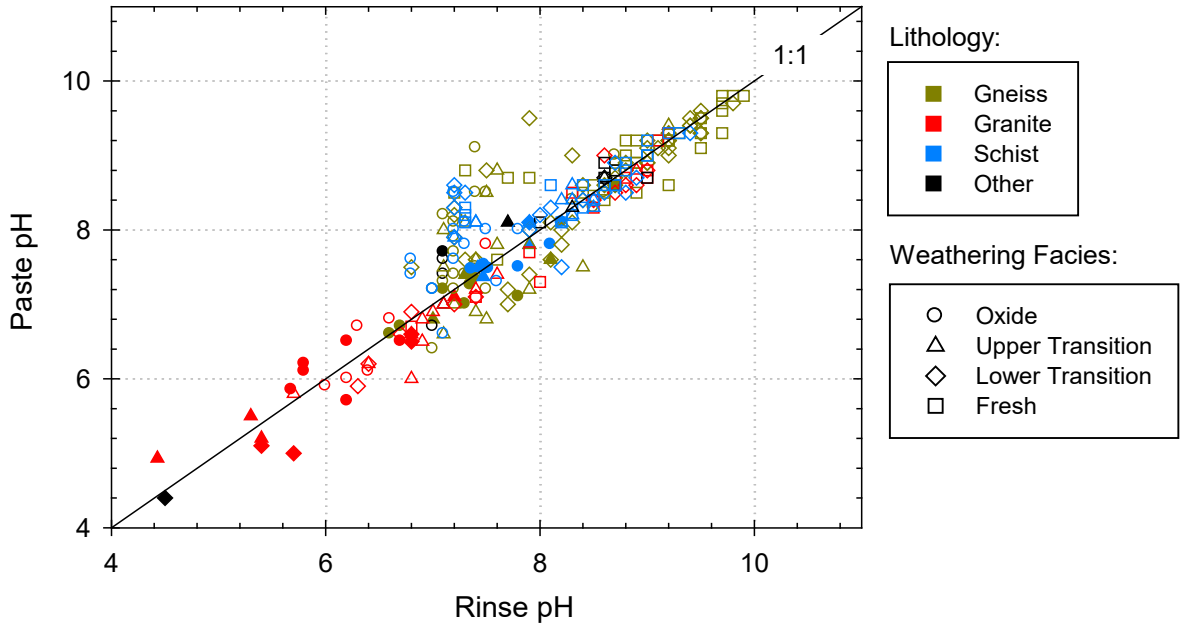


Figure 4-1: Rinse pH vs paste pH for Coffee Gold Mine waste rock and ore samples as presented by lithology and weathering facies. Waste rock samples are represented by hollow samples and ore samples are represented by filled symbols

4.1.3.2 Acid Potential

The acid generating potential (AP) of a rock sample is estimated from the sulphur (S) content. The amount of acidity generated per mass of S depends in large part on the mineralogy and solid phase speciation of sulphur. That is, different sulphide and sulphate minerals produce different amounts of acidity when oxidized. Mineralogical investigations (Section 4.1.2) identified pyrite as the dominant S-bearing mineral. The AP of pyrite is calculated based on the stoichiometry of pyrite oxidation and $Fe(OH)_3$ precipitation:

$$2FeS_2 + 7.5O_2 + 7H_2O = 4SO_4^{2-} + 2Fe(OH)_3 + 8H^+$$

Based on this equation, two moles of H^+ are produced per mole of S. Other S-bearing minerals identified by mineralogical determination include pyrrhotite, galena, natroalunite, gypsum and hydronium-jarosite. Of these minerals, pyrrhotite, natroalunite and hydronium-jarosite have the potential to generate acidity. With the exception of pyrrhotite, the acidity potential per mole of S is equal or less than that of pyrite. Due to the similar acidity potential and scarcity of other S bearing minerals, the above stoichiometry of pyrite oxidation is assumed to be appropriate for relating total-S to AP.

AP from ABA

Figure 4-2 shows the relationship between sulphide-S and total-S, with samples on the 1:1 line demonstrating perfect agreement. Overall, strong agreement is observed between the two measures of S, with total-S values being generally slightly higher than those for sulphide-S. This indicates that the majority of S in host lithology types is present in sulphide minerals, which is consistent with the mineralogical assessment which found the dominant sulphur mineral is pyrite. Given the above considerations, total-S was used to calculate AP. This assumption is considered to represent a conservative means to assess the acid generating potential of waste rock for the Project. Note that of the 252 waste rock samples measured for sulphide-S, 148 show total-S and sulphide-S concentrations at or below the detection limit of 0.01 wt.%; therefore, symbols for these data points overlap in Figure 4-2.

Sulphur species abundances are presented by weathering facies for gneiss, schist and granite waste rock in Table 4-8, Table 4-9 and Table 4-10. In general, total and sulphide-S concentrations decrease with increased weathering for each major lithologic unit, and relative concentrations of total and sulphide-S are highest in the schist samples and lowest in the granite samples. Specifically, total and sulphide-S concentrations are at or below the detection limit in a majority of the samples from the most weathered (oxide) facies, with the median value for the schist, 75th percentile value for the gneiss and all of the granite waste rock samples at or below 0.01 wt.% (Table 4-8, Table 4-9 and Table 4-10). In the schist samples, there is a distinct correlation between total-S content and weathering facies, with 75th percentile concentrations of 0.07, 0.08, 0.11, and 0.16 wt.% for the oxide, upper transition, lower transition and fresh facies, respectively. Sulphate-S concentrations are low in all samples (<0.06 wt.%), with the majority of samples at or near the detection limit (0.01 wt.%).

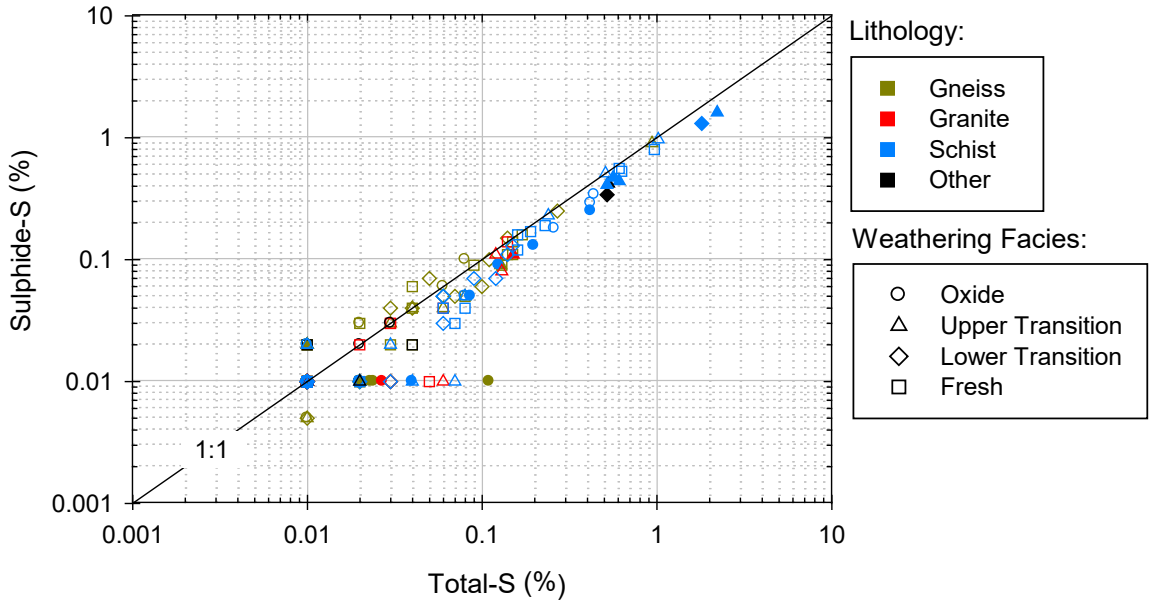


Figure 4-2: Total-S versus sulphide-S for waste rock and ore samples as presented by lithology and weathering facies. Ore samples are represented by filled symbols, waste rock samples are represented by hollow symbols.

AP Surrogates

A considerably larger sample population is available from the exploration assay database which comprises 26,549 analyses by aqua regia digestion and ICP-OES analysis (Section 3.2.4). This database included measurements of S, and has the potential to vastly expand statistics on sulphur distribution throughout the deposit. However, aqua regia often provide an incomplete digestion of sulphur minerals, with Leco furnace being the preferred method to obtain more reliable sulphur measurements. In order to determine the reliability of sulphur measured by an aqua regia digestion, results for the Leco furnace and aqua regia digestions conducted as part of the ABA sampling program are compared in Figure 4-3.

Comparison of total-S results from the ABA database shows that the majority of the samples plot along the 1:1 line (Figure 4-3), indicating near perfect agreement. Samples near or below the detection limit (0.01 wt.%) show greater variation, which in part can be attributed to the increased uncertainty near the limits of the analytical instrument. However, where there is deviation from the 1:1 line at higher concentrations, total-S measurements from aqua regia digestion are generally higher than those measured by LECO furnace. This exercise demonstrates that the application of total-S values from the exploration database as a surrogate to derive AP is a conservative means to evaluate ARD potential of mine rock. The statistical distribution of surrogate AP values (presented as total-S) are presented in Table 4-11.

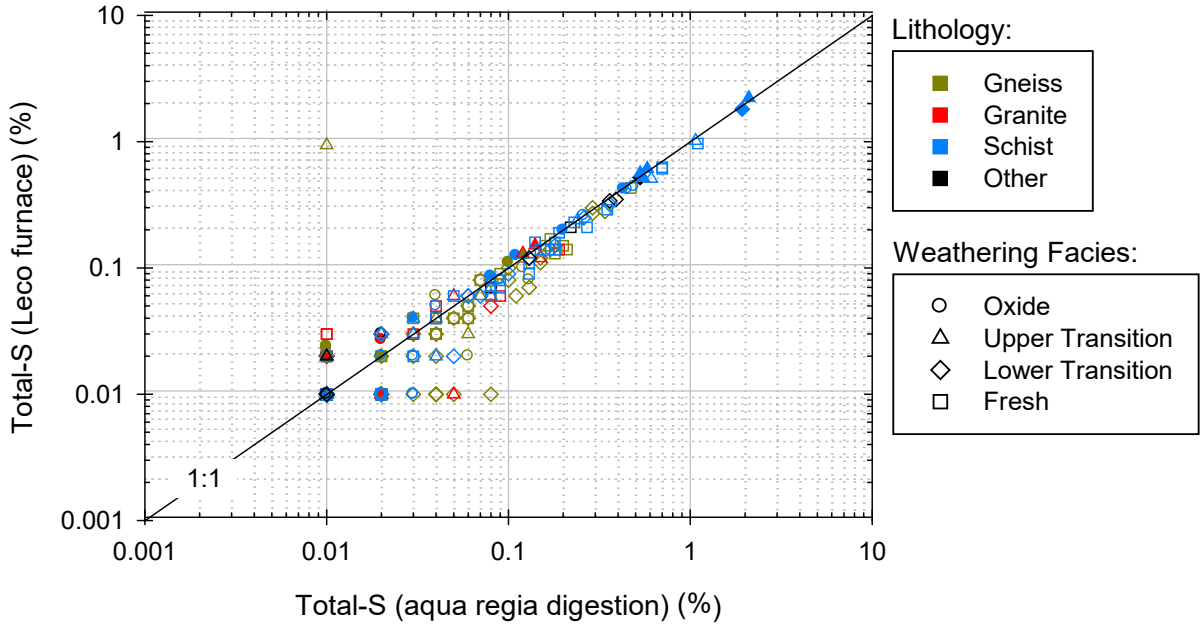


Figure 4-3: Total-S by LECO furnace vs total-S by aqua regia digestion for Coffee Gold Mine waste rock samples as presented by lithology and weathering facies. Ore samples are represented by filled symbols

Table 4-11:
Statistical Distribution of Sulphur (wt.%) Measured in Assay Database Used for Surrogate Acid Potential Values for Waste Rock Lithologies

Lithology	Statistic	Oxide	Upper Transition	Lower Transition	Fresh	All Weathering Facies
Gneiss	*n*	3218	4367	5647	1073	14305
	n <DL	1861	1951	1871	410	6093
	Max	1.3	0.67	2.2	1.0	2.2
	95th PCTL	0.07	0.12	0.17	0.19	0.14
	75th PCTL	0.01	0.02	0.05	0.05	0.03
	Median	*<0.01*	0.01	0.01	0.01	0.01
	25th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Schist	*n*	2355	2175	3330	861	8721
	n <DL	443	229	748	96	1516
	Max	1.2	2.6	2.3	3.4	3.4
	95th PCTL	0.22	0.64	0.4	0.6	0.45
	75th PCTL	0.05	0.15	0.11	0.31	0.12
	Median	0.02	0.04	0.02	0.11	0.03
	25th PCTL	0.01	0.02	0.01	0.02	0.01
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Granite	*n*	578	140	235	24	977
	n <DL	406	120	144	13	683
	Max	0.46	0.31	0.22	0.43	0.46
	95th PCTL	0.022	0.021	0.02	0.15	0.03
	75th PCTL	0.01	*<0.01*	0.01	0.05	0.01
	Median	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	25th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Other	*n*	1411	585	710	241	2947
	n <DL	388	133	187	29	737
	Max	1.91	1.6	1.3	4.1	4.1
	95th PCTL	0.38	0.38	0.27	1.9	0.43
	75th PCTL	0.06	0.09	0.03	0.35	0.07
	Median	0.02	0.03	0.01	0.04	0.02
	25th PCTL	*<0.01*	0.01	*<0.01*	0.01	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

Notes: Values in grey italics are below the analytical detection limit. *n* is the number of samples included in the statistical distribution, *n* < DL is the number of samples below the detection limit.

4.1.3.3 Neutralization Potential

A variety of analytical methods are available to measure NP, including bulk NP (Sobek NP and siderite NP methods) and carbonate mineral specific NP (NP derived from total carbon and inorganic carbon content) (Section 3.2.2). Each NP method contributes to the understanding of the NP of a material; however, no one method provides an accurate measurement of the effective 'field' neutralization capacity (i.e., the ability of a potential NP source to maintain a neutral drainage chemistry). It is therefore important to understand the mineralogy of the phases contributing to the overall NP of the sample. The solubility of fast dissolving carbonate allows for the rapid neutralization of acid generated via sulphide mineral oxidation. Conversely, non-carbonate minerals (*e.g.,* silicates) are a less reliable NP source since the rate of dissolution for these minerals is considerably slower and requires that the generation of acidity also be slow in order for these minerals to provide effective neutralization potential.

The Sobek NP procedure involves soaking the sample in strong acid (heated) to ensure effective dissolution, and then back titrating to determine the remaining un-neutralized acidity. This method is generally thought to underestimate the NP of slowly dissolving aluminosilicate minerals since it is carried out for a limited duration. Further, this method can overestimate NP from other minerals which would not be predicted to dissolve under neutral-pH weathering (i.e., due to the aggressive extraction technique) or would not contribute to the effective NP (*e.g.*, presence of Fe and/or Mn bearing carbonate minerals such as ankerite and siderite).

Siderite NP is similar to the Sobek method but attempts to correct for Fe and Mn bearing carbonate minerals that do not contribute to the overall effective NP of a sample by adding a chemical oxidant (H_2O_2) to ensure that any reduced species (Fe^{2+} and Mn^{2+}) are oxidized during the analysis. In contrast, Carbonate NP is based on the measurement of inorganic C in a sample and assumes that all carbonate minerals contributing to CaNP react like calcite. Therefore, similar to the Sobek NP method, the CaNP procedure can overestimate the effective NP of a material if significant Fe or Mn-carbonate minerals are present.

A comparison of the bulk NPs and CaNP can provide information about the NP sources and capacity of the carbonate minerals. If Sobek NP is higher than CaNP, for example, it can be inferred there is measurable neutralization available from non-carbonate minerals. Conversely, if CaNP and Sobek NP are higher than siderite NP, then a measurable portion of the inorganic C is not generating alkalinity or is unreactive and indicates either the presence of Fe or Mn-bearing carbonates (Price, 1997).

NP from ABA

Figure 4-4 plots siderite NP and CaNP as a function of Sobek NP for waste rock and ore samples from each weathering facies of each dominant lithologic unit. The results demonstrate that Sobek NP and siderite NP are generally very similar. The similarity between these NP measurements shows, that although Fe and Mn oxides are present (Section 4.1.1), they are not prevalent enough to significantly affect NP measurements. Furthermore, siderite NP is often slightly higher than Sobek NP. This is an artifact of the analytical technique, caused by an additional boiling step in the siderite procedure to breakdown any residual peroxide. Hydrochloric acid is volatile and is lost during the boiling step thereby leaving less acidity to back titrate, resulting in higher NP. This results in siderite NP overestimating Sobek NP when little or no Mn or Fe carbonates are present. Variance between the two bulk NP measurements in the lower range of NP concentrations (less than approximately 10 kg $CaCO_3$/t), can also in part be attributed to analytical limitations near the detection limits. The bulk NP methods generally produce higher NP estimates compared to CaNP, indicating that non-carbonate minerals are contributing to the overall Sobek and siderite NP measurements. Based on the NP data presented in Figure 4-4, CaNP provide a conservative estimate of NP compared to Sobek or siderite measurements for waste rock and ore.

Overall, the schist waste rock samples exhibit the highest CaNP (range: <4.5 to 268 kg $CaCO_3$/t; median of 65 kg $CaCO_3$/t; Table 4-8) while the granite waste rock samples have the lowest CaNP (range: 2.3 to 18 kg $CaCO_3$/t; median of <4.5 kg $CaCO_3$/t; Table 4-9). The gneiss samples are also characterized by low CaNP, with concentrations ranging from 2.3 to 98 kg $CaCO_3$/t (median of 4.5 kg $CaCO_3$/t) (Table 4-10). Waste rock CaNP is generally inversely related to the degree of weathering within a given lithologic unit, with oxide facies samples showing the overall lowest CaNP values and samples from the fresh facies having the highest CaNP. Median CaNP values for granite waste rock samples are below the detection limit (<4.5 kg $CaCO_3$/t) for all weathering facies. Median CaNP values for the gneiss samples are also below the detection limit for the oxide and upper transition facies but are slightly higher for the lower transition and fresh facies (8 kg $CaCO_3$/t for both facies). CaNP values for the gneiss waste rock weathering facies increase with decreasing degree of weathering, with 75th percentile values of 15, 25 and 35 kg $CaCO_3$/t CaNP for the oxide, upper transition and lower transition and fresh facies, respectively. The opposite is true for the schist waste rock samples where median values for the oxide and upper transition facies samples have higher CaNP (116 and 93 kg $CaCO_3$/t) compared to the lower transition and fresh facies (57 and 59 kg $CaCO_3$/t).

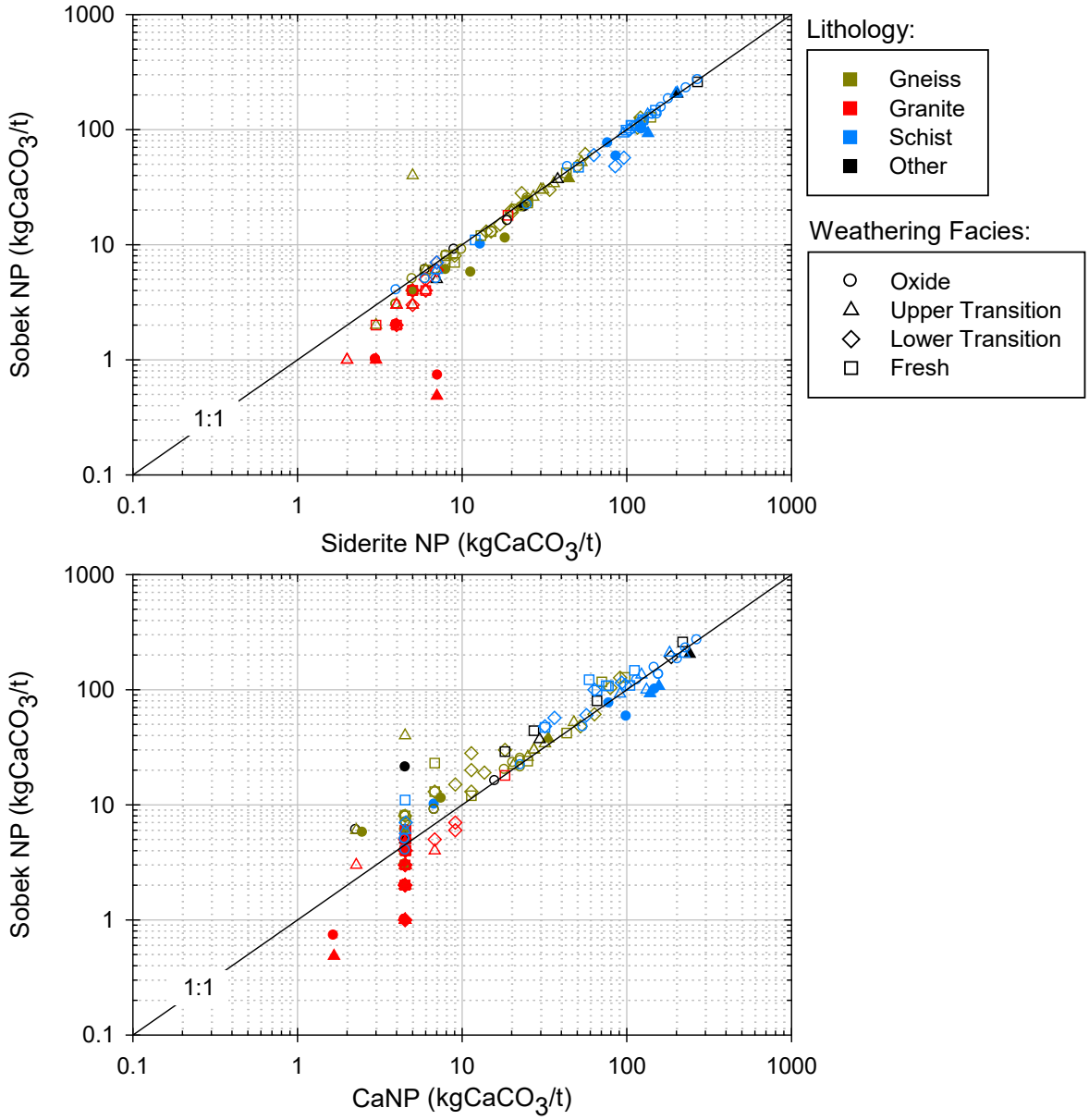


Figure 4-4: Relationship between Sobek NP and siderite NP (top) and Sobek NP and CaNP (bottom) waste rock samples as presented by lithology and weathering facies. Ore samples are represented by filled symbols.

The use of total-C to derive NP in place of CaNP (derived from TIC) was assessed given the considerably lower detection limit (0.01 wt.%) for total-C measurements and the more rapid and cost effective analytical method for total-C (LECO furnace). Total-C and CaNP show a strong correlation ($R^2 = 0.99$), illustrating a high degree of predictability for CaNP based on total-C measurements (Figure 4-5). This relationship can be expressed by the following equation:

$$\text{CaNP (kg } CaCO_3\text{/t)} = 77.6 \times \text{Total C (wt.\%)}$$

The minor variation between the CaNP and total-C values in Figure 4-5 is attributed to either a small amount of organic C present in the sample (present in situ or as a result of sample contamination) and/or from analytical differences between the total-C and TIC determinations.

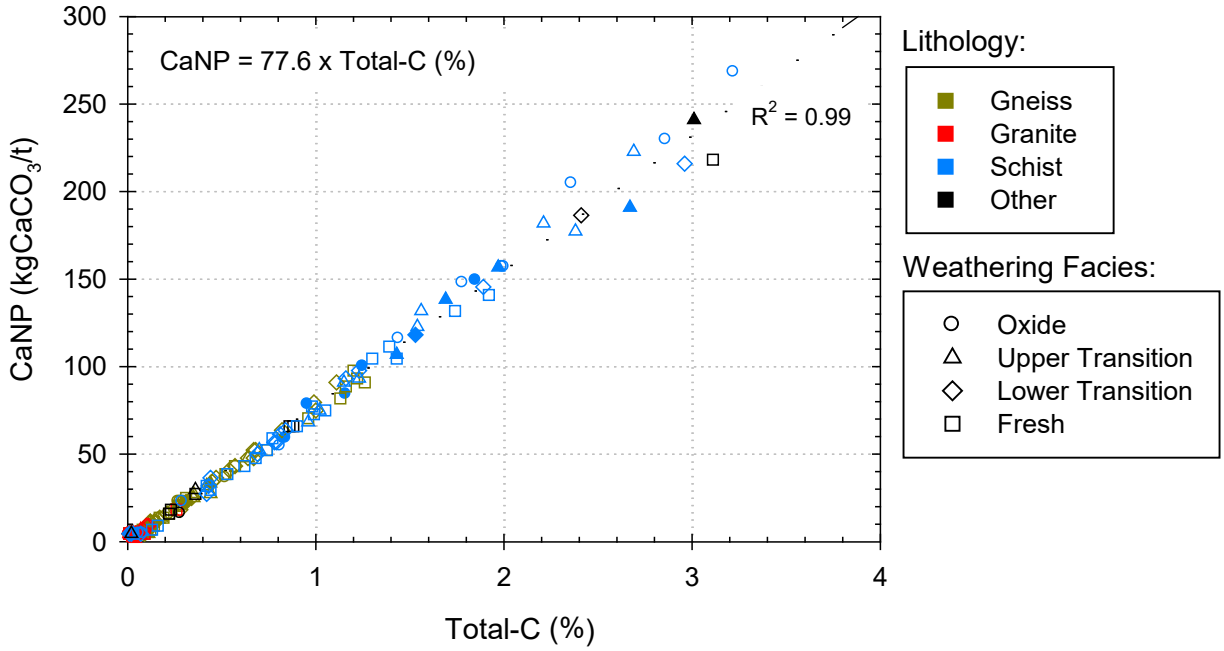


Figure 4-5: Total-C (Leco) plotted against CaNP for waste rock samples as presented by lithology and weathering facies. Ore samples are represented by filled symbols. Dotted line shows the linear regression as per the equation shown on the figure.

NP Surrogates

It is often the case that surrogates for NP measurements can be found in metal assay data. The potential for surrogate NPs were investigated in order to determine if the large exploration database can provide an indication of NP distribution throughout the deposit. This investigation found a relationship between Ca and Sobek NP. A comparison of Sobek NP (via ABA analysis) versus ICP Ca NP (as measured through solid phase Ca determination by aqua regia digestion) is presented in Figure 4-6. This estimate of surrogate NP assumes that all Ca is present in the form of $CaCO_3$. The majority of the samples plot just above the 1:1 line, indicating that Sobek NP is generally higher than NP derived from the Ca measurements. Accordingly, the application of Ca from aqua regia digestion as a surrogate to derive NP represents a conservative means to augment the ABA

data set for site rock NP determinations. Assuming that 100% of Ca resides in $CaCO_3$ results in the following forumla which relates Ca wt.% to NP.

$$NP = Ca \times 40.08^{-1} \times 1000$$

Where NP is in units of $kgCaCO_3/t$, Ca is in units of wt.% and 40.08 is the molar weight of Ca. As discussed in Section 3.2.4, a considerably larger sample population is available from the exploration assay database which comprises 26,549 calcium (Ca) analyses by aqua regia digestion. Utilization of this larger dataset allows for a more robust assessment of the ARD potential of waste rock and ore using Ca values to derive NP. The statistical distribution for surrogate NP values (calculated using Ca from the exploration database) are presented in Table 4-12.

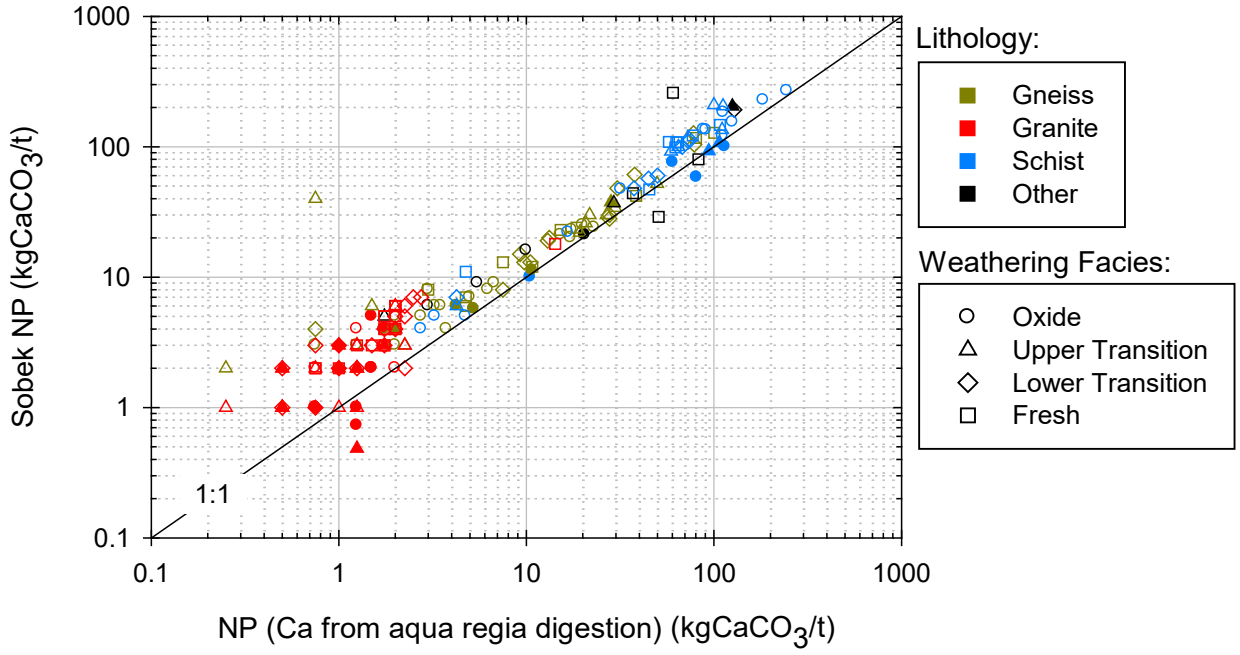


Figure 4-6: Sobek NP versus surrogate NP calculated using Ca from aqua regia digestion (ABA database) for static test samples. Waste rock samples are hollow symbols, ore samples are represented by filled symbols.

Table 4-12:
Statistical Distribution of Neutralization Potential (kg $CaCO_3$/t) Values Calculated from Ca Measured in Assay Database for Waste Rock Lithologies

Lithology	Statistic	Oxide	Upper Transition	Lower Transition	Fresh	All Weathering Facies
Gneiss	*n*	3218	4367	5647	1073	14305
	Max	195	245	280	167.8	280
	95th PCTL	57.3	60.8	75.8	78.1	70.5
	75th PCTL	7.5	19.3	34.5	35.3	25
	Median	1.8	6	17	18.3	9.5
	25th PCTL	1	1.8	6.5	9	2
	5th PCTL	0.5	0.8	1.5	3	0.5
	Min	*<0.3*	*<0.3*	0.3	0.8	*<0.3*
Schist	*n*	2355	2175	3330	861	8721
	Max	625	625	625	625	625
	95th PCTL	237.5	255	165	227.5	220
	75th PCTL	116	120.8	78.8	97	103
	Median	74.8	79.8	47	63	63.5
	25th PCTL	33.5	50.8	25.5	39.8	33.3
	5th PCTL	2.5	11.8	8.8	13.3	6.5
	Min	0.3	0.5	2	4.5	0.3
Granite	*n*	578	140	235	24	977
	Max	11.5	4.5	10.8	3	11.5
	95th PCTL	2.5	3	3	2.7	2.8
	75th PCTL	1.8	2.3	2.3	1.3	2
	Median	1.3	1.8	1.8	0.5	1.5
	25th PCTL	0.8	1.3	1.3	0.3	1
	5th PCTL	0.5	0.5	*<0.3*	*<0.3*	0.5
	Min	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*
Other	*n*	1411	585	710	241	2947
	Max	592.5	505	540	287.5	592.5
	95th PCTL	197.5	222.5	167.5	137.8	197.5
	75th PCTL	113.5	115.8	74.1	79	101.6
	Median	54.8	50.3	35.5	46.3	43.3
	25th PCTL	5.3	9	13	19.5	8.5
	5th PCTL	0.8	0.8	1.5	5	1
	Min	0.3	0.3	*<0.3*	*<0.3*	*<0.3*

Notes: Values in grey italics are below the analytical detection limit. *n* is the number of samples included in the statistical distribution, *n* < DL is the number of samples below the detection limit

4.1.3.4 Net Potential Ratio

The acid generating potential of mine rock will be defined by the ratio of NP to AP and a minimum sulphur content. The NP/AP ratio, or net potential ratio (NPR), used to define the acid generating potential of mine rock will vary depending on the type of NP estimate used in the calculation. Bulk NP measurements, such as the Sobek method, involve boiling a rock sample in acid and often releases NP that would not be effective at maintaining a neutral pH in a mine waste environment. Therefore, when Sobek NP is used to calculate NPR a criterion of 3 is used to define non-PAG rock. Conversely, carbonate minerals are generally effective at maintaining a neutral pH while present, and an NPR ratio of 2 is applied when carbonate mineral specific NP estimates are used to estimate NPR. For the purposes of PAG definition, AP will be defined by a total-S measurement for all material types.

In addition to this NPR criteria, samples require a minimum quantity of AP to be classified as acid generating. A total-S cutoff of 0.02 wt.% is used to define non-reactive samples. This is considered highly conservative given that this low concentration is below average continental abundance (0.04 wt.%) and much of the mine rock is at a highly weathered state. The classification criteria used to screen for ARD potential are as follows:

- Where the total-S content is <0.02 wt.% the sample is classified as non-reactive
- Where the total-S content is ≥0.02 wt.%, and the Sobek NP/AP ratio is greater than 3 or carbonate - NP/AP of greater than 2, the sample is classified as non-PAG.
- Where the total-S content is ≥0.02 wt.%, the Sobek NP/AP ratio between 1 and 3 or a carbonate-NP/AP of between 1 and 2, the sample is classified as having an uncertain acid generating potential.
- Where the total-S content is ≥0.02 wt.%, the Sobek NP/AP ratio or a carbonate-NP/AP is less than 1, the sample is classified as potentially acid generating.

For the purposes of this pre-mining geochemical assessment a variety of methods are used to estimate NP, AP and NPR. As such there is some variability in the classification scheme depending on the type of measurement being applied. During mine operations set of definitive criteria and set analyses will be used to classify mine waste as PAG or non-PAG. These criteria are described in the Mine Waste ML/ARD Management and Monitoring Plan.

Figure 4-7 presents Sobek NP, CaNP and T-C NP versus T-AP. The results show that all samples with total-S at or below the detection limit (T-AP ≤ 0.3 kg $CaCO_3$/t) are non-PAG. The plots also indicate that several granite waste rock and ore samples (generally from the upper transition facies) are either PAG or have an uncertain PAG potential when Sobek

NP is applied. When the most conservative NP is applied (T-C NP), a few granite and gneiss samples are indicated to be PAG or have an uncertain potential. With the exception of one upper transition ore sample, the schist waste rock and ore samples are indicated to be non-PAG.

The statistical distribution for NPR derived using the different NP values are presented by weathering facies for each lithology Table 4-8, Table 4-9 and Table 4-10. Consistent with the distribution of NP for the waste rock lithologies, the schist samples have the overall highest NPR (T-C NP*) values (median NPR = 28) and the granite samples have the lowest (median NPR = 7.5). Within a given lithology, the lowest NPR distribution is generally indicated for the oxide facies compared to relatively higher NPR values for fresh facies. The considerably higher NP of the schist waste rock samples is further supported by the high net neutralization potential (NNP) values, which is the amount of excess NP relative to AP (*i.e.,* NNP = NP – AP). To provide context, a NNP of 0 is equivalent to a NPR of 1. Median values for T-C NNP* for the schist, gneiss and granite waste rock samples are 59.4, 4.4 and 2.0 kg $CaCO_3$/t, respectively (Table 4-9).

The statistical distributions presented in Table 4-8, Table 4-9 and Table 4-10 do not take into account the samples with negligible AP. Table 4-13 provides a summary of the relative proportions of PAG, uncertain, neutral and non-PAG waste rock samples by lithologic units according to the different NP methods and criteria described above. Also presented in Table 4-13 are the relative proportions of PAG and non-PAG waste rock samples according to NPR values derived using surrogate NP and AP values calculated using Ca and S from the exploration database. The results demonstrate that the distribution of PAG and non-PAG waste rock is generally consistent, with all schist and other minor lithology samples indicated to be non-PAG and 1 to 4% of gneiss samples indicated to have some PAG potential. A higher proportion of the granite samples are classified as PAG or uncertain (10% using surrogate NP and AP), however, a majority of this rock unit is classified as being non-PAG or as neutral independent of NPR criteria applied. Overall, the results of the ABA analyses indicate that ARD is not expected to be an issue for the Coffee Creek waste rock.

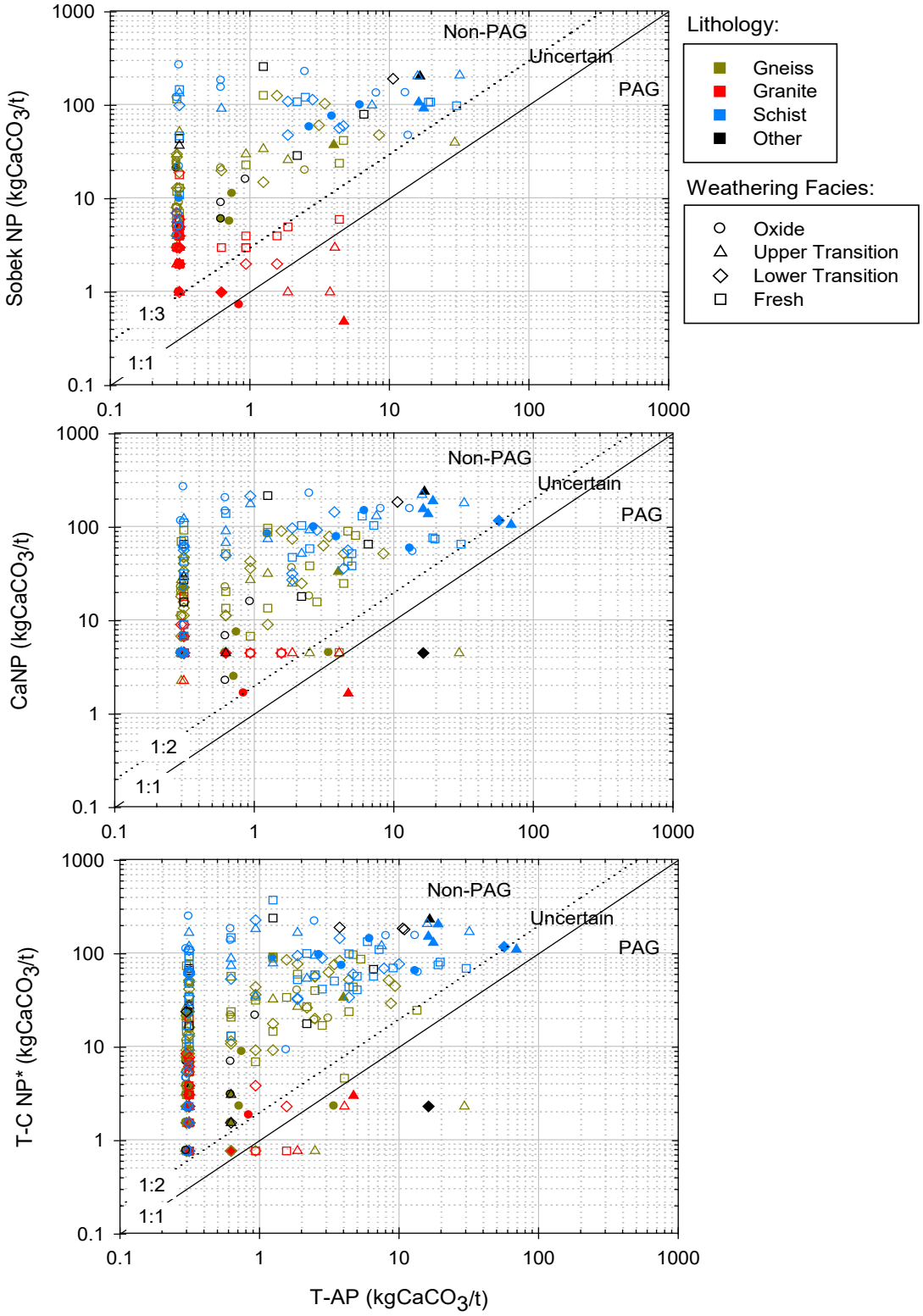


Figure 4-7: Sobek NP (top), CaNP (middle) and T-C NP* (bottom) *vs* T-AP for Coffee Gold Mine waste rock and ore as presented by lithology and weathering facies. Ore samples are represented by filled symbols while waste rock is shown as hollow symbols.

Table 4-13:
ARD Distributions for Coffee Gold Mine Waste Rock Lithologies based on Various Estimates of Neutralization Potential

Lithology	ARD Designation	NPR (T-C NP*/AP)		NPR (CaNP/T-AP)		NPR (Sobek NP/T-AP)		NPR (surrogate NP/AP)	
		n	%	*n*	%	*n*	%	*n*	%
GNEISS	*Total No. Samples*	*188*		*117*		*51*		*14305*	
	Non-reactive	135	72%	82	70%	35	69%	9303	65%
	Non-PAG	46	24%	32	27%	15	29%	4531	32%
	Uncertain	4	2%	2	2%	1	2%	347	2%
	PAG	3	2%	1	1%	0	0%	124	1%
SCHIST	*Total No. Samples*	*79*		*58*		*33*		*8721*	
	Non-reactive	31	39%	23	40%	13	39%	3099	36%
	Non-PAG	48	61%	35	60%	20	61%	5336	61%
	Uncertain	0	0%	0	0%	0	0%	263	3%
	PAG	0	0%	0	0%	0	0%	23	0%
GRANITE	*Total No. Samples*	*42*		*42*		*57*		*977*	
	Non-reactive	36	86%	36	86%	45	79%	865	89%
	Non-PAG	1	2%	5	12%	4	7%	11	1%
	Uncertain	1	2%	1	2%	5	9%	50	5%
	PAG	4	10%	0	0%	3	5%	51	5%
Other (including Metabasalt)	*Total No. Samples*	*24*		*15*		*11*		*2546*	
	Non-reactive	11	46%	6	40%	3	27%	1089	43%
	Non-PAG	13	54%	9	60%	8	73%	1284	50%
	Uncertain	0	0%	0	0%	0	0%	96	4%
	PAG	0	0%	0	0%	0	0%	77	3%

Notes:
n = number of analyses included in distribution.
* adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.3.3 for discussion).
NPR (surrogate NP/AP) is NP derived from Ca and AP derived from S from the aqua regia digestion exploration database.
All samples with total-S <0.02 wt.% are considered non-reactive.
Criteria for NPRs derived using sobek NP and ICP data are defined as NPR ≥3 (non-PAG), 1≤NPR<3 (uncertain), NPR<1 (PAG).
Criteria for NPRs derived using T-C NP* and CaNP are defined as NPR ≥2 (non-PAG), 1≤NPR<2 (uncertain), NPR<1 (PAG).

4.1.4 Shake Flask Extractions

Metal concentrations measured in SFE provide an indication of the readily soluble metals which will be immediately available for leaching upon exposure to infiltrating water. In order to highlight the significance of various SFE results, the results are compared to Metal Mining Effluent Regulations (MMER, 2002) and Canadian Council of Ministers of the Environment (CCME, 2007) water quality guidelines for the protection of aquatic life. A summary of the relevant guidelines is presented Table 4-14.

Table 4-14:
Summary of Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life and Metal Mining Effluent Regulations (MMER) Water Quality Guidelines

Parameter	Units	CCME[1]		MMER[2]		
		30-day	Max	MMM	MCS	MGS
Total Cyanide	mg/L		0.005			
Sulphate	mg/L	218				
Al	mg/L	0.1				
Sb	mg/L		0.009			
As	mg/L	0.005		0.5	0.75	1
Cd	mg/L	0.0001	0.0011			
Co	mg/L	0.004	0.11			
Cr	mg/L		0.001			
Cu	mg/L	0.002		0.3	0.45	0.6
Fe	mg/L	0.3				
Pb	mg/L	0.001		0.2	0.3	0.4
Hg	mg/L	0.000026				
Mo	mg/L	0.073				
Ni	mg/L	0.025		0.5	0.75	1
Se	mg/L	0.001				
Ag	mg/L	0.00025				
Tl	mg/L	0.0008				
U	mg/L	0.015	0.033			
Zn	mg/L	0.03		0.5	0.75	1
^{226}Ra	Bq/L			0.37	0.74	1.11

Notes: All guidelines are for total metals unless otherwise indicated

1. Canadian Council of Ministers of the Environment (CCME, 2007) Freshwater Quality Guidelines for Protection of Aquatic Life; Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); Underlined guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.
2. Metal Mines Effluent Regulations (MMER, 2002); maximum authorized monthly mean (MMM); maximum authorized concentration in a composite sample (MCS); and maximum authorized concentration in a grab sample (MGS).

A statistical distribution of SFE parameters that exceed water quality guidelines are presented by weathering facies for gneiss, schist and granite in Table 4-15, Table 4-16 and Table 4-17. Aluminium, Sb, As and Hg are indicated to exceed the CCME guidelines in SFE from almost all of the weathering facies of each dominant lithology. In particular, As exceeds the CCME guideline in median values for the schist unit and nearly every sample from the gneiss and granite units. Maximum values for each weathering facies of the granite unit also exceed the maximum MMER guideline (1 mg/L As). Concentrations of Cu, Fe, Pb and U exceed the CCME guidelines in SFE from one or more samples from each of the weathering facies for the granite and gneiss units, while Cr exceeds the CCME

guideline from several of the gneiss and schist samples. Two oxide schist samples contain sulphate in SFE at values that exceed the reference guideline. The elevated sulphate in SFE leachate from these samples is consistent with higher solid phase sulphur measured in the samples (0.42 and 0.26 wt.%S, Appendix C.1-2), and reflects the rinsing of surface oxidation products from the highly weathered material. It should be noted that a detection limit of 0.00005 mg/L for Hg was often applied during analysis, which is higher than the CCME guideline (0.000026 mg/L); therefore, it is difficult to provide an accurate assessment of the proportion of samples for each lithology with soluble Hg at levels that exceed the guideline. In general, Hg is not enriched in solid phase of the waste rock samples; however, median values for the oxide facies of schist and granite waste rock show enrichment (Section 4.1.4). Soluble metal concentrations in SFE from other minor lithologies are generally low, with one or more samples having Al, Sb, As or Hg at concentrations that exceed the respective CCME guidelines (Appendix C.1-2).

Overall, the highest median and maximum metal concentrations in SFE are from all weathering facies of the granite unit (Table 4-16), while the lowest are generally from the schist unit (in particular samples from the fresh facies). Leachate pH for the gneiss and schist samples are neutral to alkaline, ranging from 7.4 to 9.5 (median values >8), reflecting the higher NP of these units. Leachate pH values for the granite samples are slightly lower, ranging from 6.4 to 9.2, with consistently lower pH measured for the oxide samples (median of 6.7).

Aluminum and Fe are sparingly water soluble under neutral pH and aerobic conditions. Therefore, the high concentrations of these metals are expected to be due to fine suspended solids (colloidal size) that passed through the 0.45µm filter during the extraction experiment. The exceedances observed for other metals in SFEs may also be associated with suspended solids given that the samples comprising the highest concentrations of Al and Fe in SFEs tend to also comprise the most elevated concentrations of other metals (As, Co, Cu, Fe, Pb, Mn, Ni, U and/or Ag and Zn). This is particularly evident for samples from the more weathered facies of each lithology and for the granite samples (*e.g.*, samples ABA064, ABA096, ABA059, ABA067, ABA065, ABA054, ABA174, ABA152, ABA166; Appendix C.1-2). However, there are also several SFE samples that contain elevated As, Sb and Cr but low Al and Fe (*e.g.*, ABA146, ABA143, ABA148, oxide schist samples and ABA132; Appendix C.1-2). Overall, the results of the SFE indicate that Cr may be a concern in gneiss and schist lithologies, while As and Sb may be metals of potential concern from all waste rock lithologies. It is interesting to note that U concentrations are generally low in SFE data, with median values of all lithologies and weathering facies being below CCME guidelines. This is likely related to the low alkalinity produced during the SFE procedure inhibiting U solubility (median alkalinity of 21 mg$CaCO_3$/L, 30 mg$CaCO_3$/L and 4.3 mg$CaCO_3$/L for gneiss, schist and granite, respectively).

Table 4-15:
Shake Flask Extraction Results for Gneiss Waste Rock by Weathering Facies

Gneiss	pH	Sulfate	Al	Sb	As	Cr	Co	Cu	Fe	Pb	Hg	Se	Tl	U	Zn
	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide (*n* = 9)															
Min	7.2	*<0.5*	0.019	0.0014	0.0095	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	*<0.0001*	0.00007	0.005
25th PCTL	8.0	0.52	0.13	0.0049	0.035	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00018	*<0.01*
Median	8.3	1.3	0.43	0.0069	0.12	0.0005	0.0001	*<0.001*	0.062	0.00013	*<0.00005*	*<0.0005*	0.00012	0.0018	*<0.01*
75th PCTL	8.8	1.9	3.0	0.021	0.18	0.0029	0.00071	0.0018	3.2	0.0068	0.000065	*<0.0005*	0.00013	0.0036	*<0.01*
Max	9.4	16	3.8	0.046	1.2	0.004	0.001	0.0044	5.7	0.01	0.00014	*<0.0005*	0.00063	0.019	*<0.01*
Upper Transition (*n* = 7)															
Min	7.3	*<0.5*	0.028	0.00045	0.0079	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	0.00005	0.000069	0.005
25th PCTL	7.8	0.62	0.078	0.0016	0.014	0.0005	0.000075	0.00075	0.031	0.000075	0.000025	0.00038	*<0.0001*	0.00016	0.0075
Median	8.1	0.89	0.28	0.0049	0.046	0.00069	0.00033	0.001	0.24	0.0001	0.00005	*<0.0005*	0.0001	0.00039	*<0.01*
75th PCTL	8.4	1.3	2.3	0.0097	0.087	0.0015	0.0011	0.0034	1.4	0.0028	0.00061	*<0.0005*	0.00018	0.0031	*<0.01*
Max	9.5	12	7.6	0.028	0.2	0.0029	0.0017	0.0053	4.7	0.023	0.0056	0.0005	0.00027	0.0074	0.01
Lower Transition (*n* = 19)															
Min	7.4	*<0.5*	0.016	0.00011	0.0045	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	*<0.0001*	0.000038	0.005
25th PCTL	8.4	0.52	0.22	0.00038	0.012	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00023	*<0.01*
Median	9.2	1.1	0.34	0.00082	0.017	*<0.0005*	*<0.0001*	*<0.001*	0.051	0.0001	*<0.00005*	*<0.0005*	*<0.0001*	0.00058	*<0.01*
75th PCTL	9.3	2.2	0.65	0.0023	0.031	0.0005	0.0001	*<0.001*	0.14	0.00026	*<0.00005*	*<0.0005*	*<0.0001*	0.0015	*<0.01*
Max	9.8	15	4.1	0.0064	0.092	0.011	0.00086	0.0031	2.4	0.0035	0.0014	0.0021	0.00025	0.026	0.01
Fresh (*n* = 16)															
Min	8.1	*<0.5*	0.062	*<0.0001*	0.0022	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000036	*<0.01*
25th PCTL	8.9	0.6	0.21	0.00027	0.006	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00043	*<0.01*
Median	9.1	1.2	0.45	0.00052	0.014	*<0.0005*	*<0.0001*	*<0.001*	0.14	0.00011	*<0.00005*	*<0.0005*	*<0.0001*	0.0011	*<0.01*
75th PCTL	9.1	4.3	0.68	0.0014	0.033	*<0.0005*	0.00016	0.0011	0.32	0.00046	*<0.00005*	*<0.0005*	*<0.0001*	0.0018	*<0.01*
Max	9.4	10	5.5	0.028	0.16	0.0046	0.0016	0.0066	5.0	0.0044	0.000076	0.00082	*<0.0001*	0.059	*<0.01*

Notes:
Values in grey italics are below the analytical detection limit; All guidelines are for total metals unless otherwise indicated.
Values that exceed the Metal Mines Effluent Regulations (MMER, 2002) maximum (MMM) water quality guideline are shaded in dark grey.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2007) Water Quality Guidelines are shaded in light blue (30-day) and dark blue (maximum);
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016);
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI);
Guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-16:
Shake Flask Extraction Results for Schist Waste Rock by Weathering Facies

Schist	pH	Sulfate	Al	Sb	As	Cr	Co	Cu	Fe	Pb	Hg	Se	Tl	U	Zn
	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide (*n* = 7)															
Min	8	1.8	0.048	0.0012	*<0.001*	*<0.0005*	*<0.0001*	*<0.001*	0.015	*<0.0001*	0.000025	*<0.0005*	*<0.0001*	0.000019	*<0.01*
25th PCTL	8.3	3.2	0.065	0.0025	0.0035	0.0005	*<0.0001*	*<0.001*	0.022	*<0.0001*	0.000038	*<0.0005*	*<0.0001*	0.000063	*<0.01*
Median	8.5	4.5	0.088	0.0041	0.007	0.00077	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000079	*<0.01*
75th PCTL	8.6	280	0.13	0.0098	0.052	0.0033	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	0.00006	0.0008	0.00038	0.0048	*<0.01*
Max	8.8	920	0.22	0.012	0.16	0.0044	0.0001	0.001	*<0.03*	0.0001	0.0017	0.0022	0.00092	0.012	0.01
Upper Transition (*n* = 2)															
Min	8.3	8.4	0.092	0.00011	0.0005	0.00025	0.00005	0.0005	0.015	0.00005	*<0.00005*	0.00025	0.00005	0.00016	0.005
Max	8.8	29	0.14	0.0028	*<0.001*	0.00061	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	0.00014	*<0.0005*	*<0.0001*	0.00035	*<0.01*
Lower Transition (*n* = 8)															
Min	7.8	*<0.5*	0.055	0.00053	0.0005	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	0.00005	0.000046	0.005
25th PCTL	8.4	4.0	0.16	0.0011	0.0048	*<0.0005*	0.000088	0.00088	0.026	0.000088	0.000025	*<0.0005*	*<0.0001*	0.0003	0.0088
Median	8.7	9.9	0.26	0.0018	0.0098	0.0007	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00056	*<0.01*
75th PCTL	9	12	0.57	0.0057	0.019	0.0014	0.00029	*<0.001*	0.61	0.00036	0.000062	*<0.0005*	*<0.0001*	0.00081	*<0.01*
Max	9.3	130	7.3	0.022	0.36	0.0046	0.00099	0.0037	4.6	0.0036	0.00062	0.0011	0.00015	0.0041	0.01
Fresh (*n* = 7)															
Min	8.6	0.52	0.072	0.00017	*<0.001*	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000022	*<0.01*
25th PCTL	8.9	0.54	0.11	0.00023	0.0036	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000042	*<0.01*
Median	9.3	0.93	0.14	0.00026	0.0049	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000078	*<0.01*
75th PCTL	9.3	11	0.16	0.00036	0.0063	*<0.0005*	0.00012	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00018	*<0.01*
Max	9.4	97	0.22	0.011	0.0078	0.00087	0.00014	*<0.001*	0.09	*<0.0001*	*<0.00005*	0.00073	*<0.0001*	0.008	*<0.01*

Notes:
Values in grey italics are below the analytical detection limit; All guidelines are for total metals unless otherwise indicated.
Values that exceed the Metal Mines Effluent Regulations (MMER, 2002) maximum (MMM) water quality guideline are shaded in dark grey.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2007) Water Quality Guidelines are shaded in light blue (30-day) and dark blue (maximum);
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016);
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI);
Guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-17:
Shake Flask Extraction Results for Granite Waste Rock Weathering Facies

Granite	pH	Sulfate	Al	Sb	As	Cr	Co	Cu	Fe	Pb	Hg	Se	Tl	U	Zn
	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide (*n* = 3)															
Min	6.6	*<0.5*	0.005	0.017	0.096	*<0.0005*	*<0.0001*	*<0.001*	0.034	*<0.0001*	0.00017	*<0.0005*	0.0001	0.000046	*<0.01*
Median	6.7	0.5	0.11	0.018	0.25	*<0.0005*	*<0.0001*	*<0.001*	0.29	0.00022	0.00024	*<0.0005*	0.0001	0.00015	*<0.01*
Max	6.8	1.7	5.2	0.029	3.5	0.0005	0.0024	0.0032	8.5	0.017	0.00029	*<0.0005*	0.0013	0.0083	*<0.01*
Upper Transition (*n* = 7)															
Min	6.5	*<0.5*	*<0.005*	0.00034	0.018	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	0.000025	*<0.0005*	0.0001	0.000035	*<0.01*
25th PCTL	7.1	0.92	3.7	0.0039	0.021	*<0.0005*	0.00018	*<0.001*	1.8	0.0043	*<0.00005*	*<0.0005*	0.00012	0.0038	*<0.01*
Median	7.5	4.0	4.9	0.0055	0.059	*<0.0005*	0.00082	*<0.001*	4.1	0.0074	0.00005	*<0.0005*	0.00015	0.0073	0.011
75th PCTL	8	4.9	7.3	0.011	0.61	0.00058	0.001	0.002	5.8	0.019	0.00012	*<0.0005*	0.0002	0.012	0.034
Max	8.8	16	14	0.035	1.5	0.00066	0.0017	0.0091	13	0.027	0.00055	0.0005	0.00023	0.022	0.066
Lower Transition (*n* = 6)															
Min	6.4	*<0.5*	4.3	0.00058	0.018	*<0.0005*	0.00099	*<0.001*	4.2	0.002	*<0.00005*	*<0.0005*	*<0.0001*	0.0051	0.022
25th PCTL	7.8	0.51	4.6	0.001	0.036	0.00052	0.0012	*<0.001*	5.6	0.0051	*<0.00005*	*<0.0005*	0.00016	0.0071	0.023
Median	8.6	0.62	5.1	0.0015	0.082	0.00059	0.0013	0.0014	6.6	0.0077	*<0.00005*	*<0.0005*	0.00018	0.012	0.024
75th PCTL	8.8	0.9	5.5	0.032	0.3	0.00069	0.002	0.0026	7.1	0.0094	0.000083	*<0.0005*	0.00022	0.016	0.028
Max	8.9	1.2	6.5	0.16	2.5	0.001	0.0045	0.0048	18	0.015	0.0001	*<0.0005*	0.00032	0.017	0.035
Fresh (*n* = 8)															
Min	6.6	*<0.5*	0.0074	0.00039	0.0031	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	0.00005	0.00012	0.005
25th PCTL	7.4	*<0.5*	0.4	0.0006	0.024	*<0.0005*	0.00017	0.001	0.23	0.00038	*<0.00005*	*<0.0005*	*<0.0001*	0.0025	*<0.01*
Median	8.2	1.2	3.4	0.0024	0.061	0.0005	0.00099	0.0012	3.2	0.0021	*<0.00005*	*<0.0005*	0.00012	0.0068	*<0.01*
75th PCTL	8.8	3.8	5.0	0.016	0.31	0.00074	0.0021	0.0034	5.6	0.008	*<0.00005*	*<0.0005*	0.00019	0.013	0.03
Max	9.2	27	7.5	0.064	1.3	0.00088	0.0071	0.0059	5.8	0.013	*<0.00005*	*<0.0005*	0.00022	0.017	0.038

Notes:
Values in grey italics are below the analytical detection limit; All guidelines are for total metals unless otherwise indicated.
Values that exceed the Metal Mines Effluent Regulations (MMER, 2002) MGS water quality guideline are shaded in dark grey.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2007) Water Quality Guidelines are shaded in light blue (30-day) and dark blue (maximum);
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016);
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI);
Guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg CaCO3/L.

4.1.5 Solid-Phase Elemental Abundance

Statistical summaries of solid phase element results are presented by weathering facies for by lithologic unit Table 4-18, Table 4-19 and Table 4-20 compared to average continental abundances (ACA; Price, 1997). The complete set of solid phase element results are presented in Appendix C.1-3. The results show that the waste rock samples are enriched in Sb, As, Bi, Hg, Se and U with respect to ACAs (shaded values in the tables). In order to compare relative metal enrichment between different lithologies, Table 4-21 presents the median values with a colour gradient superimposed to highlight relative concentrations. The data demonstrate that elemental enrichment is related to both lithology and weathering facies. In general, the highest Sb, As and Hg concentrations were measured in samples from the granite oxide facies (10 ppm, 2400 ppm, 0.46 ppm, respectively) as well as in samples from the oxide facies of the other lithologic units. The highest U content was measured in all weathering facies of the granite samples (median of 6.0 - 6.7 ppm). In contrast, the schist samples show the highest abundance of Se (median of 0.5 - 0.7 ppm) as well as other metals generally associated with sulphide mineralization (*i.e.,* Cr, Co, Cu, Zn) (Table 4-19). The enrichment of Sb, As, Hg and U in the waste rock are particularly relevant given that these elements also exceeded water quality guidelines in SFE (Section 4.1.3).

Also presented for comparison are Sb and As concentrations from the exploration ICP-OES database (Table 4-21). Data for other elements (*e.g*., U) could not be compared due to the high detection limits applied in support of the exploration program analyses. Further, some elements (*e.g.,* Se) were not analyzed as part of the assays for the exploration program. Table 4-22 presents the statistical distribution of Sb and As for each lithology as a whole, with light and dark grey shading representing three and ten times higher than the ACA values. Note that for the larger assay database, the 95th and 5th percentile values are shown in place of the maximum and minimum values to provide a more representative upper and lower limit for the lithologic and weathering facies and avoid highlighting outliers. Also provided in Table 4-22 are the distributions of Sb and As by weathering facies for each lithologic unit, with a colour gradient superimposed to highlight the relative concentrations. The data from the larger sample population of the assay database indicate that the highest concentrations of Sb and As (95th percentiles of 74 and 4240 ppm) are associated with the fresh facies of the granite unit, followed by the oxide facies. This contrasts with the results of the ICP-MS database which shows the highest values for the granite oxide; however, considerably fewer samples are available for this unit. With the exception of these samples, the data in Table 4-22 demonstrate that the highest Sb and As concentrations are generally associated with the oxide facies for each lithology. The overall lowest Sb and As concentrations are indicated for the gneiss and schist waste rock samples, particularly for the lower transition and fresh facies (median Sb = <2 ppm and median As = 6-12 ppm). For complete statistics of the exploration ICP-OES see Appendix C.1-4.

Table 4-18:
Solid Phase Elements by Aqua Regia Digestion for Gneiss Waste Rock by Weathering Facies

ACA	*8.23*	*0.2*	*1.8*	*0.0085*	*102*	*25*	*60*	*5.6*	*14*	*0.085*	*0.05*	*2.7*	*70*
Gneiss	**Al**	**Sb**	**As**	**Bi**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Se**	**U**	**Zn**
	%	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Oxide (*n* = 34)													
Min	0.33	0.47	2.7	0.05	3.0	0.60	0.60	0.48	2.1	*<0.01*	0.2	1.2	5.0
25th PCTL	0.55	1.5	41	0.092	5.0	1.4	2.3	0.79	5.9	0.032	0.4	3.7	8.2
Median	0.68	3.1	98	0.13	6.5	1.8	3.4	1.0	7.6	0.085	0.45	7.0	12
75th PCTL	0.86	13	220	0.18	11	3.0	8.0	1.3	11	0.2	0.6	9.7	18
Max	1.9	52	2100	2.1	110	21	17	4.0	33	0.91	1.2	29	45
Upper Transition (*n* = 26)													
Min	0.36	0.11	3.7	0.02	3.0	0.4	1.6	0.32	4.0	0.01	0.2	2.2	2.0
25th PCTL	0.61	3.7	85	0.1	5.0	1.6	3.8	0.88	7.2	0.06	0.3	3.7	9.2
Median	0.7	6.4	240	0.16	7.0	2.4	5.0	1.0	10	0.16	0.4	6.2	14
75th PCTL	0.86	15	480	0.38	13	5.0	7.7	1.5	13	0.76	0.5	13	23
Max	3.1	83	2100	2.1	60	31	27	4.6	32	5.2	1.0	22	70
Lower Transition (*n* = 79)													
Min	0.27	*<0.05*	2.6	0.03	2	0.6	0.8	0.43	1.2	*<0.01*	*<0.2*	0.29	2.0
25th PCTL	0.57	0.44	11	0.08	5	1.6	2.3	0.83	4.2	*<0.01*	0.4	2.5	9.0
Median	0.81	1.4	20	0.14	7	2.4	3.5	1.2	6.2	0.01	0.4	3.6	16
75th PCTL	1.3	3.2	56	0.25	22	7.8	6.8	2	8	0.06	0.5	5.9	26
Max	4.2	28	330	1.0	160	22	26	7.3	88	1.7	1	19	72
Fresh (*n* = 49)													
Min	0.22	*<0.05*	2.0	0.02	5.0	0.6	0.9	0.44	1.5	0.01	0.3	0.27	4.0
25th PCTL	0.52	0.22	4.7	0.09	6.0	1.5	2.8	0.99	3.3	0.01	0.4	1.9	11
Median	1.1	0.5	6.3	0.18	11	5.0	4.8	1.7	5.2	0.01	0.5	2.7	20
75th PCTL	1.6	1.1	18	0.51	55	13	9.3	2.5	7.6	0.01	0.6	3.5	32
Max	2.3	14	240	8.4	370	20	29	3.7	43	0.07	1.3	20	64

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA.

Table 4-19:
Solid Phase Elements by Aqua Regia Digestion for Schist Waste Rock by Weathering Facies

ACA	*8.23*	*0.2*	*1.8*	*0.0085*	*102*	*25*	*60*	*5.6*	*14*	*0.085*	*0.05*	*2.7*	*70*
Schist	**Al**	**Sb**	**As**	**Bi**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Se**	**U**	**Zn**
	%	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Oxide (*n* = 15)													
Min	0.5	3.0	25	0.09	4.0	1.1	1.0	0.68	2.4	0.08	0.3	0.63	5.0
25th PCTL	0.76	5.1	160	0.17	12	6.5	6.3	1.9	7.2	0.25	0.4	1.6	28
Median	0.9	9.1	190	0.26	30	9.6	14	2.7	9.7	0.33	0.7	2.1	44
75th PCTL	1.1	11	390	0.36	38	13	21	3.0	11	0.42	0.9	3.3	60
Max	1.4	44	1400	1.6	46	19	57	4.3	19	0.75	1.4	9.6	67
Upper Transition (*n* = 14)													
Min	0.81	0.95	6.4	0.09	8.0	5.0	5.2	1.8	4.7	0.01	0.4	1.0	16
25th PCTL	0.98	3.4	23	0.2	26	9.1	11	2.4	6.9	0.022	0.62	1.5	37
Median	1.2	4.1	47	0.28	32	11	17	2.6	8.4	0.12	0.7	2.1	48
75th PCTL	1.5	8.4	160	0.48	39	13	28	3.5	11	0.19	0.98	2.6	68
Max	2.4	66	310	3.9	130	29	110	4.7	37	0.32	1.1	4.3	140
Lower Transition (*n* = 19)													
Min	0.39	0.06	3.5	0.09	6.0	2.3	3.2	0.91	1.6	0.01	0.2	0.81	7.0
25th PCTL	1.6	0.74	9.6	0.27	38	12	6.6	2.5	6.4	0.01	0.4	1.3	47
Median	1.9	1.7	20	0.43	60	14	14	3.2	8.8	0.01	0.6	1.6	53
75th PCTL	2.3	3.0	31	0.68	78	17	25	3.4	12	0.025	0.8	1.9	63
Max	2.7	19	48	2.4	150	22	42	4.4	49	0.32	1.3	3.7	99
Fresh (*n* = 31)													
Min	0.81	0.11	1.4	0.04	10	4.2	4.1	1.4	2.2	0.01	*<0.2*	0.34	12
25th PCTL	1.6	0.3	10	0.14	41	13	8.4	2.6	4.2	0.01	0.25	0.7	39
Median	2.0	0.81	20	0.21	67	15	14	3.2	6.3	0.01	0.5	1.4	46
75th PCTL	2.2	1.7	30	0.34	130	19	22	3.4	8.6	0.01	0.8	2.2	58
Max	3.0	10	130	18	230	28	48	4.6	30	0.06	1.1	6.2	130

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA.

Table 4-20:
Solid Phase Elements by Aqua Regia Digestion for Granite Waste Rock by Weathering Facies

ACA	*8.23*	*0.2*	*1.8*	*0.0085*	*102*	*25*	*60*	*5.6*	*14*	*0.085*	*0.05*	*2.7*	*70*
Granite	**Al**	**Sb**	**As**	**Bi**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Se**	**U**	**Zn**
	%	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Oxide (*n* = 6)													
Min	0.43	0.82	81	0.06	2.0	0.7	1.7	1.0	7.7	0.01	*<0.2*	5.3	5.0
25th PCTL	0.49	7.8	1700	0.07	2.2	1.2	1.9	1.6	18	0.2	0.2	5.6	8.5
Median	0.57	10	2400	0.07	3.0	2.0	2.4	1.6	21	0.46	0.25	6.0	24
75th PCTL	0.69	29	2800	0.092	3.8	2.6	2.9	1.9	22	0.81	0.38	7.6	30
Max	0.73	38	3000	0.77	5.0	10	14	2.0	26	0.84	0.4	22	36
Upper Transition (*n* = 17)													
Min	0.33	0.11	2.7	0.07	2.0	0.1	1.1	0.36	6.8	*<0.01*	*<0.2*	4.6	5.0
25th PCTL	0.48	0.83	110	0.1	4.0	0.6	1.5	0.7	9.9	0.03	0.3	5.7	13
Median	0.61	1.2	200	0.12	4.0	0.9	2.3	0.93	13	0.13	0.4	6.7	19
75th PCTL	0.73	2.0	360	0.13	5.0	1.1	4.7	1.2	20	0.21	0.5	9.2	23
Max	1.1	28	3000	0.27	8.0	1.6	9.2	1.4	39	0.79	0.8	46	37
Lower Transition (*n* = 14)													
Min	0.41	0.08	2.1	0.06	2.0	0.5	1.2	0.48	5.4	*<0.01*	0.2	4.4	4.0
25th PCTL	0.49	0.31	13	0.06	3.0	1.3	1.6	0.97	5.6	0.01	0.3	5.1	24
Median	0.57	1.0	33	0.075	5.0	1.5	1.8	1.2	8.2	0.02	0.4	6.0	31
75th PCTL	0.87	3.5	410	0.088	7.0	2.4	2.4	1.6	12	0.22	0.4	8.9	36
Max	0.95	85	2300	1.0	12	5.0	13	2.8	25	1.7	0.5	26	88
Fresh (*n* = 20)													
Min	0.4	0.06	3.3	0.05	3.0	1.1	0.8	0.88	4.9	*<0.01*	0.2	4.4	19
25th PCTL	0.44	0.2	5.8	0.068	5.0	1.4	1.5	1.1	5.7	*<0.01*	0.38	6.3	26
Median	0.46	0.48	20	0.1	6.0	1.5	3.0	1.2	6.4	0.01	0.4	6.7	29
75th PCTL	0.53	2.0	80	0.32	7.0	2.0	3.9	1.4	8.6	0.022	0.5	7.4	37
Max	1.0	16	1400	1.3	10	3.4	7.2	1.7	15	0.22	0.7	29	72

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA.

Table 4-21:
Comparison of Median Solid Phase Values for Enriched Elements in Waste Rock by Weathering Facies and Lithologies

Lithologic Unit	Al	Sb	As	Bi	Cr	Co	Cu	Fe	Pb	Hg	Se	U	Zn
	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
Gneiss *(Medians)*													
Oxide (n = 34)	0.68	3.1	98	0.13	6.5	1.8	3.4	1.0	7.6	0.085	0.45	7.0	12
Upper Transition (n = 26)	0.7	6.4	240	0.16	7.0	2.4	5.0	1.0	10	0.16	0.4	6.2	14
Lower Transition (n = 79)	0.81	1.4	20	0.14	7.0	2.4	3.5	1.2	6.2	0.01	0.4	3.6	16
Fresh (n = 49)	1.1	0.5	6.3	0.18	11	5.0	4.8	1.7	5.2	0.01	0.5	2.7	20
Schist *(Medians)*													
Oxide (n = 15)	0.9	9.1	190	0.26	30	9.6	14	2.7	9.7	0.33	0.7	2.1	44
Upper Transition (n = 14)	1.2	4.1	47	0.28	32	11	17	2.6	8.4	0.12	0.7	2.1	48
Lower Transition (n = 19)	1.9	1.7	20	0.43	60	14	14	3.2	8.8	0.01	0.6	1.6	53
Fresh (n = 31)	2.0	0.81	20	0.21	67	15	14	3.2	6.3	0.01	0.5	1.4	46
Granite *(Medians)*													
Oxide (n = 6)	0.57	10	2400	0.07	3.0	2.0	2.4	1.6	21	0.46	0.25	6.0	24
Upper Transition (n = 17)	0.61	1.2	200	0.12	4.0	0.9	2.3	0.93	13	0.13	0.4	6.7	19
Lower Transition (n = 14)	0.57	1.0	33	0.075	5.0	1.5	1.8	1.2	8.2	0.02	0.4	6.0	31
Fresh (n = 20)	0.46	0.48	20	0.1	6.0	1.5	3.0	1.2	6.4	0.01	0.4	6.7	29
Other *(Median)*													
All (n = 24)	1.4	3.1	81	0.16	16	14	8.8	3.2	8.7	0.07	0.5	3.0	51

Notes:
Green gradient shading represents relative concentrations of elements for all weathering facies and lithologic units.

Table 4-22:
Solid Phase As and Sb Concentrations in Waste Rock from the Exploration Database

Lithology	**Gneiss**		**Schist**		**Granite**		**Other Lithologies**	
Parameter	**Sb**	**As**	**Sb**	**As**	**Sb**	**As**	**Sb**	**As**
Units	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Total for Lithologic Unit								
n	*14296*	*14296*	*8715*	*8715*	*975*	*975*	*2895*	*2895*
5th PCTL	*<2*	2	*<2*	2	*<2*	3	*<2*	4
25th PCTL	*<2*	7	*<2*	8	*<2*	23	*<2*	21
Median	2	26	2	24	2	118	4	85
75th PCTL	5	118	6	89	6	582	12	412
95th PCTL	26	578	25	737	36.3	2540	56	1540
Oxide facies								
n	*3218*	*3218*	*2355*	*2355*	*578*	*578*	*1411*	*1411*
5th PCTL	*<2*	15	*<2*	8	*<2*	10	*<2*	15
25th PCTL	3	66	3	36.5	*<2*	59.5	4	70
Median	7	179	7	116	3	288	8	284
75th PCTL	16	349	14	368	8	859	20	680
95th PCTL	52	1060	61	1360	36	2710	76	2000
Upper Transition Facies								
n	*4367*	*4367*	*2175*	*2175*	*140*	*140*	*585*	*585*
5th PCTL	*<2*	3	*<2*	4	*<2*	2	*<2*	5
25th PCTL	*<2*	13	*<2*	13	*<2*	10	2	23
Median	2	38	3	32	*<2*	27	4	65
75th PCTL	6	124	7	100	2	95	9	248
95th PCTL	25	583	18	633	13	1460	45	1760
Lower Transition Facies								
n	*5647*	*5647*	*3330*	*3330*	*235*	*235*	*710*	*710*
5th PCTL	*<2*	*<2*	*<2*	2	*<2*	2	*<2*	2
25th PCTL	*<2*	4	*<2*	5	*<2*	6	*<2*	8
Median	*<2*	10	*<2*	12	*<2*	32	*<2*	18
75th PCTL	2	29	2	28	3	108	4	56
95th PCTL	8	174	8	133	24	1620	25	460
Fresh Facies								
n	*1073*	*1073*	*861*	*861*	*24*	*24*	*241*	*241*
5th PCTL	*<2*	*<2*	*<2*	*<2*	*<1.4*	37.9	*<2*	*<2*
25th PCTL	*<2*	3	*<2*	5	6	685	*<2*	6
Median	*<2*	6	*<2*	10	33	1650	*<2*	23
75th PCTL	2	14	2	18	39.5	3160	5	457
95th PCTL	8	74.8	5	74	74	4240	19	4730

Notes:
Values in grey italics are below the analytical detection limit.
Values shaded in light grey are 3x's the Average Continental Abundance (ACA) for Sb (2 ppm) and As (1.8 ppm), according to Price (1997), values shaded in dark grey are 10x's the ACA values.
Red and green gradient shading represent relative concentrations of Sb and As, for all weathering facies and lithologic units.

4.1.6 Kinetic Test Samples

4.1.6.1 Sample Selection Criteria and Rationale

A total of six unsaturated columns, eight humidity cells and eight field bins have been initiated for the different weathering facies (oxide, transition and fresh) of the dominant waste rock lithologies (gneiss, schist and granite) to assess the ML/ARD potential of stockpiled waste rock. A summary of the waste rock kinetic test material, sample selection criteria and rationale for the testwork are presented in Table 4-23. With the exception of HC7 and HC8, which were initiated to evaluate the potential extreme-case of As-leaching from gneiss and schist waste rock, waste rock used for laboratory kinetic testwork (columns and humidity cells) are representative split samples from the waste rock field bins (*i.e.,* duplicates in Table 4-23).

The compositions of kinetic test samples are compared to the range of metal and sulphur concentrations observed in the greater static test database in Figure 4-8 and Figure 4-9. These figures are box plots showing the distribution of total-S and solid phase element concentrations (As, Sb and U) for the larger sample populations (exploration and ABA databases) by waste rock lithology and weathering facies (as presented in Section 4.1.4), with the results for the kinetic test sub-samples superimposed. Total-S concentrations for the kinetic test sub-samples indicate that the kinetic tests represent moderate to high total-S with respect to the larger sample population (i.e*.,* exploration database); therefore, leachate data compiled from the kinetic tests represent 'best-estimate' to 'worst-case' drainage quality with respect to potential acid generation from subaerially stockpiled gneiss, schist and granite waste rock for the Project (Figure 4-8 and Table 4-23).

Solid phase concentrations of As, Sb and U for the kinetic test sub-samples are generally in the moderate to very high concentration ranges with respect to the larger sample populations (*i.e.,* exploration database for As and Sb and ABA database for U); therefore, leachate data compiled from kinetic testwork represent 'best-estimate' to 'worst-case' drainage quality with respect to potential metals of concern. Only the granite fresh facies kinetic test sub-sample comprises low concentrations of As and Sb with respect to the exploration database distribution; therefore, As and Sb may be under-represented in leachate collected from the granite fresh kinetic tests.

Table 4-23:
Waste Rock Kinetic Test Summary

Lithology	Weathering Facies	Test ID	Kinetic Test	Sample Description	Dry Wt. of Sample (kg)	Test Duration (weeks)	Recirculation Cycles
Gneiss	Oxide	Col 5	Unsaturated Column	Moderate T-S (60th PCTL) and As, Sb, U.	10.0	86	45-77
		FB-GO	Field Bin (Dup of Col 5)		183	70	-
	Transition	Col 6	Unsaturated Column	High T-S (85th PCTL) and As, Sb, U (>75th PCTL).	10.0	84	43-75
		HC3	Humidity Cell (Dup of Col 6)		1.0	87	46-73
		FB-GT	Field Bin (Dup of Col 6 and HC 3)		229	70	-
	Fresh	HC4	Humidity Cell	Very high T- S, As, U (95th PCTL), low Sb.	1.0	87	46-73
		FB-GS	Field Bin (Dup of HC 4)		190	70	-
		HC8	Humidity Cell	Very high T-S and U (95th PCTL) and As (> 95th PCTL).	1.0	28	-
Schist	Oxide	Col 3	Unsaturated Column	Moderate T-S and U (65th PCTL), high As and Sb (>75th PCTL).	10.0	86	45-77
		FB-SO	Field Bin (Dup of Col 3)		171	70	-
	Transition	Col 4	Unsaturated Column	High T-S (70th PCTL), As and U (80th PCTL), low Sb.	10.0	86	45-77
		HC1	Humidity Cell (Dup of Col 4)		1.0	87	46-73
		FB-ST	Field Bin (Dup of Col 4 and HC 1)		165	70	-
	Fresh	HC2	Humidity Cell	Very high T-S (~90th PCTL), high As, Sb, U (~80th PCTL)	1.0	87	46-73
		FB-SS	Field Bin (Dup of HC 2)		202	70	-
		HC7	Humidity Cell	Very high T-S, As, Sb (>95th PCTL), U (90th PCTL)	1.0	28	-
Granite	Transition	Col 13	Unsaturated Column	Very high T-S (>95th PCTL), high As (85th PCTL), very low Sb (<5th PCTL), moderate U (60th PCTL)	10.0	41	-
		HC5	Humidity Cell (Dup of Col 13)		1.0	42	-
		FB-GGT	Field Bin (Dup of Col 13 and HC 5)		166	18	-
	Fresh	Col 14	Unsaturated Column	High T-S (70th PCTL), low to very low As, Sb and U (<25th PCTL)	10.0	41	-
		HC6	Humidity Cell (Dup of Col 14)		1.0	42	-
		FB-GGS	Field Bin (Dup of Col 14 and HC 6)		134	18	-

Notes: All columns and humidity cells are constructed of Plexiglas with acrylic perforated disk & nylon mesh; All tests operated at temperature of 4°C; Leachate is sampled bi-weekly from all columns and weekly from all humidity cells; All columns are operated as trickle leach and all humidity cells operated as flood leach according to the MEND method (discussed in more detail in Section 3.2.6) Test duration refers to data available prior to cutoff date of March, 2016.

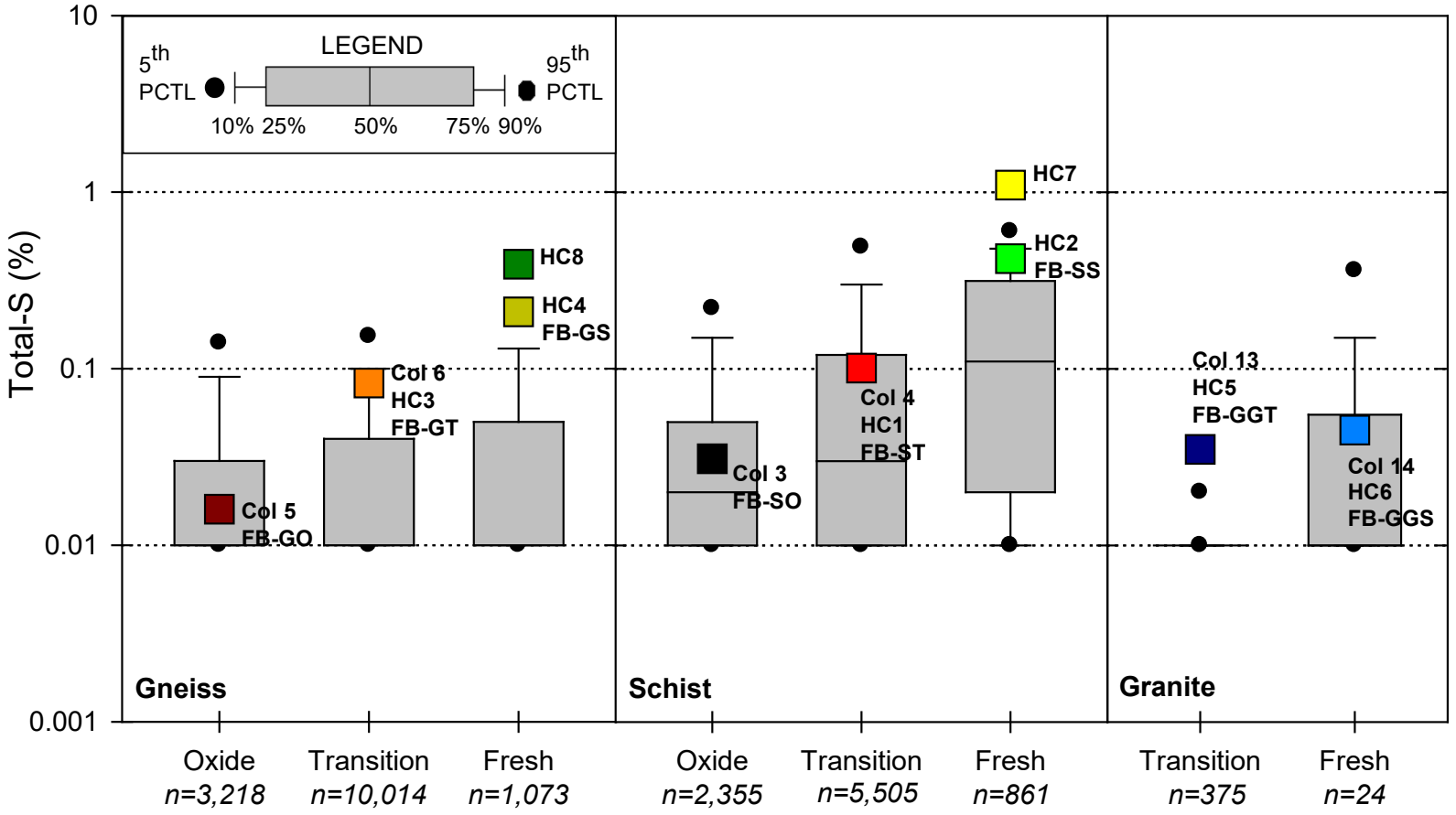


Figure 4-8: Box plots showing the ranges of total-S for the exploration database with total-S for the kinetic test sub-samples superimposed.

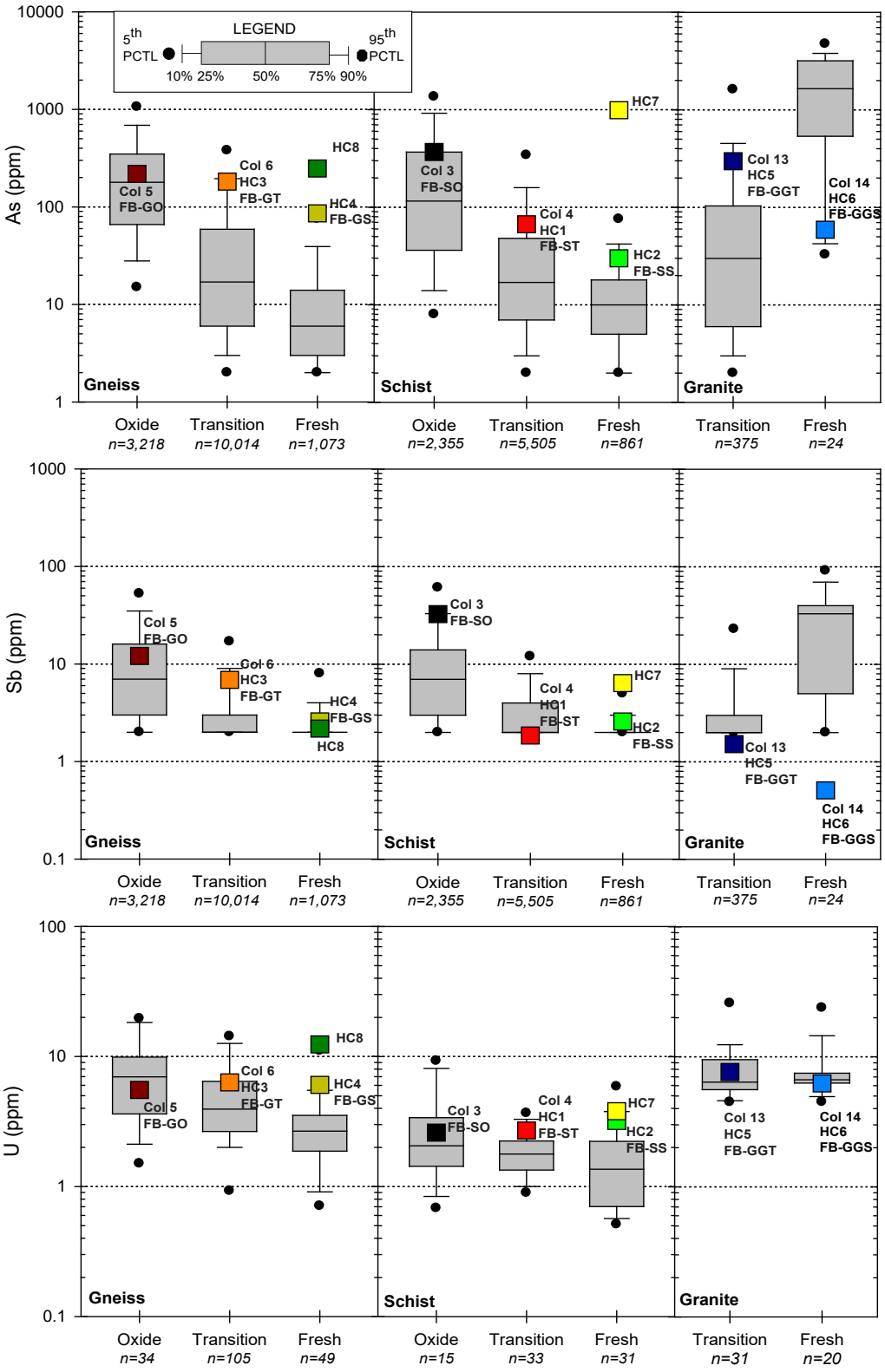


Figure 4-9: Box plots showing the ranges of As and Sb for the exploration database and U for the ABA database with concentrations for the kinetic test sub-samples superimposed

4.1.6.2 Static Tests

Mineralogy

A sub-sample from each of the waste rock kinetic tests was submitted for quantitative phase analysis using the Rietveld Method XRD. The minerals identified by XRD in the waste rock kinetic test sub-samples are provided in Table 4-24. The major rock forming minerals identified in each sample are quartz and feldspars, with lesser amounts of muscovite, biotite, chlorite and other silicates. Each sample also comprises measurable concentrations of kaolinite (1.4 – 15 wt.%), demonstrating the weathered state of the waste rock. Pyrite was only identified in the two sub-samples comprising high total-S (> 95th percentile, Figure 4-8), the gneiss fresh facies HC8 (0.5 wt.%) and schist fresh facies HC7 (1.3 wt.%).

Four carbonate minerals were identified in the schist and gneiss kinetic test sub-samples (Table 4-24). The highest proportion of carbonate minerals were identified in the schist sub-samples, with 8.2 wt.% measured in the oxide facies and approximately 20 wt.% measured in both fresh facies. The dominant carbonate mineral in the schist sub-samples is calcite, with concentrations ranging from 3.9 wt.% in the oxide facies up to 14.6 wt.% in the transition facies. High concentrations of ankerite (an Fe and Mn-bearing and therefore less effective neutralizing carbonate) were also identified in each schist sub-sample, with up to 9 wt.% identified in one of the fresh facies (HC2). Siderite (another Fe-bearing carbonate) was identified in appreciable amounts (4.5 wt.%) in the schist fresh facies sub-sample HC7. The distribution of carbonates in the schist kinetic test sub-samples is consistent with the wide range of carbonate concentrations (0.09 up to 29 wt.%) identified for the static test samples (Section 4.1.3).

The gneiss sub-samples comprise considerably less carbonates than the schist, with 3.0 wt.% measured in the oxide facies and up to 6.8 wt.% measured in one of the fresh facies (HC4). The dominant carbonate in the gneiss sub-samples is ankerite (1.3 – 4.5 wt.%), with lesser amounts of calcite (1 – 2.3 wt.%). Ankerite was also identified in appreciable amounts (up to 8.1 wt.%) in the transition static test samples (Section 4.1.1).

No carbonate minerals were detected in sub-samples from the granite kinetic tests, which is consistent with very low concentrations of carbonate minerals (<0.9 wt.%) identified in only a few of static test samples (Section 4.1.1).

Table 4-24:
X-Ray Diffraction Results for Waste Rock Kinetic Test Sub-Samples

		Lithology	Gneiss				Schist				Granite	
		Weathering Facies	Oxide	Transition	Fresh		Oxide	Transition	Fresh		Transition	Fresh
		Column	Col 5	Col 6	-	-	Col 3	Col 4	-	-	Col 13	-
Kinetic Test IDs		Humidity Cell	-	HC3	HC4	HC8	-	HC1	HC2	HC7	HC5	HC6
		Field Bin	FB-GO	FB-GT	FB-GS	-	FB-SO	FB-ST	FB-SS	-	FB-GGT	FB-GGS
Mineral	**Formula**		**wt. %**									
Quartz	SiO_2		47	46	39	49	55	31	33	49	35	29
Microcline	$KAlSi_3O_8$		19	16.3	12	23	0.7	7.8	11	1.6	27	29
Albite	$NaAlSi_3O_8$		7.5	9.7	17		1.2	20	8.7		18	22
Anorthite	$CaAl_2Si_2O_8$										6.7	9.8
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$		7.9	5.3	9.6	14	14	6.2	11	14	5.7	4.6
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$		1.0	1.2	3.0		1.3	7.0	4.4		0.7	1.4
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$		4.1	3.6	2.8		5.3	3.5	5			
Kaolinite	$Al_2Si_2O_5(OH)_4$		8.7	12	6.7	9.6	13	1.4	5.6	15	7.0	4.4
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$		0.3	0	0.4		0.4	2.3	0.3			
Diopside	$CaMgSi_2O_6$		1.7	1.3	2.1		0.6	3.9	1.8			
Calcite	$CaCO_3$		1.7	1.0	2.3		3.9	15	11			
Dolomite	$CaMg(CO_3)_2$					4.1				9.3		
Ankerite	$CaFe(CO_3)_2$		1.3	4.4	4.5		4.3	1.8	9.0	5.5		
Siderite	$FeCO_3$									4.5		
Pyrite	FeS_2					0.5				1.3		

Acid Base Accounting and Solid Phase Elements

Acid-base accounting and solid phase element result for the waste rock kinetic test sub-samples are presented in Table 4-25. All sub-samples have neutral to slightly alkaline rinse pH. The lowest pH (7.1) was measured in the granite transition sub-sample and reflects the low, but measurable, total-S (0.035 wt.%) and a lack of CaNP (0.8 kg $CaCO_3$/t), consistent with XRD results (Table 4-24).

For the gneiss and schist kinetic test sub-samples, concentrations of total-S and CaNP increase with decreasing degree of weathering within a lithology. The lowest total-S concentrations are indicated for the gneiss and schist oxide facies sub-samples (0.016 and 0.031 wt.%, respectively) and the highest total-S concentrations are indicated for the gneiss fresh facies (0.21 and 0.39 wt.%) and schist fresh facies (0.42 and 1.1 wt.%). The schist fresh facies sub-samples also comprise the highest CaNP values (174 kg$CaCO_3$/t and 151 kg $CaCO_3$/t). Of note, CaNP for the schist oxide facies (78 kg $CaCO_3$/t) is higher than the highest CaNP for the gneiss fresh facies (55 kg $CaCO_3$/t) (Table 4-2). The lowest CaNP values are indicated for the two granite kinetic test sub-samples (< 9.2 kg $CaCO_3$/t).

Sub-samples HC8 (gneiss) and HC7 (schist), which were selected for kinetic testwork to evaluate the potential for an ‘extreme-case’ of As leaching, comprise the highest total-S concentrations (0.39 and 1.1 wt.%, respectively) and As concentrations (248 and 989 ppm, Table 4-25). The highest metal concentrations were measured in the schist kinetic test sub-samples, with the overall highest values measured in the high total-S and As schist fresh facies sub-sample, HC7.

Table 4-25:
Acid-Base Accounting for Waste Rock Kinetic Test Sub-Samples

Lithology		Gneiss				Schist				Granite	
Weathering Facies		Oxide	Transition	Fresh		Oxide	Transition	Fresh		Transition	Fresh
Kinetic Test IDs	Column	Col 5	Col 6	-	-	Col 3	Col 4	-	-	Col 13	Col 14
	Humidity Cell	-	HC3	HC4	HC8	-	HC1	HC2	HC7	HC5	HC6
	Field Bin	FB-GO	FB-GT	FB-GS	-	FB-SO	FB-ST	FB-SS	-	FB-GGT	FB-GGS
Acid Base Accounting Parameters											
Rinse pH	s.u.	8.5	8.0	8.2	8.6	8.4	8.4	8.5	8.2	7.1	8.6
Total-S	wt.%	0.016	0.083	0.21	0.39	0.031	0.10	0.42	1.1	0.035	0.045
Sulphate-S	wt.%	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	0.01	*<0.01*	0.02	*<0.01*	*<0.01*
Sulphide-S	wt.%	0.01	0.07	0.18	0.38	0.01	0.05	0.35	1.1	*<0.01*	0.03
CaNP	kg $CaCO_3$/t	19	40	55	20	78	132	174	151	0.8	9.2
Sobek NP	kg $CaCO_3$/t	23	33	52	20	75	173	181	127	2.8	5.7
Siderite NP	kg $CaCO_3$/t	27	41	57	-	76	193	200	-	7.6	9.9
Solid Phase Elements by Aqua Regia											
Ag	ppm	0.17	0.03	0.03	0.06	0.17	0.05	0.11	0.05	0.04	0.03
Al	%	0.58	0.47	0.92	0.34	0.49	1.5	1.4	0.57	0.4	0.38
As	ppm	218	182	86	248	369	67	30	989	298	59
Cd	ppm	0.07	0.05	0.03	0.07	0.14	0.07	0.1	0.13	0.05	0.05
Co	ppm	6.2	4.1	8	1	13	15	14	17	1.6	1.6
Cr	ppm	142	122	112	100	125	190	145	111	132	125
Cu	ppm	9.8	5.9	6.7	2	24	16	18	27	7.6	5.6
Fe	%	1.5	1.2	1.8	0.6	2.9	2.6	2.9	3.7	0.87	1.1
Hg	ppm	0.15	0.24	0.07	0.11	0.44	0.03	0.12	0.51	0.14	0.08
Mn	ppm	339	280	373	102	530	589	660	733	384	678
Mo	ppm	5.0	4.9	4.5	5.4	3.8	5.5	3.3	3.6	6.7	6.2
Ni	ppm	9.7	5.7	13	5.7	27	50	54	43	6.4	5.8
Pb	ppm	11	7.4	6	6	17	9.3	15	43	16	8
Sb	ppm	12	6.9	2.6	2.2	32.6	1.9	2.6	6.4	1.5	0.51
Se	ppm	*<1*	*<1*	*<1*	2	*<1*	*<1*	*<1*	3	*<1*	*<1*
U	ppm	5.5	6.3	6.1	12.4	2.6	2.7	3.2	3.8	7.6	6.2
Zn	ppm	21	16	19	4	41	43	58	91	29	32

Notes: Values in grey italics are below the analytical detection limit; n = number of analyses included in statistical distribution; * adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.2.3.1 for discussion); NNP = net neutralization potential, derived by subtracting AP from NP.

Particle Size Distribution

The rate of dissolution increases as particle surface area increases; therefore, it is important to know the relative volume of fine particles when discussing the bulk samples as a whole (Jambor, 2002). Table 4-26 presents the distribution of grain sizes determined from sub-samples collected from the kinetic tests. These data indicate that the gneiss and schist waste rock kinetic tests are predominantly composed of particles measuring >0.425 mm (>70%), with the greatest proportion composed of particles measuring >0.425 and <6.3 mm. The HC8 and HC7 sub-samples, however, are dominantly composed of particles measuring >6.3 mm in diameter. The granite samples have a finer particle size range, with ~80% of each sub-sample composed of particles measuring <1.7 mm in diameter.

Table 4-26:
Particle Size Distribution for Waste Rock Kinetic Test Sub-Samples

Lithology		Gneiss				Schist				Granite	
Weathering Facies		Oxide	Transition	Fresh		Oxide	Transition	Fresh		Transition	Fresh
Kinetic Test IDs		Col 5	Col 6	-	-	Col 3	Col 4	-	-	Col 13	-
		-	HC3	HC4	HC8	-	HC1	HC2	HC7	HC5	HC6
		FB-GO	FB-GT	FB-GS	-	FB-SO	FB-ST	FB-SS	-	FB-GGT	FB-GGS
Sieve Designation	Aperture (mm)	Weight Retained (%)									
+ 3/8"	9.5	0.6	2.4	1.5	15	1.5	2.2	1.1	13	*ND*	*ND*
-3/8" + 1/4"	6.3	5.1	17	10	47	12	13	12	40	0.08	0
-1/4" + 5	4.0	17	26	22	17	23	19	20	17	1.9	2.4
5	1.7	19	18	21	11	20	15	17	14	18	20
25	0.425	27	18	22	7.7	23	24	23	12	35	35
65	0.15	13	7.3	9.0	1.6	9.0	11	11	3.1	18	17
170	0.053	9.5	5.6	7.5	1.0	5.9	8.5	7.6	1.3	13	12
-270	-0.053	8.9	5.7	7.0	0.10	5.8	7.4	7.6	1.1	15	13
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

4.1.6.3 Laboratory Kinetic Test Results

Results of the waste rock laboratory kinetic test program, including unsaturated columns and humidity cell tests, for gneiss, schist and granite weathering facies are presented and discussed in this section. A summary of the final and median loading rates from each kinetic test is presented in Table 4-27 (gneiss), Table 4-28 (schist) and Table 4-29 (granite). Note that the program for the granite waste rock was initiated after the gneiss and schist programs; therefore, there are fewer weeks of data for the granite tests (Table 4-23). Time series plots for weekly loading rates are presented in Figure 4-10 through Figure 4-14. The complete set of leachate concentrations, calculated loading rates and time series plots for unsaturated columns and humidity cell waste rock kinetic tests are provided in Appendix D.1.

Leachate pH and Sulphate Loading

Leachate pH for the gneiss, schist and granite waste rock laboratory kinetic tests are neutral to slightly alkaline, with weekly pH values for gneiss and schist kinetic tests generally ranging between 7.5 and 8.3 over the test period (Figure 4-10) and increasing over the recirculation experiment (between the dashed lines, Figure 4-10). Leachate pH values for the granite waste rock, particularly the fresh facies (Col 13 and HC6), are slightly lower, ranging from 6.7 to 8.2, and shows a slight decrease over the test period.

Weekly alkalinity loadings from the waste rock columns and humidity cells show a slight decrease over the test period. Alkalinity loading rates decrease from ~6 to ~2 mg $CaCO_3$/kg/wk from the columns and from ~25 to ~15 mg $CaCO_3$/kg/wk from the humidity cells, with a greater decrease observed during the recirculation experiment and from the high S fresh facies tests (HC8 and HC7). In general, alkalinity production rates are higher (by nearly an order of magnitude) from the transition and fresh facies humidity cell tests (particularly from the schist) compared to the columns. The slightly lower pH for the granite transition and fresh facies is consistent with a more prominent decrease in alkalinity production from the granite waste rock, particularly the fresh facies column (decreasing to <0.4 mg $CaCO_3$/kg/wk, Figure 4-11).

After the initial flush of the test material loading rates for sulphate decrease to <1 mg/kg/wk around week 20 from all waste rock kinetic tests (Figure 4-12). Weekly sulphate loadings from the humidity cells remain stable near or below the detection limit (equivalent to 2 mg/L) for the rest of the test period. Sulphate loadings from the columns continue to decrease over the test period, with lower rates (<0.1 mg/kg/wk) measured for the oxide facies of the gneiss and schist waste rock (Col 5 and Col 6). Loading rates are observed to decrease further during re-circulation experiment, as discussed below.

Table 4-27:
Loading Rates for Gneiss Waste Rock Laboratory Kinetic Tests

Parameter	Unit	Gneiss														
		Oxide (Col 5)			Transition (Col 6)			Transition (HC 3) (DUP of Col 6)			Fresh (HC 4)			Fresh (HC 8)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH	s.u.	8.2	8.2	8.2	8.3	8.2	8.3	7.5	7.7	7.8	7.8	7.8	7.8	7.3	7.4	7.5
Alkalinity	mg $CaCO_3$/kg/wk	1.7	2.4	2.7	2.0	2.2	2.2	8.7	11	13	16	16	18	5.3	5.2	5.4
Sulphate	mg/kg/wk	0.098	0.099	0.11	0.23	0.32	0.34	1.0	1.0	1.0	0.98	0.98	1.00	0.99	0.99	0.99
D-Al	mg/kg/wk	0.000069	0.000069	0.000088	0.000074	0.000095	0.00011	0.0072	0.0095	0.012	0.016	0.020	0.023	0.0054	0.0060	0.0067
D-Sb	mg/kg/wk	0.000039	0.000040	0.000041	0.00017	0.00014	0.00016	0.00025	0.00040	0.00045	0.00069	0.0014	0.0016	0.00064	0.00064	0.00067
D-As	mg/kg/wk	0.00025	0.00021	0.00024	0.00078	0.00079	0.00085	0.0016	0.0025	0.0040	0.0013	0.0024	0.0031	0.0076	0.0084	0.0091
D-Cd	mg/kg/wk	0.000000090	0.000000098	0.00000016	0.000000093	0.00000013	0.00000022	0.0000015	0.0000015	0.0000019	0.0000015	0.0000015	0.0000015	0.0000015	0.0000020	0.0000023
D-Ca	mg/kg/wk	0.43	0.43	0.45	0.50	0.49	0.50	2.3	2.4	2.6	4.0	3.8	4.3	1.1	1.1	1.1
D-Cr	mg/kg/wk	0.000010	0.0000067	0.0000094	0.0000011	0.0000011	0.0000014	0.000015	0.000015	0.000015	0.000015	0.000015	0.000015	0.000015	0.000015	0.000017
D-Co	mg/kg/wk	0.00000056	0.00000095	0.0000012	0.00000040	0.00000076	0.00000085	0.0000045	0.000010	0.000015	0.0000048	0.0000074	0.0000097	0.0000078	0.0000096	0.000011
D-Cu	mg/kg/wk	0.000014	0.000019	0.000021	0.0000060	0.000013	0.000015	0.00012	0.00014	0.00020	0.00011	0.00015	0.00024	0.00013	0.00025	0.00030
D-Fe	mg/kg/wk	0.00011	0.000100	0.00011	0.000100	0.000100	0.00011	0.0035	0.0035	0.0035	0.0034	0.0034	0.0035	0.0035	0.0035	0.0035
D-Pb	mg/kg/wk	0.00000049	0.00000049	0.00000084	0.00000047	0.00000019	0.00000051	0.0000051	0.0000051	0.000014	0.0000049	0.0000050	0.0000099	0.000010	0.000015	0.000025
D-Mg	mg/kg/wk	0.15	0.15	0.16	0.23	0.24	0.25	0.62	0.69	0.80	1.2	1.2	1.4	0.42	0.43	0.44
D-Mn	mg/kg/wk	0.0000029	0.0000088	0.000014	0.0000020	0.0000061	0.000010	0.0030	0.0034	0.0040	0.0033	0.0041	0.0047	0.0029	0.0026	0.0029
D-Hg	mg/kg/wk	0.00016	0.00014	0.00016	0.00014	0.00014	0.00015	0.0051	0.0050	0.0051	0.0049	0.0049	0.0050	0.0050	0.0050	0.0062
D-Mo	mg/kg/wk	0.00035	0.00032	0.00034	0.00023	0.00045	0.00051	0.00020	0.00041	0.00059	0.00018	0.00033	0.00041	0.000055	0.00012	0.00024
D-Ni	mg/kg/wk	0.0000033	0.0000058	0.0000070	0.0000034	0.0000067	0.0000075	0.000051	0.000050	0.000051	0.000049	0.000049	0.000050	0.000050	0.000051	0.000098
D-Se	mg/kg/wk	0.0000011	0.0000029	0.000013	0.0000012	0.0000026	0.000014	0.000020	0.000020	0.00040	0.000020	0.000025	0.00039	0.000020	0.000020	0.000040
D-Ag	mg/kg/wk	0.000000033	0.000000030	0.000000035	0.000000029	0.000000029	0.000000034	0.0000010	0.0000010	0.0000010	0.00000098	0.00000098	0.00000099	0.00000099	0.00000099	0.0000010
D-U	mg/kg/wk	0.0013	0.0013	0.0014	0.0038	0.0035	0.0038	0.0079	0.011	0.013	0.0034	0.0036	0.0042	0.0094	0.0099	0.010
D-Zn	mg/kg/wk	0.000016	0.000015	0.000017	0.000014	0.000014	0.000016	0.00051	0.00050	0.00051	0.00049	0.00049	0.00050	0.00050	0.00050	0.00050

Notes: All* excludes the first 10 cycles (which represent the flushing of surface oxidation products) and the recirculation cycles.

Table 4-28:
Loading Rates for Schist Waste Rock Laboratory Kinetic Tests

Parameter	Unit	Schist													
		Oxide (Col 3)			Transition (Col 4)			Transition (HC 1) (DUP of Col 4)			Fresh (HC 2)			Fresh (HC 7)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH	s.u.	8.2	8.1	8.2	8.2	8.2	8.2	7.8	7.8	7.9	7.9	7.9	7.9	7.5	7.6	7.6
Alkalinity	mg $CaCO_3$/kg/wk	2.0	2.1	2.3	1.9	2.2	2.3	16	17	18	18	18	20	11	11	11
Sulphate	mg/kg/wk	0.12	0.18	0.26	0.88	1.0	1.2	1.0	1.0	1.5	1.0	0.99	1.5	1.5	2.0	2.3
D-Al	mg/kg/wk	0.000070	0.000068	0.000078	0.000070	0.000076	0.000098	0.013	0.013	0.014	0.018	0.021	0.025	0.0068	0.0078	0.0091
D-Sb	mg/kg/wk	0.000063	0.000050	0.000052	0.000026	0.000031	0.000034	0.000099	0.00015	0.00019	0.0020	0.0040	0.0057	0.0030	0.0031	0.0035
D-As	mg/kg/wk	0.00018	0.00011	0.00016	0.000099	0.00010	0.00011	0.0010	0.0012	0.0015	0.0014	0.0028	0.0045	0.0075	0.0093	0.010
D-Cd	mg/kg/wk	0.000000052	0.000000041	0.000000062	0.00000014	0.00000014	0.00000020	0.0000015	0.0000015	0.0000017	0.0000015	0.0000015	0.0000023	0.0000015	0.0000015	0.0000016
D-Ca	mg/kg/wk	0.51	0.50	0.53	0.56	0.52	0.55	4.5	4.4	4.6	4.8	4.7	5.0	2.7	2.7	2.8
D-Cr	mg/kg/wk	0.000016	0.0000094	0.000012	0.000011	0.0000072	0.000011	0.000040	0.000030	0.000045	0.000015	0.000015	0.000023	0.000015	0.000015	0.000016
D-Co	mg/kg/wk	0.00000051	0.00000059	0.00000091	0.00000060	0.0000012	0.0000016	0.0000020	0.0000064	0.0000087	0.000020	0.000021	0.000026	0.00014	0.00015	0.00017
D-Cu	mg/kg/wk	0.0000090	0.000015	0.000020	0.000017	0.000022	0.000027	0.00011	0.00019	0.00028	0.000099	0.00015	0.00021	0.000078	0.00015	0.00020
D-Fe	mg/kg/wk	0.00012	0.000092	0.000098	0.00012	0.00011	0.00012	0.0035	0.0034	0.0035	0.0035	0.0035	0.0035	0.0034	0.0034	0.0035
D-Pb	mg/kg/wk	0.0000015	0.00000029	0.00000066	0.0000015	0.00000061	0.0000015	0.0000050	0.0000050	0.000015	0.0000050	0.0000050	0.000015	0.000015	0.000015	0.000023
D-Mg	mg/kg/wk	0.21	0.20	0.23	0.29	0.28	0.29	0.93	1.1	1.3	1.3	1.4	1.7	1.1	1.2	1.2
D-Mn	mg/kg/wk	0.0000044	0.0000075	0.000010	0.0000079	0.000029	0.000044	0.0017	0.0018	0.0021	0.0071	0.0060	0.0068	0.0057	0.0055	0.0061
D-Hg	mg/kg/wk	0.00017	0.00013	0.00014	0.00017	0.00016	0.00017	0.0050	0.0049	0.0050	0.0050	0.0050	0.0050	0.0049	0.0049	0.0050
D-Mo	mg/kg/wk	0.000063	0.000041	0.000053	0.00025	0.00037	0.00045	0.00031	0.00064	0.00093	0.000055	0.00013	0.00017	0.000044	0.00012	0.00029
D-Ni	mg/kg/wk	0.0000035	0.0000059	0.0000070	0.000015	0.000020	0.000026	0.000050	0.000050	0.000050	0.00020	0.00020	0.00025	0.00064	0.00077	0.00084
D-Se	mg/kg/wk	0.0000043	0.0000052	0.000013	0.0000087	0.0000096	0.000014	0.000045	0.000058	0.00041	0.000020	0.000031	0.00042	0.000020	0.000020	0.000042
D-Ag	mg/kg/wk	0.000000033	0.000000026	0.000000029	0.000000033	0.000000033	0.000000045	0.0000010	0.00000099	0.0000012	0.0000010	0.00000099	0.0000010	0.00000098	0.00000099	0.0000012
D-U	mg/kg/wk	0.000074	0.000069	0.000075	0.00057	0.00059	0.00061	0.0010	0.0015	0.0018	0.0020	0.0027	0.0034	0.0020	0.0023	0.0025
D-Zn	mg/kg/wk	0.000018	0.000014	0.000020	0.000017	0.000017	0.000019	0.00050	0.00049	0.00050	0.00050	0.00050	0.00050	0.00049	0.00049	0.00049

Notes: All* excludes the first 10 cycles (which represent the flushing of surface oxidation products) and the recirculation cycles.

Table 4-29:
Loading Rates for Granite Waste Rock Laboratory Kinetic Tests

Parameter	Unit	Granite											
		Transition (Col 13)			Fresh (Col 14)			Transition (HC 5) (DUP of Col 13)			Fresh (HC 6) (DUP of Col 14)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH	s.u.	7.5	7.5	7.5	8.2	8.2	8.2	6.7	7.1	7.3	7.0	7.3	7.3
Alkalinity	mg $CaCO_3$/kg/wk	0.31	0.29	0.32	1.4	1.6	1.6	1.6	2.0	2.2	4.8	5	6
Sulphate	mg/kg/wk	0.45	0.46	0.53	0.60	0.60	0.67	1.0	1.0	1.0	0.98	0.99	0.99
D-Al	mg/kg/wk	0.000045	0.000050	0.000077	0.000074	0.000077	0.000088	0.0072	0.017	0.029	0.0094	0.021	0.030
D-Sb	mg/kg/wk	0.00010	0.000090	0.00010	0.000094	0.000093	0.000094	0.00029	0.00054	0.00080	0.00025	0.00037	0.00044
D-As	mg/kg/wk	0.0016	0.0015	0.0016	0.00045	0.00045	0.00046	0.014	0.026	0.050	0.0047	0.0076	0.012
D-Cd	mg/kg/wk	0.000000077	0.000000073	0.000000084	0.00000015	0.00000013	0.00000017	0.0000015	0.0000019	0.0000052	0.0000015	0.0000015	0.0000022
D-Ca	mg/kg/wk	0.050	0.049	0.050	0.52	0.53	0.55	0.16	0.15	0.16	1.2	1.4	1.6
D-Cr	mg/kg/wk	0.00000045	0.00000045	0.00000078	0.00000044	0.00000051	0.00000073	0.000015	0.000017	0.000020	0.000015	0.000015	0.000015
D-Co	mg/kg/wk	0.000015	0.000014	0.000015	0.000012	0.000012	0.000014	0.000049	0.000050	0.000058	0.000032	0.000027	0.000033
D-Cu	mg/kg/wk	0.0000084	0.0000083	0.000013	0.0000068	0.0000072	0.0000084	0.00029	0.00022	0.00026	0.00013	0.00012	0.00018
D-Fe	mg/kg/wk	0.00011	0.000085	0.000098	0.000100	0.000100	0.00010	0.0035	0.0073	0.012	0.0034	0.0051	0.0093
D-Pb	mg/kg/wk	0.00000060	0.00000053	0.0000011	0.0000019	0.0000019	0.0000037	0.000025	0.000050	0.000081	0.0000099	0.000039	0.000053
D-Mg	mg/kg/wk	0.013	0.012	0.013	0.10	0.11	0.11	0.043	0.040	0.044	0.21	0.23	0.26
D-Mn	mg/kg/wk	0.0070	0.0060	0.0067	0.012	0.012	0.012	0.024	0.021	0.023	0.039	0.033	0.038
D-Hg	mg/kg/wk	0.00015	0.00012	0.00014	0.00014	0.00014	0.00015	0.0051	0.0050	0.0051	0.0049	0.0049	0.0050
D-Mo	mg/kg/wk	0.000032	0.000045	0.000048	0.00016	0.00016	0.00020	0.00013	0.00066	0.0011	0.00010	0.00032	0.00044
D-Ni	mg/kg/wk	0.0000045	0.0000046	0.0000051	0.0000029	0.0000030	0.0000044	0.000051	0.000050	0.000051	0.000049	0.000049	0.000050
D-Se	mg/kg/wk	0.00000060	0.00000065	0.00000087	0.00000058	0.00000064	0.0000010	0.000020	0.000020	0.000037	0.000020	0.000020	0.000022
D-Ag	mg/kg/wk	0.000000030	0.000000026	0.000000037	0.000000029	0.000000029	0.000000029	0.0000010	0.0000010	0.0000042	0.00000098	0.00000100	0.0000017
D-U	mg/kg/wk	0.000013	0.000013	0.000014	0.00081	0.00081	0.00088	0.00014	0.00023	0.00044	0.00031	0.00041	0.00048
D-Zn	mg/kg/wk	0.000	0.000036	0.000050	0.000015	0.000015	0.000028	0.00098	0.00051	0.00098	0.00049	0.00049	0.00050

Notes: All* excludes the first 10 cycles (which represent the flushing of surface oxidation products) and the recirculation cycles.

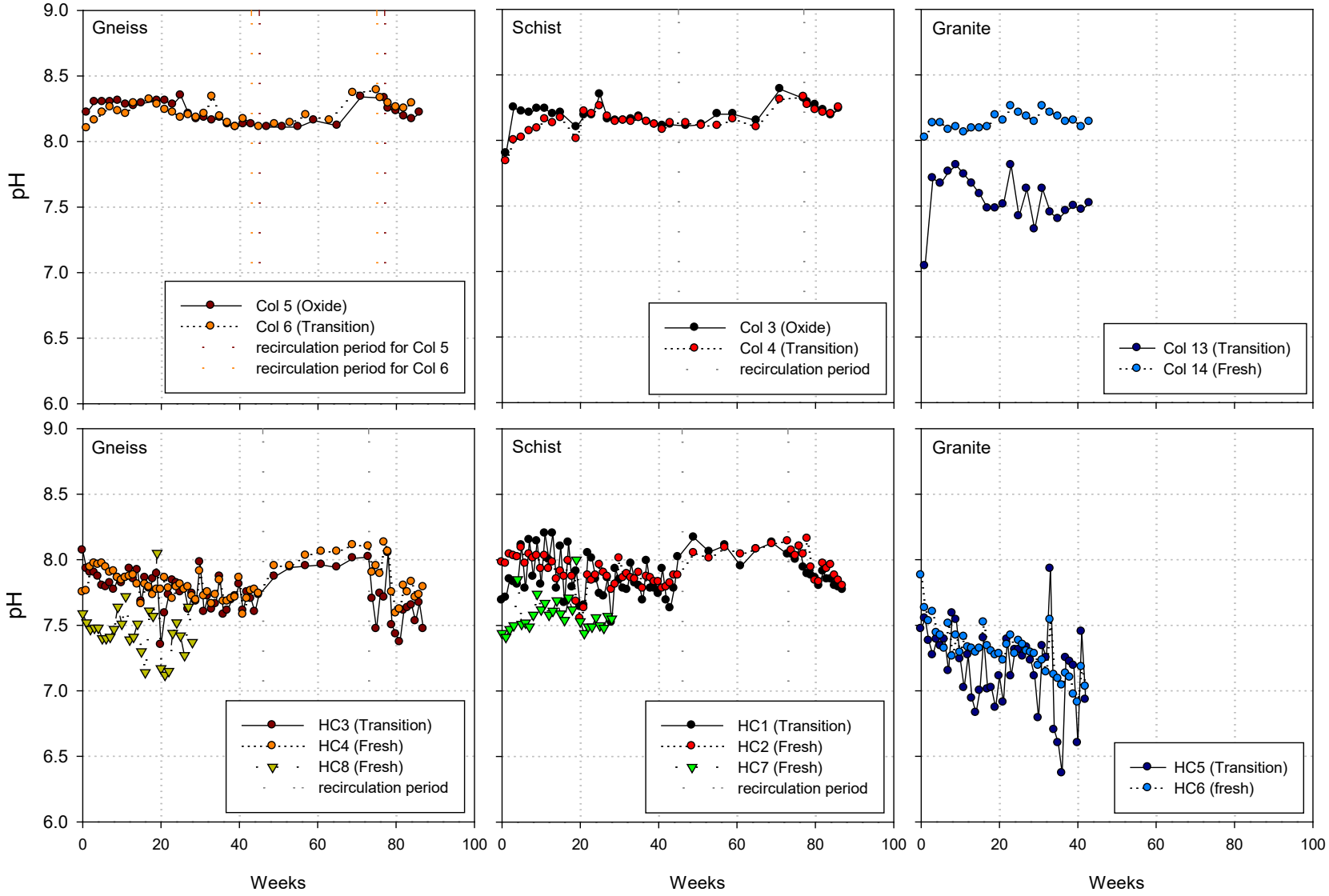


Figure 4-10: Leachate pH from gneiss, schist and granite waste rock unsaturated columns and humidity cells.

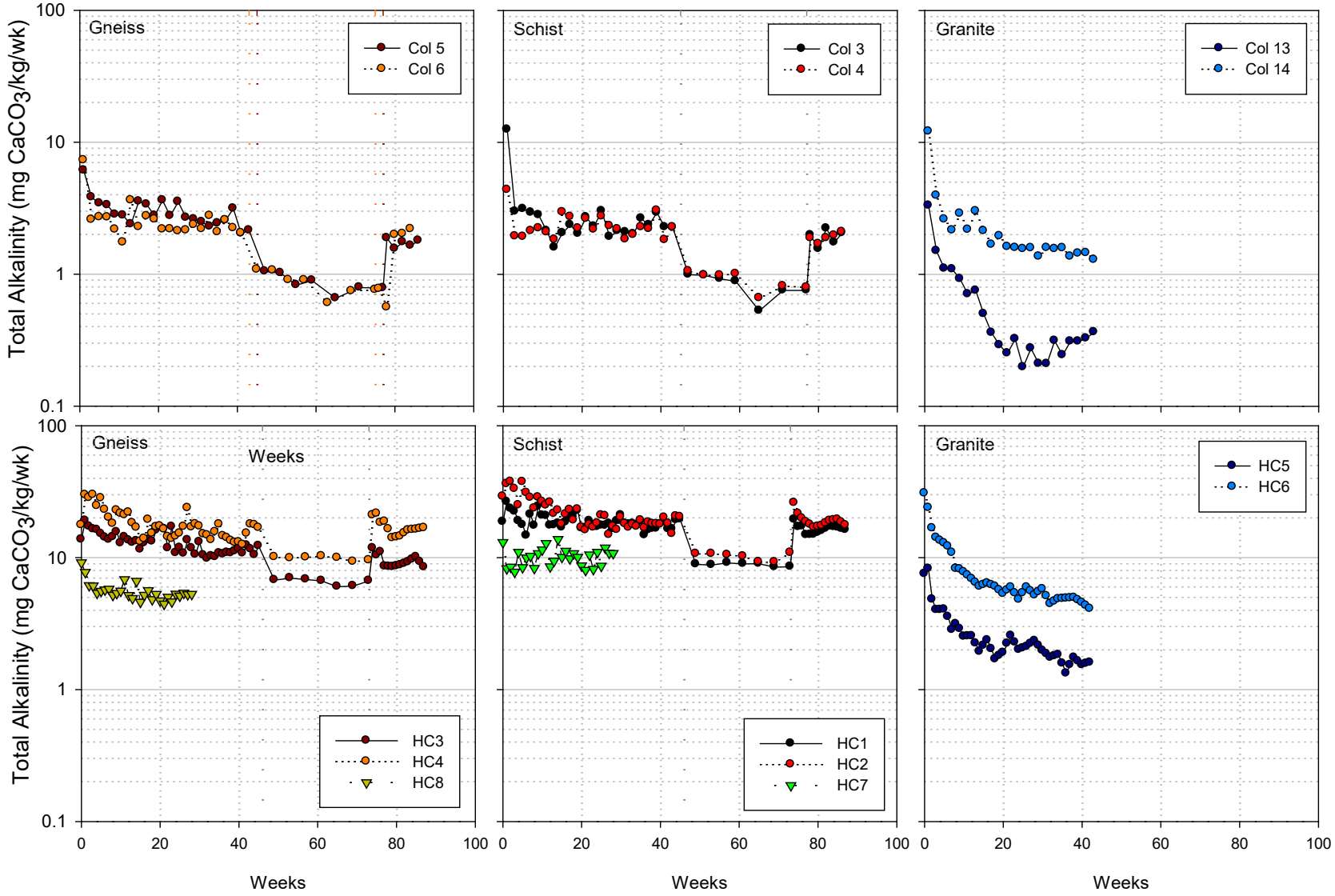


Figure 4-11: Alkalinity loading rates from gneiss, schist and granite waste rock unsaturated columns and humidity cells.

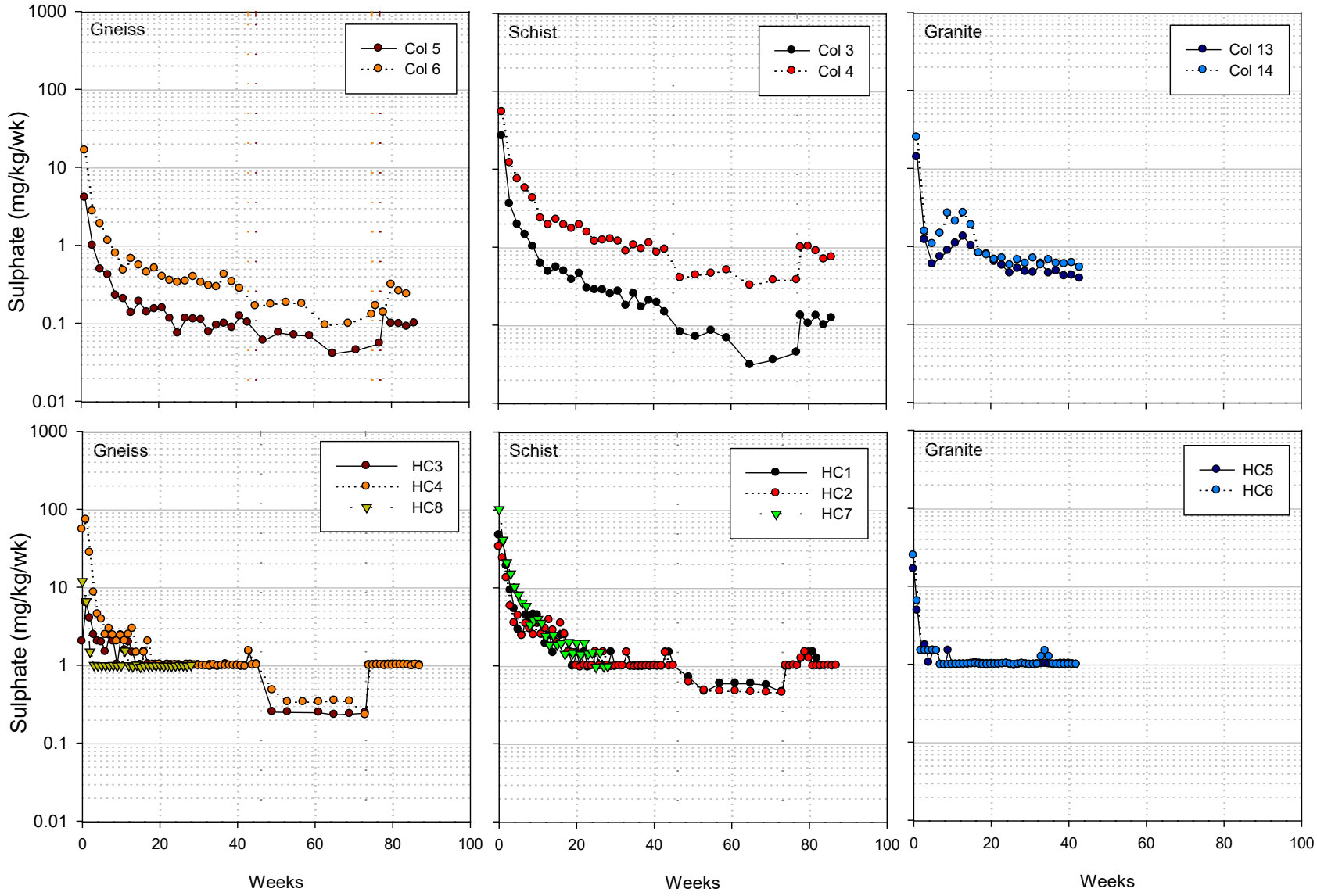


Figure 4-12: Sulphate loading rates from gneiss, schist and granite waste rock unsaturated columns and humidity cells

Metal Leaching Results

Potential metals of concern identified during static testwork include As, Sb, Cr, U and possibly Hg (Section 4.1.4 and 4.1.5). Loading rates for Hg decrease rapidly to below the analytical detection limit (0.01 µg/L; Appendix D.1) from all waste rock kinetic tests following the initial flushing of surface oxidation products. Time series profiles for the other parameters (As, Sb, Cr and U) from the waste rock kinetic tests are shown in Figure 4-13 (columns) and Figure 4-14 (humidity cells). Kinetic test results show that metal loading rates are affected by both rock type and the kinetic test procedure (i.e., humidity cell versus column).

The highest As loading rates are observed in the granite humidity cells and columns, which is consistent with SFE results but not necessarily solid phase metal abundance. Several kinetic test samples (Col 5, Col 3, and HC7) have higher As content than the granite samples but are producing lower As loading rates. This result can be related to differences in pH and Fe abundance, which will be discussed in more detail in Section 5.1.4.1.

Antimony loading rates vary widely between different kinetic tests. Column results Figure 4-14 generally show similar Sb loading rates for the three major lithologies. There is some indication that higher loading rates are associated with less weathered mine rock. This result is inconsistent with relative Sb enrichment in Sb test samples, as Sb content has a relationship with the degree of weathering.

Chromium loading rates are generally highest in the schist lithology, as indicated by column results. However, leachate concentrations are relatively low even in the schist columns, with the maximum concentration after the first flush being 0.00102 mg/L. Humidity cells generally produced Cr concentrations at or below the detection limit of 0.00003 mg/L, confounding any comparison between rock units.

The highest U loadings are generally observed in the gneiss lithology. The granite lithology, which contains similar solid phase U concentrations, produced a wide range of U loading rates. This variation in U loading rates can be related to alkalinity. That is, granite kinetic tests Col 13 and HC6 which are producing relatively high U loading rates, compared to Col 15 and HC5, are also producing relatively high alkalinity loading rates. This result is related to alkalinity supporting uranium solubility in neutral pH environments.

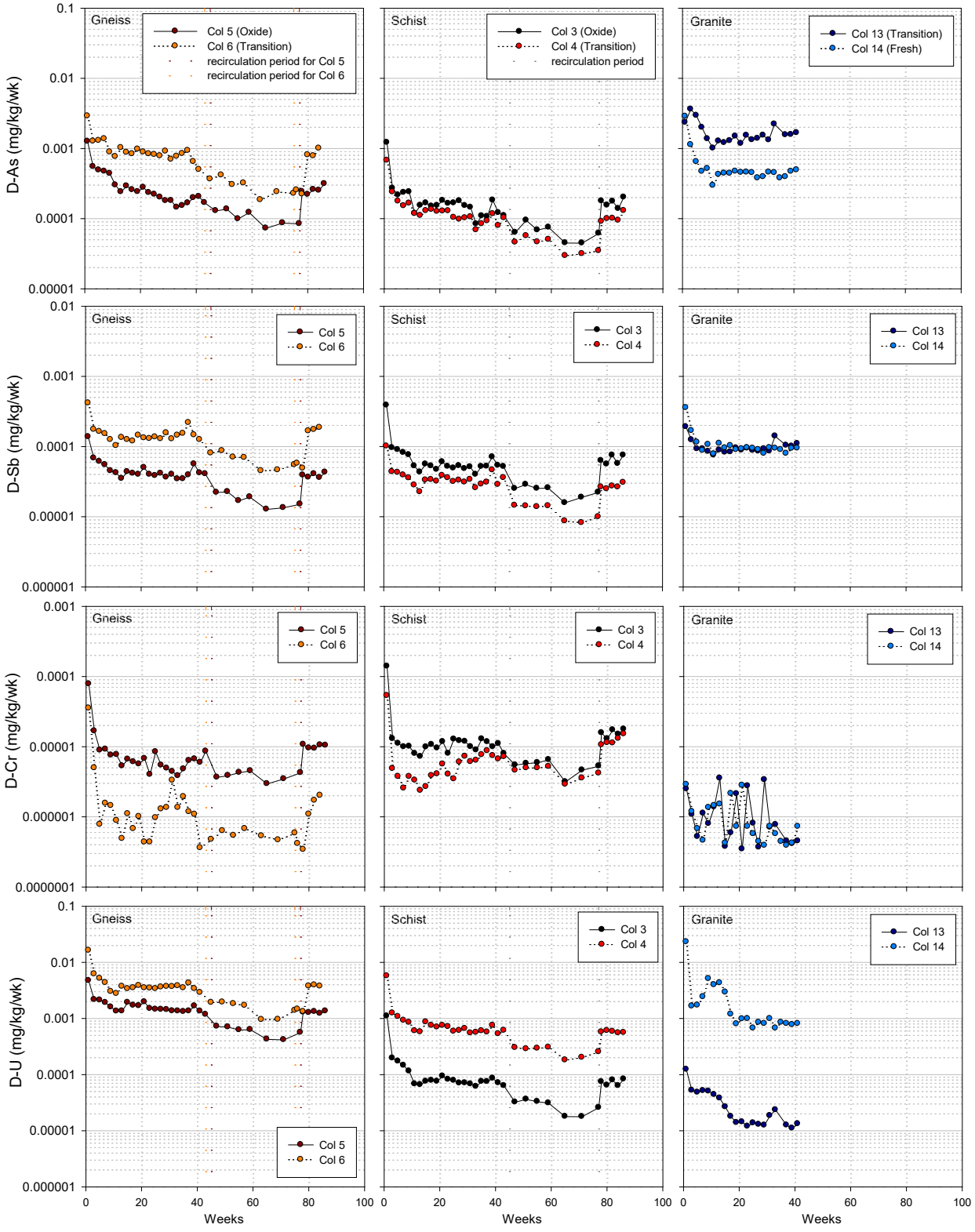


Figure 4-13: Metal (As, Sb, Cr and U) loading rates from gneiss, schist and granite waste rock unsaturated columns

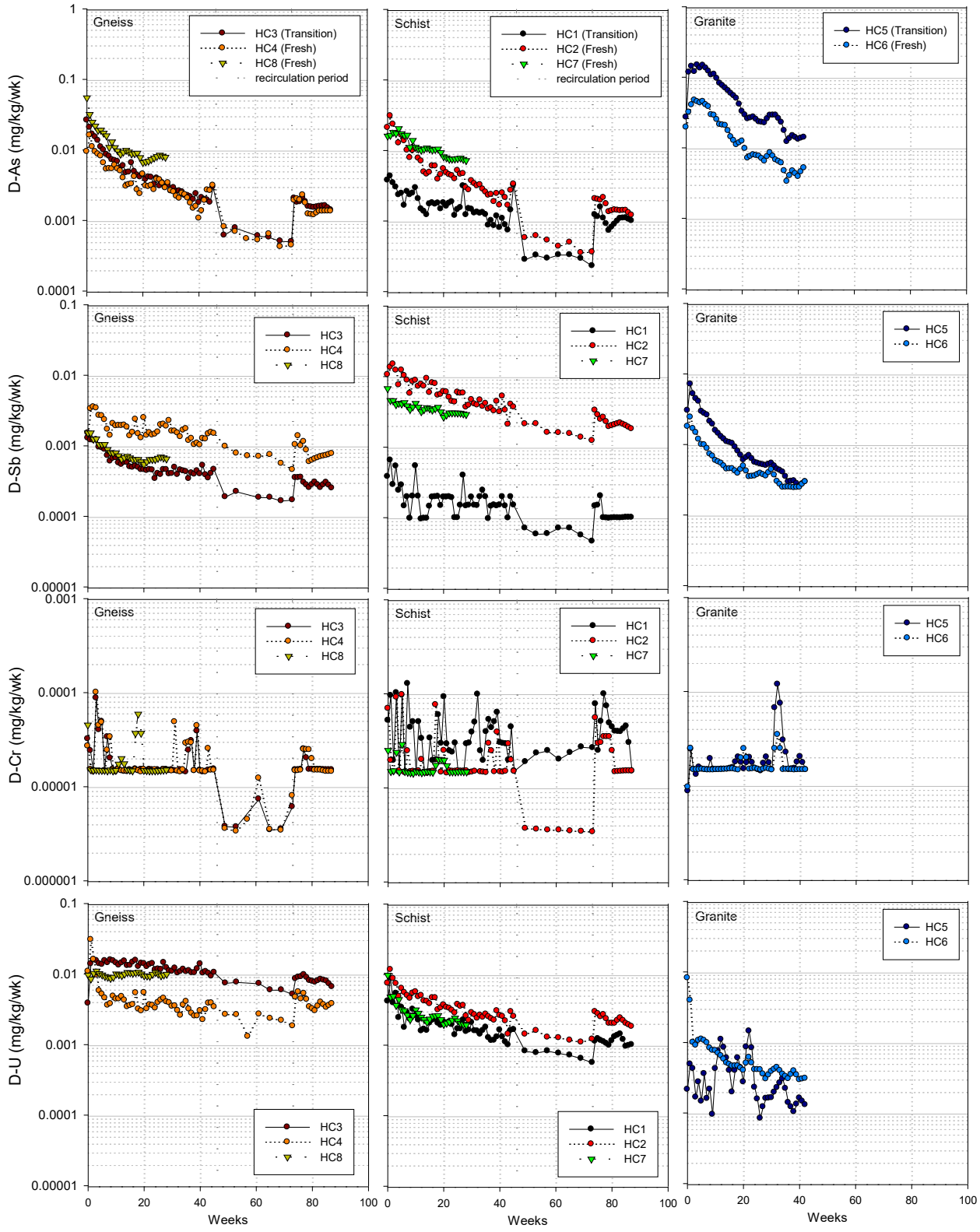


Figure 4-14: Metal (As, Sb, Cr and U) loading rates from gneiss, schist and granite waste rock humidity cells

In general, kinetic tests composed of the same test sub-samples are producing similar results with respect to leachate quality. In particular, preliminary data for the field kinetic tests (presented in Section 4.1.5.4), which are subjected to the actual site conditions and precipitation rates, support the results produced by the controlled (increased weathering) laboratory kinetic tests. Specifically, the highest As concentrations are leaching from field and laboratory kinetic tests composed of granite waste rock, in particular the transition facies and the highest Sb concentrations are produced by the schist fresh facies kinetic tests. The highest U concentrations are produced by the gneiss waste rock, transition and fresh facies, as well as the fresh facies for the schist and granite waste rock. The gneiss and schist oxide facies kinetic tests are producing the highest Cr concentrations and the lowest As and Sb concentrations (as well as the lowest U for the schist oxide).

Furthermore, the highest sulphate concentrations are produced by the gneiss and schist fresh facies kinetic tests and Mn tends to be elevated in all the granite transition and fresh facies kinetic tests compared to the gneiss and schist kinetic tests.

Recirculation Experiment

The gneiss and schist waste rock unsaturated columns and humidity cell tests were subjected to recirculation periods (Table 4-30) that involved recirculating the weekly (or biweekly) effluent (leachate) as influent to the tests. The objective of the recirculation experiment was to simulate a slower flowrate and therefore a longer residence time to allow for assessment of whether the leachate chemistry produced by the kinetic tests are controlled primarily by the kinetic loading rates or by pH related solubility influences.

Table 4-30 presents the final loading rate prior to the recirculation experiment (*i.e.,* reduction in flow rate), the final loading rate of the recirculation experiment and the median value for the recirculation period. The calculated differences between the final loading rate prior to the experiment and the final and median loading rates of the recirculation period are highlighted in yellow in Table 4-30. The recirculation periods are marked on the time series plots by dashed vertical lines (Figure 4-10 to Figure 4-14).

All kinetic tests show a slight increase in pH over the recirculation period. The increase in pH is particularly evident for the gneiss transition and fresh facies humidity cell tests, which increase by approximately half a pH unit. Loading rates for alkalinity, sulphate and nearly all metals decrease following the reduced flow conditions in the unsaturated waste rock laboratory kinetic tests (Table 4-30), with the majority of parameters from the waste rock columns and humidity cells decreasing by more than 50% (i.e., Diff of -50 or lower) by the final cycle of the recirculation period. For humidity cell tests comprising gneiss waste rock, many parameters decrease by more than 75%. Of note, are the increases in Cr from Col 6 (gneiss transition) and HC1 (schist transition) and the increase in Mo from HC2

(schist fresh). Other parameters such as Cd show increased, but fluctuating, loading rates over the recirculation period (Appendix D.1). The largest production decreases from the gneiss and schist waste rock columns are for Mn, Ni, Se, Ag and, to a lesser degree, Sb and Cu (as well as sulphate from schist oxide, Col 3). The largest decreases from the gneiss and schist humidity cells are for Al, As, Cd and Hg (>76%) as well as sulphate, Cu, Ni and Zn production rates from both gneiss waste rock humidity cells (HC3 and HC4).

Table 4-31 presents the concentrations prior to and during the recirculation experiment and the calculated percent differences (highlighted in yellow in Table 4-31). Time series profiles for leachate concentrations are presented in Appendix D.1. Concentrations for many parameters from the waste rock kinetic tests, particularly the columns, remain relatively unchanged (a percent difference of 0 indicates no change in concentration over the recirculation period), further supporting that metal release is primarily controlled by flushing rates and sample mass (i.e., solubility controls). Moreover, a pronounced increase in pH and alkalinity is observed for the humidity cells over the recirculation period, consistent with the increase in several metals over the same time frame, namely anion forming metals (i.e., Sb, As, Cr, Mo, U) (Table 4-31; Appendix D.1). In columns where pH and alkalinity remain relatively stable during the re-circulation time period, no such increase in anion forming metal concentrations is observed.

Table 4-30:
Loading Rate and Percent Differences for Recirculation Experiment for Gneiss and Schist Waste Rock Kinetic Tests

Kinetic Test	Loading Rates	pH	Cond.	Alkalinity (as $CaCO_3$)	Sulphate	Al	Sb	As	Cd	Cr	Cu	Fe	Mn	Hg	Mo	Ni	Se*	Ag	U	Zn
		s.u.	µS/cm	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	µg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
Unsaturated Columns																				
Gneiss Oxide (Col 5)	Cycle immediately before recirculation period (Cycle 43)	8.1	278	2.1	0.10	0.000074	0.000041	0.00017	0.000000044	0.0000086	0.000017	0.00010	0.0000088	0.00015	0.00030	0.0000058	0.0000012	0.000000058	0.0012	0.000015
	Final cycle of recirculation period (Cycle 77)	8.3	256	0.78	0.055	0.000040	0.000015	0.000084	0.000000021	0.0000042	0.0000077	0.000048	0.0000013	0.000068	0.00015	0.0000014	0.00000048	0.000000014	0.00056	0.0000068
	Median for recirculation period (cycles 45-77)	8.1	256	0.83	0.060	0.000043	0.000017	0.000099	0.000000084	0.0000039	0.0000071	0.000049	0.0000018	0.000084	0.00019	0.0000015	0.00000051	0.000000017	0.00063	0.0000070
	% Change of Final Recirculation Cycle		-8.2	-64	-46	-46	-63	-50	-53	-50	-56	-53	-85	-53	-51	-76	-61	-76	-52	-53
	% Change of Median for Recirculation Period		-8.2	-61	-41	-42	-59	-41	93	-55	-59	-52	-80	-42	-38	-74	-58	-71	-47	-52
Gneiss Transition (Col 6)	Cycle immediately before recirculation period (Cycle 41)	8.2	343	2.0	0.28	0.00010	0.00012	0.00050	0.000000036	0.00000036	0.000014	0.000084	0.0000088	0.00012	0.00027	0.0000060	0.0000023	0.000000036	0.0029	0.000012
	Final cycle of recirculation period (Cycle 75)	8.4	316	0.76	0.13	0.000044	0.000055	0.00023	0.000000018	0.00000058	0.0000041	0.000041	0.00000058	0.000058	0.000094	0.0000012	0.00000064	0.000000012	0.0014	0.0000058
	Median for recirculation period (cycles 43-75)	8.2	310	0.90	0.17	0.000059	0.000070	0.00030	0.000000042	0.00000058	0.0000047	0.000047	0.0000038	0.000068	0.00014	0.0000020	0.00000088	0.000000016	0.0017	0.0000068
	% Change of Final Recirculation Cycle		-7.8	-63	-54	-57	-56	-54	-51	62	-72	-51	-93	-51	-65	-81	-72	-68	-52	-51
	% Change of Median for Recirculation Period		-9.6	-56	-40	-42	-44	-39	13	50	-67	-44	-73	-44	-50	-66	-62	-56	-41	-44
Schist Oxide (Col 3)	Cycle immediately before recirculation period (Cycle 43)	8.1	318	2.3	0.15	0.000072	0.000052	0.00011	0.000000040	0.0000080	0.000020	0.000093	0.0000073	0.00013	0.000041	0.0000053	0.0000040	0.000000040	0.000063	0.000013
	Final cycle of recirculation period (Cycle 77)	8.3	263	0.76	0.044	0.000039	0.000022	0.000061	0.000000019	0.0000053	0.0000062	0.000044	0.0000011	0.000063	0.000025	0.0000013	0.00000082	0.000000013	0.000026	0.0000063
	Median for recirculation period (cycles 45-77)	8.2	269	0.89	0.068	0.000039	0.000025	0.000063	0.000000021	0.0000055	0.0000068	0.000047	0.0000018	0.000070	0.000025	0.0000014	0.0000011	0.000000014	0.000031	0.0000070
	% Change of Final Recirculation Cycle		-17	-67	-70	-46	-57	-44	-52	-34	-69	-52	-85	-52	-39	-76	-79	-68	-59	-52
	% Change of Median for Recirculation Period		-16	-61	-54	-46	-51	-42	-47	-31	-66	-49	-75	-47	-39	-75	-72	-65	-51	-47
Schist Transition (Col 4)	Cycle immediately before recirculation period (Cycle 43)	8.1	375	2.3	0.93	0.00010	0.000036	0.00010	0.000000049	0.0000072	0.000027	0.00011	0.000021	0.00016	0.00043	0.000021	0.0000060	0.00000013	0.00061	0.000016
	Final cycle of recirculation period (Cycle 77)	8.3	365	0.79	0.38	0.000036	0.0000099	0.000035	0.000000021	0.0000042	0.0000071	0.000050	0.0000015	0.000071	0.000092	0.0000057	0.0000023	0.000000014	0.00025	0.0000071
	Median for recirculation period (cycles 45-77)	8.1	365	0.98	0.40	0.000044	0.000014	0.000046	0.000000041	0.0000046	0.0000071	0.000055	0.0000041	0.000081	0.00015	0.0000075	0.0000030	0.000000024	0.00029	0.0000081
	% Change of Final Recirculation Cycle		-2.7	-65	-59	-65	-72	-66	-56	-42	-74	-56	-93	-56	-78	-73	-61	-89	-59	-56
	% Change of Median for Recirculation Period		-2.7	-57	-57	-58	-61	-55	-17	-36	-74	-52	-80	-50	-65	-64	-50	-81	-53	-50
Humidity Cells																				
Gneiss Transition (HC3)	Cycle immediately before recirculation period (Cycle 45)	7.7	38	12	1.0	0.0096	0.00046	0.0030	0.0000015	0.000015	0.00033	0.0036	0.0034	0.0051	0.00031	0.000051	0.0005*	0.0000010	0.010	0.0010
	Final cycle of recirculation period (Cycle 73)	8.0	98	6.7	0.24	0.0015	0.00017	0.00050	0.00000036	0.0000061	0.000047	0.0022	0.0015	0.0012	0.00024	0.000012	0.000017	0.00000036	0.0051	0.00012
	Median for recirculation period (cycles 46-73)	8.0	106	6.7	0.24	0.0015	0.00018	0.00059	0.00000036	0.0000037	0.000047	0.00086	0.0015	0.0012	0.00019	0.000012	0.0000050	0.00000025	0.0059	0.00012
	% Change of Final Recirculation Cycle		157	-46	-76	-84	-63	-83	-76	-60	-86	-39	-55	-76	-21	-76	*NA*	-64	-51	-88
	% Change of Median for Recirculation Period		181	-45	-76	-85	-60	-80	-76	-76	-86	-76	-55	-76	-39	-76	*NA*	-76	-43	-88
Gneiss Fresh (HC4)	Cycle immediately before recirculation period (Cycle 45)	7.7	62	17	0.99	0.021	0.0015	0.0031	0.0000015	0.000015	0.00020	0.0035	0.0047	0.0050	0.00032	0.000050	0.0005*	0.00000099	0.0034	0.00050
	Final cycle of recirculation period (Cycle 73)	8.1	145	9.5	0.23	0.0014	0.00046	0.00044	0.00000034	0.0000080	0.000043	0.0025	0.0018	0.0011	0.00025	0.000011	0.000020	0.00000023	0.0018	0.00011
	Median for recirculation period (cycles 46-73)	8.1	172	9.9	0.33	0.0015	0.00071	0.00055	0.00000035	0.0000036	0.000040	0.00080	0.0018	0.0011	0.00022	0.000022	0.0000089	0.00000024	0.0023	0.00011
	% Change of Final Recirculation Cycle		137	-43	-77	-93	-69	-86	-77	-46	-78	-28	-62	-77	-21	-77	*NA*	-77	-46	-77
	% Change of Median for Recirculation Period		179	-41	-66	-93	-52	-83	-77	-76	-80	-77	-62	-77	-29	-55	*NA*	-76	-32	-77
Schist Transition (HC1)	Cycle immediately before recirculation period (Cycle 45)	8.0	73	20	1.0	0.013	0.00015	0.0032	0.0000015	0.000015	0.00017	0.0035	0.0016	0.0050	0.00077	0.000050	0.0005*	0.0000010	0.0017	0.00050
	Final cycle of recirculation period (Cycle 73)	8.0	138	8.5	0.46	0.0022	0.000046	0.00023	0.00000035	0.000026	0.000071	0.00092	0.00058	0.0012	0.00035	0.000012	0.000028	0.0000015	0.00056	0.00023
	Median for recirculation period (cycles 46-73)	8.1	161	8.9	0.59	0.0012	0.000059	0.00029	0.00000035	0.000024	0.000041	0.00082	0.00046	0.0012	0.00029	0.000024	0.000018	0.00000024	0.00076	0.00012
	% Change of Final Recirculation Cycle		89	-56	-54	-83	-69	-93	-77	76	-57	-74	-63	-77	-55	-77	*NA*	50	-66	-54
	% Change of Median for Recirculation Period		121	-54	-41	-91	-61	-91	-77	57	-75	-77	-71	-77	-62	-53	*NA*	-77	-54	-77
Schist Fresh (HC2)	Cycle immediately before recirculation period (Cycle 45)	7.9	73	20	0.99	0.020	0.0037	0.0033	0.0000015	0.000015	0.00020	0.0035	0.0064	0.0050	0.000050	0.00020	0.0005*	0.00000099	0.0025	0.0015
	Final cycle of recirculation period (Cycle 73)	8.1	172	11	0.45	0.0012	0.0012	0.00036	0.00000034	0.0000034	0.00012	0.0045	0.0034	0.0011	0.00017	0.00017	0.000012	0.00000034	0.0012	0.00023
	Median for recirculation period (cycles 46-73)	8.1	172	10	0.47	0.0015	0.0016	0.00049	0.00000036	0.0000035	0.000052	0.00082	0.0037	0.0012	0.000052	0.00020	0.0000069	0.00000024	0.0013	0.00012
	% Change of Final Recirculation Cycle		134	-46	-55	-94	-67	-89	-77	-77	-40	30	-47	-77	243	-15	*NA*	-66	-52	-85
	% Change of Median for Recirculation Period		134	-48	-53	-93	-57	-85	-76	-76	-75	-76	-42	-76	4.4	0.88	*NA*	-76	-50	-92

Notes: Negative values represent a decrease in production rates; percent difference values are highlighted, * a high detection limit of 0.001 mg/L was often applied for Se analyses; as a result, for all columns, the second to last cycle prior to the recirculation period (which provided a measurable value) was applied for calculation of percent differences; however, for humidity cells, the 13 cycles prior to the recirculation period applied the high detection limit (*i.e.* 0.0005 mg/kg/wk) which is considered to be a disproportionately high value to use in the calculation of percent differences.

Table 4-31:
Concentrations and Percent Differences for Recirculation Experiment for Gneiss and Schist Waste Rock Kinetic Tests

Kinetic Test	Concentrations	pH	Cond.	Alkalinity (as $CaCO_3$)	Sulphate	Al	Sb	As	Cd	Cr	Cu	Fe	Mn	Hg	Mo	Ni	Se*	Ag	U	Zn
		s.u.	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Unsaturated Columns																				
Gneiss Oxide (Col 5)	Cycle immediately before recirculation period (Cycle 43)	8.1	278	148	7.0	0.0051	0.0028	0.012	0.0000030	0.00059	0.0012	0.0070	0.00061	0.010	0.021	0.00040	0.000090	0.0000040	0.081	0.0010
	Final cycle of recirculation period (Cycle 77)	8.3	256	114	8.0	0.0058	0.0022	0.012	0.0000030	0.00062	0.0011	0.0070	0.00019	0.010	0.022	0.00020	0.000070	0.0000020	0.082	0.0010
	Median for recirculation period (cycles 45-77)	8.1	256	122	8.0	0.0066	0.0025	0.015	0.000010	0.00059	0.0011	0.0070	0.00027	0.010	0.026	0.00020	0.000070	0.0000020	0.084	0.0010
	% Change of Final Recirculation Cycle		-8.2	-23	14	14	-21	6.0	0	5.1	-5.9	0	-69	0	3.4	-50	-22	-50	1.1	0
	% Change of Median for Recirculation Period		-8.2	-18	14	29	-11	31	233	0	-6.7	0	-56	0	24	-50	-22	-50	3.3	0
Gneiss Transition (Col 6)	Cycle immediately before recirculation period (Cycle 43)	8.2	343	170	23	0.0085	0.010	0.042	0.0000030	0.000030	0.0012	0.0070	0.00073	0.010	0.022	0.00050	0.00017	0.0000030	0.24	0.0010
	Final cycle of recirculation period (Cycle 77)	8.4	316	130	22	0.0075	0.0094	0.039	0.0000030	0.00010	0.00070	0.0070	0.00010	0.010	0.016	0.00020	0.00011	0.0000020	0.24	0.0010
	Median for recirculation period (cycles 45-77)	8.2	310	135	22	0.0086	0.010	0.046	0.0000060	0.00010	0.00070	0.0070	0.00030	0.010	0.020	0.00030	0.00013	0.0000020	0.24	0.0010
	% Change of Final Recirculation Cycle		-7.8	-24	-4.3	-12	-9.6	-6.3	0	233	-42	0	-86	0	-28	-60	-35	-33	-1.3	0
	% Change of Median for Recirculation Period		-9.6	-21	-4.3	1.2	-0.96	11	100	233	-42	0	-59	0	-10	-40	-24	-33	1.3	0
Schist Oxide (Col 3)	Cycle immediately before recirculation period (Cycle 43)	8.1	318	171	11	0.0054	0.0039	0.0083	0.0000030	0.00060	0.0015	0.0070	0.00055	0.010	0.0031	0.00040	0.00029	0.0000030	0.0048	0.0010
	Final cycle of recirculation period (Cycle 77)	8.3	263	119	7.0	0.0061	0.0035	0.0097	0.0000030	0.00083	0.00098	0.0070	0.00017	0.010	0.0040	0.00020	0.00013	0.0000020	0.0041	0.0010
	Median for recirculation period (cycles 45-77)	8.2	269	135	10	0.0065	0.0037	0.0098	0.0000030	0.00083	0.0010	0.0070	0.00025	0.010	0.0040	0.00020	0.00017	0.0000020	0.0046	0.0010
	% Change of Final Recirculation Cycle		-17	-30	-36	13	-10	17	0	38	-35	0	-69	0	28	-50	-55	-33	-15	0
	% Change of Median for Recirculation Period		-16	-21	-9.1	20	-5.1	18	0	38	-33	0	-55	0	28	-50	-41	-33	-3.6	0
Schist Transition (Col 4)	Cycle immediately before recirculation period (Cycle 43)	8.1	375	140	57	0.0064	0.0022	0.0063	0.0000030	0.00044	0.0017	0.0070	0.0013	0.010	0.026	0.0013	0.00046	0.0000080	0.038	0.0010
	Final cycle of recirculation period (Cycle 77)	8.3	365	112	53	0.0051	0.0014	0.0049	0.0000030	0.00059	0.0010	0.0070	0.00021	0.010	0.013	0.00080	0.00033	0.0000020	0.036	0.0010
	Median for recirculation period (cycles 45-77)	8.1	365	124	56	0.0064	0.0017	0.0057	0.0000050	0.00061	0.0011	0.0070	0.00050	0.010	0.018	0.0010	0.00036	0.0000030	0.036	0.0010
	% Change of Final Recirculation Cycle		-2.7	-20	-7.0	-20	-36	-22	0	34	-40	0	-84	0	-51	-38	-28	-75	-4.8	0
	% Change of Median for Recirculation Period		-2.7	-11	-1.8	0.00	-23	-9.5	67	39	-32	0	-61	0	-30	-23	-22	-63	-4.8	0
Humidity Cells																				
Gneiss Transition (HC3)	Cycle immediately before recirculation period (Cycle 45)	7.7	38	24	2.0	0.019	0.00090	0.0058	0.0000030	0.000030	0.00064	0.0070	0.0066	0.010	0.00060	0.00010	0.0010*	0.0000020	0.021	0.0020
	Final cycle of recirculation period (Cycle 73)	8.0	98	55	2.0	0.012	0.0014	0.0041	0.0000030	0.000050	0.00039	0.018	0.012	0.010	0.0020	0.00010	0.00014	0.0000030	0.042	0.0010
	Median for recirculation period (cycles 46-73)	8.0	106	54	2.0	0.012	0.0015	0.0049	0.0000030	0.000030	0.00045	0.0070	0.014	0.010	0.0016	0.00010	0.000045	0.0000020	0.055	0.0010
	% Change of Final Recirculation Cycle		157	129	0	-35	56	-29	0	67	-39	157	87	0	232	0	*NA*	50	107	-50
	% Change of Median for Recirculation Period		181	127	0	-35	67	-16	0	0	-30	0	105	0	167	0	*NA*	0	170	-50
Gneiss Fresh (HC4)	Cycle immediately before recirculation period (Cycle 45)	7.7	62	34	2.0	0.043	0.0030	0.0063	0.0000030	0.000030	0.00040	0.0070	0.0095	0.010	0.00064	0.00010	0.0010*	0.0000020	0.0069	0.0010
	Final cycle of recirculation period (Cycle 73)	8.1	145	84	2.0	0.012	0.0040	0.0039	0.0000030	0.000070	0.00038	0.022	0.016	0.010	0.0022	0.00010	0.00018	0.0000020	0.016	0.0010
	Median for recirculation period (cycles 46-73)	8.1	172	86	3.0	0.013	0.0064	0.0049	0.0000030	0.000030	0.00035	0.0070	0.016	0.010	0.0020	0.00020	0.000080	0.0000020	0.020	0.0010
	% Change of Final Recirculation Cycle		137	147	0	-71	33	-38	0	133	-5.0	214	64	0	244	0.00	*NA*	0	133	0
	% Change of Median for Recirculation Period		179	152	50	-69	113	-22	0	0	-13	0	64	0	214	100	*NA*	0	192	0
Schist Transition (HC1)	Cycle immediately before recirculation period (Cycle 45)	8.0	73	39	2.0	0.026	0.00030	0.0064	0.0000030	0.000030	0.00033	0.0070	0.0032	0.010	0.0015	0.00010	0.0010*	0.0000020	0.0033	0.0010
	Final cycle of recirculation period (Cycle 73)	8.0	138	74	4.0	0.019	0.00040	0.0020	0.0000030	0.00023	0.00062	0.0080	0.0050	0.010	0.0030	0.00010	0.00024	0.000013	0.0049	0.0020
	Median for recirculation period (cycles 46-73)	8.1	161	76	5.0	0.010	0.00050	0.0026	0.0000030	0.00020	0.00035	0.0070	0.0039	0.010	0.0025	0.00020	0.00015	0.0000020	0.0065	0.0010
	% Change of Final Recirculation Cycle		89	90	100	-26	33	-69	0	667	88	14	59	0	97	0	*NA*	550	48	100
	% Change of Median for Recirculation Period		121	94	150	-61	67	-59	0	567	6.1	0	23	0	61	100	*NA*	0	96	0
Schist Fresh (HC2)	Cycle immediately before recirculation period (Cycle 45)	7.9	73	41	2.0	0.040	0.0074	0.0067	0.0000030	0.000030	0.00041	0.0070	0.013	0.010	0.00010	0.00040	0.0010*	0.0000020	0.0051	0.0030
	Final cycle of recirculation period (Cycle 73)	8.1	172	97	4.0	0.011	0.011	0.0032	0.0000030	0.000030	0.0011	0.040	0.030	0.010	0.0015	0.0015	0.00011	0.0000030	0.011	0.0020
	Median for recirculation period (cycles 46-73)	8.1	172	87	4.0	0.013	0.014	0.0043	0.0000030	0.000030	0.00045	0.0070	0.031	0.010	0.00044	0.0017	0.000060	0.0000020	0.011	0.0010
	% Change of Final Recirculation Cycle		134	136	100	-72	47	-52	0	0	163	471	132	0	1410	275	*NA*	50	110	-33
	% Change of Median for Recirculation Period		134	112	100	-69	82	-36	0	0	9.8	0	141	0	340	325	*NA*	0	110	-67

Notes: Negative values represent a decrease in concentration; percent difference values are highlighted, * a high detection limit of 0.001 mg/L was often applied for Se analyses; as a result, for all columns, the second to last cycle prior to the recirculation period (which provided a measurable value) was applied for calculation of percent differences; however, for humidity cells, the 13 cycles prior to the recirculation period applied the high detection limit (*i.e.* 0.0005 mg/kg/wk) which is considered to be a disproportionately high value to use in the calculation of percent differences.

4.1.6.4 Field Kinetic Test Results

Leachate chemistry for the field kinetic tests are presented by lithology in Table 4-32 to Table 4-36. The results are compared to MMER (2002) and CCME (2007) water quality guidelines for the protection of aquatic life to highlight the significance of the preliminary field bin leachate data. A summary of the relevant guidelines is presented in Table 4-14.

A number of parameters exceed CCME guidelines in field bin drainage. Parameters which exceed 10x CCME guidelines in gneiss waste rock are As, SO_4 and U. Of these parameters U consistently exceeds 10x CCME in the FB-GT and FB-GS field bins, while As consistently exceeds 10x CCME in FB-GO. In schist field bins, Hg, As, Se and U were observed above 10x CCME. With the exception of U and Zn, these parameters was only observed above 10x CCME on one occasion which was generally the first field bin sample produced from the initial irrigation of the waste rock with DI water after it was packed in the field bin. Uranium consistently exceeded 10x CCME in FB-SS and Zn exceeded 10x CCME in FB-SO on two occasions. In granite field bins As, Mn and SO_4 were found above 10x CCME in multiple samples, and ^{226}Ra and As were found above MMER in the first flush of FB-GGT.

The only field bin to become mildly acidic during the test duration is FB-GGT. This field bin dropped from an initial pH of 7.9 to 5.1, which is near the pH of rainwater (approximately pH 5.6). Most metal concentrations remain relatively unchanged over this pH decline, which the exception of Mn which was relatively low in the first sample and then increased from 3.7 mg/L in the first sample to 25 - 20 mg/L in subsequent samples. Other metal cations, such as Zn, Cr, Cu, Cd and Pb show little, or no increase associated with the pH decline. The low pH produced by FB-GGT is not considered representative of broader granite transition material, as it has a sulphur content that is above the 95th percentile of typical granite transition waste rock (Figure 4-8). Therefore, the mildly acidic pH produced from this kinetic test is not considered representative of what will be produced from stockpiled granite waste rock at site.

Overall, the gneiss waste rock is leaching the highest concentrations of Mo and U, the schist waste rock is leaching the highest concentrations of Sb and Zn, and the granite waste rock is leaching the highest concentrations of As, Mn and ^{226}Ra.

The highest concentrations of parameters are often measured in the first sample from each of the field bins, which is in response to the dissolution of fine particles and secondary surface oxidation products and high TSS leading to a high potential for colloidal particles to pass through the 0.45 µm filter. This is particularly evident for the nitrogen species and dissolved Sb, As, Cu, Hg, Ni and Se which show a decrease in concentration following the initial leachate sample. Other parameters, namely sulphate and dissolved Cr, Mo, U and Zn, show fluctuating levels in leachate from the gneiss and schist field bins over the two field seasons.

Loading rates for gneiss and schist field bins are presented in Table 4-37. These loading rates are calculated excluding the first sample which was collected by irrigating the field bins with DI water immediately after they were built.

Table 4-32:
Leachate Concentrations for Oxide and Transition Gneiss Waste Rock Field Bins

Lithology		Gneiss											
Facies (Field Bin)		Oxide (FB-GO)						Transition (FB-GT)					
Date Sampled		17-Jun-14	25-Sep-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016	17-Jun-14	6-Oct-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume	L	4	0.55	8.2	5	8.8	11.9	4	1.5	3.8	4	4.2	3.1
pH	s.u.	7.8	8.2	8.3	8.2	8.2	8.0	7.7	8.1	8.0	7.9	8.0	7.7
Anions and Nutrients													
$Alkalinity_T$	$mgCaCO_3/L$	339	148	114	76	92.7	65.0	243	91	69	63	66.3	40.5
Cl	mg/L	44	14	2.3	2.4	3.74	1.79	20	13	5.3	5.4	3.5	1.16
F	mg/L	0.7	ND	0.58	0.87	0.865	0.855	0.51	ND	0.37	0.35	0.463	0.374
NH_3-N	mg/L	0.026	ND	0.01	<0.005	< 0.005	<0.0050	0.0086	0.025	0.0097	<0.005	< 0.005	<0.0050
NO_3-N	mg/L	3.6	0.084	0.0081	0.22	0.292	0.184	0.43	<0.05	<0.005	0.041	0.096	<0.0050
NO_2-N	mg/L	0.14	ND	<0.001	0.0011	ND	ND	0.023	ND	0.0012	<0.002	ND	ND
SO_4	mg/L	109	150	51.8	63.9	76.0	83.4	301	572	310	570	473	250
Dissolved Metals													
Al	mg/L	0.0078	0.0057	0.017	0.048	0.0455	0.0296	0.0091	0.0051	0.0034	0.0049	0.0071	0.0062
Sb	mg/L	0.0081	0.0043	0.0037	0.0041	0.00517	0.00411	0.018	0.01	0.01	0.0073	0.0117	0.00686
As	mg/L	0.047	0.032	0.041	0.066	0.0665	0.0879	0.088	0.045	0.043	0.035	0.0468	0.0440
Ba	mg/L	0.107	0.044	0.015	0.029	0.038	0.033	0.077	0.03	0.02	0.026	0.027	0.037
Cd	mg/L	<0.00002	<0.00001	<0.000005	<0.000005	< 0.000005	<0.0000050	<0.00002	0.000014	<0.000005	0.000019	0.0000109	0.0000184
Cr	mg/L	0.0012	0.0016	0.00028	0.0033	0.0025	0.0024	0.00011	<0.001	<0.0001	0.00022	< 0.001	<0.0010
Co	mg/L	0.0008	<0.0003	0.00012	0.00016	< 0.0003	<0.00030	0.0009	0.0006	0.00014	0.00029	< 0.0003	<0.00030
Cu	mg/L	0.0075	0.0025	0.001	0.0022	0.0023	0.0023	0.01	0.0024	0.0013	0.0018	0.0018	0.0015
Fe	mg/L	<0.01	<0.03	<0.01	0.044	< 0.03	<0.030	<0.01	<0.03	<0.01	<0.01	< 0.03	<0.030
Pb	mg/L	<0.00005	<0.0005	<0.00005	0.00016	< 0.0005	<0.00050	<0.00005	<0.0005	<0.00005	0.000085	< 0.0005	<0.00050
Mn	mg/L	0.027	0.007	0.00018	0.0058	0.00059	0.00082	0.065	0.016	0.0006	0.0075	0.00054	0.00025
Hg	mg/L	0.00023	0.000021	0.000008	0.000011	0.0000065	0.0000051	0.0002	<0.00001	<0.000005	0.000007	< 0.000005	<0.0000050
Mo	mg/L	0.036	0.056	0.058	0.16	0.118	0.129	0.044	0.049	0.046	0.049	0.0602	0.0526
Ni	mg/L	0.0039	0.0013	<0.0005	<0.0005	< 0.001	<0.0010	0.007	0.001	0.001	0.00071	< 0.001	<0.0010
Se	mg/L	0.0049	0.0022	0.00047	0.00033	0.000306	0.000108	0.004	0.002	0.001	0.00044	0.000276	0.000184
Ag	mg/L	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020
U	mg/L	0.13	0.16	0.075	0.067	0.0880	0.0487	0.44	0.59	0.39	0.57	0.470	0.215
Zn	mg/L	0.0044	0.019	<0.001	0.0091	< 0.005	<0.0050	0.0053	0.01	0.0045	0.11	0.0435	0.0556
Radioisotopes													
Ra-226	Bq/L	ND	ND	0.026	0.026	0.019	< 0.01	ND	ND	0.026	0.026	0.033	0.033

Notes: Values in grey italics are below the analytical detection limit; *ND* = no data; all guidelines are for total metals except Al and Fe; values that exceed the MMER (2002) MGS water quality guideline are shaded in grey. Values that exceed the maximum or 30-day CCME (2007) water quality guidelines are shaded in light blue, and by 10 times are shaded in dark blue; guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-33:
Leachate Concentrations for Fresh Gneiss Waste Rock Field Bins

Lithology		Gneiss					
Facies (Field Bin)		Fresh (FB-GS)					
Date Sampled		17-Jun-14	6-Oct-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume	L	4	1.5	8	4	3	1.1
pH	s.u.	7.6	7.7	7.9	8.0	8.0	8.0
Anions and Nutrients							
T-Alkalinity	$mgCaCO_3/L$	251	97	62	76	70.7	75.9
Cl	mg/L	17	17	5	2.8	4.9	<5.0
F	mg/L	<0.4	ND	0.43	0.19	0.24	<0.20
NH_3-N	mg/L	0.17	0.012	0.037	<0.005	< 0.005	<0.0050
NO_3-N	mg/L	2.4	1.5	0.72	1.1	1.80	<0.050
NO_2-N	mg/L	0.045	ND	<0.01	<0.005		
SO_4	mg/L	1060	2280	1120	1180	1180	937
Dissolved Metals							
Al	mg/L	0.009	0.005	0.0021	0.0091	< 0.005	<0.0050
Sb	mg/L	0.017	0.012	0.012	0.01	0.0126	0.00994
As	mg/L	0.066	0.015	0.013	0.012	0.0143	0.0103
Ba	mg/L	0.049	<0.02	0.013	0.029	< 0.02	< 0.02
Cd	mg/L	0.000012	<0.00002	<0.000005	0.0000073	0.0000122	0.0000132
Cr	mg/L	<0.0001	<0.001	0.00014	<0.0001	< 0.001	<0.0010
Co	mg/L	0.0017	0.0014	0.00042	0.00035	< 0.0003	<0.00030
Cu	mg/L	0.0072	0.0022	0.0009	0.0013	0.0011	0.0010
Fe	mg/L	<0.01	<0.03	<0.01	<0.01	< 0.03	<0.030
Pb	mg/L	<0.00005	<0.0005	<0.00005	<0.00005	< 0.0005	<0.00050
Mn	mg/L	0.14	0.044	0.006	0.013	0.00192	0.00030
Hg	mg/L	0.00002	<0.00001	<0.000005	<0.000005	< 0.000005	<0.0000050
Mo	mg/L	0.017	0.016	0.013	0.023	0.0302	0.0360
Ni	mg/L	0.011	0.0078	0.0037	0.0028	0.0029	0.0020
Se	mg/L	0.0052	0.0064	0.0014	0.000603	0.000608	0.000437
Ag	mg/L	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020
U	mg/L	0.4	0.75	0.43	0.49	0.443	0.375
Zn	mg/L	0.001	<0.005	0.0016	0.076	0.0461	0.0777
Radioisotopes							
Ra-226	Bq/L	ND	ND	0.06	0.057	0.053	0.033

Table 4-34:
Leachate Concentrations for Oxide and Transition Schist Waste Rock Field Bins

Lithology		Schist											
Facies (Field Bin)		Oxide (FB-SO)						Transition (FB-ST)					
Date Sampled		17-Jun-14	25-Sep-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016	17-Jun-14	25-Sep-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume	L	4	2	7.8	4	1.2	3.5	4	2	6.2	3	5	3.0
pH	s.u.	7.9	7.7	8.2	8.1	7.8	7.9	7.8	7.8	8.0	7.9	7.9	7.7
Anions and Nutrients													
T-Alkalinity	mg$CaCO_3$/L	499	41	89	85	55.3	47.7	118	46	70	51	65.9	47.3
Cl	mg/L	68	5.9	3.8	2.9	1.66	<0.5	15	5.5	1.7	4.4	2.5	<2.5
F	mg/L	0.69	ND	0.47	0.52	0.392	0.234	0.5	ND	0.41	0.22	0.431	0.29
NH_3-N	mg/L	0.17	<0.005	<0.005	<0.005	ND	<0.005	0.044	<0.005	<0.005	<0.005	<0.005	<0.005
NO_3-N	mg/L	3.2	<0.005	<0.005	<0.005	<0.005	<0.005	0.97	<0.05	<0.005	0.26	0.203	<0.025
NO_2-N	mg/L	0.22	ND	<0.001	<0.001	ND	ND	0.014	ND	<0.001	<0.002	ND	ND
SO_4	mg/L	732	133	158	109	62.2	21.9	516	633	416	575	512	366
Dissolved Metals													
Al	mg/L	0.0063	0.024	0.0033	0.003	0.0192	0.0246	0.011	0.014	0.0026	0.0023	0.0065	<0.0050
Sb	mg/L	0.009	0.0012	0.0032	0.003	0.00201	0.00181	0.0023	0.0015	0.0018	0.0013	0.00242	0.00106
As	mg/L	0.031	0.004	0.010	0.0092	0.00685	0.00702	0.013	0.0025	0.0033	0.0022	0.00371	0.00232
Ba	mg/L	0.089	0.03	0.013	0.054	0.034	0.040	0.052	0.029	0.023	0.034	0.041	0.044
Cd	mg/L	0.000013	0.000023	<0.000005	0.0000061	0.0000110	<0.0000050	<0.00001	0.000021	<0.000005	0.000013	<0.000005	0.0000119
Cr	mg/L	0.0015	<0.001	0.00089	0.0023	<0.001	<0.001	<0.0001	<0.001	0.00013	0.00052	<0.001	<0.001
Co	mg/L	0.0015	0.0008	<0.0001	0.00012	0.00033	<0.00030	0.001	0.00036	0.00012	0.00018	< 0.0003	<0.00030
Cu	mg/L	0.006	0.003	0.0006	0.00063	0.0016	<0.0010	0.0061	0.0016	0.00074	0.00087	0.0021	<0.0010
Fe	mg/L	<0.01	0.074	<0.01	<0.01	0.039	0.056	<0.01	0.032	<0.01	<0.01	<0.03	<0.030
Pb	mg/L	<0.00005	0.00084	<0.00005	0.00013	0.00079	<0.00050	<0.00005	0.00067	<0.00005	0.000053	0.00122	<0.00050
Mn	mg/L	0.036	0.096	0.0014	0.011	0.0528	0.0197	0.049	0.036	0.0021	0.02	0.00495	0.00307
Hg	mg/L	0.00031	0.000059	0.000009	0.0000052	< 0.000005	0.0000059	0.000019	<0.00001	<0.000005	<0.000005	<0.000005	<0.000005
Mo	mg/L	0.0037	0.0011	0.0052	0.0059	0.0032	0.0023	0.023	0.015	0.022	0.016	0.0277	0.0182
Ni	mg/L	0.005	<0.001	<0.0005	<0.0005	< 0.001	<0.0010	0.012	0.0024	0.0013	0.0013	0.0024	<0.0010
Se	mg/L	0.008	0.0011	0.00095	0.00031	0.000131	0.000058	0.013	0.0069	0.0015	0.0024	0.00108	0.000481
Ag	mg/L	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020
U	mg/L	0.032	0.0036	0.0052	0.0062	0.00332	0.00199	0.047	0.064	0.044	0.045	0.0458	0.0230
Zn	mg/L	0.0026	0.56	0.024	0.15	0.325	0.0076	<0.001	0.21	0.030	0.11	0.0383	0.0449
Radioisotopes													
Ra-226	Bq/L	ND	ND	<0.01	0.011	0.013	< 0.01	ND	ND	0.025	0.023	0.016	0.021

Notes: Values in grey italics are below the analytical detection limit; *ND* = no data; all guidelines are for total metals except Al and Fe; values that exceed the MMER (2002) MGS water quality guideline are shaded in grey. Values that exceed the maximum or 30-day CCME (2007) water quality guidelines are shaded in light blue, and by 10 times are shaded in dark blue; guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-35:
Leachate Concentrations for Fresh Schist Waste Rock Field Bins

Lithology		Schist					
Facies (Field Bin)		Fresh (FB-SS)					
Date Sampled		17-Jun-14	25-Sep-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume	L	4	2	7.8	3	3.9	2
pH	s.u.	7.7	7.8	8.1	8.1	8.1	7.9
Anions and Nutrients							
T-Alkalinity	$mgCaCO_3/L$	294	146	79	91	84.9	80.8
Cl	mg/L	24	24	3.8	6.9	5.4	2.6
F	mg/L	0.83	ND	0.36	0.25	0.30	0.23
NH_3-N	mg/L	0.29	ND	0.021	ND	<0.005	<0.005
NO_3-N	mg/L	0.95	<0.1	<0.025	<0.025	< 0.025	<0.025
NO_2-N	mg/L	0.013	ND	<0.005	<0.005	ND	ND
SO_4	mg/L	451	1660	679	882	916	686
Dissolved Metals							
Al	mg/L	0.013	<0.005	0.0017	0.0037	< 0.005	<0.0050
Sb	mg/L	0.059	0.043	0.041	0.025	0.0279	0.0180
As	mg/L	0.088	0.019	0.014	0.0092	0.0108	0.00623
Ba	mg/L	0.055	0.025	0.015	0.023	0.023	0.027
Cd	mg/L	0.000011	<0.00002	<0.000005	<0.000005	< 0.000005	0.0000059
Cr	mg/L	0.00024	<0.001	<0.0001	<0.0001	<0.001	<0.001
Co	mg/L	0.0018	0.0045	0.001	0.0011	< 0.0003	<0.00030
Cu	mg/L	0.011	0.0025	0.00079	0.00096	0.0011	<0.0010
Fe	mg/L	<0.01	<0.03	<0.01	<0.01	< 0.03	<0.030
Pb	mg/L	<0.00005	<0.0005	<0.00005	<0.00005	< 0.0005	<0.00050
Mn	mg/L	0.053	0.15	0.014	0.053	0.00377	0.00031
Hg	mg/L	<0.00001	<0.00001	<0.000005	<0.000005	< 0.000005	<0.0000050
Mo	mg/L	0.012	0.017	0.0081	0.0072	0.0062	0.0092
Ni	mg/L	0.063	0.058	0.021	0.015	0.0140	0.0090
Se	mg/L	0.0054	0.0056	0.00094	0.00049	0.000323	0.000244
Ag	mg/L	0.000013	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020
U	mg/L	0.13	0.57	0.22	0.25	0.239	0.151
Zn	mg/L	0.002	0.012	0.0013	0.088	0.0631	0.0677
Radioisotopes							
Ra-226	Bq/L	ND	ND	0.016	0.028	0.03	0.024

Table 4-36:
Leachate Concentrations for Granite Waste Rock Field Bins

Lithology		Granite							
Facies (Field Bin)		Fresh (FB-GGT)				Transition (FB-GGS)			
Date Sampled		17-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016	17-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume		4.0.	6	4.5	3.6	1.5	5	3	7.8
pH	s.u.	7.9	6.4	5.32	5.13	8.3	7.7	8.10	7.44
Anions and Nutrients									
T-Alkalinity	mg$CaCO_3$/L	123	1.2	<1	<1	227	41	29.9	20.7
Cl	mg/L	26	6	2.0	<2.5	24	5	1.81	<2.5
F	mg/L	<0.2	0.1	0.082	<0.10	<0.8	0.86	0.803	0.77
NH_3-N	mg/L	1.6	0.73	0.233	<0.005	0.42	0.19	<0.005	<0.005
NO_3-N	mg/L	1.2	0.015	<0.01	<0.025	0.4	0.066	0.253	0.915
NO_2-N	mg/L	0.17	<0.002	ND	ND	0.03	0.07	ND	ND
SO_4	mg/L	317	708	554	424	597	497	225	380
Dissolved Metals									
Al	mg/L	0.012	0.028	0.0434	0.0614	0.0059	0.0037	0.0209	0.0120
Sb	mg/L	0.016	0.0089	0.0107	0.00662	0.0088	0.0073	0.00734	0.00537
As	mg/L	0.64	0.15	0.133	0.105	0.13	0.081	0.0473	0.0374
Ba	mg/L	0.083	0.03	0.039	0.028	0.049	0.027	< 0.02	0.028
Cd	mg/L	0.00011	0.0002	0.000198	0.000135	0.000091	0.000073	0.0000284	0.000105
Cr	mg/L	<0.0001	<0.0005	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001
Co	mg/L	0.021	0.074	0.0661	0.0570	0.029	0.0054	0.00095	0.00518
Cu	mg/L	0.0015	0.0011	0.0014	0.0015	0.0025	0.00048	< 0.001	<0.0010
Fe	mg/L	<0.01	0.013	<0.03	0.033	<0.01	<0.01	<0.03	<0.03
Pb	mg/L	<0.00005	<0.00025	<0.0005	<0.0005	0.000053	<0.00005	<0.0005	<0.0005
Mn	mg/L	3.7	25	22.8	20.0	3.7	3.1	1.43	4.92
Hg	mg/L	0.000046	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Mo	mg/L	0.00073	0.00045	< 0.001	<0.0010	0.02	0.02	0.0110	0.0087
Ni	mg/L	0.0053	0.02	0.0183	0.0160	0.0031	0.00068	< 0.001	<0.0010
Se	mg/L	0.0011	0.00049	0.00029	<0.00025	0.00056	0.00019	< 0.00005	<0.000050
Ag	mg/L	<0.00001	<0.00005	<0.00005	<0.00005	<0.00001	<0.00001	<0.00002	<0.00002
U	mg/L	0.0058	0.0008	0.00134	0.00271	0.53	0.12	0.0308	0.0128
Zn	mg/L	0.14	0.25	0.227	0.212	0.0068	0.0075	< 0.005	0.0187
Radioisotopes									
Ra-226	Bq/L	0.39	0.099	0.019	0.017	ND	0.028	0.01	0.039

Notes: Values in grey italics are below the analytical detection limit; *ND* = no data; all guidelines are for total metals except Al and Fe; values that exceed the MMER (2002) MGS water quality guideline are shaded in grey. Values that exceed the maximum or 30-day CCME (2007) water quality guidelines are shaded in light blue, and by 10 times are shaded in dark blue; guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-37:
Loading Rates for Waste Rock Field Kinetic Tests

Lithology		Gneiss			Schist			Granite	
Weathering Facies		Oxide	Transition	Fresh	Oxide	Transition	Fresh	Transition	Fresh
Field Test ID		FB-GO	FB-GT	FB-GS	FB-SO	FB-ST	FB-SS	FB-GGT	FB-GGS
Sulphate	mg/kg/wk	0.11	0.26	0.95	0.10	0.47	0.67	0.67	0.72
P	mg/kg/wk	0.000078	0.00003	0.000039	0.000045	0.000049	0.000039	0.00017	0.000092
Al	mg/kg/wk	0.000052	0.0000032	0.0000035	0.0000094	0.0000051	0.0000027	0.00005	0.00002
Ag	mg/kg/wk	0.000000025	9.2E-09	0.00000001	0.000000012	0.000000015	0.000000011	0.000000058	0.00000003
As	mg/kg/wk	0.00011	0.000026	0.00001	0.0000076	0.0000029	0.0000095	0.00015	0.0001
Ca	mg/kg/wk	0.019	0.05	0.17	0.017	0.093	0.11	0.13	0.2
Cd	mg/kg/wk	0.000000008	7.9E-09	6.6E-09	6.8E-09	8.8E-09	5.2E-09	0.00000021	0.00000015
Co	mg/kg/wk	0.00000041	0.00000027	0.00000042	0.00000023	0.00000031	0.00000087	0.000077	0.0000082
Cr	mg/kg/wk	0.0000041	0.00000037	0.00000046	0.0000012	0.00000075	0.00000037	0.00000094	0.0000012
Cu	mg/kg/wk	0.0000031	0.00000095	0.0000009	0.0000011	0.0000013	0.00000095	0.0000015	0.0000015
Fe	mg/kg/wk	0.000043	0.000012	0.000013	0.000024	0.00002	0.000014	0.000028	0.000042
Hg	mg/kg/wk	0.000000011	3.6E-09	4.2E-09	0.000000011	5.4E-09	4.3E-09	5.8E-09	9.2E-09
Mg	mg/kg/wk	0.007	0.024	0.12	0.0087	0.052	0.085	0.029	0.033
Mn	mg/kg/wk	0.0000022	0.0000022	0.0000076	0.000018	0.0000089	0.000024	0.026	0.0067
Mo	mg/kg/wk	0.00018	0.000031	0.000015	0.0000037	0.000021	0.0000066	0.00000092	0.000024
Ni	mg/kg/wk	0.0000013	0.00000056	0.0000029	0.00000061	0.0000015	0.000016	0.000021	0.0000016
Pb	mg/kg/wk	0.00000054	0.00000018	0.00000015	0.00000026	0.00000048	0.00000019	0.00000047	0.00000062
Sb	mg/kg/wk	0.0000068	0.0000055	0.0000089	0.0000022	0.0000017	0.000026	0.00001	0.000012
Se	mg/kg/wk	0.00000031	0.00000037	0.00000095	0.00000055	0.000002	0.00000095	0.00000041	0.00000018
Tl	mg/kg/wk	0.00000024	0.00000011	0.0000001	0.00000013	0.00000014	0.00000011	0.00000041	0.00000031
U	mg/kg/wk	0.00011	0.00026	0.00036	0.000004	0.000042	0.0002	0.0000018	0.0001
Zn	mg/kg/wk	0.0000076	0.000029	0.000024	0.000068	0.000044	0.000028	0.00027	0.000022

Note: Loading rates calculated excluding the first flush sample.

4.1.6.5 Comparison of Duplicate Kinetic Tests

To assess scale issues between the measured kinetic test rates and predictions of full scale waste rock storage conditions, duplicate samples of each lithology and weathering facies were submitted in multiple masses for kinetic testing under different operating conditions (i.e., unsaturated columns, humidity cells and field bins) (Table 4-36).

Loading rates measured from duplicate kinetic tests are compared in Table 4-36. This table shows median loading rates measured in laboratory kinetic tests and mean loading rates measured in field bins over the test duration. In general results for SO_4, As, Sb and U show that loading rates decline as kinetic tests become progressively larger. That is, humidity cells have the greatest loading rates, columns have intermediate loading rates and field bins have the lowest field bins. For example, the As loading rate in the gneiss transition humidity cell (HC3) is 2.3 and 17 times greater than that observed in a duplicate column (Col 6) and field bin (FB-GT), respectively. A similar result is observed for U, where HC3 is producing loading rates that are a factor of 3.1 and 38 times greater than Col 6 and FB-GT. The discrepancy between loading rates from duplicate kinetic tests at different scales and operating conditions suggests that loading rates are being affected by solubility constraints.

Arsenic solubility in neutral pH aerobic environments is pH sensitive, with sorption reactions often controlling dissolved concentrations (Pierce and Moore, 1982). Concentrations of As are plotted against pH in Figure 4-15. Note that in this figure and in Figure 4-16, the initial three cycles from laboratory kinetic tests and the first flush from field bins are excluded from the plots. These plots show that a similar concentration range of As is produced in kinetic test leachate where loading rates varied by over an order of magnitude. While there is some variability in the concentration produced by differing kinetic tests, the differences in concentration are smaller in magnitude than the differences in loading rates and can generally be related to pH.

In aerobic pH-neutral to alkaline environments uranium solubility has been shown to be sensitive to pH and alkalinity, with alkalinity general being the more influential (Davis and Curtis, 2003). The relationship between U and Alkalinity is presented in Figure 4-16 for duplicate kinetic tests below. In general, laboratory kinetic tests show a similar relationship between U concentrations and alkalinity, while field bin data deviates from this relationship in most cases. This variation in the relationship between U and alkalinity may be related to the relatively long storage time of field bin leachate. That is, drainage collected in collection jugs may be held for weeks to months in the field between water quality measurements, over this time temperature fluctuations, interaction with atmospheric CO_2 and potential precipitation reactions will affect alkalinity. Note that the first flush sample,

which was collected immediately after field bins were irrigated with DI water shows considerably higher alkalinity values than subsequent measurements (Table 4-32, Table 4-33 and Table 4-34).

Table 4-38:
Comparison of Loading Rates from Duplicate Samples Operated in Kinetic Tests with Different Masses and Operating Procedure

Sample Description	Kinetic Test ID	Mass	Time	Leachate	SO_4	As	Sb	U
		Kg	Week	L	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
Gneiss Oxide	Col 5	10	86	14	0.099	0.00021	0.000040	0.0013
	FB-GO	183	120	38	0.11	0.00011	0.0000068	0.00011
Gneiss Transition	HC3	1.0	87	43	1.0	0.0025	0.00040	0.011
	Col6	10	84	14	0.32	0.00079	0.00014	0.0035
	FB-GT	229	120	20.6	0.26	0.000026	0.0000055	0.00026
Gneiss Fresh	HC4	1.0	87	42	0.98	0.0024	0.0014	0.0036
	FB-GS	190	70	18	0.95	0.00001	0.0000089	0.00036
Schist Oxide	Col 3	10	86	14	0.18	0.00011	0.000050	0.000069
	FB-SO	171	120	22.5	0.10	0.0000076	0.0000022	0.000004
Schist Transition	HC1	1.0	87	43	1.0	0.0012	0.00015	0.0015
	Col 4	10	86	15	1.0	0.00010	0.000031	0.00059
	FB-ST	165	70	23.2	0.47	0.0000029	0.0000017	0.000042
Schist Fresh	HC2	1.0	87	43	0.99	0.0028	0.0040	0.0027
	FB-SS	202	120	22.7	0.67	0.0000095	0.000026	0.00020
Granite Transition	HC5	1.0	42	22	1.0	0.026	0.00054	0.00023
	Col13	10	41	6.2	0.46	0.0015	0.000090	0.000013
	FB-GGT	166	68	14.1	0.67	0.00015	0.00001	0.0000018
Granite Fresh	HC6	1.0	42	22	0.99	0.0076	0.00037	0.00041
	Col 14	10	41	6.6	0.60	0.00045	0.000093	0.00081
	FB-GGS	134	68	17.3	0.72	0.0001	0.000012	0.0001

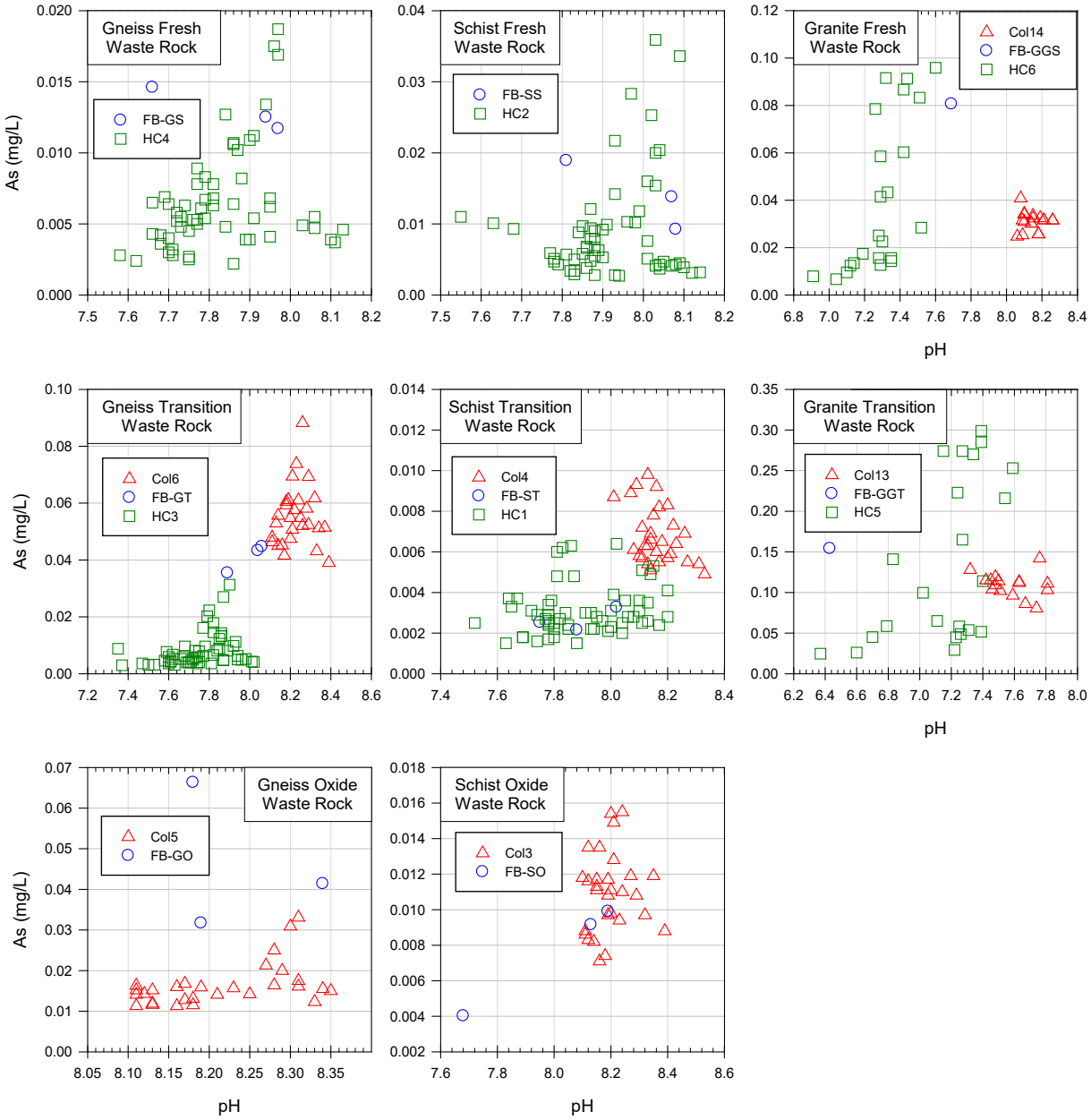


Figure 4-15: Arsenic versus pH measured in duplicate kinetic test samples containing different masses and operated under different procedures

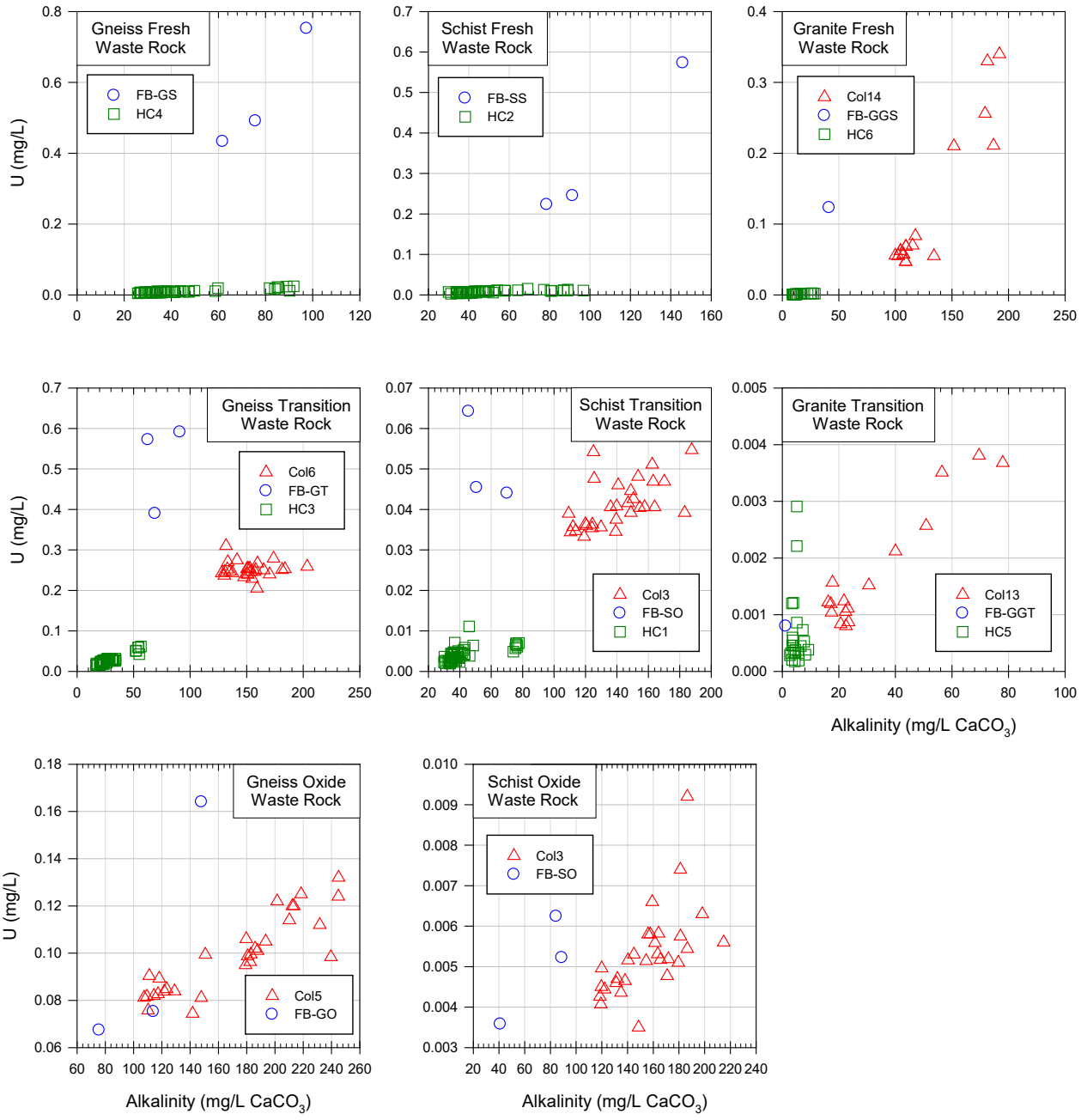


Figure 4-16: Uranium versus alkalinity measured in duplicate kinetic test samples containing different masses and operated under different procedures

4.1.7 Radioisotopes

4.1.7.1 Occurrence

Solid samples of waste rock, ore, and overburden were analyzed for NORM isotopes at SRC. The purpose of this analysis was to determine if geologic material at the Project site exceeds the Health Canada (2011) guidelines for Unconditional Derived Release Limits (UDRLs) of NORM.

The SRC NORM results, along with U and Th concentrations measured in the ICP-OES database, were reviewed by radioisotope specialists at Arcadis Canada Inc. (Arcadis). The elevated U detection limits in the ICP-OES database (10 ppm) did not pose a problem in this analysis, as U typically must be present in concentrations > 10ppm to exceed UDRLs.

The Arcadis review of SRC data and ICP-OES metal assays is provided in Appendix D.1-5. Overall, the data indicate secular equilibrium of the natural U and Th decay series, and there is high confidence that the materials that will be left on site can be considered as unrestricted according to the Canadian NORM Guidelines.

The Arcadis review also concluded that a state of secular equilibrium likely exists in the geologic samples, which has implications for the distribution of other radioisotopes, particularly ^{226}Ra which is regulated under MMER. Because secular equilibrium exists, the activity of ^{226}Ra in host rock can be determined by measurements of U concentration. Hence, the relative enrichment compared of ^{226}Ra and other daughter products of ^{238}U decay chain are directly proportional to the total U.

4.1.7.2 Kinetic Test Leachate

The activity of ^{226}Ra was measured in unfiltered field bin drainage. The relative activities are compared to solid phase U occurrence in the different rock samples (Table 4-25). That is, the schist waste rock field bins have the lowest range of activity (<0.01 Bq/L to 0.028 Bq/L), the gneiss has intermediate activity (0.026 to 0.06 Bq/L) and granite has the highest activity (0.028 Bq/L to 0.39 Bq/L) (Table 4-32, Table 4-33 and Table 4-34). Note that the peak activity of 0.39 Bq/L was observed in an unfiltered sample collected from the first flush of the granite field bin, and likely is an overestimate of dissolved activities.

There is generally a poor relationship between U concentration and ^{226}Ra activity in field bin leachate. For instance, FB-GGT is producing considerably higher ^{226}Ra then FB-GGS, while dissolved U is more than 100x greater in FB-GGS compared to FB-GGT (Table 4-34). In fact, FB-GGT is producing the lowest U concentrations of any of the waste rock field bins. This is related to the differences in chemistry between Ra and U. In aqueous

systems, Ra forms a bivalent cation [Ra(II)] and behaves similar to other alkaline earth metals such as Mg, Sr, Ca and particularly Ba. Conversely, U occurs in multiple oxidation states [U(IV) and U(VI)], and its solubility is dependent on redox potential, pH and complexation reactions with CO_3, PO_4 and SO_4. Hence, although these two parameters co-occur in the solid phase, different mechanisms control their release to pore water and subsequent mobility. Controls on Ra mobility are discussed further in Section 5.1.4.3.

4.2 Ore

4.2.1 Overview of Test Results

As a result of in-situ weathering, sulphide and carbonate minerals have largely been depleted from the ore. However, a few observations can be made, (1) transitional ore has slightly higher S and NP compared to oxide ore; (2) schist ore has the highest NP (51 $kgCaCO_3/t$) compared to gneiss (2.3 $kgCaCO_3/t$) and granite (median of 1.5 $kgCaCO_3/t$) ore; and (3) schist ore has the highest trace S mineralization (median of 0.07 wt.%) compared to gneiss and granite ore (median of 0.01 wt.%). As a result of the low S content, the low NP is sufficient to maintain a neutral drainage pH (rinse pH of 6.7 – 8.7) in gneiss and schist ore samples; therefore, the schist and gneiss ore are classified as non-PAG or non-reactive. Conversely, granite ore, which has the overall lowest NP values and a mildly acidic rinse pH (4.4 - 6.8), is classified as PAG.

Solid phase metal analysis shows the oxide and transition facies are enriched in Sb, As, Bi, Se, Ag and U with respect to ACA. Enrichment of As and Sb is significantly higher in ore compared to waste rock, being two orders of magnitude higher in the ore samples compared to waste rock samples.

Kinetic testing indicates that the mildly acidic conditions produced by granite ore will lead to a significant increase in metal leaching potential. Specifically, the granite transition facies produced acidic drainage (pH 4.5-5.5) over the test period, resulting in increased loads of metal cations (Al, Cd, Co, Cu, Fe, Mn, Ni and Zn) and As loads of up to two orders of magnitude higher than that produced by the schist and gneiss ore. Leachate pH produced by gneiss and schist ore kinetic tests remain slightly alkaline over the test period with metal loadings either gradually decreasing or producing relatively low and stable loading rates. Similar to the waste rock kinetic tests, loading rates from the ore kinetic tests are not proportional to the relative solid phase content of the kinetic test material but rather are influenced by pH conditions within the kinetic test.

4.2.2 Mineral Identification

The following section provides an overview of the mineralogical results of the Project ore lithologies. Mineralogical analysis of the Project ore was carried out on composite head samples developed for metallurgical testing. XRD results for Project ore samples are summarized in Table 4-37. Mineralogical laboratory reports for XRD and assessments completed at the CLS are presented in Appendix B.1 and Appendix B.2, respectively.

4.2.2.1 Gneiss Ore

The gneiss oxide ore sample is composed of quartz, microcline, kaolinite, muscovite and phengite, while the gneiss transition ore sample is composed of quartz, albite, microcline, kaolinite, muscovite, phengite, arsenopyrite, pyrite and carbonate minerals including calcite and dolomite (Table 4-37). The gneiss oxide ore sample is relatively deplete with respect to carbonate minerals.

The gneiss transition ore sample exhibits appreciable carbonate content, with near equal abundances of calcite and dolomite. Sulphide minerals were not detected by XRD in the gneiss oxide ore sample, highlighting limited AP for this material. In contrast, XRD found both pyrite and arsenopyrite in the gneiss transition sample.

4.2.2.2 Schist Ore

The schist oxide ore sample is composed of quartz, microcline, albite, phengite, kaolinite, dolomite, arsenopyrite, pyrite, orthoclase and barite, while the schist transition ore sample is composed of quartz, dolomite, muscovite, kaolinite, phengite, microcline, calcite, biotite, pyrite and barite. Carbonate minerals present in the schist ore include calcite and dolomite (Table 4-37). The carbonate assemblage of the schist oxide ore is composed solely of dolomite, while the schist transition ore exhibits both calcite and dolomite. Overall, the schist transition ore sample has approximately five times greater carbonate abundance relative to the schist oxide ore sample.

Sulphide minerals were detected in both schist ore sample. The schist oxide ore contains pyrite and arsenopyrite, while the schist transition ore contains only pyrite. Barite was detected in both schist oxide and transition ore samples.

4.2.2.3 Granite Ore

The granite oxide ore sample is composed of quartz, phengite, microcline, kaolinite and scorodite, while granite transition ore is characterized as having quartz; muscovite; kaolinite; microcline; orthoclase; and scorodite (Table 4-37). For each of the oxide and transition granite ore samples, carbonate minerals were not identified in XRD scans. Sulphides (as pyrite) were detected for the granite oxide ore material, while sulphides were not detected for the granite transition ore material.

Table 4-39:
XRD Results for Gneiss, Granite and Schist Ore Samples

Lithology		**Gneiss**		**Schist**		**Granite**	
Sample ID		**72144B**	**72146B**	**72135B**	**72137B**	**72139B**	**72140B**
Weathering		**Oxide**	**Transition**	**Oxide**	**Transition**	**Oxide**	**Transition**
Mineral		wt.%					
Calcite	$CaCO_3$		2.5		4		
Dolomite	$(Ca, Mg)CO_3$		3.4	3.5	15		
Pyrite	FeS_2		0.4	0.2	0.9	0.2	
Arsenopyrite	FeAsS		0.9	0.8			
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)_2$				1.8		
Phengite	$K(Al,Mg)_2(OH)_2(Si,Al)_4O_{10}$	18	7.7	9.2	7.3	22	
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	12	10		13		18
Kaolinite	$Al_2Si_2O_5(OH)_4$	7.2	6.3	10	7.9	12	9.3
Quartz	SiO_2	54	47	48	46	55	56
Orthoclase	$KAlSi_3O_8$			0.9			7.3
Microcline	$KAlSi_3O_8$	8.5	12	18	4.1	11	7.3
Albite	$NaAlSi_3O_8$		7.2	9.2			
Scorodite	$FeAsO_4 \cdot 2H_2O$					1.3	2.1
Magnesiohornblende	$Ca_2Mg_4Al(AlSi_7O_{22})(OH)_2$		1.7				
Barite	$BaSO_4$			0.2	0.5		
	Total	*100*	*100*	*100*	*100*	*100*	*100*

4.2.2.4 Trace Metal Occurrence

The occurrence of elements of interest (As and U) was investigated in ore samples using high-resolution microscopy examination at the CLS. The analysis included µXRF and XANES testing to determine elemental-phase associations and valence state. Results for µXRF are presented in Table 4-5 and the results for XANES are presented in Table 4-6 and Table 4-7. Elemental associations and oxidation states of As and U in ore samples are generally similar to waste rock, which is discussed in Section 4.1.1.6. The complete results of this analysis are provided in Appendix B.2.

4.2.3 Acid Base Accounting

This section discusses the ABA results for ore lithologies. A total of 38 samples were submitted for ABA testwork to characterize ore from the oxide and transition facies of the dominant lithologic units (gneiss, schist and granite). These samples were collected from 1-2 m drill core segments and from metallurgical head samples. This database is augmented

by an additional 3,579 ore samples that were submitted for metals assays as part of the exploration program. The statistical distributions for the ABA results are presented by weathering facies (oxide and transition) for gneiss, schist and granite ore in Table 4-38. The complete set of ABA results for the ore samples are provided in Appendix C.2-1.

4.2.3.1 Rinse pH

Rinse pH for the two dominant lithologies (gneiss and schist) are neutral to slightly alkaline (6.7≤pH≤8.7, median values of 7.3 and 7.7, respectively). By comparison, the granite samples show lower rinse pH values (4.4≤pH≤6.8, median values of 6.0 and 5.6 for oxide and transition, respectively). Unlike the waste rock sample set, the rinse pH values for the ore samples indicate that the in situ pH is largely controlled by lithology rather than the degree of weathering.

4.2.3.2 Acid Potential

The dominant sulphur species present in ore is generally similar between waste rock and ore, as such, acid potential is calculated based on the same assumptions as those employed for waste rock. Refer to Section 4.1.2.2 for a discussion of sulphur species and acid potential (AP).

AP from ABA

Figure 4-2 shows a strong relationship between total-S and sulphide-S, indicating that when S is detectable, it is primarily present in sulphide minerals. However, Total-S and S species abundances for ore lithologies are presented for oxide and transition facies in Table 4-38. Consistent with the results for the waste rock samples, total-S and sulphide-S are highest in the schist ore samples and lowest in the granite ore samples, with overall concentrations decreasing with increased weathering within each lithologic unit. Total-S and sulphide S for the schist ore samples, in particular, are higher than measured for the waste rock samples, with median values for the oxide and transition ore facies of 0.11 and 0.61 wt.% total-S, respectively. Median values for the gneiss and granite ore samples (0.02 and 0.01 wt.% total-S, respectively) are considerably lower and more consistent with values measured for waste rock samples.

Sulphate-S concentrations are low in the gneiss and granite ore samples, consistent with values measured for waste rock (0.01 wt.%). Notably higher sulphate-S values were measured for the schist ore samples, with median values of 0.02 and 0.15 wt.% for the oxide and transition facies, respectively.

Table 4-40:
Statistical Distribution of ABA Results by Weathering Facies for Ore Lithologies

Unit	Parameter	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	T-C NP*	CaNP	Sobek NP	Siderite NP	T-C NNP*	Sobek NNP	NPR	NPR	NPR
	Unit	s.u.	s.u.	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	T-CNP*/ T-AP	CaNP/ T-AP	SobekNP/ T-AP
Gneiss	**Oxide facies**														
	n	*5*	*5*	*5*	*5*	*3*	*5*	*5*	*3*	*3*	*5*	*3*	*5*	*5*	*3*
	Min	6.7	6.7	0.01	*<0.01*	*<0.01*	2.3	2.5	5.7	8.0	-1.1	5.0	0.7	1.3	7.9
	Median	7.3	7.2	0.02	*<0.01*	0.01	3.1	*<4.5*	6.0	11	2.5	5.4	5.0	7.2	9.6
	Max	7.4	7.4	0.11	0.01	0.06	8.9	7.5	11	18	8.2	11	12	14	15
	Transition Facies														
	n	*5*	*5*	*5*	*5*	*4*	*5*	*5*	*2*	*2*	*5*	*2*	*5*	*5*	*2*
	Min	7.0	6.8	*<0.01*	0.01	*<0.01*	1.6	*<4.5*	4.0	5.0	1.3	3.7	5.2	8.3	9.4
	Median	7.3	7.5	0.01	0.02	0.01	7.8	*<4.5*	21	25	7.5	19	8.5	15	11
	Max	8.7	8.6	0.13	0.09	0.01	34	33	38	44	30	34	77	73	13
Schist	**Oxide facies**														
	n	*6*	*6*	*6*	*6*	*3*	*6*	*6*	*4*	*4*	*6*	*4*	*6*	*6*	*4*
	Min	7.4	7.5	0.01	*<0.01*	*<0.01*	7.0	6.8	10.0	13	6.7	9.7	5.0	4.5	16
	Median	7.7	7.5	0.11	0.07	0.02	82	81	67	82	80	64	23	23	20
	Max	8.2	8.1	0.42	0.25	0.05	144	149	100	124	137	94	72	67	32
	Transition Facies														
	n	*4*	*5*	*5*	*5*	*3*	*5*	*5*	*2*	*2*	*5*	*2*	*5*	*5*	*2*
	Min	7.4	7.4	0.52	0.41	0.02	111	107	93	123	42	75	1.6	1.5	5.3
	Median	7.7	7.8	0.61	0.47	0.15	131	138	100	129	114	83	7.4	7.8	5.9
	Max	7.9	8.1	2.2	1.6	0.19	207	191	107	134	188	91	11	10	6.6
Granite	**Oxide facies**														
	n	*6*	*6*	*6*	*6*	*5*	*6*	*6*	*6*	*3*	*6*	*6*	*6*	*6*	*6*
	Min	5.7	5.7	*<0.01*	*<0.01*	*<0.01*	*<0.8*	1.7	0.7	3.0	0.5	-0.1	2.2	2.0	0.9
	Median	6.0	6.2	0.01	0.01	0.01	2.3	*<4.5*	1.5	4.0	2.0	1.2	7.4	14	4.8
	Max	6.7	6.5	0.03	0.01	0.02	6.2	*<4.5*	5.0	7.1	5.9	4.7	21	15	17
	Transition Facies														
	n	*8*	*8*	*8*	*8*	*7*	*8*	*8*	*7*	*2*	*8*	*8*	*8*	*8*	*7*
	Min	4.4	4.9	*<0.01*	*<0.01*	0.01	0.8	1.7	0.5	3.0	-1.7	-4.2	0.6	0.4	0.1
	Median	5.6	5.4	0.01	*<0.01*	0.01	2.7	*<4.5*	2.0	5.0	1.6	1.2	6.3	15	6.4
	Max	6.8	6.6	0.15	0.11	0.02	3.9	*<4.5*	3.0	7.0	3.6	2.7	13	15	10

Notes:
Values in grey italics are below the analytical detection limit; *n* = number of analyses included in statistical distribution.
* adjusted T-C NP; calculated as Total C wt.% * 77.6.
NNP = net neutralization potential, derived by subtracting AP from NP.

AP Surrogates

The exploration ICP-OES database included S measurements, which can be used to accurately estimate total-S as measured by Leco furnace as described in Section 4.1.2.2 (Figure 4-3). The exercise demonstrates that the application of S values from the exploration database as a surrogate to derive AP is a conservative means to evaluate ARD potential of mine rock. The statistical distribution of S measured by ICP-OES used to calculate surrogate AP values for ore is presented in Table 4-39.

Table 4-41:
Statistical Distribution of Sulphur (wt.%) Measured in Assay Database Used for Surrogate Acid Potential Values for Ore Lithologies and Weathering Facies

Lithology	Statistic	Oxide	Upper Transition	Lower Transition	All Weathering Facies
Gneiss	*n*	804	307	140	1251
	n <DL	344	104	22	470
	Max	1.3	1.2	1.9	1.9
	95th PCTL	0.15	0.45	1.1	0.44
	75th PCTL	0.020	0.080	0.48	0.040
	Median	0.010	0.020	0.070	0.010
	25th PCTL	*<0.01*	*<0.01*	0.010	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Schist	*n*	567	227	62	856
	n <DL	55	6.0	4.0	65
	Max	2.0	4.3	3.6	4.3
	95th PCTL	0.54	2.5	3.2	2.0
	75th PCTL	0.10	1.5	2.0	0.49
	Median	0.050	0.82	1.1	0.070
	25th PCTL	0.020	0.25	0.023	0.020
	5th PCTL	*<0.01*	0.030	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Granite	*n*	141	20	7	168
	n <DL	58	2.0	0.00	60
	Max	0.81	0.91	0.36	0.91
	95th PCTL	0.070	0.70	0.33	0.25
	75th PCTL	0.020	0.31	0.23	0.030
	Median	0.010	0.15	0.19	0.010
	25th PCTL	*<0.01*	0.018	0.020	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	0.010	*<0.01*
	Min	*<0.01*	*<0.01*	0.010	*<0.01*
Other	*n*	901	327	76	1304
	n <DL	236	58	2.0	296
	Max	4.0	4.2	4.0	4.2
	95th PCTL	0.63	1.6	2.2	1.5
	75th PCTL	0.080	0.55	1.5	0.17
	Median	0.020	0.030	1.1	0.020
	25th PCTL	*<0.01*	0.010	0.13	0.010
	5th PCTL	*<0.01*	*<0.01*	0.010	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*

4.2.3.3 Neutralization Potential

A variety of analytical methods were used to measure NP in waste rock and ore ABA samples. Refer to Section 4.1.2.3 for a discussion and interpretation of NP estimates produced form different methods.

NP from ABA

The relationship between sobek NP, siderite NP and CaNP for waste rock and ore samples are plotted in Figure 4-4. In general, the results for ore are similar to waste rock, in that siderite NP is greater than sobek NP, and sobek NP is greater than CaNP. Neutralization potential can also be estimated based on a total carbon measurement (Section 4.1.3.3). Using total carbon to estimate NP (T-C NP) and has the advantage of lower detection limits compared to CaNP.

Median NP values (CaNP, T-C NP* and sobek NP) for the ore samples are generally similar to median values for the waste rock samples, with the schist ore samples showing the overall highest NP concentrations (range: 7.0 to 207 kg $CaCO_3$/t T-C NP*; median = 110 kg $CaCO_3$/t, Appendix C.2-1) and the granite samples showing the lowest values (range: 0.8 to 6.2 kg $CaCO_3$/t T-C NP*; median = 2.3 kg $CaCO_3$/t). The gneiss samples also have overall low CaNP, with concentrations ranging from 1.6 up to 34 kg $CaCO_3$/t (median = 3.1 kg $CaCO_3$/t). The amount of NP in the ore samples is generally inversely related to the degree of weathering for a given lithologic unit, with samples from the oxide facies being characterized by lower NP values in comparison to transition facies.

NP Surrogates

The larger exploration database can be used to support interpretations of ARD potential given the strong correlation between sobek NP (as determined via ABA analysis) and CaNP (as measured through solid phase Ca determination by aqua regia digestion) (Figure 4-6). The results demonstrate that the application of aqua regia Ca from the exploration database may be used as a conservative surrogate to derive NP values. The statistical distribution of surrogate NP values (calculated using Ca from the exploration database) for ore are presented in Table 4-40.

Table 4-42:
Statistical Distribution of Neutralization Potential Values Calculated from Ca Measured in Assay Database for Ore Lithologies

Lithology	Statistic	Oxide	Upper Transition	Lower Transition	All Weathering Facies
Gneiss	*n*	804	307	140	1251
	Max	162.5	125.3	136.5	162.5
	95th PCTL	42	78.4	56.5	58
	75th PCTL	3.8	7.8	21.1	4.5
	Median	2	2.5	5.9	2.3
	25th PCTL	1.3	1.5	1.8	1.5
	5th PCTL	0.8	1	1	0.8
	Min	*<0.3*	0.3	0.8	*<0.3*
Granite	*n*	141	20	7	168
	Max	5.8	1.5	12.8	12.8
	95th PCTL	2.5	1.5	9.4	2.5
	75th PCTL	1.8	1.3	1.4	1.8
	Median	1.5	0.5	1	1.5
	25th PCTL	1	*<0.3*	*<0.3*	0.8
	5th PCTL	*<0.3*	*<0.3*	*<0.3*	*<0.3*
	Min	*<0.3*	*<0.3*	*<0.3*	*<0.3*
Schist	*n*	567	227	62	856
	Max	262.5	380	625	625
	95th PCTL	142.2	164.6	147	153.6
	75th PCTL	71.5	95	91.4	84.1
	Median	32.8	67.5	74.1	51.3
	25th PCTL	8.3	52.8	59.8	15
	5th PCTL	3.5	21.3	10.3	4.4
	Min	0.8	1.8	4.3	0.8
Other	*n*	901	327	76	1304
	Max	290	250	134	290
	95th PCTL	163.3	170.9	99.8	164.9
	75th PCTL	58.8	95.5	88.4	74.5
	Median	5	13	11.3	6.4
	25th PCTL	2	1.5	5.3	1.8
	5th PCTL	0.8	0.8	0.3	0.8
	Min	0.3	0.3	*<0.3*	*<0.3*

Notes: Values in grey italics are below the analytical detection limit. n is the number of samples included in the statistical distribution, n < DL is the number of samples below the detection limit.

4.2.3.4 Net Potential Ratio

The acid generating potential of mine rock will be defined by the ratio of NP to AP and a minimum sulphur content, as described in Section 4.1.2.4. NPR values for ore were calculated using NP derived from sobek NP, CaNP and T-C NP* and AP derived from total-S (*i.e.,* T-AP). As outlined for waste rock samples, ore samples with total-S < 0.02 wt.% is considered to have negligible AP and is non-PAG. The same criteria used to classify waste rock samples are applied to ore samples (as outlined in Section 4.1.2.4).

Figure 4-7 presents sobek NP, CaNP and T-C NP* versus T-AP for the waste rock and ore samples. The statistical distribution for NPR derived using the different NP values are presented by weathering facies for each lithology Table 4-41. Median NPR values for the ore samples are >5, indicating that the majority of the ore samples are non-PAG. Similar to NPR distribution for the waste rock samples, schist ore materials have the highest NPR(T-CNP*) values (median = 11) while granite samples show the lowest (median NPR = 7.4). Of note is the overall lower NPR values for the schist ore compared to that for of the schist waste rock (median of 28). As was noted for the schist waste rock, the schist ore samples also show appreciable NNP values, which is the amount of excess NP relative to AP, with median values of 80 and 114 kg $CaCO_3$/t T-C NNP* for the oxide and transition facies, respectively.

Table 4-41 provides a summary of the relative proportions of PAG and non-PAG ore samples by lithologic unit and weathering facies according to varying NP methods. Included in the table are the number and percentage of samples with total-S <0.02 wt.%, which are considered to have negligible AP and are therefore classified as non-PAG. Also presented in Table 4-41.are the relative proportions of PAG and non-PAG ore samples according to NPR values derived from NP and AP using Ca and S from the larger ICP-MS assay database. The exploration data are presented for reference to support the ABA database. The results demonstrate that the NPR distribution of PAG and non-PAG ore varies depending on the NP and AP methods used to calculated NPR. Given the considerably higher number of samples available from the exploration assay database, these values are considered to provide a more representative distribution for the ore lithologies. Based on these data, 5% of schist ore samples are indicated to be PAG (with another 21% indicated to have an uncertain potential), 12% of the gneiss and other minor lithology ore samples are indicated be PAG (15-17% uncertain) and 26% of the granite ore samples indicated to be PAG (13% uncertain).

Overall, the results of the ABA analyses indicate that there is a greater potential for ARD to be generated from the ore samples compared to waste rock, with up to approximately 27% of the gneiss, schist and other minor lithologic ore and up to 39% of granite ore indicated to have some PAG potential.

Table 4-43:
ARD Distributions for Coffee Gold Mine Ore Lithologies

Lithology	ARD Designation	NPR (T-CNP*/AP)		NPR (CaNP/T-AP)		NPR (Sobek NP/T-AP)		NPR (surrogate NP/AP)	
		n	%	n	%	n	%	n	%
GNEISS	*Total No. Samples*	*10*		*10*		*5*		*1251*	
	Non-Reactive	3	30%	3	30%	1	20%	711	57%
	Non-PAG	6	60%	6	60%	4	80%	201	16%
	Uncertain	0	0%	1	10%	0	0%	183	14.6%
	PAG	1	10%	0	0%	0	0%	155	12.4%
SCHIST	*Total No. Samples*	*11*		*11*		*6*		*858*	
	Non-Reactive	0	0%	0	0%	0	0%	147	17%
	Non-PAG	10	91%	10	91%	6	100%	489	57%
	Uncertain	1	9%	1	9%	0	0%	180	21.0%
	PAG	0	0%	0	0%	0	0%	42	4.9%
GRANITE	*Total No. Samples*	*14*		*14*		*13*		*168*	
	Non-Reactive	6	43%	6	43%	5	38%	98	58%
	Non-PAG	6	43%	6	43%	5	38%	4	2.0%
	Uncertain	1	7%	1	7%	1	8%	22	13.1%
	PAG	1	7%	1	7%	2	15%	44	26.2%
Other (including Metabasalt)	*Total No. Samples*	*3*		*3*		*1*		*1268*	
	Non-Reactive	2	*NA*	2	*NA*	1	*NA*	527	42%
	Non-PAG	0	*NA*	0	*NA*	0	*NA*	379	30%
	Uncertain	0	*NA*	0	*NA*	0	*NA*	213	16.8%
	PAG	1	*NA*	1	*NA*	0	*NA*	148	11.7%

Notes:
n = number of analyses included in distribution
* adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.3.3).
NPR (surrogate NP/AP): NP derived using Ca and AP derived using S from aqua regia digestion of the exploration database.
All samples with total-S <0.02 wt.% are considered Neutral.
Criteria for NPRs derived using sobek NP and surrogate NP are defined as NPR ≥3 (non-PAG), 1≤NPR<3 (uncertain), NPR<1 (PAG)
Criteria for NPRs derived using T-C NP* and CaNP are defined as NPR ≥2 (non-PAG), 1≤NPR<2 (uncertain), NPR<1 (PAG)
NA: had too few samples from ABA analyses to provide representative percentages for the unit as a whole.

4.2.4 Shake Flask Extractions

A statistical distribution of parameters that exceed the CCME and MMER water quality guidelines in SFE are presented by ore lithology and weathering facies in Table 4-42. A summary of the CCME and MMER guidelines are presented guidelines are presented Table 4-14. The complete SFE results are presented in Appendix C.2-2. Consistent with exceedances for waste rock samples, Al, Sb, As and Hg are indicated to exceed the CCME guidelines in SFE from each of the dominant lithologies and other minor lithologies (two

samples submitted for SFE). In particular, As exceeds the CCME guideline in every sample for the gneiss, schist, granite and other minor lithologic unit samples. Additionally, one sample form the gneiss and three samples from the granite ore also exceed MMER guidelines. Concentrations of Co, Cu, Fe, Pb, Tl, U and Zn exceed CCME guidelines in SFE in one or more samples from the granite unit, while sulphate and Se exceed the respective guidelines in SFE from the schist unit. The elevated sulphate, for two schist ore samples in particular, is consistent with higher solid phase sulphur measured for the same two schist samples (0.2 and 0.56 wt.% total-S, Appendix C.2-1).

The highest metal concentrations in SFE are associated with oxide and transition granite facies, while the lowest values are generally associated with samples from the oxide schist ore. Exceptions to this include sulphate and Se, which are highest in the samples form the oxide and, in particular, transition facies of the schist ore. Leachate pH for the gneiss and schist samples are neutral to alkaline, ranging from 7.5 to 8.1 (slightly lower than the ranges for waste rock). Leachate pH values for the granite samples are lower, and marginally acidic in some cases, ranging from 5.6 to 7.4, with consistently low pH measured for the oxide granite samples (median pH = 5.6).

Some of the SFE metal exceedances (Al, Co, Cu, Fe, Pb, Mn, Zn) are likely associated with fine suspended solids carried through the 0.45 µm filter during the extraction experiment. However, there are SFE samples that contain elevated As and Sb (and Se in schist samples) which do not coincide with elevated concentrations of Al and Fe.

Overall, the results of the SFE for ore samples indicate that As, Sb and Hg may be metals of potential concern from ore lithologies and that Se may also pose a potential concern from schist ore. Unlike the schist waste rock, elevated Cr was not observed for the ore. It is interesting to note that U concentrations are generally low, with only a single granite-oxide sample producing U concentrations above CCME guidelines.

Table 4-44:
Shake Flask Extraction Results for Ore Samples by Lithology by Weathering Facies

Unit	Parameter	pH	SO_4	Al	Sb	As	Cr	Cu	Fe	Pb	Mn	Hg	Se	Tl	U	Zn
	Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Gneiss	**Oxide facies (n = 2)**															
	Min	7.8	2.0	0.034	0.0052	0.096	0.000070	0.0011	*<0.007*	*<0.00001*	0.0047	0.00012	0.00004	0.000081	0.0022	*<0.001*
	Max	7.9	2.0	0.049	0.0069	0.13	*<0.00003*	0.0015	0.014	0.00004	0.0090	0.00044	0.00011	0.00020	0.0072	*<0.001*
	Transition Facies (n = 3)															
	Min	7.5	0.8	0.027	0.0083	0.14	*<0.00003*	0.0004	*<0.007*	*<0.00001*	*<0.0005*	0.00004	0.00037	*<0.0001*	0.00006	*<0.001*
	Median	7.8	7.9	0.086	0.042	0.18	*<0.00050*	*<0.001*	0.084	*<0.0001*	0.016	0.00046	*<0.0005*	0.00022	0.00096	*<0.01*
	Max	8.1	45	0.37	0.049	0.54	*<0.00050*	*<0.001*	0.16	0.00064	0.025	0.00051	*<0.0005*	0.00028	0.0089	*<0.01*
Schist	**Oxide facies (n = 3)**															
	Min	7.8	10	0.009	0.0037	0.086	*<0.00003*	0.00041	*<0.007*	*<0.00001*	0.0025	*<0.00001*	0.0003	0.000046	0.00094	*<0.001*
	Median	7.8	43	0.023	0.0046	0.12	*<0.00003*	0.001	*<0.007*	*<0.00001*	0.0042	*<0.00001*	0.00043	0.00011	0.0011	*<0.001*
	Max	8.0	225	0.026	0.0048	0.13	*<0.00003*	0.0014	*<0.007*	*<0.00001*	0.0245	0.00002	0.00094	0.00023	0.0015	*<0.001*
	Transition Facies (n = 2)															
	Min	7.7	208	0.012	0.011	0.074	*<0.00003*	0.0013	*<0.007*	*<0.00001*	0.047	*<0.00001*	0.0010	0.00024	0.0020	*<0.001*
	Max	7.8	328	0.022	0.014	0.15	*<0.00003*	0.0015	*<0.007*	*<0.00001*	0.057	*<0.00001*	0.0011	0.00033	0.0027	*<0.001*
Granite	**Oxide facies (n = 3)**															
	Min	6.1	1.7	0.092	0.020	0.51	*<0.00003*	*<0.001*	0.019	0.00013	0.0028	0.00003	0.00008	0.000051	0.00025	0.004
	Median	6.2	3.0	3.2	0.045	1.0	*<0.00005*	0.0042	0.92	0.00052	0.0031	0.0001	*<0.0005*	0.00065	0.0011	*<0.01*
	Max	7.4	9.6	18	0.17	1.8	0.00069	0.0058	25	0.029	0.48	0.0063	*<0.0005*	0.0023	0.033	0.042
	Transition Facies (n = 3)															
	Min	5.6	2.8	0.005	0.0040	0.13	*<0.0003*	*<0.001*	*<0.03*	*<0.0001*	0.0037	*<0.00001*	0.00043	0.00038	0.00025	*<0.01*
	Median	5.6	14	0.074	0.0062	0.22	*<0.0005*	*<0.001*	0.12	0.00014	0.0072	*<0.00005*	*<0.0005*	0.00086	0.00047	*<0.01*
	Max	5.7	40	1.4	0.023	1.5	*<0.0005*	0.017	0.94	0.00058	0.87	0.000073	*<0.0005*	0.00095	0.0026	0.033

Notes:
Values in grey italics are below the analytical detection limit; All guidelines are for total metals unless otherwise indicated.
Values that exceed the Metal Mines Effluent Regulations (MMER, 2002) MMM and MGS water quality guideline are shaded in light and dark grey, respectively.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2007) Water Quality Guidelines are shaded in light blue (30-day) and dark blue (maximum);
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016);
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI);
Guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

4.2.5 Solid Phase Elemental Abundance

Statistical summaries of solid phase element results for ore are presented for oxide and transition facies by lithologic unit in Table 4-43 and compared to average continental abundances (ACA; Price, 1997). The complete set of solid phase element results are presented in Appendix C.2-3. The results show that the oxide and transition facies are enriched in Sb, As, Bi, Hg, Se and Ag and U with respect to ACAs (shaded values in the tables). With the exception of Ag, the observed metal enrichments for ore samples are consistent with those observed for waste rock samples, with concentrations in the ore samples generally higher than values measured for waste rock of same lithologic and weathering group. In particular, Sb and As are one to two orders of magnitude higher in the ore samples compared to waste rock samples of the same lithology and weathering group. The exception is the schist unit, for which metal concentrations (other than Sb and As) in ore samples are consistent with concentrations in waste rock. Overall, the highest metal concentrations are observed for the schist ore samples while the lowest are observed for granite ore materials (Table 4-43).

Also presented for comparison are Sb and As concentrations from the exploration ICP-OES database (Table 4-44). This table presents the statistical distribution of Sb and As for each lithology, with light and dark grey shading representing three and ten times higher than the ACA values. Note that for the larger assay database, the 95th and 5th percentile values are shown in place of the maximum and minimum values to provide more representative upper and lower limits for the lithologic and weathering facies groups and avoid highlighting outliers. Also provided in Table 4-44 are the distributions of Sb and As by weathering facies for each lithologic unit, with colour grading superimposed to highlight the relative concentrations.

These results show that concentrations of As are highest in schist (median of 2450 ppm). Similarly, high As concentrations are observed in the granite lithology and other minor lithologies (2040 and 1790 ppm), with the considerably lower AS values observed in the gneiss lithology (966 ppm). Antimony is generally present at much lower concentrations than As in all ore lithologies. The highest concentration is observed in the 'other' lithologies grouping with (median of 32 ppm), with intermediate Sb concentrations in the gneiss and schist lithologies (median of 21 ppm and 22 ppm, respectively) and the lowest concentrations are present in the granite lithology (15 ppm). For complete statistics of the exploration ICP-OES see Appendix C.2-4.

Table 4-45:
Solid Phase Elements by Aqua Regia Digestion for Ore Lithologies by Weathering Facies

	ACA	*8.23*	*0.2*	*1.8*	*0.009*	*25*	*60*	*5.6*	*14*	*0.085*	*0.05*	*0.075*	*0.85*	*2.7*	*70*
Unit	**Parameter**	**Al**	**Sb**	**As**	**Bi**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Se**	**Ag**	**Tl**	**U**	**Zn**
	Unit	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Gneiss	**Oxide facies (*n* = 5)**														
	Min	0.29	9.3	238	0.14	1.1	2.5	0.9	12	0.35	0.3	0.1	0.43	11	9.0
	Median	0.47	34	940	0.23	4.7	5.6	1.6	22	0.55	0.9	0.14	0.5	14	25
	Max	1.1	48	1095	0.91	6.5	58	2.3	52	1.8	*<1*	0.24	0.9	20	41
	Transition Facies (*n* = 5)														
	Min	0.36	11	333	0.06	1.1	1.8	0.88	10	0.27	0.2	0.05	0.28	5.7	10
	Median	0.5	50	1185	0.29	2.2	3.5	1.6	18	0.73	0.4	0.1	1.1	11	15
	Max	1.1	161	1700	0.3	6.6	15	1.9	25	1.4	*<1*	0.3	1.2	19	27
Schist	**Oxide facies (*n* = 6)**														
	Min	0.38	6.0	1100	0.23	9.4	12	2.6	12	0.41	0.6	0.08	0.3	2.4	41
	Median	0.535	17	1450	0.52	14	14	3.0	16	0.46	0.95	0.25	0.38	2.9	48
	Max	0.9	41	5910	1.3	16	20	4.1	20	1.6	*<1*	0.59	1.5	6.0	57
	Transition Facies (*n* = 5)														
	Min	0.43	7.3	712	0.16	8.8	10	2.6	6.8	0.17	0.5	0.13	0.22	1.8	43
	Median	0.6	22	1340	0.37	12	16	2.7	14	0.33	0.7	0.25	0.4	2.6	48
	Max	0.75	49	5130	0.74	14	26	2.9	29	0.6	*<1*	0.64	0.73	3.5	49
Granite	**Oxide facies (*n* = 6)**														
	Min	0.41	6.8	714	0.07	0.2	0.8	0.82	11	0.17	*<0.2*	0.08	0.56	1.8	3.0
	Median	0.475	25	2075	0.09	1.2	1.8	1.2	18	0.98	0.45	0.095	0.93	14	21
	Max	0.54	38	7940	0.19	6.8	2.6	1.6	42	8.5	1	0.12	2.7	52	42
	Transition Facies (*n* = 8)														
	Min	0.34	3.2	603	0.04	0.3	0.7	0.62	11	0.16	*<0.2*	0.03	0.24	5.1	4.0
	Median	0.77	23	2195	0.07	1.3	3.6	1.4	18	0.37	0.3	0.07	0.77	12	17
	Max	0.94	146	*>10000*	0.1	11	17	5.9	29	4.0	*<1*	0.1	1.21	53	20

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA.

Table 4-46:
Solid Phase As and Sb Concentrations in Ore from the Exploration Database

Lithology	**Gneiss**		**Schist**		**Granite**		**Other Lithologies**	
Parameter	**Sb**	**As**	**Sb**	**As**	**Sb**	**As**	**Sb**	**As**
Units	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Total for Lithologic Unit								
n	*1251*	*1251*	*856*	*856*	*168*	*168*	*1304*	*1304*
5th PCTL	4.0	235	5.0	516	5.0	707	6.0	255
25th PCTL	10	507	10	1320	10	1350	14	828
Median	21	966	22	2450	15	2040	32	1790
75th PCTL	47	1840	54	3800	36	3290	93	3320
95th PCTL	141	3840	391	8070	169	7190	433	6760
Oxide facies								
n	*804*	*804*	*567*	*567*	*141*	*141*	*901*	*901*
5th PCTL	5.0	263	5.0	584	5.0	711	6.0	312
25th PCTL	11	498	12	1340	10	1180	17	924
Median	24	919	27	2450	16	2030	41	1920
75th PCTL	52	1740	72	3610	34	3150	103	3310
95th PCTL	144	3770	514	8010	171	7410	390	6270
Upper Transition Facies								
n	*307*	*307*	*227*	*227*	*20*	*20*	*327*	*327*
5th PCTL	3.3	194	4.0	404	3.0	1470	5.0	218
25th PCTL	11	568	7.5	1430	8.5	1730	10	452
Median	21	1060	16	2530	11.5	2010	18	1460
75th PCTL	41	1930	33	4720	24	3320	45	2660
95th PCTL	124	3850	121	7690	160	6390	595	6370
Lower Transition Facies								
n	*140*	*140*	*62*	*62*	*7*	*7*	*76*	*76*
5th PCTL	2.0	143	2.2	25	3.6	632	4.8	111
25th PCTL	6.0	445	7.0	895	26	1050	11	1520
Median	10	1010	13	2100	62	3290	39	2720
75th PCTL	21	2230	35	3650	69	5020	109	6300
95th PCTL	71.6	4080	104	7910	103	5700	1280	10000

Notes:
Values in grey italics are below the analytical detection limit.
Values shaded in light grey are 3x's the Average Continental Abundance (ACA) for Sb (2 ppm) and As (1.8 ppm), according to Price (1997), values shaded in dark grey are 10x's the ACA values.
Red and green gradient shading represent relative concentrations of Sb and As, for all weathering facies and lithologic units.

4.2.6 Kinetic Tests

4.2.6.1 Sample Selection Criteria and Rationale

A total of six unsaturated columns composed of the different ore lithologies and weathering facies (oxide and transition) were initiated for kinetic testwork to obtain information on acid generation and metal leaching rates from ore that will be temporarily sub-aerially stored in the ROM stockpiles and exposed on the pit walls. The kinetic test ore samples were sourced from composite head samples used in metallurgical testwork. A summary of the ore columns, sample selection criteria and rationale for the testwork are provided in Table 4-45. Note that the ore samples were developed as composites to represent typical ore from the various mine pits. As such, other minor lithologies may also be included the composite samples, but for the purpose of discussion they will be referred to by the dominant ore lithology within each pit. Since Double Double is hosted in gneiss similar to Supremo pit, the composite ore sample from the much larger Supremo pit is used to represent ore from both Suremo and Double Double. Figure 4-17 and Figure 4-18 present box plots showing the distribution of total-S and solid phase As, Sb and U for each ore type, with the results for the kinetic test sub-samples superimposed. The data presented Figure 4-17 and Figure 4-18 indicate that the kinetic tests represent moderate to high total-S and low to very high concentrations of As, Sb and U with respect to the larger sample population (*i.e.*, exploration or ABA database); therefore, leachate from the column tests are considered to be representative of 'best-estimate' to 'worst-case' drainage quality from sub-aerially stockpiled gneiss, schist and granite ore (Table 4-45). All the unsaturated columns were operated as trickle leach columns operated on bi-weekly cycles. Additional detail pertaining to the operating procedures are provided in Section 3.2.6 and Appendix D.2.

Table 4-47:
Ore Kinetic Test Details

Lithology	Weathering Facies	Test ID	Head Sample/ Metallurgical Column	Sample Description	Dry Wt. of Sample (kg)	Cycles/ Weeks
Gneiss (Supremo)	Oxide	Col 11	50% 72144B 50% 72145B	Moderate to high T-S (75th PCTL) and moderate As, Sb, U	5.0	45
	Transition	Col 12	72146B	Moderate to high T-S (75th PCTL) and moderate As, Sb, U	4.3	45
Schist (Latte)	Oxide	Col 9	50% 72135B, 50% 72136B	High T-S (80th PCTL); moderate to low As, Sb, U < 50th PCTL)	5.0	45
	Transition	Col 10	50% 72137B, 50% 72138B	Moderate to low T-S (40th PCTL); low As, high Sb, moderate U	5.0	45
Granite (Kona)	Oxide	Col 7	72139B	High T-S (80th PCTL); high As, Sb (>75th PCTL), moderate U	4.4	45
	Transition	Col 8	72140B	Moderate T-S (50th PCTL); very high As, Sb (>90th PCTL), low U	4.4	45

Notes: All columns are constructed of Plexiglas with acrylic perforated disk & nylon mesh; All tests operated at temperature of 4°C; Leachate is sampled bi-weekly from all columns; All columns are operated as trickle leach (discussed in more detail in Section 3.2.6).

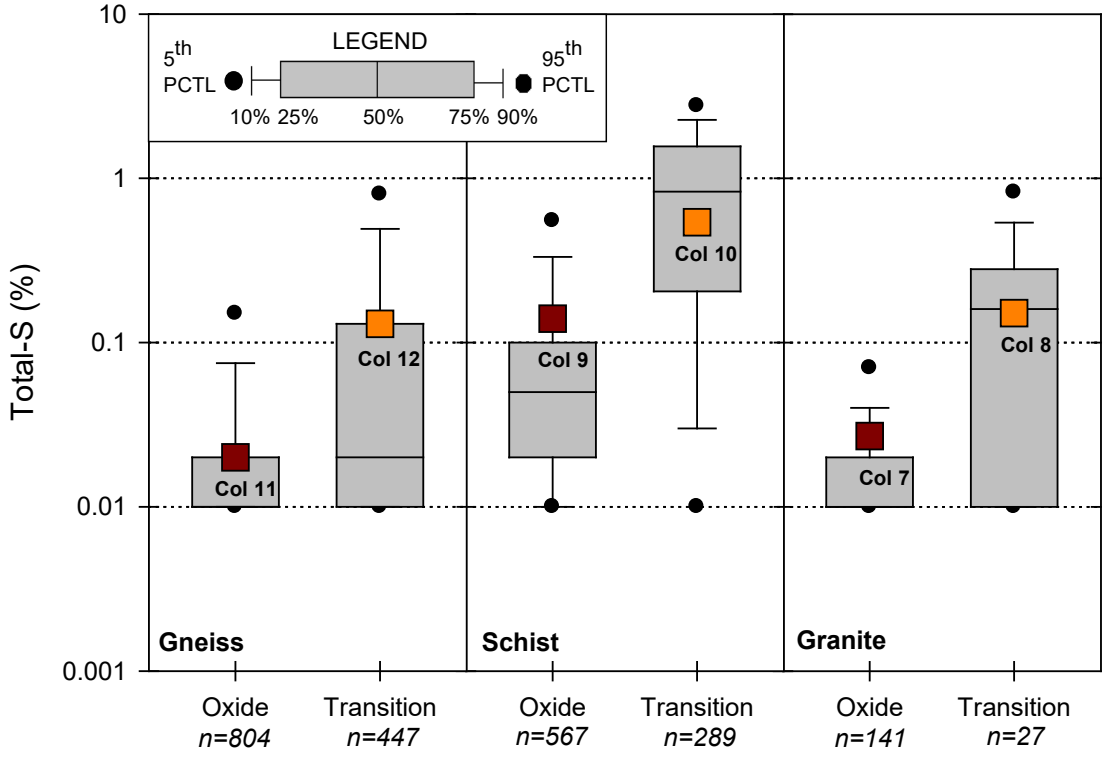


Figure 4-17: Box plots showing the concentration ranges for total-S for the exploration database ore samples with total-S for the kinetic test sub-samples superimposed

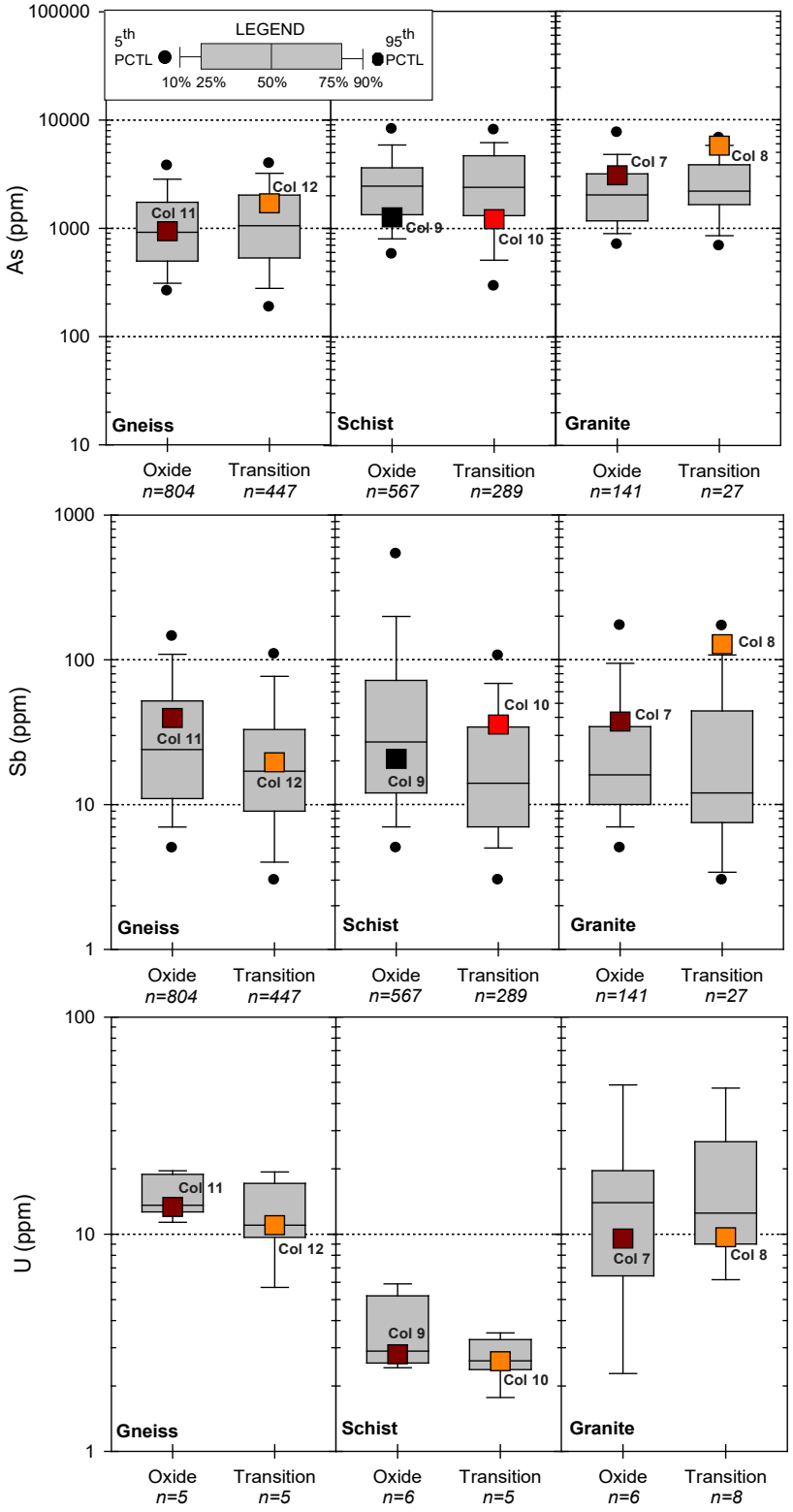


Figure 4-18: Box plots showing the concentration ranges for solid phase As and Sb for the exploration database ore samples and U for the ABA database ore samples with the kinetic test sub-samples superimposed.

4.2.6.2 Static Tests

Acid Base Accounting and Solid Phase Elements

Rinse pH for the gneiss and schist ore column sub-samples are pH-neutral (pH ~7.4, Table 4-46), owing to low total-S and presence of NP in the gneiss sub-samples and moderate total-S but higher NP in the schist sub-samples. Both granite ore sub-samples have acidic rinse pH values of pH 5.7 (oxide facies, Col 7) and 4.4 (transition facies, Col 8). Despite the low total-S content of these samples, they lack carbonate mineralization (CaNP) allowing even minor amounts of sulphur to produce a mildly acidic pH.

Consistent with the larger static test ore sample population, the highest total-S value was measured in the schist transition sub-sample (0.54 wt.%, Col 10) and the lowest total-S values were measured in the gneiss and granite oxide facies (0.02 and 0.03 wt.%, respectively). The schist oxide and transition sub-samples comprise the highest CaNP (125 and 148 kg $CaCO_3$/t) while the lowest CaNP values were measured in the granite oxide and transition sub-samples (1.7 kg $CaCO_3$/t for both) and the gneiss oxide facies sub-sample (5 kg $CaCO_3$/t).

The schist oxide facies and, in particular, transition facies sub-samples comprise the highest overall solid phase element concentrations (Ag, Al, Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn; Table 4-46). However, the highest solid phase As and Sb concentrations were measured in the granite transition sub-sample (5770 and 128 ppm, respectively) and the highest U concentrations was measured in the gneiss oxide and transition sub-samples (13 and 11 ppm). Selenium concentrations are below the detection limit (<1 ppm) for each sub-sample.

Particle Size Distribution

Table 4-47 presents the distribution of grain sizes determined from representative sub-samples of the ore columns. These data indicate that the ore columns are predominantly composed of particles measuring > 0.425 and < 9.5 mm (81 – 91%), with the greatest proportion of test material composed of particles measuring >6.3 and < 9.5 mm.

Table 4-48:
Acid Base Accounting and Solid Phase Elements for Ore Column Sub-Samples

Lithology		Gneiss		Schist		Granite	
Weathering Facies		Oxide	Transition	Oxide	Transition	Oxide	Transition
Column ID		Col 11	Col 12	Col 9	Col 10	Col 7	Col 8
Acid Base Accounting Parameters							
Rinse pH	s.u.	7.4	7.3	7.4	7.4	5.7	4.4
Total-S	wt.%	0.02	0.13	0.14	0.54	0.03	0.15
Sulphate-S	wt.%	*<0.01*	0.02	0.04	0.05	*<0.01*	0.02
Sulphide-S	wt.%	*<0.01*	0.09	0.09	0.44	0.01	0.11
CaNP	kg $CaCO_3$/t	5	33	125	148	1.7	1.7
Sobek NP	kg $CaCO_3$/t	8	38	79	100	0.7	0.5
Siderite NP	kg $CaCO_3$/t	15	44	105	129	7.1	7.0
Solid Phase Elements by Aqua Regia							
Ag	ppm	0.11	0.16	0.25	0.29	0.080	0.090
Al	%	0.43	0.56	0.44	0.65	0.41	0.34
As	ppm	940	1700	1265	1215	3080	5770
Cd	ppm	0.060	0.040	0.10	0.090	0.060	0.040
Co	ppm	5.6	6.6	11	11	1.2	1.9
Cr	ppm	84	107	86	83	77	76
Cu	ppm	4.1	3.5	20	21	0.8	3.8
Fe	%	1.6	1.8	2.7	2.6	1.3	1.5
Hg	ppm	0.96	1.15	0.48	0.47	0.83	4.0
Mn	ppm	300	396	545	502	114	217
Mo	ppm	2.0	3.1	1.5	2.8	1.9	2.3
Ni	ppm	17	12	52	44	1.9	2.3
Pb	ppm	13	14	17	17	15	16
Sb	ppm	40	20	21	36	37	128
Se	ppm	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
U	ppm	13	11	2.8	2.6	9.6	9.7
Zn	ppm	26	27	55	48	18	19

Notes: Values in grey italics are below the analytical detection limit.

Table 4-49:
Particle Size Distribution for Ore Column Sub-Samples

Sieve	Aperture	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12
Designation	(mm)	Weight Retained (%)					
+ 3/8"	9.500	1.7	8.6	6.8	5.3	4.1	4.6
-3/8" + 1/4"	6.300	26.8	30.7	36.2	37	42.6	25.7
-1/4" + 5	4.000	22.2	26.2	23	22.9	23.7	18.3
-5 + 10	1.700	18.3	18.9	15.4	13	14	17.1
-10 + 35	0.425	19.8	11.8	11.9	14	10.6	19.7
-35 + 100	0.150	5.4	2.3	3.8	4.3	2.7	7.3
-100 + 270	0.053	2.8	0.9	2.0	2.1	1.3	4.5
-270	-0.053	3.0	0.6	0.9	1.4	1.0	2.8
	Total	*100*	*100*	*100*	*100*	*100*	*100*

4.2.6.3 Column Results

Results for unsaturated column testwork for ore samples are presented in this section. The complete set of leachate concentrations, calculated loading rates and time series plots for unsaturated ore columns are provided in Appendix D.2. A summary of the final and median loading rates from each kinetic test is presented in Table 4-48, Table 4-49 and Table 4-50. Time series profiles for weekly loading rates are presented in Figure 4-19 and Figure 4-20.

Leachate pH and Sulphate Loading

Leachate pH for the gneiss and schist oxide and transition ore columns remain slightly alkaline over the test period (median of 8.1; Table 4-48, Table 4-49, and Figure 4-19). Leachate pH for the granite oxide facies ore column remains neutral over the test period (median of 7.2, Table 4-50 and Figure 4-19) but an overall gradual decrease is evident from the initial pH of 7.6 to < 7.0 in the last few weeks of testing. Note that a subsample of this material produced a mildly acidic rinse pH during static testing (pH 5.7), indicating that the kinetic test sample is a heterogeneous mix of material, some of which lacks effective NP (Table 4-46). The granite transition facies ore column is acidic over the test period, fluctuating between pH 4.5 and 5.5. The low pH for Col 8 is consistent with low alkalinity production from the column (<0.03 mg $CaCO_3$/kg/wk). Sulphate loading rates from each of the ore columns shows a consistent decrease of one to two orders of magnitude over the test period to <5 mg/kg/wk. The initial sulphate load is generally proportional to the solid phase S content of the test material, with >100 mg/kg/wk leached from all transition facies columns (Col 12, Col 10 and Col 8) and the schist oxide facies column while <5 mg/kg/wk leached from the gneiss oxide facies column (Col 7).

Metal Leaching Trends

Metal loadings from the gneiss and schist oxide and transition ore columns are either gradually decreasing over the test period or are producing relatively low and stable loading rates (following the initial flush). A notable exception is Sb, which shows increased loadings in leachate from the gneiss transition column (Col 12). Uranium loadings from the gneiss oxide and transition ore columns (Col 11 and Col 12) are elevated with respect to the other ore columns and produced relatively stable loadings of >0.001 mg/kg/wk since week 25 of testing (Figure 4-20). The same is observed for Mo, with fairly stable loads of 0.0003 and 0.0005 mg/kg/wk produced by the gneiss oxide and transition ore columns, respectively.

The granite transition ore column (Col 8), which is producing acidic leachate, is producing the highest loads of metal cations, which include Al, Cd, Co, Cu, Fe, Mn, Ni and Zn (Appendix D.2) consistent with the lower pH environment for the column (Figure 4-19).

In particular, As loadings from the granite transition column (0.47 mg/kg/wk) are up to two orders of magnitude higher than that produced by the schist and gneiss columns (Figure 4-20). The sub-sample for Col 8 comprises the highest solid phase As concentrations of the ore kinetic tests (5770 ppm, Table 4-46); however, the schist ore columns generally comprise the highest solid phase concentrations of other metals. Similar to the waste rock kinetic tests, loading rates from the ore columns are not proportional to the relative solid phase content of the kinetic test material but rather are influenced by pH conditions within the kinetic test.

Table 4-50:
Loading Rates for Gneiss Ore Columns

Parameter	Unit	Gneiss					
		Oxide (Col 11)			Transition (Col 12)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH		8.1	8.1	8.1	8.1	8.1	8.1
Alkalinity	mg $CaCO_3$/kg	2.9	3.1	3.4	3.7	4.0	4.4
Sulphate	mg/kg/wk	0.27	0.29	0.31	1.9	2.0	2.3
D-Al	mg/kg/wk	0.00012	0.00014	0.00017	0.00016	0.00017	0.00029
D-Sb	mg/kg/wk	0.00021	0.00022	0.00025	0.0018	0.0013	0.0016
D-As	mg/kg/wk	0.0052	0.0053	0.0057	0.013	0.012	0.013
D-Cd	mg/kg/wk	0.00000013	0.00000013	0.00000018	0.00000013	0.00000016	0.00000025
D-Ca	mg/kg/wk	1.0	1.0	1.1	1.5	1.6	1.7
D-Cr	mg/kg/wk	0.0000080	0.0000072	0.0000079	0.0000013	0.0000014	0.0000028
D-Co	mg/kg/wk	0.0000019	0.0000022	0.0000022	0.0000042	0.0000041	0.0000055
D-Cu	mg/kg/wk	0.000015	0.000020	0.000024	0.000018	0.000021	0.000022
D-Fe	mg/kg/wk	0.00031	0.00031	0.00031	0.00031	0.00031	0.00032
D-Pb	mg/kg/wk	0.0000013	0.00000045	0.0000011	0.00000045	0.00000045	0.00000076
D-Mg	mg/kg/wk	0.28	0.27	0.29	0.45	0.47	0.50
D-Mn	mg/kg/wk	0.000056	0.000033	0.000054	0.00085	0.00081	0.00093
D-Hg	µg/kg/wk	0.00044	0.00044	0.00045	0.00044	0.00045	0.00045
D-Mo	mg/kg/wk	0.00038	0.00040	0.00044	0.00054	0.00060	0.00072
D-Ni	mg/kg/wk	0.0000044	0.0000044	0.0000086	0.000013	0.000015	0.000021
D-Se	mg/kg/wk	0.0000018	0.0000032	0.0000035	0.000011	0.000011	0.000015
D-Ag	mg/kg/wk	0.000000087	0.000000088	0.000000090	0.000000089	0.000000090	0.000000091
D-U	mg/kg/wk	0.0012	0.0013	0.0014	0.00097	0.0011	0.0012
D-Zn	mg/kg/wk	0.000044	0.000044	0.000045	0.000045	0.000045	0.000046

Notes: All* Excludes first 10 cycles (which represent the initial flushing of surface oxidation products).

Table 4-51:
Loading Rates for Schist Ore Columns

Parameter	Unit	Schist					
		Oxide (Col 9)			Transition (Col 10)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH		8.1	8.1	8.1	8.1	8.1	8.1
Alkalinity	mg $CaCO_3$/kg	3.6	3.9	4.1	2.8	2.9	3.1
Sulphate	mg/kg/wk	1.9	2.0	2.5	4.5	5.9	9.1
D-Al	mg/kg/wk	0.00013	0.00015	0.00023	0.00017	0.00017	0.00022
D-Sb	mg/kg/wk	0.00013	0.00014	0.00015	0.00069	0.00070	0.00073
D-As	mg/kg/wk	0.0039	0.0049	0.0053	0.0053	0.0052	0.0056
D-Cd	mg/kg/wk	0.00000017	0.00000021	0.00000032	0.00000013	0.00000013	0.00000016
D-Ca	mg/kg/wk	1.5	1.6	1.7	2.2	2.8	3.4
D-Cr	mg/kg/wk	0.0000050	0.0000043	0.0000049	0.0000013	0.0000014	0.0000020
D-Co	mg/kg/wk	0.0000024	0.0000025	0.0000033	0.000013	0.000015	0.000018
D-Cu	mg/kg/wk	0.000027	0.000029	0.000035	0.000019	0.000023	0.000031
D-Fe	mg/kg/wk	0.00030	0.00031	0.00031	0.00029	0.00029	0.00030
D-Pb	mg/kg/wk	0.0000020	0.00000095	0.0000026	0.0000029	0.00000087	0.0000026
D-Mg	mg/kg/wk	0.58	0.60	0.63	0.60	0.73	0.87
D-Mn	mg/kg/wk	0.00013	0.00013	0.00021	0.0012	0.0015	0.0017
D-Hg	µg/kg/wk	0.00044	0.00044	0.00044	0.00042	0.00042	0.00043
D-Mo	mg/kg/wk	0.00010	0.00011	0.00012	0.00012	0.00012	0.00014
D-Ni	mg/kg/wk	0.000037	0.000045	0.000053	0.000099	0.00012	0.00015
D-Se	mg/kg/wk	0.000022	0.000025	0.000028	0.000037	0.000043	0.000047
D-Ag	mg/kg/wk	0.000000089	0.00000011	0.00000017	0.000000084	0.000000084	0.000000086
D-U	mg/kg/wk	0.000050	0.000066	0.000087	0.00018	0.00023	0.00032
D-Zn	mg/kg/wk	0.000044	0.000044	0.000050	0.000042	0.000042	0.000050

Notes: All* Excludes first 10 cycles (which represent the initial flushing of surface oxidation products).

Table 4-52:
Loading Rates for Granite Ore Columns

Parameter	Unit	Granite					
		Oxide (Col 7)			Transition (Col 8)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH		7.0	7.2	7.5	4.5	4.6	5.1
Alkalinity	mg $CaCO_3$/kg	0.40	0.49	0.56	0.0045	0.0045	0.0046
Sulphate	mg/kg/wk	0.16	0.17	0.22	2.6	2.6	2.9
D-Al	mg/kg/wk	0.0047	0.0037	0.0065	0.0078	0.0084	0.0094
D-Sb	mg/kg/wk	0.00067	0.00077	0.00094	0.00031	0.00031	0.00033
D-As	mg/kg/wk	0.016	0.018	0.020	0.47	0.48	0.53
D-Cd	mg/kg/wk	0.00000021	0.00000013	0.00000017	0.0000030	0.0000031	0.0000035
D-Ca	mg/kg/wk	0.11	0.099	0.11	0.65	0.70	0.74
D-Cr	mg/kg/wk	0.0000021	0.0000021	0.0000029	0.0000018	0.0000027	0.0000038
D-Co	mg/kg/wk	0.0000035	0.0000034	0.0000039	0.0028	0.0030	0.0033
D-Cu	mg/kg/wk	0.000035	0.000039	0.000062	0.00069	0.00069	0.00074
D-Fe	mg/kg/wk	0.00064	0.00052	0.0011	0.0050	0.0053	0.0068
D-Pb	mg/kg/wk	0.0000030	0.0000029	0.0000044	0.0000065	0.0000032	0.000012
D-Mg	mg/kg/wk	0.030	0.027	0.029	0.16	0.17	0.19
D-Mn	mg/kg/wk	0.00086	0.00069	0.00086	0.11	0.11	0.12
D-Hg	µg/kg/wk	0.00084	0.00045	0.00085	0.00046	0.00045	0.00047
D-Mo	mg/kg/wk	0.000049	0.000063	0.000099	0.000015	0.000015	0.000025
D-Ni	mg/kg/wk	0.0000084	0.0000045	0.0000085	0.00071	0.00075	0.00088
D-Se	mg/kg/wk	0.0000027	0.0000027	0.0000037	0.000019	0.000023	0.000026
D-Ag	mg/kg/wk	0.000000084	0.00000011	0.00000018	0.000000092	0.000000092	0.00000021
D-U	mg/kg/wk	0.000017	0.000015	0.000032	0.000054	0.000054	0.000058
D-Zn	mg/kg/wk	0.000046	0.000045	0.000084	0.0044	0.0045	0.0048

Notes: All* Excludes first 10 cycles (which represent the initial flushing of surface oxidation products).

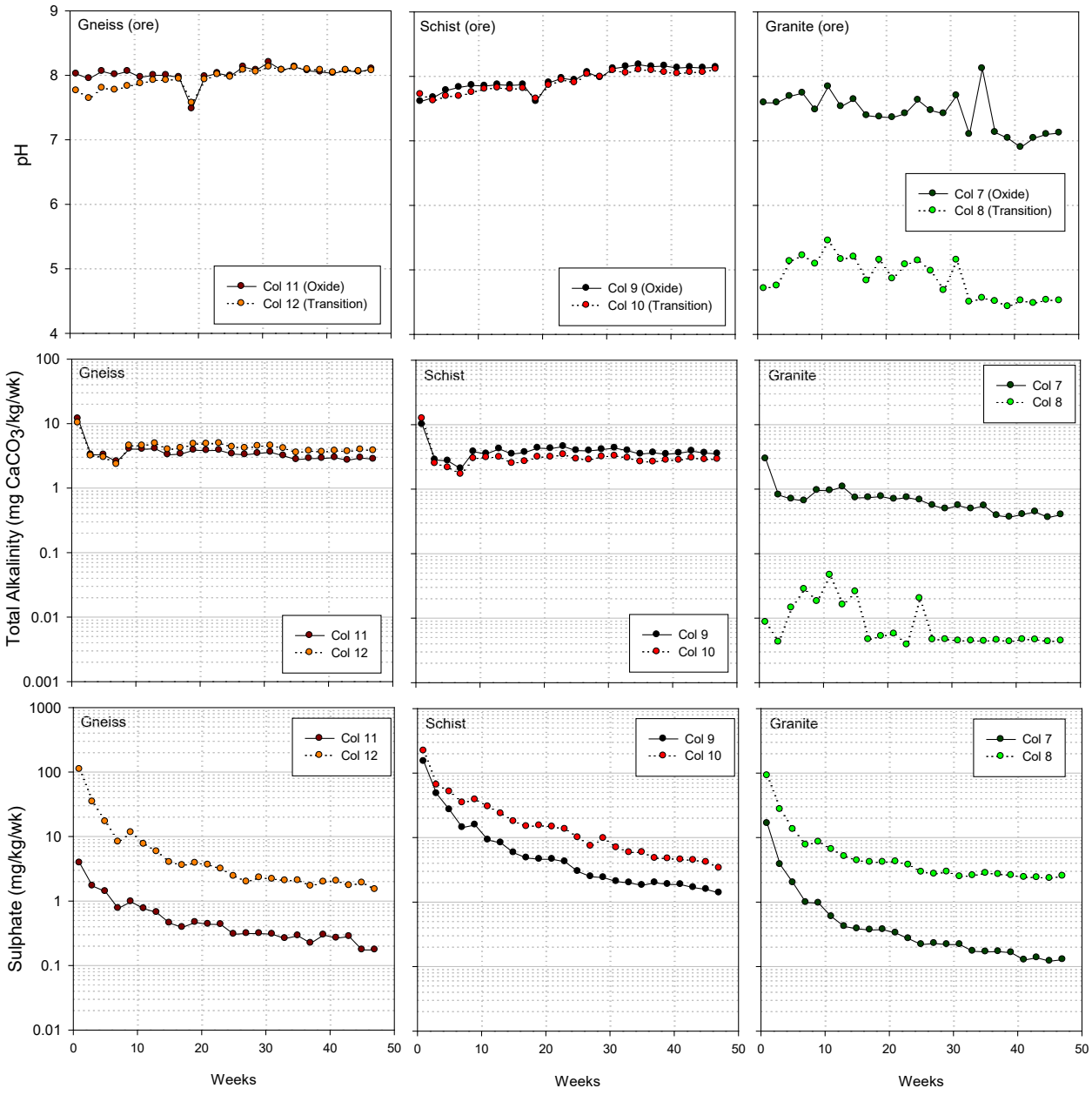


Figure 4-19: Time series plots for leachate pH, total alkalinity and weekly sulphate loadings for ore columns.

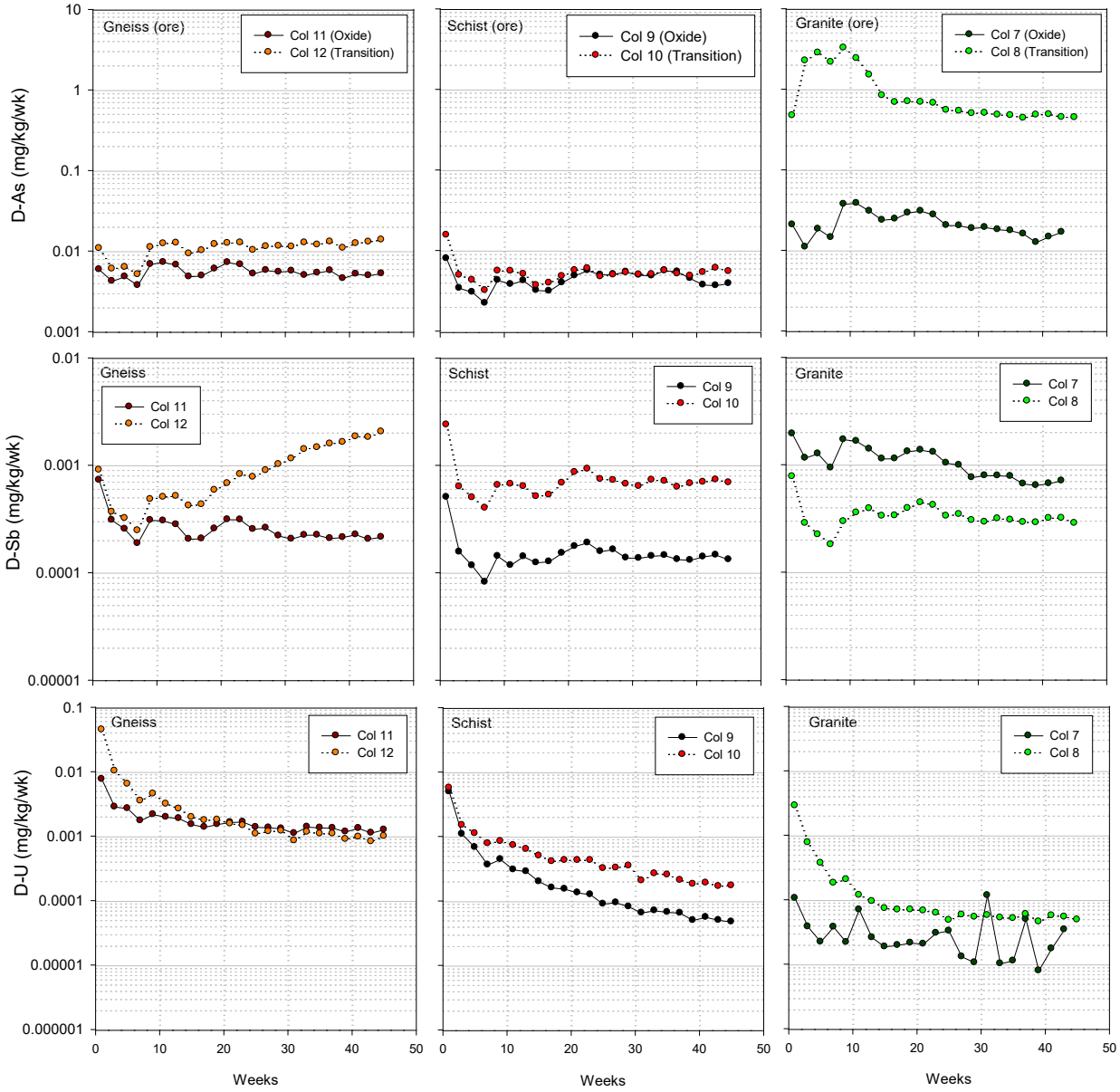


Figure 4-20: Weekly leaching rates for Sb, As and U in leachate from ore columns

4.2.7 Radioisotopes

4.2.7.1 Occurrence

The NORM results for ore samples are presented in Appendix D.1-5 and summarized in Section 4.1.6. Overall, the results show that ore can be considered as unrestricted according to the Canadian NORM Guidelines.

4.2.7.2 Kinetic Test Leachate

The activity of ^{226}Ra was measured in filtered leachate from the six laboratory ore columns on two occasions. Due to the large volume required for ^{226}Ra measurements (250 ml to 1000 ml), samples were collected over several cycles (Table 4-51). The first round of samples collected a volume of 250ml from each column, which gave an elevated detection limit of 0.03 Bq/L. Most samples produced activities below this detection limit, therefore, a second round of samples was submitted with a larger volume of water (1000 ml) to achieve a lower detection limit of 0.01 Bq/L.

Results of ^{226}Ra measurements in ore columns are presented alongside Ba and U concentrations averaged over the same cycles in Table 4-51. A majority of activity measurements are at or below the method detection limit. The relationship between ^{226}Ra activities, with ore type, Ba concentration or U occurrence is difficult to ascertain from this data due to the large number of detection limit values. In general, the results indicate that there is a low potential for ^{226}Ra leaching from ore as shown by ^{226}Ra concentrations generally at or below detection limits.

Table 4-53:
Activity of ^{226}Ra in Ore Column Kinetic Test Leachate

Column ID	Sample Description	Cycle/Week	Ba (mg/L)	U (mg/L)	^{226}Ra (Bq/L)
Col 12	Supremo Transition Ore	05-Jul	0.0041	0.047	*<0.03*
		10-Dec	0.0047	0.026	*<0.01*
Col 11	Supremo Oxide Ore	05-Jul	0.044	0.039	*<0.03*
		10-Dec	0.046	0.031	0.03
Col 10	Latte Transition Ore	05-Jul	0.0046	0.014	*<0.03*
		10-Dec	0.0063	0.0080	0.01
Col 9	Latte Oxide Ore	05-Jul	0.011	0.0063	0.04
		10-Dec	0.016	0.0023	*<0.01*
Col 8	Kona Transition Ore	05-Jul	0.00030	0.0018	*<0.03*
		10-Dec	0.00070	0.0011	0.01
Col 7	Kona Oxide Ore	05-Jul	0.00060	0.00050	0.03
		10-Dec	0.0010	0.00060	0.01

Notes: Values in grey italics are below the analytical detection limit.

4.3 Leach Tailings

This section presents the geochemical characterization results for leach tailings generated by the heap leach facility (HLF). Leach tailings will be generated when ore placed in the HLF is mixed with lime (CaO) and irrigated with NaCN solution which will change the character of metal leaching by raising pore water pH and by the formation of CN-metal

complexes. At the end of mine life, the HLF will be rinsed to remove residual CN from HLF pore water. Lime that remains in the HLF will eventually be rinsed or re-precipitate as calcite, resulting in a decline in pH from the alkaline values required to support CN stability to more neutral values. The goal of this geochemical characterization testwork is to describe HLF drainage at the end of mine life and in the long term after rinsing and detoxification is complete.

Leach tailings samples were collected from metallurgical cyanide leach columns operated at Kappes, Cassiday & Associates (KCA) in 2014 and 2015 and are considered to be representative of the leach tailings that will be generated by the HLF during Operation. Specifically, the leach tailings represent ore that has been mixed with lime and leached with NaCN to extract Au.

4.3.1 Overview of Test Results

Leach tailings have a lower ARD potential compared to ore due to the increased NP from lime that is added to maintain CN stability. Geochemical test work completed for tailings samples are consistent with results for ore (and waste rock), whereby tailings samples derived from granite ore have a lower NP content and, therefore, a greater potential to be PAG. Metal enrichment is expected to be similar between leach tailings and ore, as only a minor fraction of the total metal content will be removed during HLF operation.

Elements of potential concern from the HLF process water include Sb, As, Cr, Cu, Hg and possibly Cd and Zn from each of the ore units, sulphate and Se from the schist unit, and U from the granite and gneiss units. Metal solubility in process solution is supported by the high pH (>9.8) and presence of CN.

Kinetic testing on leach tailings sampled produced from metallurgical testing showed an immediate decline in pH from rinsing of residual lime, with pH values stabilizing at slightly alkaline values. Initial production rates for As, Sb and U are similar to the rates measured for ore of the same lithology and weathering facies; however, rates for the leach tailings columns show a continuous decrease following the initial flush. This is likely related to rinsing of water soluble metals during metallurgical testwork. The lowest U loading rates (by nearly an order of magnitude) are from the schist tailings, consistent with metallurgical column leach solution.

4.3.2 Mineralogy

The mineralogy of leach tailings is expected to be generally similar to that of ore. During the CN leaching process, some water soluble minerals, such as sulphates (*i.e.*, gypsum) or other secondary oxidation products (*i.e.*, oxides) may be rinsed from particle surfaces. The addition of lime may also result in the precipitation of secondary oxides and carbonates.

4.3.3 Acid Base Accounting

Select ABA results for 16 leach tailings samples are presented in Table 4-52. The full suite of ABA results for leach tailings samples are provided in Appendix C.3-1. The rinse pH of the leach tailings is alkaline (8.6≤pH≤9.7) reflecting the addition of lime during the metallurgical testing to support CN stability. Sobek NP measured in tailings show a large range in values (0.37 to 146 kg $CaCO_3$/t). Siderite NP values are uniformly greater than Sobek NP measurements. This difference in NP values was also observed in waste rock and ore, as described in Section 4.1.3.3. Note that NP estimated from carbon content will not accurately describe leach tailings due to the presence of lime, which contributes to NP but does not contain carbon. Both tailings samples derived from granite ore (oxide and transition facies) exhibit low sobek NP (≤ 1 kg $CaCO_3$/t).

Net potential ratio values for tailings samples were calculated using Sobek NP and AP derived from both total-S and sulphide-S. With the exception of granite, all leach tailings samples have NPR >4.7 when total-S is used to derive AP, and NPR>7.0 when sulphide-S is applied. The two tailings samples derived from granite ore have NPR values ranging from 0.1 to 0.6, and as such, are classified as PAG. The NPR results for tailings are consistent with results for ore (and waste rock), whereby tailings samples derived from granite ore have a greater potential to be PAG.

4.3.4 Trace Metal Enrichment

Solid phase element results for leach tailings are presented in Table 4-53 and are compared to ACA values (Price, 1997). The complete set of solid phase element results are presented in Appendix C.3-2. Antimony, As, Bi, Hg and U are indicated to be enriched in the leach tailings with respect to ACAs, with Sb, As and Bi enriched in all samples by 10x's the ACA. Solid phase elemental abundance in leach tailings are generally similar, or higher, than median values for ore of the same lithology and weathering facies.

Table 4-54:
Acid Base Accounting Results for Leach Tailings

Geologic Unit	Weathering Facies	Metallurgical ID (leach tailings)	Head Sample ID (ore)	Sample Description	Rinse	Total- S	Sulphide-S	Sulphate-S	Sobek NP	Siderite NP	NPR	NPR
					pH	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	NP/TAP	NP/SAP
Gneiss	Oxide	73004	72134	Supremo Mine Block (1")	9.7	0.007	*<0.01*	*<0.01*	3.5	12	16.2	11.3
		73013	72142	Supremo #1	9.6	0.014	*<0.01*	*<0.01*	6.2	13	14.2	19.9
		73022	72143	Supremo #2	9.7	0.015	*<0.01*	*<0.01*	2.2	8.7	4.7	7.0
		73028	72144	Supremo Oxide T1	9.6	0.033	0.01	*<0.01*	12	18	11.5	37.9
		73034	72145	Supremo Oxide T4	9.7	0.022	0.01	*<0.01*	30	36	43.3	95.2
	Transition	73040	72146	Supremo 80%	9.5	0.097	0.05	0.02	38	44	12.4	24.1
Gneiss/Schist	Oxide/Transition	70340	-	Supremo/Latte	8.4	0.08	0.04	0.02	48	-	19.2	38.4
Schist/Gneiss	Oxide	72186	72141	DD oxide	9.6	0.13	0.1	0.01	79	83	19.5	25.3
Schist	Oxide	72117	72101	Latte -583150 Trench (6")	9.6	0.035	*<0.01*	0.02	65	69	59.4	208.0
		72123	72102	Latte 583350 Trench (6")	9.7	0.048	0.02	0.02	96	119	63.9	153.3
		73001	72133	Latte mine block (1")	9.5	0.051	*<0.01*	0.04	5.6	15	3.5	18.0
		72150	72135	Latte Oxide West	8.6	0.11	0.07	0.02	124	154	36.1	56.7
		72156	72136	Latte Oxide East	9.6	0.087	0.06	0.02	79	85	29.2	42.3
	Transition	72162	72137	Latte 80%'	8.9	0.41	0.33	0.04	146	175	11.4	14.2
		72168	72138	Latte 60%	8.9	0.47	0.39	0.03	127	155	8.6	10.4
Granite	Oxide	72174	72139	Kona Oxide	9.7	0.033	0.02	*<0.01*	0.37	8.3	0.4	0.6
	Transition	72180	72140	Kona 80% CN	9.7	0.18	0.14	0.01	0.61	7.6	0.1	0.1

Notes:
Values in grey italics are below the analytical detection limit.
NNP: net neutralization potential calculated by subtracting TAP (acid potential derived from T-S) from Sobek NP.
NPR: net potential ratio

Table 4-55:
Solid Phase Element Results for Leach Tailings

		Average Continental Abundance		*8.23*	*0.2*	*1.8*	*0.01*	*0.15*	*102*	*25*	*60*	*5.6*	*14*	*0.09*	*1.2*	*84*	*0.08*	*2.7*	*70*
Geologic Unit	**Weathering Facies**	**Metallurgical ID (leach tailings)**	**Head Sample ID (ore)**	**Al**	**Sb**	**As**	**Bi**	**Cd**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Mo**	**Ni**	**Ag**	**U**	**Zn**
				%	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Schist	Oxide	72117	72101	0.76	138	1120	0.82	0.08	102	14.3	33.1	3.32	12.4	0.2	3.75	42.6	0.07	1.69	62
		72123	72102	0.53	52.7	1580	0.5	0.15	88	12.8	24.5	3.18	15.8	0.57	3.64	30	0.08	2.09	58
		73001	72133	0.44	243	9020	0.5	0.13	90	11	24.9	3.89	16.3	0.81	3.63	33.2	0.64	4.49	75
		72150	72135	0.4	25.5	1380	0.37	0.1	126	12.1	21.3	2.69	13.8	0.31	3.99	102	0.13	2.11	46
		72156	72136	0.52	27.4	1280	0.39	0.15	109	11.5	12.3	2.8	15.4	0.26	4.27	55.9	0.06	2.59	55
	Transition	72162	72137	0.65	20.8	1710	0.45	0.09	88	12.6	14.5	2.51	14.8	0.36	3.39	58.5	0.11	2.58	50
		72168	72138	0.83	55.5	932	0.46	0.1	103	10.6	19.5	2.75	12.5	0.28	4.28	40.8	0.08	2.42	49
Granite	Oxide	72174	72139	0.44	47.7	4170	0.08	0.05	93	1.4	2.2	1.48	15.6	0.55	4.84	5	0.03	8.8	17
	Transition	72180	72140	0.34	86.4	5880	0.11	0.04	103	1.4	1.6	1.23	19.5	2.99	5.47	5.4	0.06	7.35	12
Gneiss	Oxide	73004	72134	0.45	97.3	2660	0.45	0.2	122	14.8	19.9	4.35	9.3	1.39	6.52	57.8	0.25	22.6	40
		73013	72142	0.77	41.4	1060	0.23	0.12	137	13.3	8.5	2.91	14.3	0.56	4.65	70.4	0.12	20.1	42
		73022	72143	0.48	40.4	588	0.49	0.07	93	6.3	11.1	1.8	11	0.13	4.96	11.9	0.06	6.89	21
		73028	72144	0.49	54.5	969	0.32	0.09	98	8.5	7.7	2.25	14	0.6	4.82	13.5	0.09	17.7	41
		73034	72145	0.46	31.1	1040	0.18	0.06	110	4.4	6.6	1.45	12.8	1.09	5.35	15.7	0.15	12.4	21
	Transition	73040	72146	0.7	22	1760	0.57	0.08	126	6.8	2.3	1.98	13.2	1.06	6.39	22.6	0.06	12	29
Schist/Gneiss	Oxide	72186	72141	0.76	42.8	1410	0.8	0.11	120	13.1	10.1	3.15	13.7	0.41	4.09	34.2	0.06	4.91	42

Notes:
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA. Values shaded in blue are at the ACA.

4.3.5 Metallurgical Column Leach Solution

The final leach solution from CN leach columns operated at KCA was collected to provide an indication of heap leach water chemistry during operations. In the column experiments, ore samples were mixed with lime and irrigated with a NaCN solution, leading to elevated pH, cyanide species and concentrations of metals that form CN complexes (*e.g.*, Cu, Cd, Hg, Fe, Ni and Zn). Following the stripping of Au from the effluent, the barren solution was re-circulated through the column with makeup NaCN amended as required. In total, 16 columns were established to account for variations in scale, grain size, lithology and weathering facies.

Select parameters for the final leachate chemistry from the 16 metallurgical columns are provided in Table 4-56. The complete set of results are provided in Appendix C.3-3. The water chemistry of the final leachate is presented in Table 4-56 with MDMER and CCME (10x's) guidelines to provide an indication of the relative pore water quality that can be expected from the different ore types during Operation. In this manner parameters of potential concern (that may require treatment) can be identified. Key observations are as follows:

- The highest sulphate concentrations were measured in leachate from the schist ore, in particular the transition facies, which is consistent with higher total-S and sulphide-S measured for schist ore samples.
- The highest As and Sb concentrations were measured in leachate from the granite ore, in particular the transition facies, with values ranging from 40 to 85 mg/L As and 0.17 to 0.93 mg/L Sb.
- The highest Se concentrations were leached from the schist ore transition facies (0.010 to 0.019 mg/L), with all columns leaching Se at concentrations that exceed the 10x CCME value.
- The schist ore columns showed little to no potential for U leaching (<0.0059 mg/L), with all values well below 10x CCME guidelines and several orders of magnitude lower than those observed in leachate from the granite and gneiss (oxide in particular) ore columns.
- In general, higher concentrations of sulphate, As, Sb and Se are measured in leachate from the transition facies ore as compared to oxide facies ore of the equivalent lithology (with notable exception of As and Sb in schist columns).

Table 4-56:
Final Leach Solution from Metallurgical Cyanide Columns

Lithology	Weathering Zone	Head ID (ore)	Column ID (leach tailings)	Particle Size	Column mass	pH	T-Alk	T-CN	SO_4	D-Al	D-Sb	D-As	D-Ba	D-Cd	D-Cr	D-Cu	D-Hg	D-P	D-Se	D-U	D-Zn	Ra-226
				mm	kg	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
CCME	**short-term**	-	-	-	-	-	-	-	-	-	-	-	-	0.001	-	-	-	-	-	0.033	0.055	-
	long-term	-	-	-	-	6.5 - 9.0	-	0.005	218	0.1	0.009	0.005	-	0.00009	0.001	0.002	0.000026	-	0.001	0.015	0.0059	-
MDMER	**Max in a grab sample**	-	-	-	-	-	-	2	-	-	-	1	-	-	-	0.6	-	-	-	-	1	1.11
Schist	Oxide	72133	73001	12.5	48	10	458	101	43	0.035	0.082	16	0.012	0.00011	0.012	0.21	0.0012	0.24	0.00059	0.033	0.061	-
		72136	72156	12.5	50	9.9	366	144	547	0.064	0.036	2.4	0.015	0.00057	0.0078	0.75	0.0055	0.075	0.0039	0.0015	0.16	-
			72153	80	101	9.8	590	119	725	0.045	0.085	6	0.014	0.0075	0.006	2.8	0.0069	0.19	0.0044	0.0059	1.6	-
	Transition	72137	72162	12.5	50	9.8	301	168	2370	0.028	0.042	0.87	0.011	0.00009	0.0014	1.5	0.00069	<0.1	0.014	0.00012	0.096	-
			72159	80	94	9.5	322	125	2980	0.074	0.15	3	0.02	0.0032	0.0023	4.9	0.0047	<0.1	0.018	0.00026	1.4	-
		72138	72168	12.5	49	9.6	223	134	2670	0.019	0.049	0.5	0.009	0.0001	0.0014	2.1	0.0004	<0.1	0.01	0.00008	0.12	-
			72165	80	84	9.5	229	99	2570	0.086	0.21	1.8	0.025	0.0022	0.0019	4.6	0.0024	<0.1	0.019	0.00008	1	-
Granite	Oxide	72139	72174	12.5	50	10.1	580	164	38	0.39	0.17	40	0.007	0.0002	0.012	0.28	0.0017	0.32	0.0012	0.58	0.1	-
			72171	80	104	9.8	738	139	57	0.33	0.26	55	0.013	0.0059	0.0044	1.8	0.0054	0.37	0.0025	1.1	1.9	-
	Transition	72140	72180	12.5	50	10	570	168	424	1.21	0.93	85	0.004	<0.0001	<0.002	0.54	0.0048	0.26	0.0043	0.45	0.12	-
			72177	80	98	9.7	661	179	666	0.53	0.78	75	0.018	0.0026	0.0017	2.3	0.022	0.4	0.0076	0.83	1.4	-
Gneiss	Oxide	72142	73013	12.5	43	10	491	172	12	0.056	0.015	0.71	0.03	0.00017	0.013	0.16	0.00078	0.52	0.00087	0.47	0.036	-
			73010	80	83	9.8	517	100	10	0.18	0.028	0.81	0.089	0.0046	0.013	0.55	0.0015	0.16	0.0015	0.14	0.41	-
			73007	150	718	9.9	468	168	6.9	0.19	0.01	0.17	0.35	0.0374	0.037	1.9	0.06	<0.05	0.0016	0.0045	1.1	0.1
		72143	73022	12.5	44	10	473	134	12	0.18	0.02	0.67	0.024	0.00004	0.013	0.09	0.00011	0.25	0.0019	0.17	0.021	-
			73019	80	86	9.9	883	90	11	0.34	0.047	2	0.047	0.0033	0.024	0.57	0.00065	1	0.004	0.74	0.41	-
			73016	150	741	9.9	678	124	8.1	0.37	0.028	1	0.037	0.0255	0.051	1.5	0.015	0.33	0.005	0.15	1.1	0.018
		72144	73028	12.5	50	10	492	126	42	0.11	0.036	3.6	0.033	0.0003	0.021	0.32	0.0023	0.39	0.0011	0.41	0.064	-
			73025	80	99	9.9	738	124	45	0.16	0.13	5.1	0.038	0.0029	0.022	1.1	0.0027	0.51	0.00083	0.41	0.64	-
		72145	73034	12.5	49	10	418	161	63	0.04	0.033	2.8	0.015	0.00027	0.013	0.21	0.004	0.18	0.00083	0.27	0.027	-
			73031	80	95	9.8	644	170	58	0.052	0.073	2.8	0.067	0.0019	0.012	1.1	0.0045	0.19	0.00079	0.15	0.66	-
		72134	73004	12.5	46	10	676	113	8.8	0.054	0.026	1.4	0.005	0.00053	0.0091	0.29	0.0055	0.97	0.0012	1.9	0.056	-
	Transition	72146	73040	12.5	50	10	374	156	744	0.061	0.18	7.5	0.003	0.00006	0.0015	0.32	0.0024	0.12	0.0063	0.058	0.039	-
			73037	80	94	9.8	1180	136	444	0.087	0.27	13	0.007	0.001	0.012	1	0.0032	1	0.0071	0.46	0.59	-
Gneiss/Schist	Oxide	72141	72186	12.5	50	10.1	439	142	177	0.058	0.035	1.9	0.004	0.00008	0.013	0.39	0.00012	0.11	0.0057	0.00032	0.068	-
			72183	80	95	9.8	564	134	220	0.028	0.089	2.6	0.018	0.0033	0.0042	3.2	0.0027	0.089	0.0098	0.004	1.1	-

Notes:
Values in grey italics are below the analytical detection limit;
Values that exceed the Metal and Diamond Mines Effluent Regulations (MDMER, 2018) maximum authorized concentration in a grab sample are shaded in dark grey.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2019) Water Quality Guidelines for the Protection of Freshwater Aquatic Life by 10x's are shaded in light grey;
All guidelines are for total metal, except for Al, Mn, and Zn.
Guideline for Cu and Cd are based on a hardness of 50 mg $CaCO_3$/L; Guideline for Zn is based on a hardness of 50 mg/L CaCO3/L, a pH of 8.5, and a DOC of 2.5 mg/L
Guideline for Cr is for hexavalent (VI); Guidelines for sulphate and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 50 mg CaCO3/L

Total CN concentrations range from 90 to 179 mg/L in final effluent samples from the metallurgical CN columns. The presence of CN supports the solubility of a variety of metals that would otherwise be insoluble at neutral pH (*e.g.,* Cu, Cd, Zn, Hg, *etc*.). Other metals such as As, Sb and U, which are not directly associated with CN complexation, may also be present in elevated concentrations due to the increased solubility of oxyanions at high pH and alkalinity. Detoxification of the HLF will destroy CN and reduce the solubility of metals which form CN-complexes. Furthermore, pH can be expected to decline with time as lime is either rinsed from the system or re-precipitated as calcite. This will reduce the solubility of As, Sb and U; however, they will likely remain in effluent at concentrations of concern.

Based on the results of the final leach from the CN columns, elements of potential concern from the HLF include Sb, As, Cr, Cu, Hg and possibly Cd and Zn from each of the ore units, as well as sulphate and Se from the schist unit, and U from the granite and gneiss units. Of these, Sb, As, Hg and U are indicated to be enriched in solid phase analyses (Section 4.3.3).

4.3.6 Kinetic Tests

4.3.6.1 Sample Selection and Rationale

Five unsaturated columns and three field bins were constructed with leach tailings to obtain information on metal leaching rates from spent ore in the HLF after mine closure. The leach tailings used for kinetic testwork were sub-sampled from the final residue available upon completion of the metallurgical column testwork. Ore composites used for metallurgical testing were composed of lithologies and weathering facies in proportions representative of the proportions that will be placed in the HLF during the mine life. A summary of the leach tailings, sample selection criteria and rationale for the testwork are provided in Table 4-57. All the unsaturated columns were operated as trickle leach columns at 4°C. Additional detail pertaining to the operating procedures are provided in Section 3.2.6 and Appendix D.3. An overview of the metallurgical column testwork that produced the leach tailings is presented in Section 3.2.7.

Figure 4-21 and Figure 4-22 present box plots showing the distribution of total-S and solid phase As, Sb and U for each ore type, with the results for the kinetic test sub-samples superimposed. Note that several of the kinetic test samples contain a combination of lithologies (Col 1, Col 3, FB-LT1 and Col 17). These samples are compared against the the dominant rock type that composes the kinetic tests. The comparison indicates that the kinetic tests represent moderate too high total-S, with all samples except FB-LT3 plotting at or above medium values of the respective rock units. Antimony concentrations were uniformly above medium concentrations of the respective rock units. Most kinetic tests

samples plotted near or above median values of As and U, with the exception of FB-LT3 which plotted near the 25th percentile and 10th percentile for As and U, respectively.

Table 4-57:
Leach Tailings Kinetic Test Details, Sample Selection Criteria and Rationale

Lithology	Weathering Facies	Kinetic Test ID	Type of Test	Mass (kg)	Metallurg. Column ID	Weeks	Recirc. Cycles
Gneiss (82%) Schist (18%)	Oxide (90%) Transition (10%)	Col 1	Unsaturated Column	10.0	70340	98	57-89
		Col 2		20.0		98	57-89
		FB-LT1	Field Bin	76.3		70	-
Gneiss	Oxide (80%) Transition (20%)	Col 16	Unsaturated Column	5.0	40% 73028, 40% 73034, 20% 73040	39	-
Gneiss	Oxide	FB-LT2	Field Bin	200	50% 73007 50% 73016	10	-
Schist	Oxide	FB-LT3	Field Bin	200	50% 72108 50% 72111	10	-
Schist	Oxide (40%) Transition (60%)	Col 15	Unsaturated Column	5.0	20%72162, 20% 72168, 30% 72150, 30% 72156	39	-
Gneiss (90%) Granite (10%)	Oxide (80%) Transition (20%)	Col 17	Unsaturated Column	5.0	35% 73028, 35% 73034, 18% 73040, 7% 72174, 3% 72180	39	-

Notes: All columns are constructed of Plexiglas with acrylic perforated disk & nylon mesh; All tests operated at temperature of 4°C; Leachate is sampled bi-weekly from all columns; All columns are operated as trickle leach (discussed in more detail in Section 3.2.6).

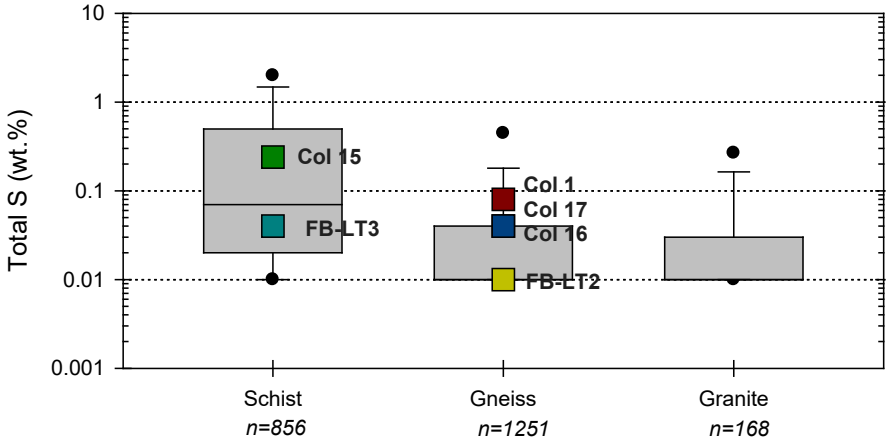


Figure 4-21: Box plots showing the concentration ranges for total-S from the exploration database ore samples with total-S for leach tailings kinetic test sub-samples superimposed

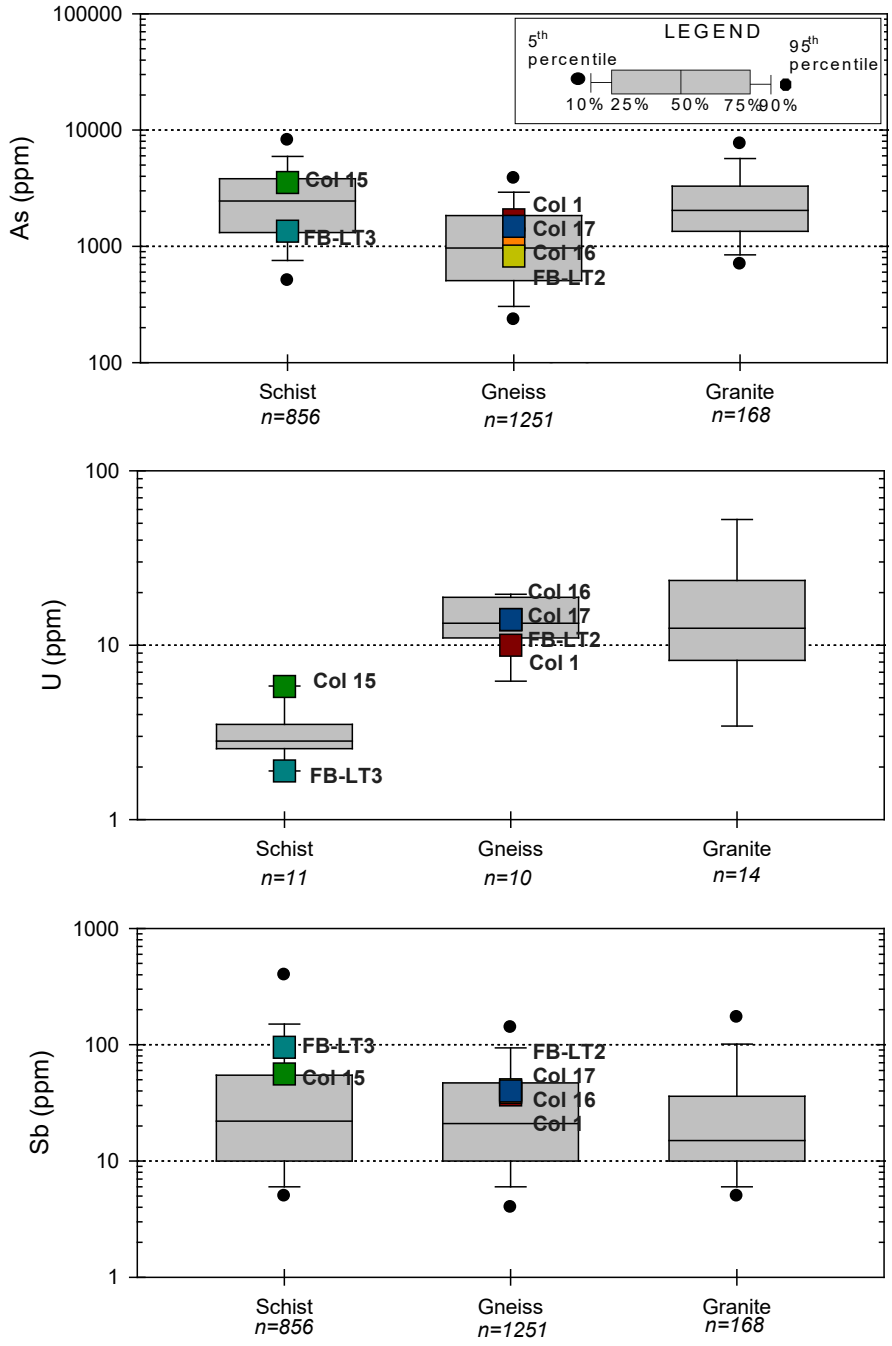


Figure 4-22: Box plots showing the concentration ranges for solid phase As and Sb from the exploration database ore samples and U from the ABA database ore samples with the leach tailings kinetic test sub-samples superimposed.

4.3.6.2 Static Tests

Mineralogy

A sub-sample of the leach tailings composite sample LT1 (derived from 82% gneiss, 18% schist and 90% oxide 10% transition ore) used for laboratory and field kinetic testwork in Col 1, Col 2 (20 kg duplicate of Col 1) and FB-LT1 was submitted for quantitative phase analysis using the Rietveld Method XRD. The minerals identified by XRD in the waste rock kinetic test sub-sample are provided in Table 4-58. The major rock forming minerals identified in each sample are quartz and feldspars (microcline and albite), with lesser amounts of muscovite, biotite, chlorite and phlogopite. The sample also comprises measurable concentrations of kaolinite (6.8 wt.%), demonstrating the weathered state of the test material. No sulphide minerals were identified in the leach tailings sample. However, two carbonate minerals, calcite (1.4 wt.%) and dolomite (4.6 wt.%), were identified.

Table 4-58:
XRD Results for Leach Tailings Kinetic Test Sub-samples

	Lithology	**Gneiss/Schist**
	Weathering Facies	**Oxide/Transition**
	Kinetic Test IDs	**Col 1/Col 2 & FB-LT1**
Mineral	**Formula**	**wt. %**
Quartz	SiO_2	56.3
Microcline	$KAlSi_3O_8$	1.6
Albite	$NaAlSi_3O_8$	4.6
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	14.8
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	0.5
Phlogopite	$KMg_3(AlSi_3O_{10})(OH)$	3.1
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	6.4
Kaolinite	$Al_2Si_2O_5(OH)_4$	6.8
Calcite	$CaCO_3$	1.4
Dolomite	$CaMg(CO_3)_2$	4.6

Acid Base Accounting and Solid Phase Elements

Rinse pH for the leach tailings kinetic test sub-samples are alkaline (8.4 – 9.6), owing in part, to the addition of lime to the ore prior to leaching (Table 4-59). Total-S values range from 0.01 wt.% in the gneiss oxide field bin sub-sample (FB-LT2) up to 0.24 wt.% in the schist oxide/transition column sub-sample (Col 15). Consistent with observations made for

the waste rock and ore, leach tailings comprising schist contain the highest amounts of Sobek NP (55 – 80 kg $CaCO_3$/t) compared to leach tailings comprising only gneiss and/or granite (NP ≤ 23 kg $CaCO_3$/t).

The overall highest solid phase metal concentrations (Al, Cd, Co, Cu, Fe, Mn, Ni, Sb and Zn) were measured in the schist oxide field bin sub-sample (FB-LT3, Table 4-59) and the highest As concentration (3,543 ppm) was measured in the schist oxide/transition sample (Col 15).

Table 4-59:
Acid-Base Accounting Results and Solid Phase Elements in Leach Tailings Kinetic Test Sub-samples

Lithology		**Gneiss/ Schist**	**Gneiss**	**Gneiss**	**Schist**	**Schist**	**Gneiss/ Granite**
Weathering Facies		**Oxide/ Transition**	**Oxide/ Transition**	**Oxide**	**Oxide/ Transition**	**Oxide**	**Oxide/ Transition**
Kinetic Test IDs	**Column**	**Col 1**	**Col 16**	**-**	**Col 15**	**-**	**Col 17**
	Field Bin	**FB-LT1**	**-**	**FB-LT2**	**-**	**FB-LT3**	**-**
Acid Base Accounting Parameters							
Rinse pH	s.u.	8.4	9.6	9.6	9.4	9.6	9.4
Total-S	wt.%	0.08	0.04	0.01	0.24	0.04	0.04
Sulphate-S	wt.%	0.02	0.012	*<0.01*	0.02	0.02	0.012
Sulphide-S	wt.%	0.04	0.02	*<0.01*	0.19	0.02	0.02
CaNP	kg $CaCO_3$/t	47	23	1.7	59	81	20
Sobek NP	kg $CaCO_3$/t	48	24	4.2	55	80	21
Siderite NP	kg $CaCO_3$/t	-	30	11	71	94	28
Solid Phase Elements by Aqua Regia							
Ag	ppm	0.13	0.11	0.09	0.065	0.075	0.0987
Al	%	0.33	0.52	0.63	0.53	0.65	0.50
As	ppm	1690	1156	824	3543	1350	1488
Cd	ppm	0.09	0.076	0.095	0.065	0.12	0.072
Co	ppm	8.2	6.5	9.8	5.5	14	5.9
Cr	ppm	123	108	115	97	95	105
Cu	ppm	15	6.2	9.8	7.9	29	5.6
Fe	%	2.3	1.9	2.4	1.9	3.3	1.8
Hg	ppm	0.57	0.89	0.35	1.2	0.39	0.91
Mn	ppm	402	412	537	284	638	376
Mo	ppm	4.5	5.4	4.8	4.6	3.7	5.2
Ni	ppm	14	16	41	23	36	15
Pb	ppm	15	13	13	16	14	13
Sb	ppm	37	39	41	56	95	40
Se	ppm	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
U	ppm	10	14	14	5.8	1.9	14
Zn	ppm	33	31	32	29	60	29

Notes: Values in grey italics are below the analytical detection limit. Green gradient shading represents relative concentrations for each parameter.

Particle Size Distribution

Table 4-60 presents the particle size distribution for individual leach tailings samples that compose the composite samples used for kinetic testwork. The proportion of each leach tailings sample used to construct the ML/ARD columns and field bins are provided in Table 4-57. Also provided in Table 4-61, are the particle size distribution of crushed ore used in the metallurgical columns. Field kinetic tests FB-LT2 and FB-LT3 comprise notably larger particles than the samples that make up the other field test and columns. Specifically, 45% of particles that compose FB-LT2 and FB-LT3 are between 37.5 and 75 mm in diameter, owing to the larger particles of crushed ore (82 – 115 mm) used in the metallurgical columns that produced the leach tailings. The leach tailings that compose kinetic tests Col 15, Col 16 and Col 17 also comprise a well sorted distribution of particles measuring < 16 mm in diameter, with the greatest proportion of particles (61-66%) comprising the 1.7 to 12.5 mm diameter fraction. Sample 70340 (Col 1 and FB-LT1) is predominantly composed of particles measuring between 6.3 mm and 37.5 mm in diameter (67%), with the greatest proportion of the test material comprising the 6.3 to 12.5 mm fraction (30%).

4.3.6.3 Unsaturated Column Results

At mine closure, it is anticipated that the heap leach tailings will be "rinsed" with barren recycle solution. As discussed in Section 3.2.7, the leach tailings were not rinsed following metallurgical testwork or prior to placing the material in the columns and field bins for ML/ARD kinetic testwork. In order to accurately account for leaching conditions at closure following the rinse of the HLF, loading rates were calculated (median and 75th percentile values) for the 10 weeks after rinsing with approximately 5 pore volumes through the leach tailings columns (Table 4-61). Time series profiles for the leach columns are presented in Figure 4-23 through Figure 4-25 and in Appendix D.3.

Leachate pH and Sulphate Loading

Leachate pH for all tailings columns remain slightly alkaline over the test period (7.9 - 8.9, Table 4-61). A gradual decline in pH reflecting rinsing of lime is evident in all leach tailings columns except Col 15 (schist) (Figure 4-23). The pH values from Col 15 were initially relatively low compared to other columns (pH 8.0) and have remained relatively constant over the test period. A decrease in leachate pH is expected from the leach tailings in response to the rinsing and/or re-precipitation of residual lime from metallurgical testing. Lime is unstable in the presence of water and atmospheric CO_2 and will re-precipitate as calcium carbonate minerals with time. The lower pH values associated with Col 15 is likely due to a smaller lime addition during metallurgical testing, which was 1 g/kg compared to 1.5 g/kg in gneiss samples (KCA, 2015).

Table 4-60:
Particle Size Distribution for Leach Tailings Kinetic Sample

ML/ARD Kinetic Test ID	Col 1/Col 2 FB-LT1	Col 17					FB-LT3		Col 15				FB-LT2	
		Col 16			*NA*	*NA*								
Metallurgical Column ID	**70340***	**73028**	**73034**	**73040**	**72174**	**72180**	**72108**	**72111**	**72162**	**72168**	**721504**	**72156**	**73007**	**73016**
	NA	12.1	12.9	12.2	11.4	12.2	82.3	115	12.2	12.4	11.5	12.4	93.8	110.3
Sieve (mm)	Weight Retained (%)													
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	8.8	0	0	0	0	5.4	5.4
100	0	0	0	0	0	0	13.6	13.3	0	0	0	0	9.4	16.1
75	0	0	0	0	0	0	6.1	14.9	0	0	0	0	11.5	15.4
62.5	0	0	0	0	0	0	8.9	8.8	0	0	0	0	4.7	6
50	0	0	0	0	0	0	6	6.9	0	0	0	0	7.6	8.5
37.5	0	0	0	0	0	0	6.4	6	0	0	0	0	7.4	4.1
25	15	0	0	0	0	0	9.1	6.6	0	0	0	0	6.9	6.1
16	22	0	0	0	0	0	9.6	6	0	0	0	0	6.4	5.9
12.5		16.4	21.6	18.1	16.3	17.1	4.8	3	17.3	18.2	15.8	17.8	3.5	3.6
9.5	30.1	23.4	22	23.3	29	37.1	9.8	6.5	37.6	38.8	34.2	38.2	7.1	7.6
6.3		20.4	19.1	18.3										
1.7	18.7	22.1	22	22.9	33.3	26.7	11.8	7.9	26.8	25.3	27.1	25.5	11.1	8
<1.7	14.4	17.8	15.3	17.4	21.4	19.2	14	11.2	18.3	17.7	22.9	18.6	19.1	13.4
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Notes:
PSD for leach tailings samples were conducted as part of the metallurgical testwork (KCA, 2015)
* PSD completed at SGS; 14.4% <1.7 mm was further subdivided into 7.7% retained on 0.425 mm sieve, 3.8% on 0.15 mm, 2.1% on 0.053 mm and 0.8% < 0.053 mm.

Table 4-61:
Loading rates for leach tailings unsaturated columns for 10 cycles after rinsing.

Parameter	Unit	Gneiss/Schist (Oxide/Transition)				Schist (Oxide/Transition)		Gneiss (Oxide/Transition)		Gneiss/Granite (Oxide/Transition)	
		Col 1 (10 kg)		Col 2 (20 kg)		Col 15 (5 kg)		Col 16 (5 kg)		Col 17 (5 kg)	
		weeks 19-37		weeks 35-53		weeks 9-27		weeks 7-25		weeks 7-25	
		Median	75th PCTL	Median	75th PCTL	Median	75th PCTL	Median	75th PCTL	Median	75th PCTL
pH		8.4	8.4	8.5	8.5	8.1	8.2	8.5	8.6	8.5	8.6
Alkalinity	$mgCaCO_3/kg/wk$	4.5	4.9	2.8	2.9	6.2	6.8	12	15	208	271
Sulphate	mg/kg/wk	0.53	0.58	0.26	0.28	5.5	8.2	0.42	0.57	0.54	0.72
Total CN	mg/kg/wk	0.0023	0.0032	0.0011	0.0013	0.013	0.021	0.014	0.022	0.014	0.023
WAD CN	mg/kg/wk	0.00017	0.00018	0.000088	0.00015	0.0012	0.0016	0.0017	0.0029	0.0016	0.0019
Ammonia-N	mg/kg/wk	0.0067	0.0092	0.0035	0.0042	0.0098	0.015	0.0051	0.0056	0.0054	0.0077
Nitrate-N	mg/kg/wk	0.00098	0.00100	0.00051	0.00053	0.0029	0.0033	0.0029	0.0033	0.0029	0.0033
Nitrite-N	mg/kg/wk	0.00050	0.00065	0.0010	0.0015	0.0015	0.0016	0.0015	0.0017	0.0015	0.0016
Al	mg/kg/wk	0.00027	0.00032	0.000074	0.000098	0.00031	0.00034	0.0015	0.0024	0.0032	0.0065
Sb	mg/kg/wk	0.00062	0.00066	0.00036	0.00039	0.0018	0.0022	0.0018	0.0020	0.0024	0.0026
As	mg/kg/wk	0.034	0.036	0.019	0.020	0.027	0.038	0.11	0.14	0.17	0.20
Cd	mg/kg/wk	0.00000011	0.00000019	0.00000011	0.00000012	0.00000022	0.00000029	0.00000016	0.00000030	0.00000018	0.00000019
Ca	mg/kg/wk	0.089	0.091	0.050	0.053	1.8	1.9	0.24	0.25	0.24	0.25
Cr	mg/kg/wk	0.000034	0.000042	0.000021	0.000023	0.0000081	0.0000097	0.000025	0.000031	0.000016	0.000022
Co	mg/kg/wk	0.000094	0.00012	0.000051	0.000060	0.00023	0.00038	0.00023	0.00035	0.00025	0.00049
Cu	mg/kg/wk	0.000019	0.000022	0.0000096	0.000010	0.000045	0.000050	0.000036	0.000045	0.000044	0.000054
Fe	mg/kg/wk	0.00070	0.00092	0.00048	0.00058	0.0043	0.0062	0.0043	0.0076	0.0051	0.0089
Pb	mg/kg/wk	0.00000033	0.00000097	0.00000017	0.00000024	0.00000057	0.0000016	0.00000096	0.00000134	0.0000014	0.0000019
Mn	mg/kg/wk	0.0000096	0.000012	0.0000046	0.0000052	0.00041	0.00049	0.000035	0.000037	0.000034	0.000046
Hg	µg/kg/wk	0.00016	0.00017	0.000088	0.000092	0.00049	0.00054	0.00056	0.00108	0.00057	0.0013
Mo	mg/kg/wk	0.00046	0.00060	0.00029	0.00035	0.00029	0.00070	0.00071	0.00091	0.00059	0.00085
Ni	mg/kg/wk	0.0000044	0.0000050	0.0000018	0.0000023	0.000064	0.000084	0.0000056	0.0000091	0.0000057	0.0000094
Se	mg/kg/wk	0.0000053	0.0000067	0.0000083	0.0000088	0.000028	0.000042	0.000014	0.000017	0.000014	0.000015
Ag	mg/kg/wk	0.000000033	0.000000036	0.000000018	0.000000023	0.00000059	0.0000022	0.00000067	0.00000130	0.00000067	0.00000088
U	mg/kg/wk	0.0032	0.0038	0.0017	0.0019	0.00059	0.00067	0.018	0.025	0.020	0.026
Zn	mg/kg/wk	0.000016	0.000017	0.0000084	0.0000088	0.000049	0.000057	0.000049	0.000055	0.000049	0.000055

Notes: All concentrations below the analytical detection limit were set at the limit for calculation of loading rates and statistics;
Weeks used in derivation of median and 75th percentile values are based on five pore volumes having passed through the leach tailings of the kinetic test column.
Green gradient shading represents relative concentrations of median values for each parameter

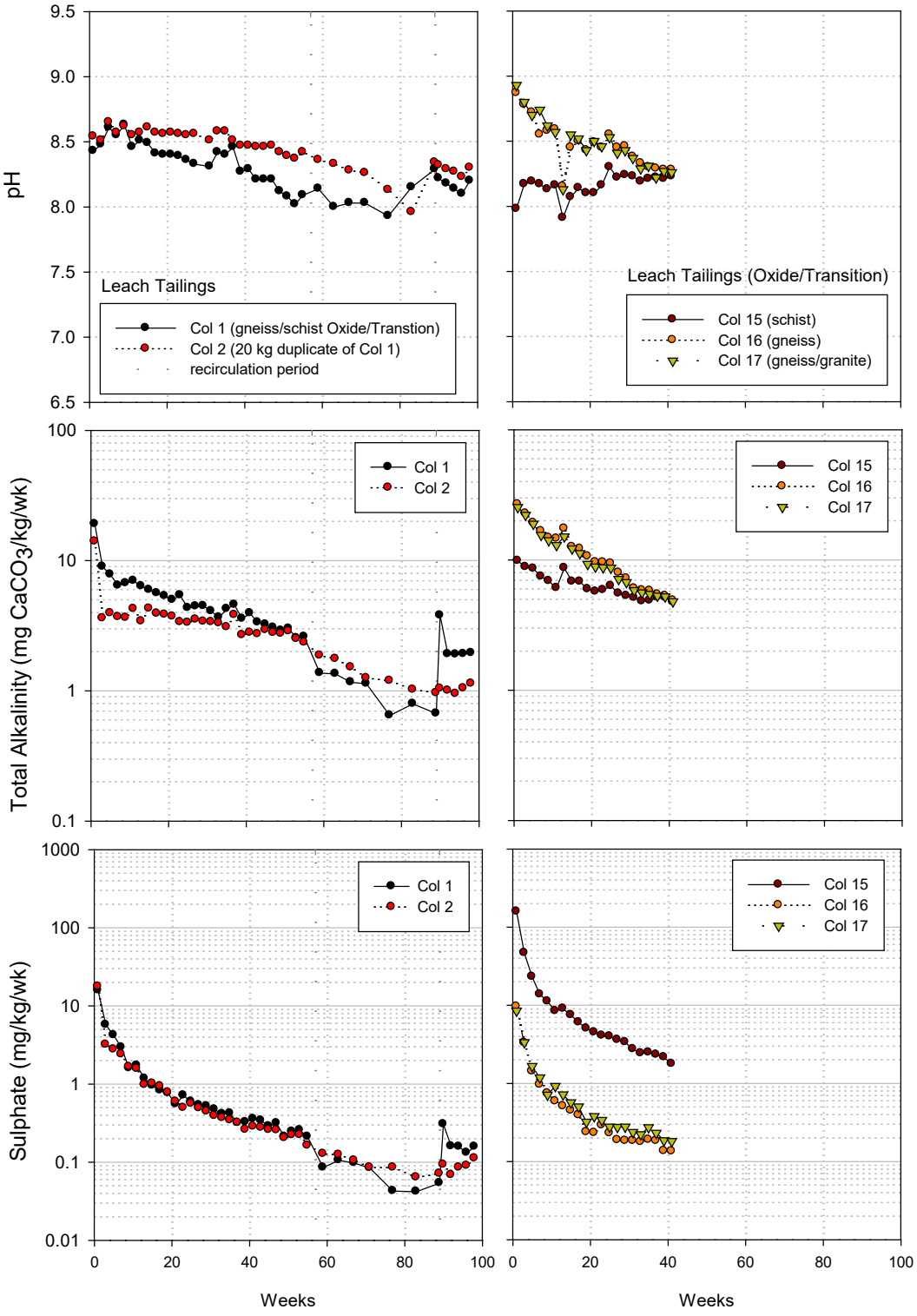


Figure 4-23: Leachate pH and weekly loading rates for total alkalinity and sulphate from leach tailings columns

Sulphate loading rates from each of the tailings columns shows a consistent decrease of one to two orders of magnitude over the test period, with Col 1, Col 2, Col 16 and Col 17 decreasing from ~10 mg/kg/wk to <0.2 mg/kg/wk. The initial sulphate load for the schist tailings (Col 15) is higher (158 mg/kg/wk), consistent with higher solid phase total and sulphide-S measured in the sub-sample (0.24 and 0.19 %, respectively; Table 4-61) and decreases to <2 mg/kg/wk over the 39 weeks of testing.

Residual Cyanide

Total and weak acid dissociable (WAD) cyanide loading rates from the leach tailings columns are initially low (< 1 mg/kg/wk) and decrease two to three orders of magnitude over the test period. The WAD cyanide analysis includes free CN and weak complexes with Zn, Cd, Ag, Cu, and Ni. Total cyanide analysis measures all of the cyanide present in any form, including in strong CN complexes with Fe, Co and Au.

Slightly higher total cyanide production rates are measured in leachate from Col 16, Col 17 and, in particular, Col 15 Table 4-61, Figure 4-24). WAD cyanide production rates decrease to near detection levels (0.01 mg/L) by approximately week 25 of testwork. Time series profiles indicate that cyanide (and WAD cyanide) production rates from Col 1 and Col 2 may be increasing following the recirculation period (Figure 4-24).

Thiocyanate (SCN) and cyanate (CNO) complexes were also evaluated in leachate samples from the tailings columns; however, with the exception of the initial flush for Col 15, 16 and 17, all values were below the detection limits (<2 and <1 mg/L, respectively)

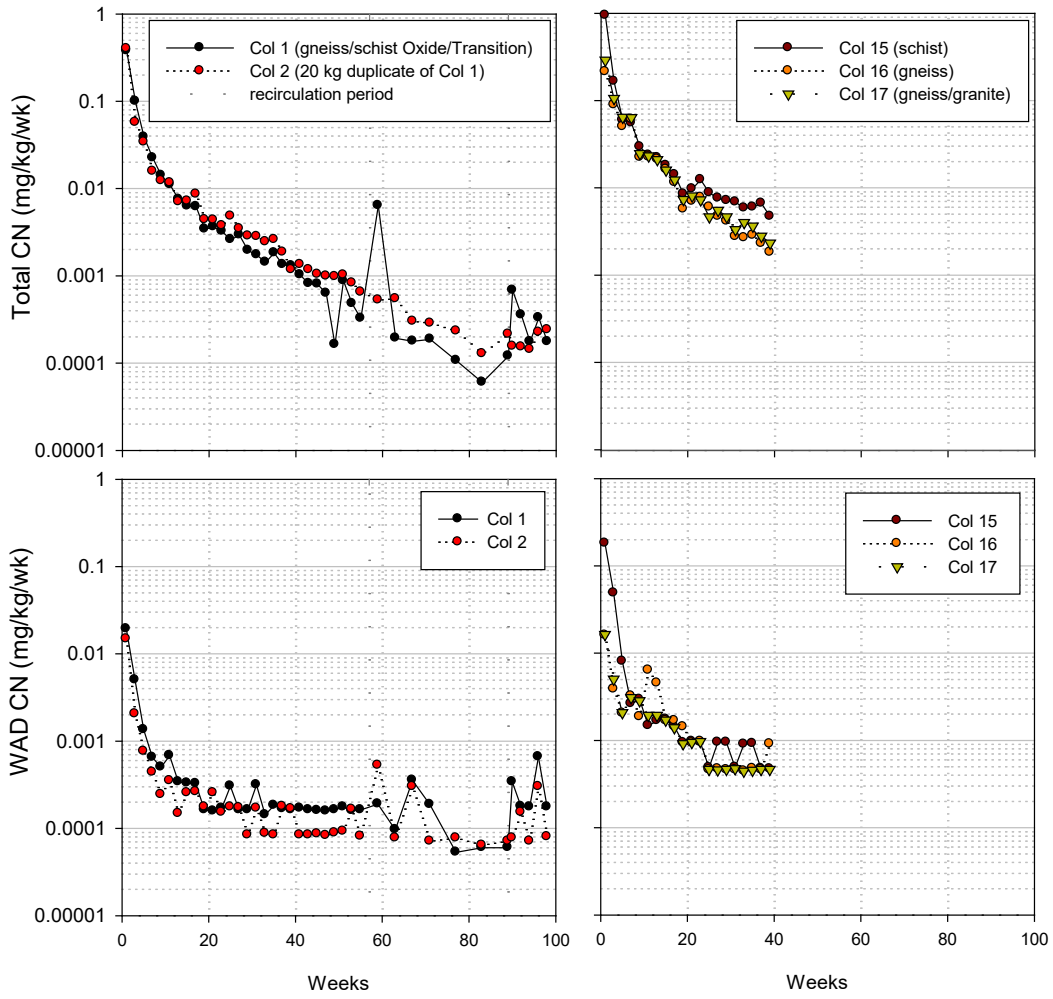


Figure 4-24: Loading rates for cyanide from leach tailings columns

Metal Leaching Trends

Time series profiles of As, Sb and U production rates are presented in Figure 4-25. Time series profiles for all other metals are provided in Appendix D.3. Loading rates for the leach tailings are generally relatively consistent (within the same order of magnitude), with slightly higher loadings observed for Col 15, Col 16 and Col 17 for most metals (Table 4-61, Figure 4-25, Appendix D.3). Loading rates for Col 16 and Col 17 are generally similar, with only slightly higher loadings of As and Al produced by the gneiss/granite tailings (Col 17) compared to the gneiss tailings (Col 16). The lowest U loading rates (by nearly an order of magnitude) are from the schist tailings (Col 15). Loading rates for the schist tailings (Col 15) are generally consistent with or slightly lower than the gneiss tailings (Col 16 and Col 17), with the exception of Mn, Ni and Se (Col 15, Appendix D.3), which are slightly higher compared to the gneiss tailings. This result is consistent with

metallurgical column leach solution, which found that schist leach columns contained significantly lower U concentrations than gneiss or granite leach columns (Table 4-57).

In general, metal production rates from each of the leach tailings columns decrease or remain relatively stable at or below the respective detection limit (Cd, Pb, Hg, Ni, Zn) over the test period (Figure 4-25; Appendix D.3). The only exception is Mn from the gneiss and gneiss/granite columns (Col 16 and Col 17), which increases an order of magnitude (0.00013 and 0.00004 mg/kg/wk, respectively) after reaching a low at approximately week 20 of testwork.

Initial production rates for As, Sb and U are similar to the rates measured for ore of similar lithology and weathering facies (Figure 4-25). However, unlike the production rates from the ore columns, rates for the leach tailings columns show a continuous decrease following the initial flush.

Recirculation Experiment

Col 1 and Col 2 were subjected to a recirculation experiment that involved recirculating leachate as influent to the columns. Table 4-62 presents the final production loading rate prior to the recirculation experiment (*i.e.*, reduction in flow rate), the final production rate of the recirculation experiment and the median value for the recirculation period. The calculated differences between the final production rate prior to the experiment and the final and median loading rates of the recirculation period are highlighted in yellow in Table 4-63. The recirculation periods are marked on the time series profiles by dashed vertical lines (Figure 4-23 through Figure 4-25).

Loading rates for nearly all parameters either decrease (by less than an order of magnitude) or remain at the detection limit following the reduced flow conditions in the leach tailings columns (Figure 4-23 through Figure 4-25). Parameters generally decrease by more than 60% (*i.e.*, Diff of -60 or lower) by the final cycle of the recirculation period (Table 4-62). The most notable exceptions are nitrate-N for both columns and, in particular, nitrite-N for Col 1, which show increases over the recirculation period.

Table 4-63 presents the concentrations prior to and during the recirculation experiment and the calculated percent differences (highlighted in yellow). Time series profiles for leachate concentrations are presented in Appendix D.3. Similar to the results of the waste rock recirculation experiment, concentrations for many parameters from the leach tailings columns remain relatively unchanged, generally decreasing by less than 50% (Diff of -50 or higher), indicating that metal release is primarily solubility controlled. A slight overall increase in Mn for Col 1 and Col 2 and a more pronounced increase in nitrate-N for both columns and nitrate-N for Col 1 is evident (Table 4-63, Appendix D.3). The increase in nitrate-N is consistent with the oxidation (and decrease) in ammonia-N for unsaturated (sub-aerial) columns.

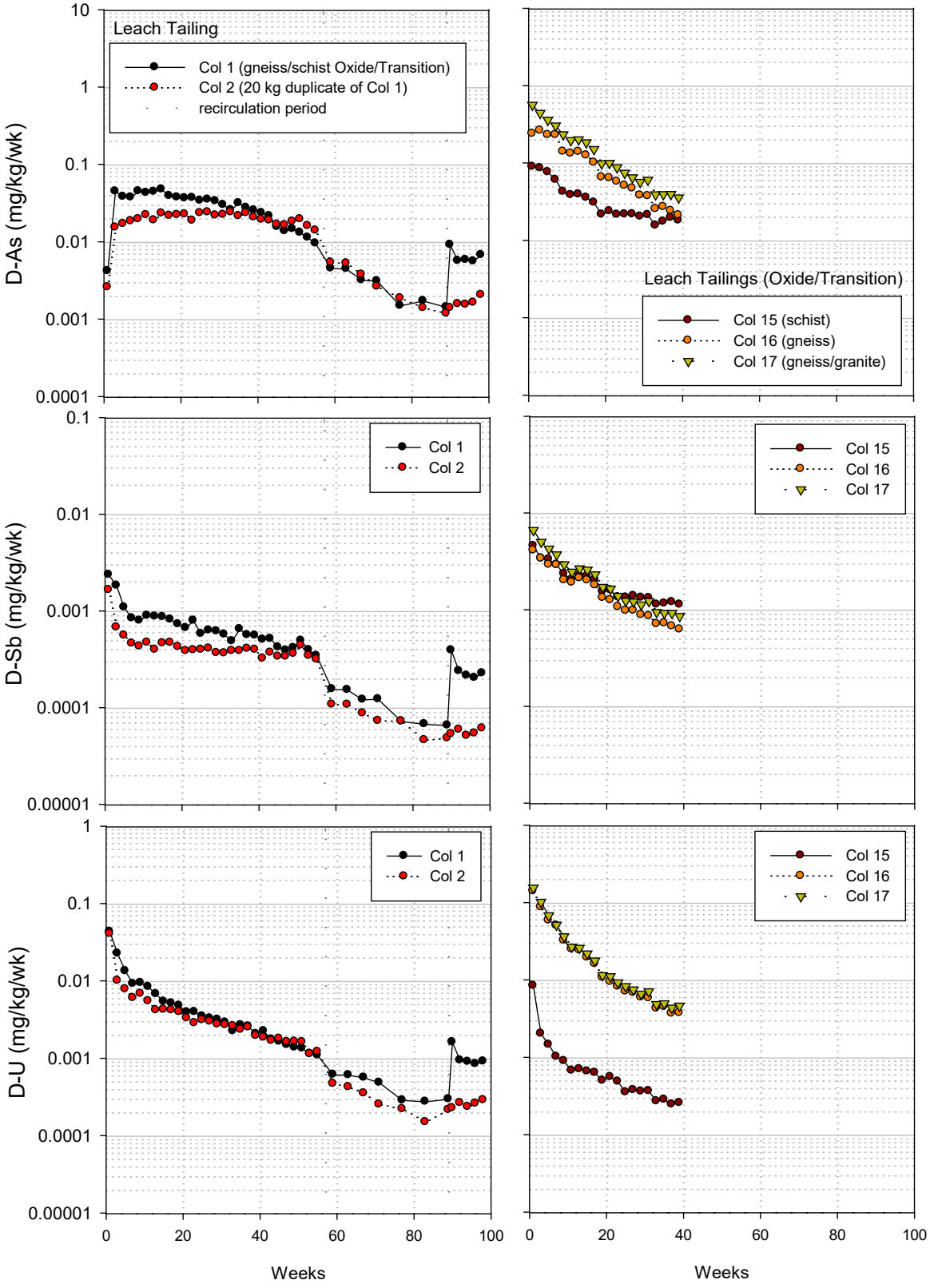


Figure 4-25: Loading rates for As, Sb and U from leach tailings columns

Table 4-62:
Loading Rates and Percent Difference of Recirculation Experiment for Gneiss/Schist Oxide/Transition Facies Leach Tailings Columns

Parameter	Unit	Col 1					Col 2				
		Loading Rates for Recirculation			*Percent Change*		Loading Rates for Recirculation			*Percent Change*	
		Cycle immediately before (Cycle 56)	Median (Cycles 57-89)	Final cycle (Cycle 89)	*Median for Recirc. Period*	*Final Recirc. Cycle*	Cycle immediately before (Cycle 56)	Median (Cycles 57-89)	Final cycle (Cycle 89)	*Median for Recirc. Period*	*Final Recirc. Cycle*
pH	s.u.	8.1	8.0	8.3	*NA*	*NA*	8.4	8.3	8.3	*NA*	*NA*
Alkalinity	mg/kg/wk	2.6	1.1	0.67	*-56*	*-74*	2.3	1.3	0.96	*-47*	*-59*
Sulphate	mg/kg/wk	0.21	0.084	0.054	*-60*	*-74*	0.16	0.086	0.071	*-47*	*-56*
Total CN	mg/kg/wk	0.00033	0.00018	0.00012	*-45*	*-63*	0.00065	0.00029	0.00021	*-56*	*-67*
WAD CN	mg/kg/wk	0.00016	0.00010	0.00006	*-41*	*-63*	0.00008	0.00008	0.00007	*-5*	*-12*
Ammonia-N	mg/kg/wk	0.0065	0.0057	0.00060	*-12*	*-91*	0.0016	0.0015	0.00036	*-8*	*-78*
Nitrate-N	mg/kg/wk	0.0010	0.0015	0.0018	*53*	*85*	0.0092	0.079	0.079	*761*	*761*
Nitrite-N	mg/kg/wk	0.0041	0.0768	0.0768	*1790*	*1790*	0.00049	0.00012	0.00011	*-76*	*-78*
Al	mg/kg/wk	0.00011	0.000047	0.000021	*-56*	*-80*	0.000076	0.000021	0.000017	*-72*	*-77*
Sb	mg/kg/wk	0.00034	0.00012	0.000065	*-65*	*-81*	0.00031	0.000073	0.000048	*-77*	*-85*
As	mg/kg/wk	0.0095	0.0031	0.0014	*-68*	*-85*	0.014	0.0026	0.0012	*-81*	*-92*
Cd	mg/kg/wk	0.00000005	0.00000003	0.00000002	*-45*	*-63*	0.00000002	0.00000002	0.00000001	*-5*	*-42*
Cr	mg/kg/wk	0.000013	0.0000061	0.0000032	*-51*	*-75*	0.000014	0.0000043	0.0000034	*-70*	*-76*
Co	mg/kg/wk	0.000028	0.000013	0.0000073	*-55*	*-74*	0.000033	0.0000078	0.0000061	*-76*	*-81*
Cu	mg/kg/wk	0.000015	0.0000048	0.0000028	*-69*	*-82*	0.000012	0.0000045	0.0000022	*-62*	*-81*
Fe	mg/kg/wk	0.00021	0.00010	0.00010	*-54*	*-52*	0.00026	0.000060	0.000046	*-77*	*-82*
Pb	mg/kg/wk	0.00000049	0.00000011	0.00000012	*-78*	*-75*	0.00000016	0.00000008	0.00000007	*-52*	*-56*
Mn	mg/kg/wk	0.000015	0.0000080	0.0000025	*-46*	*-83*	0.0000057	0.0000036	0.0000061	*-37*	*8*
Hg	µg/kg/wk	0.00033	0.000089	0.000060	*-73*	*-82*	0.000081	0.000038	0.000036	*-54*	*-56*
Mo	mg/kg/wk	0.00015	0.000059	0.000034	*-60*	*-77*	0.00020	0.000052	0.000024	*-73*	*-88*
Ni	mg/kg/wk	0.0000016	0.00000094	0.00000060	*-41*	*-63*	0.0000017	0.00000038	0.00000036	*-77*	*-78*
Se*	mg/kg/wk	0.000003	0.0000013	0.00000090	*-54*	*-67*	0.0000026	0.00000086	0.00000068	*-67*	*-74*
Ag	mg/kg/wk	0.00000094	0.00000008	0.00000005	*-92*	*-94*	0.00000042	0.00000004	0.00000002	*-90*	*-94*
U	mg/kg/wk	0.0011	0.00048	0.00029	*-56*	*-73*	0.0012	0.00025	0.00021	*-79*	*-82*
Zn	mg/kg/wk	0.000016	0.0000089	0.0000060	*-45*	*-63*	0.0000081	0.0000038	0.0000036	*-54*	*-56*

Notes: Alkalinity is presented as mg $CaCO_3$/kg/wk; Hg is presented as ug/kg/wk; negative values represent a decrease in production rates; percent difference values are highlighted; * a high detection limit of 0.001 mg/L was often applied for Se analyses; as a result, the second to last cycle prior to the recirculation period (which provided a measurable value) was applied for calculation of percent differences.

Table 4-63:
Concentrations and Percent Differences for Recirculation Experiment for Leach Tailings Columns

Parameter	Unit	Col 1					Col 2				
		Loading Rates for Recirculation			*Percent Change*		Loading Rates for Recirculation			*Percent Change*	
		Cycle immediately before (Cycle 56)	Median (Cycles 57-89)	Final cycle (Cycle 89)	*Median for Recirc. Period*	*Final Recirc. Cycle*	Cycle immediately before (Cycle 56)	Median (Cycles 57-89)	Final cycle (Cycle 89)	*Median for Recirc. Period*	*Final Recirc. Cycle*
pH	s.u.	8.1	8.0	8.3	*NA*	*NA*	8.4	8.3	8.3	*NA*	*NA*
Alkalinity	mg/L	160	131	111	-18	-30	289	176	135	-39	-53
Sulphate	mg/L	13	9.0	9.0	-31	-31	20	12	10	-40	-50
Total CN	mg/L	0.020	0.020	0.020	0	0	0.080	0.040	0.030	-50	-63
WAD CN	mg/L	*<0.01*	0.010	*<0.01*	0	0	*<0.01*	0.010	*<0.01*	0	0
Ammonia-N	mg/L	0.40	0.60	0.10	50	-75	0.20	0.40	*<0.1*	100	-50
Nitrate-N	mg/L	*<0.06*	0.17	0.30	183	400	1.1	22	22	1865	1865
Nitrite-N	mg/L	0.25	13	13	5020	5020	0.060	0.030	*<0.03*	-50	-50
Al	mg/L	0.0065	0.0051	0.0035	-22	-46	0.0093	0.0057	0.0048	-39	-48
Sb	mg/L	0.021	0.014	0.011	-36	-48	0.039	0.020	0.014	-47	-65
As	mg/L	0.59	0.33	0.24	-44	-59	1.7	0.74	0.33	-57	-81
Cd	mg/L	*<0.000003*	0.0000030	*<0.000003*	0	0	0.0000030	0.0000060	0.0000040	100	33
Cr	mg/L	0.00077	0.00065	0.00053	-16	-31	0.0018	0.0012	0.00096	-33	-46
Co	mg/L	0.0018	0.0014	0.0012	-18	-30	0.0040	0.0022	0.0017	-46	-57
Cu	mg/L	0.00095	0.00070	0.00046	-26	-52	0.0015	0.0013	0.00062	-14	-58
Fe	mg/L	0.013	0.011	0.017	-15	31	0.032	0.016	0.013	-50	-59
Pb	mg/L	0.000030	0.000020	0.000020	-33	-33	0.000020	0.000020	0.000020	0	0
Mn	mg/L	0.00091	0.00091	0.00042	0	-54	0.00070	0.0010	0.0017	44	146
Hg	µg/L	0.020	0.010	*<0.01*	-50	-50	0.010	0.010	*<0.01*	0	0
Mo	mg/L	0.0091	0.0066	0.0057	-27	-38	0.024	0.014	0.0067	-42	-72
Ni	mg/L	0.00010	0.00010	0.00010	0	0	0.00020	0.00010	0.00010	-50	-50
Se*	mg/L	0.00017	0.00016	0.00015	-6	-12	0.00032	0.00025	0.00019	-22	-41
Ag	mg/L	0.000058	0.0000090	0.0000090	-84	-84	0.000052	0.000011	0.0000070	-79	-87
U	mg/L	0.067	0.053	0.049	-20	-26	0.15	0.070	0.060	-52	-59
Zn	mg/L	*<0.001*	0.0010	*<0.001*	0	0	*<0.001*	0.0010	*<0.001*	0	0

Notes: Alkalinity is presented as mg $CaCO_3$/L; negative values represent a decrease in production rates; percent difference values are highlighted; * a high detection limit of 0.001 mg/L was often applied for Se analyses; as a result, the second to last cycle prior to the recirculation period (which provided a measurable value) was applied for calculation of percent differences.

4.3.6.4 Field Kinetic Tests

Leachate chemistry for the leach tailings field kinetic tests (FB-LT1, FB-LT2 and FB-LT3) are presented in Table 4-64. It is important to note that the leach tailings placed into the field bins were not subjected to a rinse prior to initiation of the kinetic testwork. For discussion of the preliminary results, leachate results for the field bins are compared to MMER and 10 times the CCME water quality guidelines (presented in Table 4-56) to highlight which parameters may be elevated in drainage from the HLF following rinse down. A summary of the water quality guidelines are provided in Table 4-14.

Total and WAD cyanide, ammonia-N, nitrite-N, dissolved Al, Sb, As, Cr, Cu, Fe, Hg, Ni and U, and radioisotope ^{226}Ra are indicated to exceed the MMER or 10x's the CCME guideline in at least one leachate sample from the field kinetic tests. In particular, As exceeds the MMER maximum authorized concentration in a grab sample (MGS) of 1 mg/L in every leachate sample collected to date from the field bins. Elevated concentrations of total and WAD cyanide are expected given that the contents of the kinetic tests were not subjected to a rinse down period prior to being placed in the field bins, Elevated concentrations of nitrogen species are anticipated from the natural degradation of cyanide compounds.

Leachate pH for the leach tailings field kinetic tests are slightly neutral, with slightly higher pH values measured in leachate from FB-LT2 and FB-LT3 (8.6-9.2). Concentrations are generally highest in the first sample from each field test. The exception is Zn, which reaches a maximum (0.047 mg/L) in FB-LT1 after 60 weeks of testwork. The overall highest concentrations of Al, Sb, Cr, Co, Fe, Pb, Mn, Hg, Mo and U were measured in leachate from the gneiss oxide (FB-LT2) and the overall highest concentrations of As, Cu, Ni, Se and Ag were measured in leachate from the schist oxide (FB-LT3). On-going monitoring of the field bins will provide an indication of which parameters may be of concern in drainage from the HLF after closure.

Table 4-64:
Leachate Results from Leach Tailings Field Kinetic Tests

	Lithology	Gneiss (82%) Schist (18%)					Gneiss		Schist	
	Weathering Facies	Oxide (90%) Transition (10%)					Oxide		Oxide	
	Field Bin	FBLT1					FBLT2		FBLT3	
	Date Sampled	17-Jun-14	25-Sep-14	4-Jun-15	10-Aug-15	22-Oct-15	10-Aug-15	22-Oct-15	10-Aug-15	22-Oct-15
pH	s.u.	8.5	8.5	8.6	8.4	8.5	8.7	9.2	8.9	8.6
Conductivity	uS/cm	716	991	709	529	692	595	490	780	734
T-Alkalinity	mg $CaCO_3$/L	227	15	193	*ND*	197	*ND*	254	*ND*	235
Cl	mg/L	20	18	8.4	2.1	3.7	8.3	6.2	15	16
F	mg/L	0.43	*ND*	0.31	0.36	0.35	0.35	0.27	0.54	0.60
SO_4	mg/L	119	243	135	88	118	9.89	6.2	18	24
DOC	mg/L	9	11	*ND*	*ND*	6.0	*ND*	26	*ND*	48
NH_3-N	mg/L	0.71	0.29	0.036	*ND*	*<0.005*	*ND*	5.0	*ND*	1.9
NO_3-N	mg/L	0.94	4.2	3.9	3.6	5.2	0.14	0.16	*<0.005*	0.85
NO_2-N	mg/L	2.0	*ND*	0.95	0.34	0.0046	0.18	0.080	*<0.001*	25
WAD CN	mg/L	0.18	0.019	0.34	0.010	0.017	0.047	0.052	*ND*	0.17
Total-CN	mg/L	1.6	0.34	0.83	0.27	0.38	1.5	2.6	*ND*	2.2
Dissolved Metals										
Al	mg/L	0.49	0.0084	0.0077	0.0084	0.012	10	0.85	0.30	1.7
Sb	mg/L	0.046	0.035	0.027	0.030	0.024	0.11	0.021	0.070	0.057
As	mg/L	1.2	1.8	1.6	1.3	1.4	1.2	1.1	2.3	3.2
Cd	mg/L	0.000020	*<0.00001*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.00005*	0.0000089	*<0.000005*	0.0000057
Cr	mg/L	0.020	0.010	0.0015	0.003	0.0044	0.031	0.015	0.0018	0.0050
Co	mg/L	0.077	0.10	0.043	0.021	0.024	0.57	0.46	0.12	0.20
Cu	mg/L	0.0064	0.0023	0.0024	0.0020	0.0014	0.016	0.010	0.063	0.042
Fe	mg/L	1.0	0.81	0.24	0.12	0.19	15	2.2	0.32	2.9
Pb	mg/L	0.00053	*<0.0005*	*<0.00005*	0.00010	0.00007	0.0073	0.00049	0.000073	0.00088
Mn	mg/L	0.033	0.0094	0.010	0.013	0.0042	0.30	0.022	0.008	0.085
Hg	mg/L	0.00042	0.000052	0.000039	0.000019	0.000018	*ND*	0.00064	*ND*	0.00038
Mo	mg/L	0.054	0.089	0.043	0.058	0.061	0.22	0.17	0.034	0.048
Ni	mg/L	0.042	*<0.001*	0.00054	*<0.0005*	*<0.0005*	0.061	0.016	0.26	0.085
Se	mg/L	0.0019	0.0020	0.0010	0.00075	0.00082	0.0017	0.0017	0.0029	0.0024
Ag	mg/L	0.00020	*<0.00002*	0.000025	*<0.00001*	*<0.00001*	0.000043	0.000033	0.000075	0.00030
U	mg/L	0.21	0.36	0.23	0.16	0.21	0.46	0.67	0.036	0.027
Zn	mg/L	0.0016	0.019	0.0065	0.047	0.021	0.019	0.0019	*<0.001*	0.0066
Radioisotopes										
Ra226	Bq/L	*ND*	*ND*	0.012	0.020	0.012	*ND*	0.42	*ND*	0.03

Notes: ND = no date; values in blue italics are below the analytical detection limit. Values that exceed the MMER (2002) MGS water quality guideline are shaded in dark grey and the MMM guideline are shaded in light grey. Values that exceed 10 times the CCME (2007) water quality guidelines are shaded in blue; guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg CaC.

4.3.6.5 Comparison of Duplicates Kinetic Tests

Duplicate samples of leach tailings sample LT1 were submitted in multiple masses for kinetic testing under different operating conditions to assess scaling effects on metal leaching rates. This sample was submitted for a 10 kg column (Col 1) a 20 kg column (Col 2) and a 76 kg field bin (FB-LT1). A comparison of Col 1 (10 kg) and Col 2 (20 kg) indicates that these columns initially produce similar concentrations, but after the first few cycles Col 2 begins to produce lower loading rates, but greater concentrations of alkalinity, sulphate, total cyanide and dissolved As, Sb, Cr, Co, Fe, Mo, Se and U (Appendix D.3). Conversely, peak concentrations of alkalinity, sulphate, total cyanide, U and As are greater in Col 1 and Col 2 compared to the field bin (FB-LT1, 76.3 kg). In general, the differences between these duplicate samples can be related to variations in pH and alkalinity produced under different test conditions.

The relationship between As and pH, and U and alkalinity are shown in Figure 4-26 below. The results are generally similar to that of waste rock described in Section 4.1.5.5. Arsenic concentrations appear to be primarily related to pH in kinetic tests of different masses, consistent with As sorption to mineral surfaces which decreases with increasing pH (Pierce and Moore, 1982). The relationship between U and alkalinity is consistent for the different scale kinetic tests, while the field bin produces U concentrations within the concentration range observed from the column samples but shows little relation to alkalinity. This variation in the relationship between U and alkalinity in the field bin experiment may be related to the relatively long storage time of field bin leachate in collection jugs before sample collection. That is, field bin drainage in collection jugs may be held for weeks to months in the collection jug between sampling events, over this time temperature fluctuations (including freezing conditions), and interaction with atmospheric CO_2 will affect alkalinity.

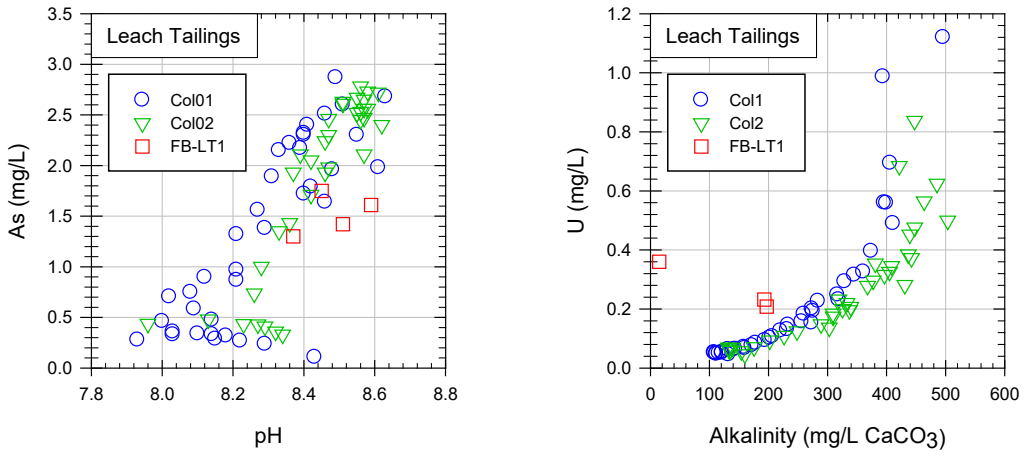


Figure 4-26: Comparison of As versus pH (left) and U versus alkalinity (right) in duplicate leach tailings kinetic test samples.

4.3.7 Radioisotopes

4.3.7.1 Occurrence

The NORM isotope results for leach tailings are expected to be analogous to that of ore because no solid separation will occur during ore processing (*e.g.*, sulphide flotation). That is, there is no potential for radioisotope enrichment in the leach tailings because the mass of ore on the leach pad is essentially unchanged by CN irrigation and Au recovery. The NORM results for ore samples are presented in Appendix D.1-5, and summarized in Section 4.1.5.

4.3.7.2 Kinetic Test Leachate

The activity of ^{226}Ra in leach tailings drainage was investigated by monitoring ^{226}Ra concentrations in metallurgical colums and field bin experiments (Table 4-56 and Table Table 4-64). The CN leach columns represent process water during mine life, while leach tailings field bins provide an indication of drainage chemistry at mine closure.

Field bins were monitored for ^{226}Ra starting in June 2015, however, not all samples subsequent to this time point had sufficient volume (1L) for ^{226}Ra analysis. Activities in FB-LT1 and FB-LT3 were an order of magnitude below the lowest MMER criteria (0.37 Bq/L), ranging from 0.012 to 0.03 Bq/L. The only exceedance of this MMER criteria was found in the single ^{226}Ra measurement in the gneiss oxide field bin (FB-LT2) of 0.42 Bq/L. Note that field bin samples of ^{226}Ra were not filtered, potentially leading to overestimate of dissolved activities due to incorporation of colloidal particles.

Dissolved ^{226}Ra was measured from the two large scale (718 to 741 kg) leach columns containing gneiss oxide ore samples during the metallurgical test program. These samples produced ^{226}Ra concentrations ranging from 0.1 Bq/L to 0.018 Bq/L in column 73022 and 73016, respectively (Table 4-56). It is interesting to note that the dissolved Ra concentrations follow dissolved Ba more closely than U in CN leach column samples. That is, column 73016 has a lower ^{226}Ra activity and Ba concentration, but considerably higher U concentrations than column 73022. Radium occurs as a radioactive decay product of ^{238}U, hence, the ^{226}Ra is expected to be elevated in the solid phase in samples with elevated U. However, in an aqueous system, ^{226}Ra forms a bivalent cation [Ra(II)] and behaves similar to other alkaline earth metals such as Mg, Sr, Ca and particularly Ba. The relationship between Ba and ^{226}Ra release from geologic material are described in more detail in Section 5.1.4.3.

4.4 Overburden and Borrow Material

Topsoil and overburden will be stripped from mine facilities and either stockpiled or used as fill depending on the source, ice content and material type. According to the JDS (2016) mine plan, approximately 1.5 Mm^3 of topsoil and 3.5 Mm^3 of inorganic overburden is planned to be excavated. Organic topsoil has an average depth of 0.3 m and will be stripped from the footprints of mine facilities and stored in the soil stockpile for later use as cover material at the end of mine life. Inorganic overburden has a depth ranging from 1.3 to 4.1 m and will either be used as fill within the mine facility footprint area that the material is sourced from or stored in the frozen soil stockpile. Note that overburden from pit shell areas is sent to WRSFs and are therefore not differentiated from waste rock.

Thirty samples of overburden were collected from test pits on the HLF and mine facility area footprints, while 75 samples were collected from drill cores from the pits and WRSF areas. The depth of overburden at the site is approximately 1.5 m in thickness. At each test pit and drill core site, a composite of the entire overburden profile was sampled for analyses. Locations of overburden samples in respect to mine facility footprints and surface geology is shown in Figure 3-2.

4.4.1 Overview of Test Results

Geochemical test results indicate that the mine site overburden has little or no potential for acid generation, owing to the low S content (median of 0.01%). The static test results demonstrate that the mine site overburden is at a highly weathered state, as indicated by the lack of carbonate or sulphide mineralization and the circumneutral to mildly acidic rinse-pH (5.2-8.9; median of 7.2) similar to that of rain water (~pH 5.6). Due to the lack of acid generating minerals, the mine site overburden is classified as non-PAG or unreactive.

The metal leaching potential from overburden is also considered to be low, with test samples indicated to be relatively deplete compared to ACA in a number of metals (Al, Cd, Co, Cr, Cu, Mn, Ni and Zn). Some samples showed enrichment in As, Bi, Hg, Sb and Se with respect to ACAs, consistent with solid phase element results for waste rock and ore. The most frequently elevated elements are Bi and Se; however, metal leaching results show concentrations of these metals are generally below the respective detection limits showing that these elements are not readily water.

4.4.2 Acid Base Accounting

Statistical summaries of select ABA results for overburden samples are presented by underlying geologic unit in Table 4-65. The complete set of ABA results are presented in

Appendix C.4-1. In general, ABA results indicate that the mine site overburden has little to no potential for acid generation, regardless of the location or underlying geology. This is primarily due to the overall low total-S and sulphide-S values for the overburden samples (<0.01-0.14 wt.% total-S; median = 0.01 wt.%) and the parent material. Total inorganic C is also low and generally below the detection limit (<0.05 wt.%C; <4.2 kg $CaCO_3$/t CaNP), particularly for the granite and gneiss (90th an 75th percentiles, respectively, below detection limit). Sobek NP values are also generally low, with median values of 3, 6, and 11 kg $CaCO_3$/t measured for overburden samples overlying granite, gneiss and schist bedrock, respectively (Table 4-65). NPR values were evaluated using sobek NP and AP calculated from total-S or sulphide-S, whichever was higher, and follow the same criteria as was applied to waste rock and ore for NPR values using sobek NP, as described in Section 4.1.2.4.

More than 95% of the overburden samples are classified as non-PAG (NPR>3) or neutral (total-S <0.02 wt.%), while none of the overburden samples are indicated to be PAG (NPR<1) when the most conservative S value is used to calculate AP. One sample from overburden overlying the meta-gabbro and two samples each from overburden overlying the schist and gneiss bedrock have NPRs between 1 and 3, indicating that they have an uncertain potential. The few samples with NPR values between 1 and 3 have measurable total-S >0.04 wt.%.

Of note is the general correlation between the ABA results for overburden with the ABA results for the respective underlying geologic unit, whereby overburden overlying granite bedrock has the overall lowest total-S and NP, while overburden overlying schist bedrock has slightly higher total-S and sulphide-S values and NP.

The ABA results demonstrate that the mine site overburden is highly weathered. This is shown by the relative absence of carbonate or sulphide mineralization, and the circum-neutral to mildly acidic rinse-pH values ($5.2 \leq pH \leq 8.9$; median = 7.2), which is higher than the pH of rain water (~pH 5.6). Due to the overall general lack of neutralizing or acid generating minerals in the samples, as well as high NPR values, the mine site overburden can be classified as non-PAG. Drainage from stockpiled overburden and from site pads comprising overburden can be expected to be similar to in-situ rinse pH measurements, as presented in Table 4-65.

Table 4-65:
Statistical Distribution of Acid Base Accounting Results for Mine Site Overburden

Underlying Geologic Unit	Rinse pH	Paste pH	Total S	Sulphide S	Sulphate S	TIC	Sobek NP	Sobek NNP	NPR
	s.u.	s.u.	wt.%	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	obek NP/AP
Overburden overlying Granite (n = 28)									
Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	*<0.05*	1	0.7	3.2
10th PCTL	6.1	6.0	0.01	*<0.01*	*<0.01*	*<0.05*	2	1.4	3.2
25th PCTL	6.3	6.3	0.01	*<0.01*	0.01	*<0.05*	2	1.7	4.7
Median	6.6	6.6	0.01	0.01	0.01	*<0.05*	3	2.4	6.4
75th PCTL	7.0	6.9	0.02	0.02	0.01	*<0.05*	4	3.7	12.8
90th PCTL	7.3	7.5	0.02	0.02	0.02	*<0.05*	4.6	4.3	14.7
Max	8.9	8.7	0.02	0.03	0.02	0.05	8	7.7	25.6
Overburden overlying Gneiss (n = 41)									
Min	5.5	5.3	*<0.01*	*<0.01*	*<0.01*	*<0.05*	1	0.7	2.4
10th PCTL	6.7	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.05*	3	2.7	9.6
25th PCTL	7.0	6.9	*<0.01*	*<0.01*	0.01	*<0.05*	5	4.7	10.0
Median	7.5	7.5	0.01	*<0.01*	0.01	*<0.05*	6	5.7	16.7
75th PCTL	7.9	7.9	0.01	*<0.01*	0.02	*<0.05*	8	7.3	23.3
90th PCTL	8.1	8.1	0.01	0.01	0.02	0.07	11	10.7	35.2
Max	8.4	8.4	0.12	0.02	0.11	0.14	18	17.7	60.0
Overburden overlying Schist (n = 33)									
Min	6.0	5.9	*<0.01*	*<0.01*	*<0.01*	*<0.05*	3	1.8	2.4
10th PCTL	6.6	6.6	*<0.01*	*<0.01*	0.01	*<0.05*	5	4.4	8.6
25th PCTL	7.3	7.3	*<0.01*	*<0.01*	0.01	*<0.05*	7	6.7	13.3
Median	7.6	7.5	0.02	*<0.01*	0.02	0.05	11	10.1	22.4
75th PCTL	8.0	8.1	0.02	0.01	0.02	0.1	15	14.7	48.0
90th PCTL	8.3	8.3	0.038	0.02	0.02	0.89	90	89.4	141.0
Max	8.8	8.8	0.14	0.07	0.04	2.89	253	248.6	275.2
Overburden overlying Meta-gabbro (n = 3)									
17555	5.2	5.1	0.06	0.03	0.01	*<0.05*	3	1.1	1.6
R553404	9.2	9.2	*<0.01*	*<0.01*	0.02	1.3	138	137.7	460.0
R553602	7.4	7.4	0.01	*<0.01*	0.03	*<0.05*	8	7.7	25.6

Notes: Values in grey italics are below he analytical detection limit;
NP is neutralization potential;
NPR is sobek NP over acid potential (AP) calculated from total or sulphide-S, whichever was higher; and
NNP is net neutralization potential, calculated by subtracting AP from sobek NP

4.4.3 Shake Flask Extractions

Statistical summaries of shake flask extraction experiments for mine site overburden are presented by underlying geologic unit in Table 4-66 and compared to CCME freshwater quality guidelines for the protection of aquatic life (CCME, 2007). No water-soluble parameters exceed the MMER guidelines. Concentrations of Al, As, Cr, Cu, Fe, Pb and

Hg exceed the 30-day or maximum CCME guideline in at least one sample from overburden overlying the granite, gneiss and schist bedrock. The largest exceedances are associated with As, Al, Cu, Cr and Fe from overburden overlying gneiss and schist bedrock (25th percentile exceed CCME guidelines). Overall, the highest median concentrations for metals (Al, As, Sb, Cr, Co, Cu, Fe, Mn, Ni) in SFEs are observed for overburden samples overlying schist bedrock. The overall lowest metal concentrations in SFEs are observed for overburden overlying meta-gabbro and granite bedrock; however, the overburden overlying the granite has the highest median and maximum Pb and U concentrations in SFEs.

Iron and Al are sparingly water soluble under neutral pH and aerobic conditions. Accordingly, the high Al and Fe values are likely caused by fine suspended solids carried through the 0.45µm filter during the extraction experiment. The exceedances observed for other metals (*e.g.,* As, Cr, Cu, Pb) in SFEs may also be associated with suspended solids given that the samples (i.e*.,* CFR0864, SRK-15TP-41, -22 and -24, CFR0937 and CFR0984, Appendix C.4-2) which exhibit the highest concentrations of Al and Fe in SFEs also show elevated concentrations of As, Cr, Cu, Pb as well as other metals (*e.g*., Sb, Co, Mn, Mo, Ni, Ag).

4.4.4 Trace Metal Enrichment

Statistical summaries of solid phase element results for mine site overburden are presented by underlying geologic unit in Table 4-67 and compared to average continental abundances (ACA; Price, 1997). The complete set of solid phase element results are presented in Appendix C.4-3. The results presented show that overburden is relatively deplete in a number of metals, with 90th percentile values for Al, Cd, Co, Cr, Cu, Mn, Ni and Zn falling below ACAs. Consistent with solid phase element results for waste rock and ore, the overburden samples are enriched in As, Bi, Hg, Sb and Se with respect to 10 times the ACAs (dark shading in Table 4-67). In general, median concentrations of enriched metals are lowest in the overburden overlying granite bedrock and highest in the overburden overlying schist bedrock. This is consistent with the observed relative enrichment for waste rock samples, with the exception of Sb and As which are considerably higher in the oxide granite waste rock samples (Section 4.1.4). The most frequently elevated elements are Bi and Se; however, SFE concentrations (Table 4-66) were generally below the respective detection limits, indicating that this element is not in a readily water-soluble form. Overall, the data suggest that elements of potential concern for stockpiled overburden are As and possibly Hg. These elements are indicated to be enriched in the solid phase and exceed CCME limits in extraction experiments.

Table 4-66:
Statistical Summary of Shake Flask Extraction Results for Mine Site Overburden

	Unit	CCME		Overburden overlying Granite (n = 11)					Overburden overlying Gneiss (n = 12)					Overburden overlying Schist (n = 7)					Meta-gabbro
		Max	30-day	Min	25th PCTL	Median	75th PCTL	Max	Min	25th PCTL	Median	75th PCTL	Max	Min	25th PCTL	Median	75th PCTL	Max	CFB030
T-Alk.	mg CaCO3/L	-	-	*<2*	3.0	4.9	5.0	5.8	4.8	8.3	12.9	22.3	47.8	5.3	7.0	8.0	25.4	45.2	35.0
F	mg/L	-	-	*<0.02*	0.03	0.08	0.10	0.17	0.05	0.13	0.15	0.18	0.23	0.06	0.11	0.19	0.24	0.28	0.17
pH	pH	-	6.5-9.0	5.9	6.1	6.3	6.5	6.5	6.1	6.6	7.2	7.7	8.4	6.2	6.8	7.1	7.5	7.7	9.3
SO_4	mg/L	-	**218**	*<0.5*	*<0.5*	*<0.5*	0.53	1.36	*<0.5*	0.5875	0.67	0.735	1.78	0.54	0.84	1	1.95	3.09	2.89
Al	mg/L	-	0.1	0.0808	0.423	0.899	1.35	1.94	0.16	0.547	0.845	1.0425	2.11	0.71	1.14	1.43	1.55	1.89	0.22
Sb	mg/L	**0.009**	-	0.00013	0.00016	0.00021	0.00026	0.00069	0.00035	0.00086	0.00106	0.00195	0.00841	0.00023	0.00054	0.0016	0.0029	0.0075	*<0.0001*
As	mg/L	-	0.005	*<0.001*	0.0011	0.0016	0.0024	0.0263	0.0041	0.006375	0.01255	0.017025	0.0962	0.002	0.0062	0.0131	0.01495	0.0414	0.0021
Bi	mg/L	-	-	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Cd	mg/L	0.0011	0.0001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Cr	mg/L	0.001	-	*<0.0005*	0.0010	0.0018	0.0028	0.0037	*<0.0005*	0.0016	0.0022	0.0030	0.0048	0.0012	0.0029	0.0031	0.0040	0.0043	*<0.0005*
Co	mg/L	**0.11**	**0.004**	*<0.0001*	0.00015	0.00043	0.00054	0.00096	*<0.0001*	0.00028	0.00055	0.0010	0.0029	0.00028	0.00078	0.00086	0.0009	0.001	*<0.0001*
Cu	mg/L	-	0.002	*<0.001*	0.0021	0.0040	0.0050	0.0077	0.0021	0.0046	0.0056	0.0071	0.0091	0.0044	0.0069	0.0078	0.0122	0.0187	*<0.001*
Fe	mg/L	-	0.3	*<0.03*	0.24	0.75	1.14	1.93	0.05	0.55	0.81	1.05	2.06	0.74	0.94	1.13	1.39	2.01	*<0.03*
Pb	mg/L	-	0.001	0.0001	0.0003	0.0007	0.0007	0.0016	*<0.0001*	0.0002	0.0004	0.0006	0.0010	0.0004	0.0005	0.0005	0.0011	0.0014	*<0.0001*
Mn	mg/L	**1.15**	**0.85**	0.002	0.023	0.052	0.078	0.153	0.015	0.026	0.037	0.065	0.198	0.038	0.040	0.049	0.089	0.318	*<0.0005*
Hg	mg/L	-	3E-05	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.000065	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	0.00026	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.00012	*<0.00005*
Mo	mg/L	-	0.73	0.0001	0.0005	0.0011	0.0013	0.0027	0.0007	0.0017	0.0020	0.0024	0.0042	0.0008	0.0016	0.0017	0.0033	0.012	0.0057
Ni	mg/L	-	0.025	*<0.0005*	0.0010	0.0015	0.0022	0.0036	*<0.0005*	0.0014	0.0025	0.0053	0.0071	0.0014	0.0022	0.0051	0.0056	0.0056	*<0.0005*
Se	mg/L	-	0.001	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.00064	*<0.0005*
Ag	mg/L	-	0.0003	*<0.00005*	*<0.00005*	*<0.00005*	0.00006	0.00014	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
U	mg/L	0.033	0.015	0.0011	0.0015	0.0023	0.0024	0.0041	0.0002	0.0002	0.0004	0.0006	0.0015	0.0001	0.0004	0.0007	0.0009	0.0011	0.00001
Zn	mg/L	-	0.03	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

Notes:
Values in grey italics are below the analytical detection limit; ND = no data.
Canadian Council of Ministers of the Environment (CCME, 2007); Water Quality Guidelines for the Protection of Freshwater Aquatic Life, sourced at st-ts.ccme.ca/en/index.html, March 2016.
Values that exceed the 30-day guideline are shaded in light grey, values that exceed the Max guideline are shaded in dark grey.
All guidelines are for total metals unless otherwise indicated.
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg CaCO3/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016).
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg CaCO3/L.
Guideline for Cr is for hexavalent (VI), which is the principal species found in surface waters.
Underlined guidelines for sulphate, Bi, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L

Table 4-67:
Statistical Distribution of Solid Phase Element Results for Mine Site Overburden Samples

ACA	*0.075*	*8.2*	*1.8*	*0.0085*	*0.15*	*25*	*102*	*60*	*5.6*	*0.085*	*950*	*1.2*	*84.0*	*14*	*0.2*	*0.05*	*9.6*	*2.7*	*70*
Underlying Geologic Unit	**Ag**	**Al**	**As**	**Bi**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Hg**	**Mn**	**Mo**	**Ni**	**Pb**	**Sb**	**Se**	**Th**	**U**	**Zn**
	ppm	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Overburden overlying Granite (n = 28)																			
Min	0.01	0.2	1.1	0.04	0.01	0.2	2	0.4	0.5	0.01	39	0.2	0.3	4.4	0.07	0.2	5.5	2.4	4
10th PCTL	0.02	0.4	4.1	0.06	0.01	0.51	4.1	1.4	0.6	0.01	126	0.6	1.8	6.8	0.16	0.34	14	2.8	10
25th PCTL	0.02	0.6	5.6	0.08	0.04	2.6	8.8	4.1	1.2	0.01	428	0.7	3.6	7.2	0.21	0.4	17	3.5	24
Median	0.03	0.8	10	0.11	0.06	4.0	13	6.8	1.5	0.04	567	0.8	5.6	8.5	0.28	0.5	21	3.8	31
75th PCTL	0.04	0.9	26	0.15	0.07	4.8	15	9.4	1.7	0.10	669	1.0	7.9	9.8	0.51	0.7	25	5.0	35
90th PCTL	0.05	1.2	547	0.22	0.09	5.8	19	13	2	0.39	803	1.4	11	16	4.6	0.8	37	6.2	38
Max	0.07	1.4	>10000	0.4	0.33	6.5	25	15	3	1.3	1240	3.2	12	27	86	1.1	44	15	51
Overburden overlying Gneiss (n = 41)																			
Min	0.01	0.3	15	0.07	0.01	1.5	8	5.4	0.9	0.01	179	0.6	4.1	4.2	0.57	0.3	5.4	0.69	11
10th PCTL	0.02	0.6	27	0.1	0.03	3.6	12	6.7	1.4	0.02	233	0.8	7.8	4.7	1.3	0.4	11	1.1	17
25th PCTL	0.02	0.7	44	0.12	0.04	5.1	17	8	1.5	0.03	294	1.1	9.2	6.0	2.2	0.4	15	1.3	20
Median	0.04	1.0	83	0.16	0.06	7.0	25	12	2	0.05	358	1.4	13	7.4	3.4	0.5	20	2.1	25
75th PCTL	0.05	1.5	117	0.25	0.08	9.6	34	14	2	0.09	409	1.7	19	9.3	6.3	0.6	24	2.6	35
90th PCTL	0.07	1.9	372	0.38	0.09	15	78	19	3	0.39	502	2.4	37	11	17	0.7	27	4.4	41
Max	0.18	2.2	894	0.63	0.17	19	345	89	3	1.4	666	3.9	266	18	42	0.9	31	12	47
Overburden overlying Schist (n = 33)																			
Min	0.01	0.5	7.2	0.04	0.01	3.9	13	7.2	1.4	*<0.01*	210	0.5	8.3	1.3	0.19	0.3	0.8	0.25	12
10th PCTL	0.03	0.8	23	0.09	0.03	4.6	18	8.8	1.7	*<0.01*	275	0.6	10	3.4	0.4	0.4	5.9	0.8	20
25th PCTL	0.03	1.0	39	0.13	0.05	6.6	23	14	2	0.02	319	0.7	13	5.4	1.0	0.6	8.6	1.1	27
Median	0.04	1.4	90	0.19	0.07	11	37	22	2	0.05	437	1.0	25	7.2	3.0	0.7	11	1.6	46
75th PCTL	0.07	1.9	190	0.26	0.1	14	59	26	3	0.18	525	1.4	34	13	8.4	0.8	17	2.3	57
90th PCTL	0.14	2.4	667	0.38	0.14	18	72	34	4	0.44	728	1.9	39	16	19	0.98	20	3.0	60
Max	0.25	3.1	2370	0.53	0.31	21	94	39	5	1.1	879	3.9	62	25	30	1.4	30	6.2	71
Overburden overlying Meta-gabbro (n = 3)																			
17555	0.1	2.2	9	0.22	0.1	6.9	49	19	2.3	0.03	270	0.9	21	8.9	1.3	0.6	3.8	1.6	51
R553404	0.01	2.3	3.8	0.09	0.01	14	29	14	3	*<0.01*	635	0.8	18	1.3	0.14	0.3	3	0.49	50
R553602	0.03	1.7	66	0.5	0.07	13	36	17	3	0.04	477	0.8	26	11	1.2	0.9	13	1.3	49

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA. Values shaded in blue are at the ACA

4.4.5 Radioisotopes

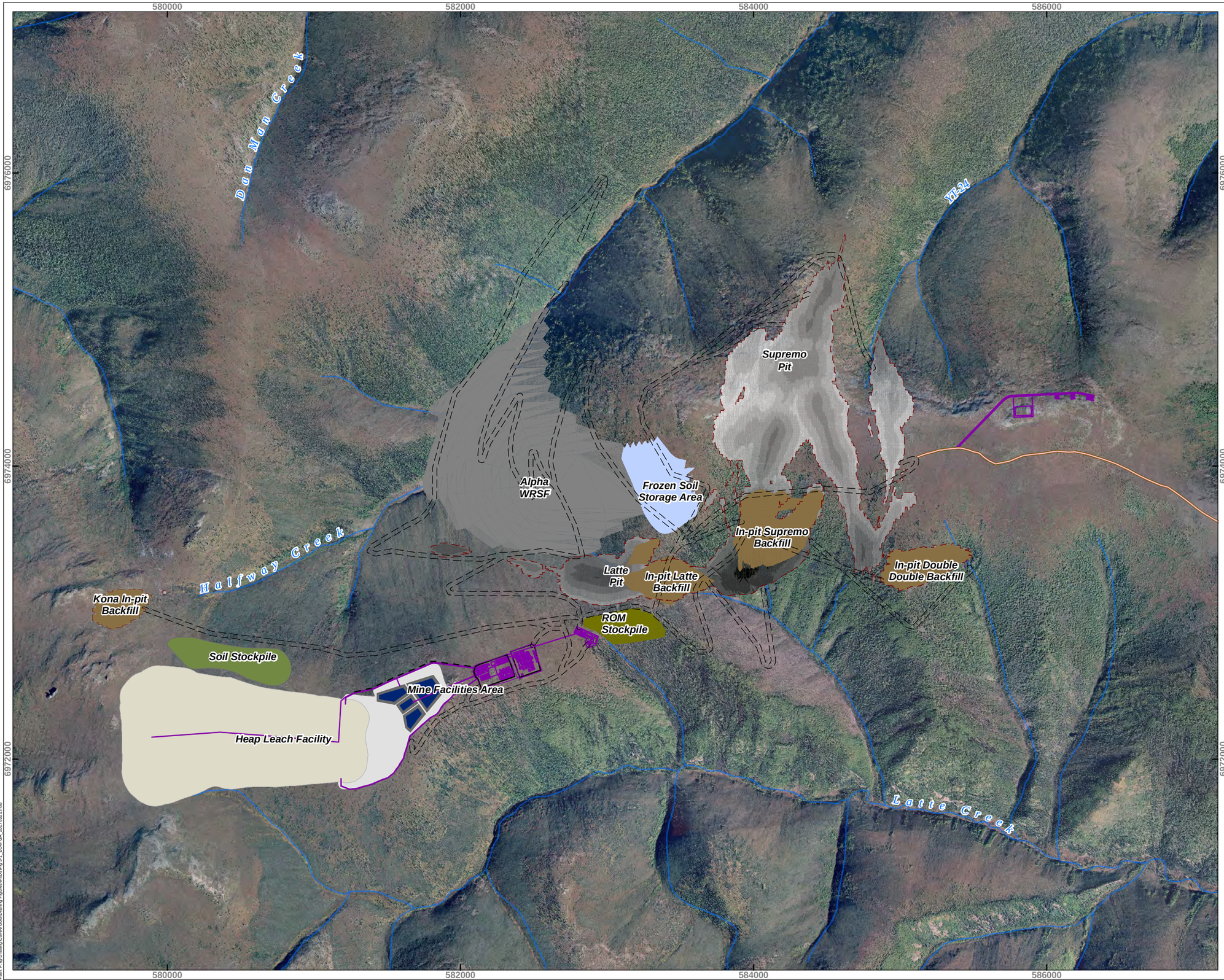
The NORM results for overburden samples are presented in Appendix D.1-5 and summarized in Section 4.1.5. Overall, the results show that overburden can be considered as unrestricted according to the Canadian NORM Guidelines.

5. Source Term Predictions

In this chapter, the geochemical test results described in the previous sections are combined with site specific information, such as waste facility design, composition, climate and hydrology, to produce geochemical source term predictions. The geochemical characterization results used to develop source terms are described in Chapter 4. Nitrogen loadings from mine waste facilities consider proposed explosive use as well as operating mine data and are described in Appendix E-1. The site climate and hydrology of mine facilities is presented in Appendix 12-C, and mine facility design and composition are provided in the JDS (2016).

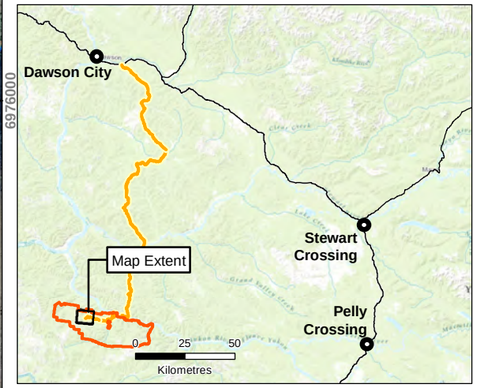
Geochemical source terms are water quality predictions for water in contact with geologic material disturbed by mining activities. Individual source terms are developed for each mine component at end of mine life and considering the full mine footprint. These source terms therefore include: one out of pit waste rock storage facility (Alpa WRSF), four in-pit backfill WRSFs, pit wall rock exposures, the heap leach facility (HLF) and the mine facilities area. Geochemical source terms are not developed for facilities which only exist during mine life, such as run-of mine (ROM) stockpile, frozen materials stockpile, HLF pore water during operations, and Beta WRSF which is backfilled into the Kona Pit before mine closure. The Coffee Gold Mine site layout at the end of mine life is shown in Figure 5-1. This figure shows the location of the various mine facilities and pits. The soil stockpile is not assigned a geochemical source term as this facility will contain organic topsoil that will be used for reclamation at the end of mine life. While runoff from this facility may be elevated in total suspended solids (TSS), the runoff chemistry is expected to be similar to background water quality.

For each mine component, an upper case and a base case source term has been calculated. The base case source term is meant to reflect a best estimate, while the upper case is meant to reflect a reasonably conservative upper estimate. These predictions become inputs to the site wide water quality model used to assess potential effects of the Project on the receiving environment at the end of mine life and throughout all closure phases.



COFFEE PROJECT

Project Layout at End of Mine Life



Legend

- Municipalities
- Coffee Property
- Highway
- Northern Access Route
- Waterbody
- Watercourse

Proposed Infrastructure

- WRSF
- Backfill
- Total Pit Outline
- ROM Stockpile
- Organics Stockpile
- Heap Leach Pad Base
- Event Pond
- Heap Leach Access Disturbance Footprint
- Frozen Soil Storage Area
- Haul Road
- Support Infrastructure

N

1:25,000

0 400 800 1,200

Meters

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 5-1	Date: Mar 21, 2017	Drawn by: GM	Reviewed: JD

GOLDCORP

Path: P:\@Drafting\Coffee Gold\Drafting Figures\MxdFig 5-1_EOM GA_20170321.mxd

5.1 Waste Rock Storage Facilities

Approximately 299 Mt of waste rock will be excavated from the Supremo, Double Double, Latte and Kona pits over the life of the Project. Waste rock produced from mine pits will be stored primarily in the Alpha WRSF. Waste rock will also be placed as backfill in the In-pit Kona, In-pit Latte, In-pit Supremo and In-pit Double Double WRSFs. Each of the WRSFs are described below.

The mass, lithology and oxidation state of waste rock to be excavated from the four mine pits is tabulated in Table 5-1 below. The composition of individual waste rock WRSFs is inferred from the year-by-year mine sequence. The general sequencing shows that the Latte pit which is geologically distinct, being the primary host of schist waste, is excavated in Year -1 to Year 3 of mine life, during which time the Alpha WRSF is the only waste rock storage area. Therefore, it is assumed that all of the waste rock from Latte pit is stored in the Alpha WRSF, while waste rock from Double Double and Supremo pits is equally distributed between the Alpha WRSF, and the Supremo, Double Double, and Latte In-pit WRSFs. The size and assumed composition of the WRSFs at the end of mine life is tabulated in Table 5-2. The surface area of each WRSF is provided in Table 5-4. Note that a minor amounts metabasalt waste rock be produced from the Supremo pit, Latte, and Double Double Pit. This waste type constitutes approximately 1.1 % of waste rock and is therefore not explicitly considered in source term calculations. The mass associated with this minor lithology is assigned the same geochemical signature as gneiss, which is the dominant rock type in each of the WRSFs containing metabasalt.

Table 5-1:
Mass, lithology and oxidation of waste rock produced from the four mine pits.

Lithology	Facies	Mine Pit				
		Latte	Double Double	Kona	Supremo	Total
Gneiss	Oxide (Mt)	1.95	0.81	0.00	33.60	**36.36**
	Trans (Mt)	1.05	3.65	0.00	137.18	**141.87**
	Fresh (Mt)	0.22	10.72	0.00	67.38	**78.31**
	Total	**3.23**	**15.17**	**0.00**	**238.15**	**256.55**
Metabasalt	Oxide (Mt)	0.13	0.26	0.00	0.24	**0.64**
	Trans (Mt)	0.09	0.36	0.00	1.68	**2.14**
	Fresh (Mt)	0.00	0.11	0.00	0.25	**0.37**
	Total	**0.23**	**0.74**	**0.00**	**2.17**	**3.14**
Schist	Oxide (Mt)	10.64	0.00	0.00	0.14	**10.78**
	Trans (Mt)	15.71	0.00	0.00	0.66	**16.37**
	Fresh (Mt)	10.20	0.02	0.00	0.00	**10.21**
	Total	**32.76**	**0.03**	**0.00**	**1.09**	**33.88**
Granite	Oxide (Mt)	0.00	0.00	1.40	0.00	**1.40**
	Trans (Mt)	0.00	0.00	1.55	0.00	**1.55**
	Fresh (Mt)	0.00	0.00	2.34	0.00	**2.34**
	Total	**0.00**	**0.00**	**5.30**	**0.00**	**5.30**
All	**Total**	**36.21**	**15.94**	**5.30**	**241.41**	**298.86**

Table 5-2:
Mass, lithology and oxidation of waste rock stored waste rock storage areas.

Lithology	Facies	Waste Rock Storage Facilities				
		Alpha WRSF	In-Pit Kona	In-Pit Latte	In-Pit Supremo	In-Pit Double Double
Gneiss	Oxide (Mt)	29.84	-	0.98	4.22	1.23
	Trans (Mt)	116.43	-	3.82	16.48	4.79
	Fresh (Mt)	64.27	-	2.11	9.09	2.64
	Total	**210.55**	**-**	**6.91**	**29.79**	**8.66**
Meta	Oxide (Mt)	0.52	-	0.02	0.07	0.02
	Trans (Mt)	1.75	-	0.06	0.25	0.07
	Fresh (Mt)	0.30	-	0.01	0.04	0.01
	Total	**2.58**	**-**	**0.08**	**0.36**	**0.11**
Schist	Oxide (Mt)	10.78	-	-	-	-
	Trans (Mt)	12.89	-	-	-	-
	Fresh (Mt)	10.21	-	-	-	-
	Total	**33.88**	**-**	**-**	**-**	**-**
Granite	Oxide (Mt)	-	1.40	-	-	-
	Trans (Mt)	-	1.55	-	-	-
	Fresh (Mt)	-	2.34	-	-	-
	Total	**-**	**5.30**	**-**	**-**	**-**
All	Total	247.00	5.30	6.99	30.16	8.77

Table 5-3:
Surface area of mine facilities in each year of mine life

In-Pit Kona Backfill	Alpha WRSF	In-pit Double Double Backfill	In-pit Latte Backfill	In-Pit Supremo Backfill
(ha)	(ha)	(ha)	(ha)	(ha)
8.27	151	10.5	8.20	32.2

5.1.1 Approach

Source terms for WRSFs are calculated by upscaling geochemical loading rates observed in field bin experiments and applying empirical scaling factors from an analogue mine site. Empirical scaling factors are developed based on a comparison between field bin data to a full-scale waste rock seepage data. The scaled loading rates are then applied to the mass, footprint, hydrology and rock types stored in the various WRSFs. Solubility controls are then derived for a number of parameters that are not expected to behave conservatively.

These solubility controls are based on a combination of first principles (thermodynamic equilibria and aqueous speciation), experimental data and field monitoring data.

5.1.2 Data Sources

Geochemical loading rates for different lithologies and waste rock oxidation types are calculated from field bin data (Table 4-37). These loading rates are calculated from field bin data gathered between June 2014 to October 2016. The loading rates are scaled based on data from an analogue mine site provided in Altura (2009) and Lorax (2011). Hydrology of WRSFs is obtained from Appendix 12-C. The WRSFs composition, mass and surface area are provided in the Project Description.

5.1.3 Data Scaling

5.1.3.1 Waste Rock

Loading rates are scaled based on empirical observations from the Mount Nansen Mine (Mt. Nansen) site. This mine site is considered an appropriate analogue due to similarities in geology and climate. The Mt. Nansen is a former Au and Ag mine located in Central Yukon, approximately 60 km west of Carmacks. Both Mt. Nansen and the Coffee Project are located in the Dawson Range within Yukon-Tanana Terrane. The mineralization and geology at Mt. Nansen is generally similar to that of the Project. Gold is hosted in epithermal quartz/sulphide veins which have been weathered by infiltrating meteoric water to a depth of 70 m. As such, the waste rock is a mixture of oxide and sulphide weathering zones. The waste rock also has similar geology, with the primary lithologies being augen gneiss, quartz-feldspar-chlorite gneiss, amphibolite, quartz-chlorite schist and granodiorite. The waste rock at Mt. Nansen was placed in a single waste rock facility. The exact proportions of the oxidation types are unknown, but it is assumed that a majority of the waste facility consists of oxide material (Strathcona, 2001).

Geochemical characterization of the waste rock shows that it has a median total-S content of 0.3 wt.%, with most sulphur occuring as sulphide. Sulphide minerals identified in ore (in decreasing abundance) are pyrite, arsenopyrite, galena, sphalerite, chalcopyrite, stibnite and tetrehedrite. No description of sulphide mineralogy specific to waste rock is available. Waste rock contains the carbonate mineral calcite, with median a TIC content of 0.4 wt.% (Lorax, 2011).

Mt. Nansen was active from 1996 to 1999, over which time approximately 1.85 Mt of waste rock was produced from the Brown and McDade pits. A portion of this waste rock was used as fill or for road construction, and it is estimated that approximately 1 Mt remains in the waste rock facility adjacent to the mine pit with a surface area of approximately

9.02 ha (Altura, 2009). Drainage chemistry of the waste rock facility has been monitored from naturally occurring seeps from at least May 2009 to July 2010. Seepage pH over this time period has remained circumneutral to alkaline, with pH ranging from 8.1 to 6.5 (median of 7.5).

A waste rock field bin was constructed at Mt Nansen using a similar design as those constructed for the Project. The field bin consisted of HDPE barrels of the same dimensions (76 cm high, 56 cm diameter) containing a similar mass of waste rock (166 kg) which was collected from the existing waste rock pile. The waste rock field bin was constructed in July, 2009 and operated until August, 2010; over which time period, a total of 23.5 L of leachate was produced and seven samples were collected for chemical analysis (Lorax, 2011).

Scaling factors are developed by comparing loading rates measured in the field bin with loading rates estimated for the full scale WRSF. Loading rates for the full scale WRSF are estimated by assuming that the same runoff coefficient as used for WRSFs at the Project (runoff coefficient of 0.35) and using the 90th percentile and median concentrations measured in seeps at Mt. Nansen. Select loading rates from the field bin and the full scale WRSF for Mt. Nansen are shown in Table 5-4. The major ions, SO_4, Ca, Mg and K, are generally soluble and in high enough concentrations so that detection limit values do not affect estimated loading rates. In order to check what solubility controls might be affecting these parameters, waste rock seepage and field bin chemistry was speciated using the geochemical modeling program PHREEQC coupled to the Lawrence Livermore National Laboratories database (Parkhurst and Apello, 1999).

The saturation indices (SI) calculated for calcite and gypsum are presented in Figure 5-2 and Figure 5-3, respectively. An SI of 0 indicates that a mineral is in equilibrium with the solution, a mineral may be dissolving or precipitating to achieve equilibrium. A positive SI denotes that a mineral is oversaturated and therefore may be precipitated from solution. A negative SI denotes that a mineral is unsaturated; if the solid phase is present it will dissolve until equilibrium is reached. However, it should be noted that saturation indices are based on the thermodynamics of mineral formation/dissolution and do not account for kinetic limitations that affect mineral formation. These data show that calcite was saturated in one of the waste rock seeps (NW Seep-01), while gypsum remained below saturation. The PHREEQC input files used to develop Figure 5-2 and Figure 5-3 are provided in Appendix E.2.

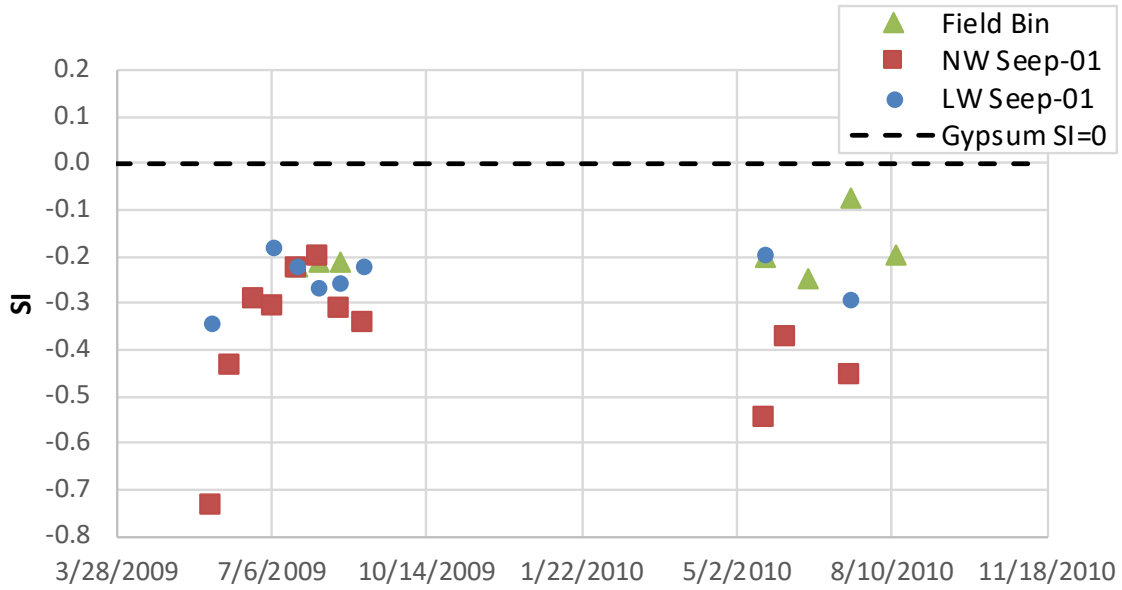


Figure 5-2: Gypsum Saturation indices (SI) calculated for analogue site

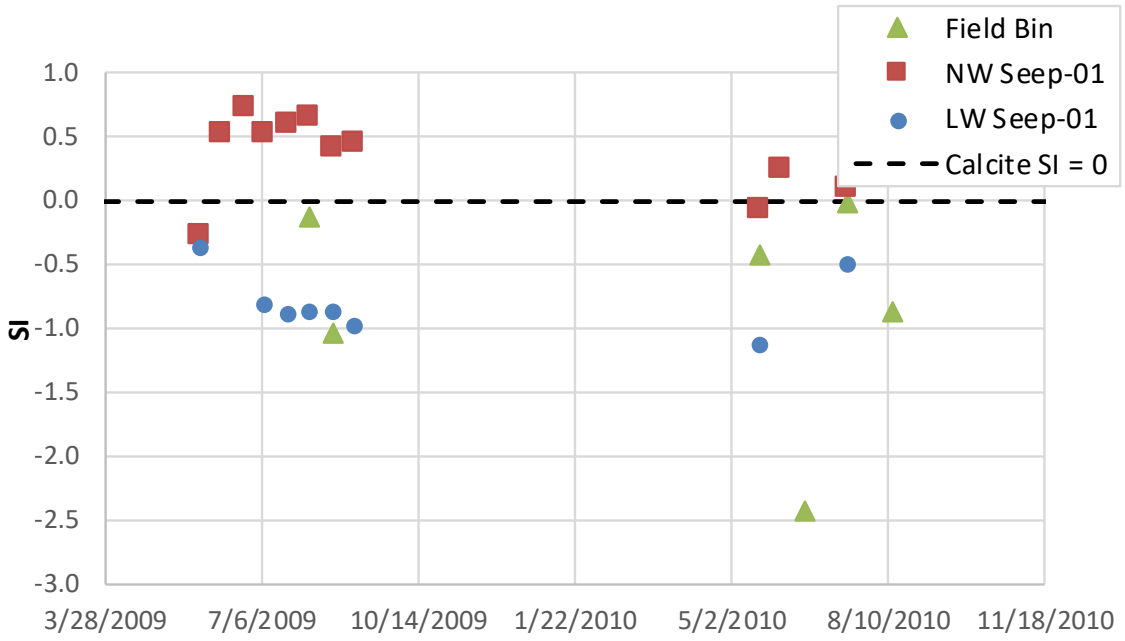


Figure 5-3: Calcite saturation indices (SI) calculated for analogue site

The ratio of the WRSF to field bin loading rates ranges from 0.052 to 0.089 when WRSF loading rates are calculated using median observed concentrations and range from 0.083 to 0.11 when 90th percentile concentrations are used to calculate WRSF loading rates.

Table 5-4:
Loading Rates from Field Bin and Full Scale WRSF at Analogue Mine Site

	units	SO_4	Ca	Mg	K
Field Bin	mg/kg/wk	4.38	1.01	0.435	0.0111
WRSF (Base)[1]	mg/kg/wk	0.28	0.09	0.023	0.00049
WRSF (Upper)[1]	mg/kg/wk	0.41	0.10	0.049	0.00093
WRSF (Base) / Field Bin	Ratio	0.065	0.089	0.052	0.044
WRSF (Upper) / Field Bin	Ratio	0.094	0.099	0.11	0.083

[1]Loading rates of analogue WRSF calculated assuming 90th percentile and median concentrations observed in seeps for base case and upper case estimates, respectively.

The ratio of field bin loading rates to full scale WRSFs loading rates provide an empirical scaling factor by which Project field bin results, presented in Table 5-4, can be related to full scale WRSFs. For the purpose of source term calculation, the empirical scaling factor observed for sulphate is applied. That is, a scaling factor of 0.065 is applied in the base case scenario and a scaling factor of 0.094 is applied in the upper case scenario. This scaling factor is applied to loading rates presented in Table 4-35 to estimate full scale WRSF source terms.

It is interesting to note that the scaling factors developed for SO_4 based on the analogue mine data are similar to what would be calculated based on differences in grain size between the field bin experiments and the full-scale waste rock facility. The Project field bins contain relatively fine-grained particles (< 0.25”), hence, material used in field bins have greater surface area to mass ratio than material in full scale WRSFs. The grain size distribution of granitic waste rock at Sudbury, found that 12% of the waste is <0.78”, while only 3% is < 0.24” (Fines *et al*., 2003). This would produce a scaling factor of 0.12 to 0.03 which is similar to scaling factors derived at the analogue minesite (0.11 to 0.044 for major ions in Table 5-4).

To convert the loading rate into a concentration, the scaled loading rate is multiplied by the mass of the WRSF in each year of mine life and divided by the surplus water available for each facility. Surplus water is estimated by multiplying the mean annual precipitation (MAP) (485 mm) by the runoff coefficient for WRSFs (0.35) and the surface area in each year of mine life (Table 5-1).

5.1.3.2 Underdrain

An underdrain will be constructed beneath the Alpha WRSF to convey upgradient runoff under the WRSF. The underdrain will be constructed of waste rock, and will impart a geochemical load on water moving through the drain. The underdrain consists of waste rock >0.3 m in diameter and will be 5 to 10 m in height and 30 to 50 m in width. For the purposes of source term calculation, it is assumed that the underdrain is at the maximum width and height throughout the underdrain (50 m and 10 m, respectively). A density of 2.6 t/m^3 and porosity of 0.3 are assumed. These assumptions produce an estimated mass of 910 tonnes of rock per m of underdrain.

In order to calculate underdrain loading rates, field bin loading rates presented in Table 4-37, are scaled based on particle surface area. In order to weight field bin loading rates from different lithologies, the underdrain is assumed to have the same geologic composition as the Alpha WRSF itself. The differences in grain size distribution is calculated by assuming that material in the field bins has a particle size of 6.35 mm, and the underdrain consists of material that has a particle size of 0.3 m. By assuming spherical particles, the surface area per kg of the field bin material and underdrain material is 0.36 m^2/kg and 0.0078 m^2/kg, respectively. The ratio of these two values produces a scaling factor of 0.021. This is the only scaling factor that is applied to the underdrain source term.

Note that this is an underestimate of the surface area of field bin material, as most field bin material is at a finer grain size. This is done as a conservative approximation, in that an underestimate of particle surface area in field bins produces a more conservative scaling factor. This scaling approach is used for both the base case and upper case source term calculation.

5.1.4 Solubility Controls

Upscaling kinetic test loading rates often results in concentrations that exceed solubility controls, particularly in neutral pH environments where a number of solubility limitations can exert an influence on drainage chemistry. Metal solubility can be controlled by thermodynamic mineral solubility, sorption to mineral surfaces, and aqueous complexation reactions. In the following sections the solubility controls applied to source term predictions for WRSFs are discussed.

5.1.4.1 Arsenic

Arsenic is released by a combination of sulphide mineral oxidation (*e.g.*, arsenopyrite, arsenianpyrite, and orpiment) and dissolution of oxide minerals (scorodite, yukonite, Fe-oxide mineral surfaces). In pH-neutral aerobic environments the solubility of this metalloid

is generally controlled by sorption to mineral surfaces. Unlike mineral saturation controls on solubility, sorption controls are determined by the availability and mineralogy of particle surfaces and solution chemistry. Given these complexities, solubility controls based on surface sorption are typically developed from site specific observations rather than thermodynamic data available in geochemical databases.

In aerobic neutral pH environments, arsenic speciates as the oxyanion arsenate ($HAsO4^{2-}$). Sorption of this aqueous species to mineral surfaces is controlled by a combination of pH and availability of Fe-oxide surfaces (Goldberg, 2002; Sharma and Sohn, 2009). Significant sorption of arsenate can take place on clays (Mn-oxides and Al-oxides), however, these minerals generally only become significant in Fe deficient systems (O'day, 2006). The degree of As sorption to Fe-oxides is highly pH sensitive, with maximum arsenate adsorption increasing as pH declines from 9 to 6 (Pierce and Moore, 1982).

Solubility controls for As are developed based on a scientific understanding of As behavior in mine waste environments which is supported by site specific geochemical characterization data. Data from kinetic testwork demonstrate two principles of As behaviour: As concentrations increase with increasing pH; and, the difference in As concentrations between different kinetic tests producing similar pH leachate can be related to the solid phase Fe content. The relationship between As concentrations and pH can be seen in geochemical kinetic testwork, as shown in Figure 4-15 and Figure 4-24. While the relationship between pH and arsenic is consistent between different scale kinetic tests using the same sample, the relationship varies considerably between different samples even within the same rock unit. For example, humidity cell tests using different samples of fresh gneiss waste rock (HC4 and HC8) and fresh schist waste rock (HC2 and HC7) show distinctly different relationships between pH and As (Figure 5-4). The difference can be related to the differences in solid phase As content, and more specifically, differences in As:Fe molar ratios. Specifically, the humidity cells with higher As:Fe ratios [HC7 and HC8 have As:Fe of 0.021 (mol/mol) and 0.032 (mol/mol), respectively] produce higher As compared to humidity cells of the same lithology and weathering with lower As:Fe ratios [HC2 and HC4 have As:Fe of 0.00080 (mol/mol) and 0.0037 (mol/mol)].

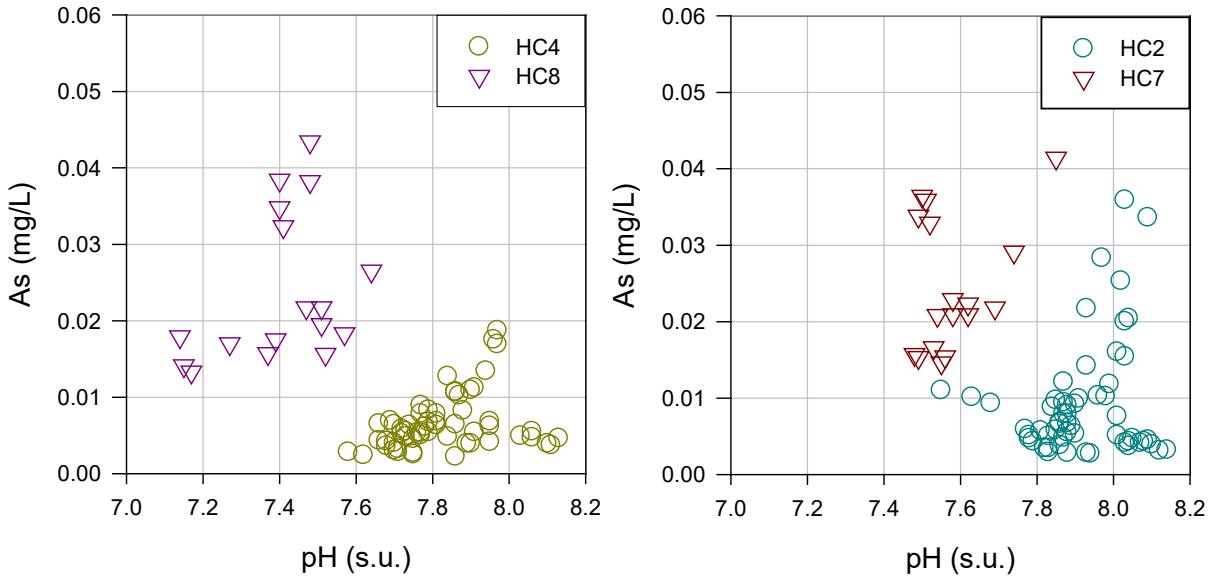


Figure 5-4: Comparison of the relationship between As and pH in two humidity cells containing different samples of the same lithology and weathering facies. Fresh gneiss waste rock humidity cells are shown on the left and fresh schist waste rock shown on the right

The relative abundance of available As and Fe-oxide mineral surfaces can be approximated based on the As:Fe molar ratios in kinetic test samples. The relationship between As concentrations produced at pH 8, and solid phase As:Fe molar ratios is shown in Figure 5-5. This result is consistent with results presented by Langmuir *et al.,* (1999), where it was shown that As concentrations in tailings pore water could be predicted based on As:Fe molar ratios. Figure 5-5. shows that a linear relationship exists over the range of As concentrations and As:Fe molar ratios in different ore and waste rock kinetic tests, with As concentrations increasing as the As:Fe molar ratio increases.

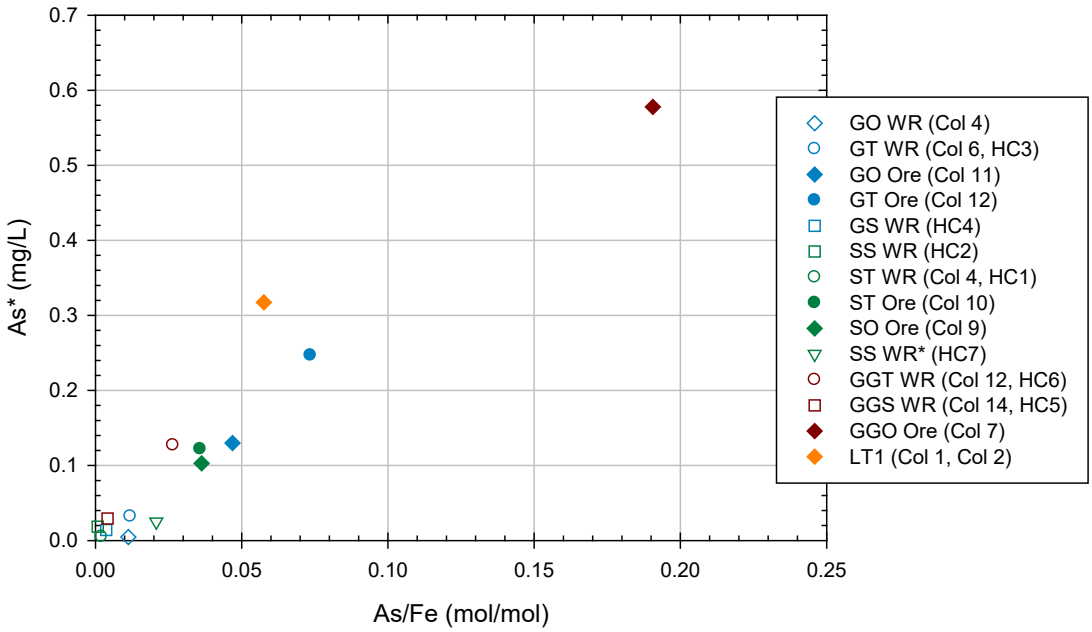


Figure 5-5: Observed arsenic concentrations at pH 8 plotted against As/Fe molar ratios measured by aqua regia analysis of kinetic test solids. Each data point represents an individual kinetic test sample.

This observed linear relationship only describe As solubility for a specific pH (8.0). In order to predict As concentrations at pHs other than 8, a relationship between As solubility and pH must be estimated. The increase in solubility of As(V) with increasing pH can be related to the shift in speciation from $H_2AsO_4^-$ to $HAsO_4^{2-}$ (Giménez *et al.*, 2007), with the ratio of these two species being directly related to the concentration of H^+ ions ($H^+ = 10^{-pH}$). Consequently, changes in As solubility can be inversely related to changes in H^+ concentrations, that is, a decline in H^+ by an order of magnitude (*i.e.,* increase of 1 pH unit) will result in an order of magnitude increase in As concentrations. Arsenic solubility in gneiss, schist and granite waste rock and ore is represented by the following equations:

$$As_{(aq)} = m \times As_{(sl)}/Fe_{(Sl)} \times 10^{-8}/H^+ \qquad (1)$$

Where $As_{(aq)}$ is the concentration of As in mg/L, As(sl) and Fe(sl) are moles of As and Fe in the solid sample, H^+ is the molar concentration of H^+ in solution (equal to 10^{-pH}) and m is the slope from the linear regressions developed from data shown in Figure 5-5 above (m equals 3.14, 2.85 and 3.06 for gneiss, schist and granite, respectively). This equation is used to define dissolved As concentrations based on As:Fe molar ratios and pH. The range of As:Fe ratios for each rock lithology broken down by weathering zone is presented in

Table 5-5 for ore and waste rock. The base case As source terms assume median As:Fe ratios, while the upper case source term calculations assumes 75th percentile As:Fe ratios.

Table 5-5:
Arsenic to Fe molar ratios in waste rock and ore lithologies and weathering zones

Statistic	Oxide	Transition	Fresh	Oxide	Transition
Gneiss	**Waste Rock**			**Ore**	
95th PCTL	3.77E-02	2.20E-02	3.10E-03	1.08E-01	1.94E-01
75th PCTL	1.92E-02	3.65E-03	7.37E-04	5.80E-02	7.60E-02
Median	1.11E-02	1.01E-03	3.22E-04	3.99E-02	4.81E-02
25th PCTL	4.24E-03	3.16E-04	1.49E-04	2.96E-02	3.13E-02
5th PCTL	9.29E-04	9.26E-05	6.33E-05	1.88E-02	1.22E-02
Schist	Waste Rock			Ore	
95th PCTL	2.02E-02	9.43E-03	1.85E-03	1.72E-01	1.98E-01
75th PCTL	2.88E-03	1.29E-03	5.08E-04	8.58E-02	1.01E-01
Median	9.13E-04	4.99E-04	2.55E-04	6.08E-02	6.92E-02
25th PCTL	3.26E-04	1.96E-04	1.37E-04	4.16E-02	3.70E-02
5th PCTL	9.95E-05	6.93E-05	5.95E-05	2.11E-02	1.00E-02
Granite	Waste Rock			Ore	
95th PCTL	1.42E-01	5.60E-02	4.92E-01	3.38E-01	4.24E-01
75th PCTL	4.53E-02	8.73E-03	1.87E-01	1.90E-01	2.68E-01
Median	2.23E-02	1.84E-03	1.19E-02	8.67E-02	1.69E-01
25th PCTL	3.98E-03	3.78E-04	1.35E-03	5.04E-02	7.42E-02
5th PCTL	6.20E-04	1.19E-04	2.87E-04	3.59E-02	3.69E-02

Note: Molar ratios calculated from ICP-OES database with the exception of the fresh granite unit, which combines both ICP-OES and ICP-MS databases due to limited number of samples

The relationship defined in equation 1 above is pH dependent, and the prediction of pH requires consideration of a variety of physical and geochemical conditions, as discussed below. Dissolution of carbonate minerals (primarily calcite and dolomite) are expected to control the pH and alkalinity WRSF pore water. Carbonate mineral equilibrium pH is determined by the partial pressure of carbon dioxide (pCO_2), temperature, and solution chemistry (*e.g.*, salinity and concentration of Ca and Mg). Waste rock field bins produced pH values from 7.7 to 8.2 in schist, and 7.7 to 8.3 in gneiss (Table 4-32 and Table 4-33). This is similar to the pH range reported for calcite and dolomite buffered full scale waste rock facilities in British Columbia. The combined dataset from Copper Mountain, Highland Valley Copper and Mount Polley waste rock facilities having 5th percentile, median and 95th percentile pHs of 7.6, 8.1 and 8.4 (SRK, 2015). For the purpose of calculating As solubility in WRSF source terms, a pH of 8.0 and 8.3 is assumed for the base case and upper case, respectively. This pH range is applied to all WRSFs.

The As solubility control is applied to WRSF source terms by calculating a concentration associated with each of the rock types within a WRSF and taking a weighted average. The same assumption regarding pore water pH is made for all rock types.

5.1.4.2 Uranium

Uranium solubility is dependent on redox potential, pH and availability of complexing ions such as CO_3, PO_4 or SO_4. Uranium primarily occurs in two oxidation states [U(IV) and U(VI)]. Uranium in the tetravalent form [U(IV)] is relatively insoluble and will typically precipitate as uraninite (UO_2). For U(IV) to be released into pore water, it must first be oxidized by atmospheric oxygen or another oxidizing agent such as Fe(III). Once oxidized to U(VI), U will speciate as a positively charged uranyl oxycation (UO_2^{2+}). In neutral pH environments the positively charged uranyl ion may be adsorbed onto negatively charged surfaces of sulfides, clays and organic matter as well as Fe, Mn and Al oxyhydroxide particles (Lottermoser, 2007). Uranyl ion solubility is enhanced by complexation with carbonate, which primarily occur with dissolved carbonate in neutral pH environments (Porcelli and Swarzenski, 2003).

Elemental associations observed with μXRF indicate that a portion of U(IV) occurs as brannerite minerals in gneiss waste rock, these minerals are generally considered relatively recalcitrant compared to other common U(IV) minerals such as uraninite and coffinite (Gilligan *et al*., 2015). X-ray adsorption near edge spectroscopy (XANES) analysis found that a portion of U is present in the oxidized U(VI) form, even in fresh (unweathered) waste rock samples (Table 4-7). This indicates that U can be mobilized to pore water by complexation with dissolved carbonate immediately, without requiring an intermediate oxidation step (*e.g.,* brannerite oxidation by oxygen) which would pose a kinetic limitation on U release.

In aerobic pH-neutral to alkaline environments U(VI) solubility is sensitive to pH and alkalinity (Dittrich and Reimus, 2015; Davis and Curtis, 2003; Waite *et al.,* 1994). Furthermore, Davis and Curtis (2003) found that alkalinity was the more influential of the two parameters controlling U(VI) solubility. This association between alkalinity and U(VI) solubility can be seen in laboratory kinetic test results (Figure 4-16 and Figure 4-24) and in site ground water and surface water quality data. The relationship between U and alkalinity in gneiss, schist and granite laboratory kinetic tests excluding the initial flushing period and ground water wells screened within the respective lithologies is shown in Figure 5-6. Note that field bin data is excluded from these plots due to uncertainties in the reliability of alkalinity measurements, as discussed in section 4.1.5.5. These plots show that there is some consistency between the relationship between alkalinity and U concentrations in both field and laboratory data. The fact that similar relationships are

observed between alkalinity and U concentrations in both site water quality and field kinetic test data supports the use of alkalinity as a proxy for U concentrations in planned mine waste facilities.

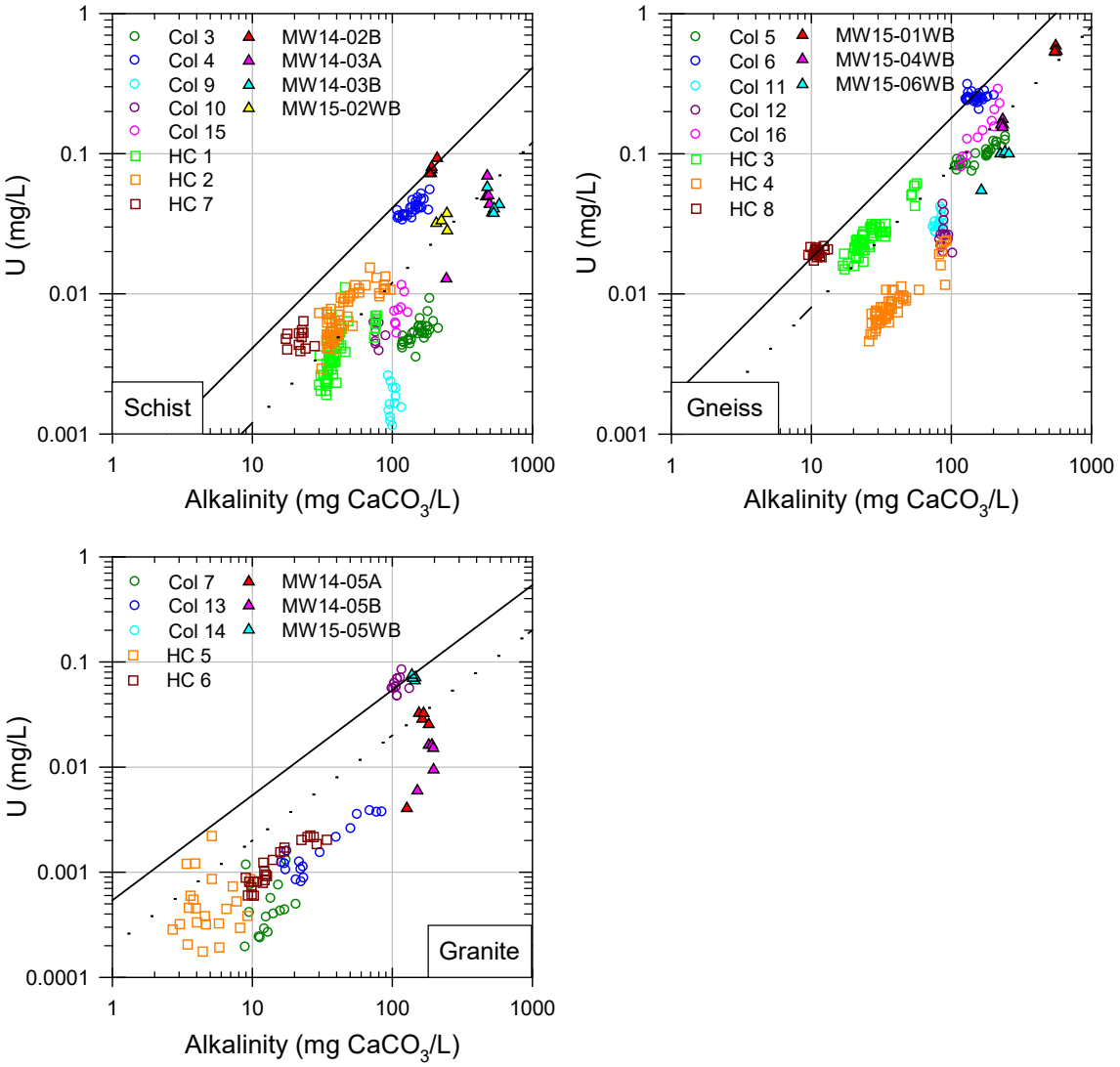


Figure 5-6: Relationship between U and alkalinity in groundwater monitoring wells and laboratory kinetic tests containing waste rock and ore. Data shown for kinetic tests containing, and groundwater wells screened in schist (upper left), gneiss (upper right) and granite (bottom left). Lines show relationship between alkalinity and U used to define base case solubility (dotted) and upper case (solid)

Source term predictions for U are based on the ratio of alkalinity to U observed in kinetic testwork and site water quality. Unlike As, variations in the relationship between U and alkalinity do not appear to be related to differences in solid phase U content. Considering that kinetic tests generally had elevated U compared to what was typical of site waste rock

(Figure 4-9), the relationship between alkalinity and U is expected to provide a conservative approximation of what can be expected from waste rock WRSFs. For source term prediction, the average and maximum U:Alk mass ratio observed in each kinetic test and groundwater sampling are presented in Table 5-6. The median ratio is used for the base case estimate and the maximum ratio is used for the upper case estimate. Note that these U:Alk ratios used to define the base case and upper case solubility are also illustrated in Figure 5-6 above.

Table 5-6:
Uranium to alkalinity ratio used to predict upper case and base case U solubility

	Base Case (mg/mg)	Upper Case (mg/mg)
Gneiss	8.0E-04	1.8E-03
Granite	2.8E-04	5.4E-04
Schist	1.2E-04	4.1E-04

In order to relate the U:Alk ratios presented in Table 5-6 to U concentration predictions requires an estimate of pore water alkalinity. The primary source of alkalinity in mine waste environments is from carbonate mineral dissolution. When present, carbonate minerals will dissolve until equilibrium is reached. The alkalinity produced by carbonate mineral equilibrium will depend primarily on the partial pressure of carbon dioxide (pCO_2), but will also be effected by temperature and solution chemistry. The interior of WRSFs generally have elevated pore gas pCO_2 compared to atmospheric concentrations due CO_2 generation from organic and inorganic processes. For the purposes of estimating alkalinity values produced from WRSFs, a range of conditions is considered. The relationship between alkalinity and pCO_2 at temperatures ranging from 10°C and 0.1°C, and TDS values ranging from 840 to 3400 mg/L are plotted in Figure 5-7. This figure was generated using the USGS geochemical modelling program PHREEQC, coupled to the Lawrence Livermore National Laboratories database (Parkhurst and Appelo, 1999). The PHREEQC input file is provided in Appendix E.2. In general, the modeled relationship shows that alkalinity is greater at lower temperatures and TDS values and increases with pCO2 from 50 $mgCaCO_3$ (atmospheric CO_2) to 470 $mgCaCO_3$/L (5% CO_2). This range of CO_2 values is similar to what has been observed at other low sulphur carbonate buffered WRSFs (MacGrergor *et al.,* 2012; Birkham *et al.,* 2003). For the purpose of source term calculation, a pore gas pCO_2 of 5% is assumed, using calcite equilibrium calculated at low TDS and 0.1°C shown in Figure 5-7. This produces an estimated alkalinity of 470 $mgCaCO_3$/L and is used the base case and upper case source term predictions for U.

The U solubility control is applied to WRSF source terms by calculating a concentration associated with each of the rock types within a WRSF and taking a weighted average. The same assumptions regarding alkalinity are made for all rock types.

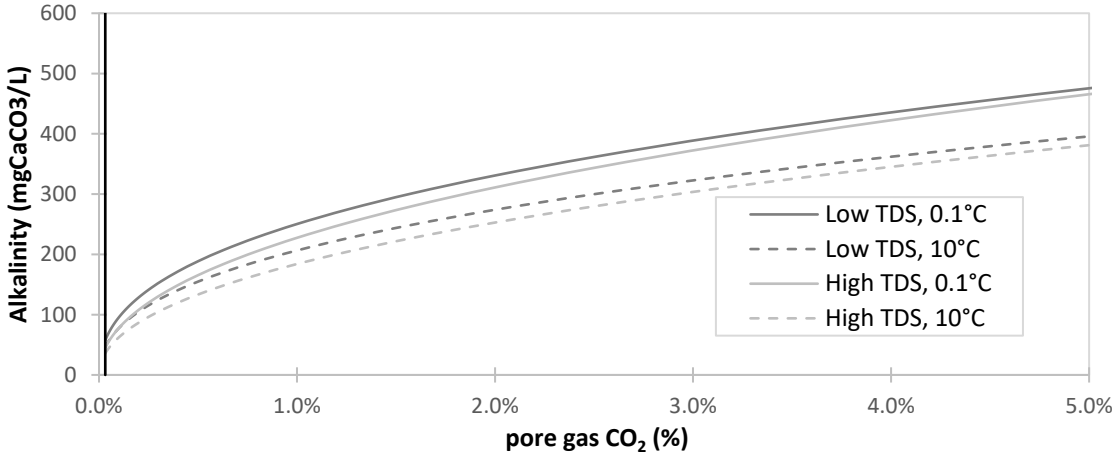


Figure 5-7: Relationship between pH and pore gas CO_2 at calcite equilibrium and varying temperatures and TDS.

5.1.4.3 Radium-226

Radium 226 is one of the main contributors to radiological doses in naturally occurring radioactive materials (NORM) and is the only radio-isotope regulated under MMER. This radio isotope is the fifth isotope of the ^{228}U decay chain and in most geologic material, the activity of ^{226}Ra in rock samples can be estimated directly from measurements of U concentrations. That is, daughter products of the ^{238}U series achieve equilibrium after about 1 million years. Secular equilibrium is a state in which the decay rate of all radioisotopes of a decay chain are equal. Analysis of naturally occurring radioactive materials (NORM) measured by gamma spectroscopy in ore, waste rock and overburden found that radioisotopes were in secular equilibrium, as is generally the case in geologic systems. This means that the activity of ^{226}Ra in host rock can be estimated based on the concentration of U. A concentration of 1 ppm of natural uranium (99.3% as ^{238}U) corresponds to 0.01235 Bq of ^{226}Ra per gram. Based on this relationship, the solid phase ^{226}Ra activity can be determined from the mass concentration of U.

In aqueous systems, Ra forms a bivalent cation [Ra(II)] and behaves similar to other alkaline earth metals such as Mg, Sr, Ca and Ba. There is abundant information from environmental radiochemical research which shows that the solubility of Ra(II) is mainly controlled by $BaSO_4$ solubility (Martin and Akber, 1999; Grandia *et al.,* 2008). The affinity of Ra to the barite crystal lattice is related to the similar ionic radius of Ra(II) and Ba(II) (1.36 Å and 1.43 Å, respectively), with $(Ba,Ra)SO_4$ behaving as a near ideal solid solution (Kulik *et al.,* 2003). The relationship between ^{226}Ra measured by alpha

spectroscopy and dissolved Ba measured by ICP-MS is shown Table 5-11 below. There is some evidence that elevated ^{226}Ra values are associated with elevated Ba, however, the relationship is confounded by the low concentration of ^{226}Ra. That is, most Ra measurements are within 10x the analytical detection limit (0.01 Bq/L). Activities within this range have a relatively large uncertainty, having a precision of +/- 50% to 100%, making these measurements semi-quantitative in nature.

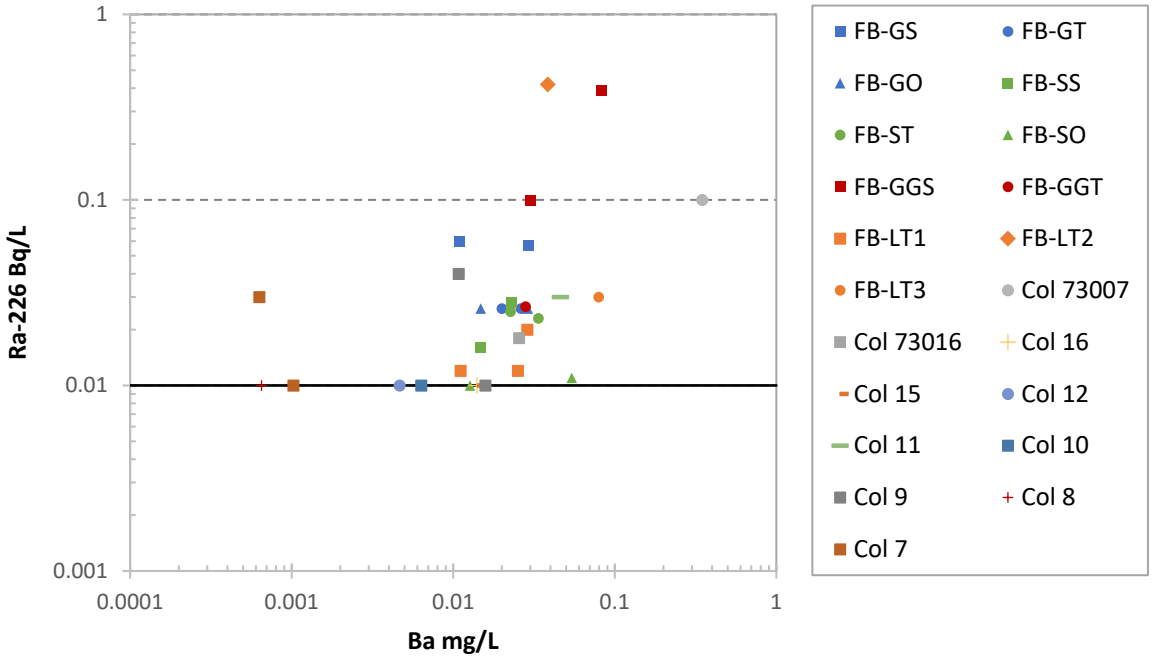


Figure 5-8: Barium concentration versus ^{226}Ra activity measured in field bins, laboratory kinetic test columns, and metallurgical cyanide leach columns. Black line shows detection limit, dotted line shows 10x detection limits for ^{226}Ra, data below this line can be considered semi-quantitative as the analytical precision is +/- 50 to 100%

Due to the large uncertainty in the relationship between Ba and ^{226}Ra in kinetic test leachate, the ratio of ^{226}Ra:Ba released into solution is assumed to be equivalent to the ratio which occurs in the solid phase. The median and 75th percentile ratios of ^{226}Ra:Ba ratios (Bq/ppm) for each of the respective rock types is presented in Table 5-7. In this table, the concentration of ^{226}Ra is calculated by assuming secular equilibrium with ^{238}U as described in section 4.1.7.

Table 5-7:
Ratio of Ra-226 to Ba measured in ICP-MS database for various lithologies, weathering types and ore/waste types.

Lithology	Weathering	Ore/Waste	Ra-226 / Ba (Bq/ppm)	
			P50	P75
Schist	Oxide	Waste	0.14	0.28
Schist	Transition	Waste	0.08	0.19
Schist	Fresh	Waste	0.07	0.12
Schist	Oxide	Ore	0.08	0.08
Schist	Transition	Ore	0.16	0.79
Gneiss	Oxide	Waste	0.84	1.16
Gneiss	Transition	Waste	0.69	1.16
Gneiss	Fresh	Waste	0.27	0.61
Gneiss	Oxide	Ore	0.73	0.97
Gneiss	Transition	Ore	0.71	0.82
Granite	Oxide	Waste	1.85	2.21
Granite	Transition	Waste	1.26	2.49
Granite	Fresh	Waste	1.01	1.34
Granite	Oxide	Ore	1.91	2.51
Granite	Transition	Ore	2.41	5.37

Thermodynamic calculations of barite saturation often underestimate barium concentrations observed in the natural environment (Martin et al., 2003). Barite solubility is graphed in Figure 5-9 and compared to metallurgical leach column data and field bin data (data presented in Table 4-32, Table 4-34, Table 4-36, Table 4-56 and Table 4-64). Note that first flush samples form field bins are excluded in this table. In this figure, barite solubility is calculated by assuming barite equilibrium (SI=0) and for barite under supersaturated conditions (SI=0.55). An SI of 0.55 is equivalent to the ion activity product (IAP) being 3.5 times the solubility product (Ksp). In other words, Ba concentrations are 3.5 times greater than what would be predicted by assuming barite equilibrium. Solubility calculations are done using the USGS geochemical modelling program PHREEQC coupled to the Lawerence Livermore National Laboratory database (Parkhusrt and Apello, 1999). The input file is provided in Appendix E.2. Most field bin data plots between the barite SI=0 and barite SI=0.55 solubility curves. This result is similar to results from Martin et al. (2003), who found that while barium generally conformed with expected behavior predicted by barite solubility (decreasing Ba with increasing SO4 concentrations), however, calculated SI values were generally greater than 0 (*i.e.*, greater than equilibrium). In order to predict Ba solubility for the purposes of source term calculations, a barite SI of 0.55 is assumed for both base case and upper case scenarios. This assumed barite SI

conservatively predicts Ba concentrations in 23 of 26 field bin samples and 24 of the 26 met column samples (Figure 5-9).

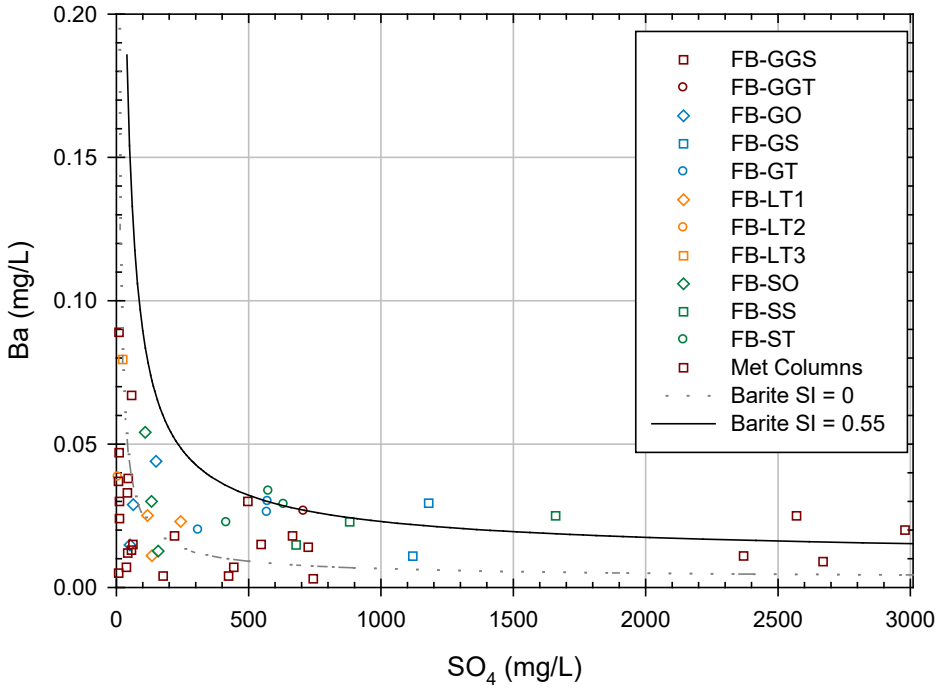


Figure 5-9: Relationship between barium and SO_4 in field bin and metallurgical leach column (met column) samples. The grey line indicates barite solubility at equilibrium (SI=0). The black line indicates barite at supersaturation (SI=0.55).

Source term predictions for ^{226}Ra are calculated by multiplying the ratio of ^{226}Ra to Ba in the solid phase by the predicted concentration of Ba assuming barite SI of 0.55. The ratio of ^{226}Ra to Ba is used as the sensitivity to differentiate the base case from the upper case. That is, the median ratio is used as the base case source term and the 75th percentile value is used in the upper case source term. Activities of ^{226}Ra, predicted by these assumptions, are plotted as a function of SO_4 concentrations for base case and upper case scenarios in Figure 5-10 and Figure 5-11, respectively. Due to the inverse relationship between Ra activities and SO_4, the base case source terms of SO_4 are used to calculate Ba solubility in both base case and upper case ^{226}Ra predictions to ensure conservative predictions. The ^{226}Ra solubility control is applied to WRSF source terms by calculating the ^{226}Ra:Ba ratio for each of the rock types within a WRSF and taking a weighted average.

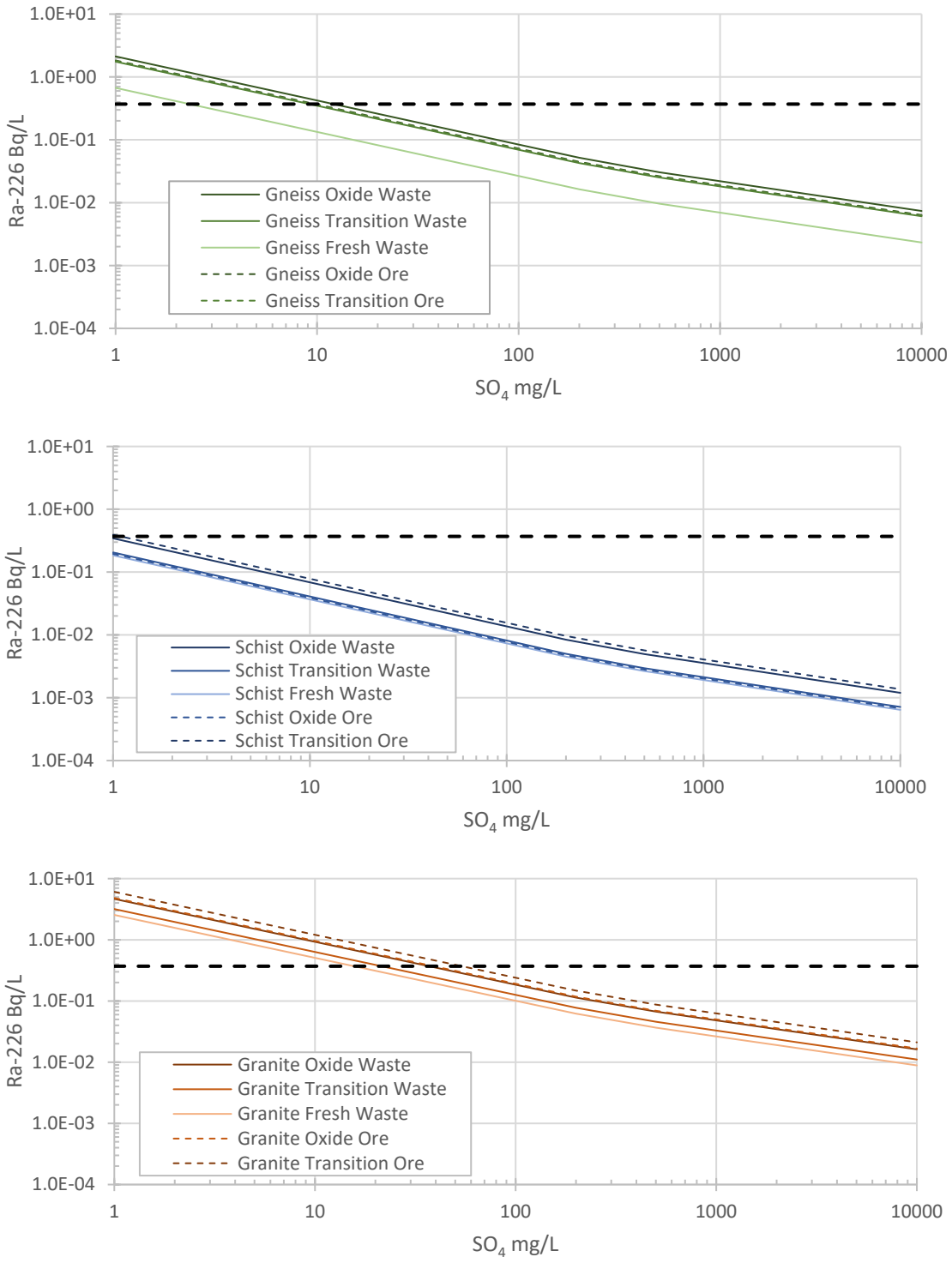


Figure 5-10: Base case solubility control of Ra-226 as a function of SO_4 concentrations. Plots show Ra-226 solubility for various gneiss (top), schist (middle), and granite (bottom) ore and waste rock units

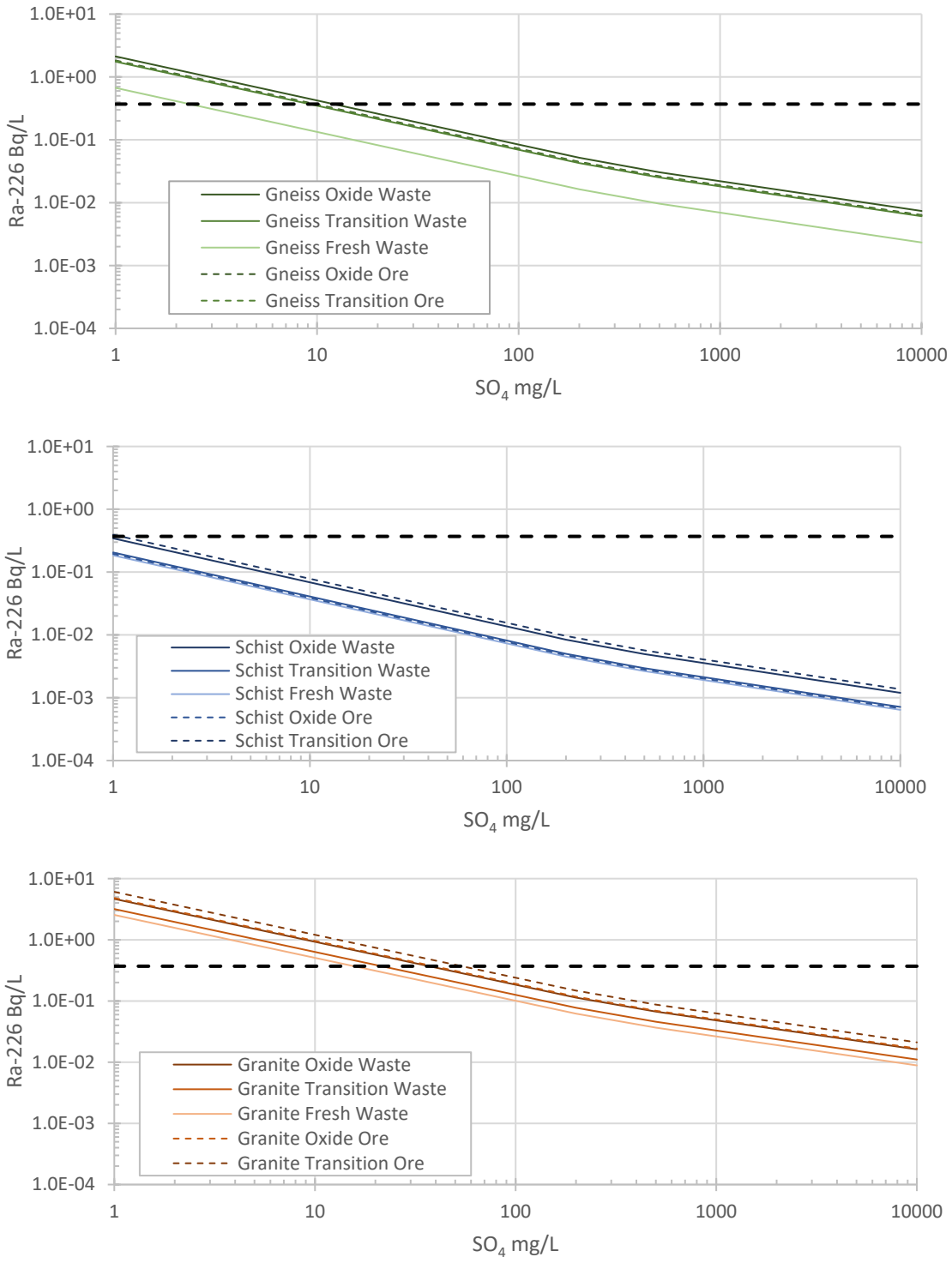


Figure 5-11: Upper case source term solubility of Ra-226 as a function of SO_4 concentrations. Plots show Ra-226 solubility for various gneiss (top), schist (middle), and granite (bottom) ore and waste rock units.

5.1.4.4 Other Parameters

Upscaling kinetic test loading rates often produces unrealistic concentrations due to detection limit values in kinetic test, or pH related solubility controls. The concentration of Hg and P were frequently at or below detection limits in kinetic testwork, and concentrations of Al and Fe are not expected to conservatively as they will precipitate as hydroxide or oxyhydroxide phases under neutral pH, aerobic conditions. Therefore, Hg, Fe and Al were set to median and 75th percentile concentrations observed in waste rock field bins for base case and upper case source term predictions, respectively. In the case of P, where all field bin values were below the relatively high detection limit value of 0.05 mg/L, the detection limit value is used in the upper case source term and the base case scenario is set at half the detection limit.

5.1.5 Source Term

Source terms for WRSFs are calculated for the maximum WRSF footprints and mass at end of mine life. Base case and upper case source term concentrations applied at end of mine life are presented in Table 5-8 and Table 5-9, respectively. The source term applied to the underdrain of the Alpha WRSF is provided in Table 5-10. The complete set of source terms is provided in Appendix E.3.

Table 5-8:
Base case source terms for WRSF for the final year of mine life,
Table 5-8closure and post-closure

Facility		Alpha WRSF	Kona Backfill	in Pit Latte	in Pit Supremo	in Pit Double Double
Sulfate	mg/L	1430	274	755	829	739
P	mg/L	0.0251	0.0267	0.025	0.025	0.025
Al	mg/L	0.00793	0.0143	0.00793	0.00793	0.00793
Ag	mg/L	0.0000387	0.0000181	0.0000199	0.0000218	0.0000195
As	mg/L	0.00631	0.0114	0.00702	0.00702	0.00702
Ca	mg/L	267	63.3	142	156	139
Cd	mg/L	0.0000241	0.0000722	0.0000126	0.0000139	0.0000124
Cr	mg/L	0.00292	0.000425	0.00155	0.00171	0.00152
Cu	mg/L	0.00397	0.000598	0.00209	0.00229	0.00204
Fe	mg/L	0.0215	0.0136	0.0214	0.0214	0.0214
Hg	mg/L	0.00000616	0.00000289	0.00000619	0.00000619	0.00000619
Mg	mg/L	162	12.1	85	93.3	83.2
Mn	mg/L	0.018	7.01	0.00647	0.00711	0.00634
Mo	mg/L	0.136	0.00437	0.0789	0.0866	0.0772
Ni	mg/L	0.00637	0.00497	0.00232	0.00255	0.00227
Pb	mg/L	0.000759	0.000213	0.000372	0.000408	0.000364
Sb	mg/L	0.0229	0.00433	0.0114	0.0125	0.0111
Se	mg/L	0.00206	0.000123	0.000911	0.001	0.000892
Tl	mg/L	0.000405	0.000145	0.00021	0.000231	0.000206
U	mg/L	0.332	0.132	0.376	0.376	0.376
Zn	mg/L	0.0898	0.063	0.0416	0.0457	0.0408
Ra-226	Bq/L	0.0114	0.0629	0.0174	0.0167	0.0176

Table 5-9:
Upper case source terms for WRSF in final year of mine life and closure

Facility		Alpha WRSF	Kona Backfill	in Pit Latte	in Pit Supremo	in Pit Double Double
Sulfate	mg/L	2090	401	1100	1210	1080
P	mg/L	0.0501	0.0782	0.05	0.05	0.05
Al	mg/L	0.015	0.021	0.0145	0.0145	0.0145
Ag	mg/L	0.0000566	0.0000264	0.0000291	0.0000319	0.0000285
As	mg/L	0.0282	0.595	0.0311	0.0311	0.0311
Ca	mg/L	391	92.6	207	227	203
Cd	mg/L	0.0000353	0.000106	0.0000185	0.0000203	0.0000181
Cr	mg/L	0.00428	0.000622	0.00227	0.0025	0.00222
Cu	mg/L	0.00581	0.000874	0.00305	0.00335	0.00299
Fe	mg/L	0.0336	0.0199	0.032	0.032	0.032
Hg	mg/L	0.0000245	4.22E-06	0.000012	0.0000132	0.0000117
Mg	mg/L	236	17.7	124	136	122
Mn	mg/L	0.0263	10.2	0.00946	0.0104	0.00927
Mo	mg/L	0.199	0.00639	0.115	0.127	0.113
Ni	mg/L	0.00931	0.00728	0.00339	0.00372	0.00332
Pb	mg/L	0.00111	0.000311	0.000544	0.000597	0.000532
Sb	mg/L	0.0335	0.00634	0.0166	0.0183	0.0163
Se	mg/L	0.00301	0.000179	0.00133	0.00146	0.0013
Tl	mg/L	0.000593	0.000211	0.000307	0.000337	0.000301
U	mg/L	0.769	0.254	0.86	0.86	0.86
Zn	mg/L	0.131	0.0921	0.0609	0.0669	0.0596
Ra-226	Bq/L	0.0195	0.0919	0.0295	0.0282	0.0298

Table 5-10:
Source term for Alpha WRSF underdrain applied in both base case and upper case.

Sulfate	mg/m/yr	439000
P	mg/m/yr	40.1
Al	mg/m/yr	9.55
Ag	mg/m/yr	0.0119
As	mg/m/yr	28.6
Ca	mg/m/yr	82200
Cd	mg/m/yr	0.00741
Cr	mg/m/yr	0.899
Cu	mg/m/yr	1.22
Fe	mg/m/yr	17.1
Hg	mg/m/yr	0.00514
Mg	mg/m/yr	49700
Mn	mg/m/yr	5.53
Mo	mg/m/yr	41.9
Ni	mg/m/yr	1.96
Pb	mg/m/yr	0.233
Sb	mg/m/yr	7.04
Se	mg/m/yr	0.632
Tl	mg/m/yr	0.125
U	mg/m/yr	245
Zn	mg/m/yr	27.6
Ra-226	Bq/m/yr	18.2

5.2 Pit Walls

Pit wall rock refers to rock exposures within the mining pit itself. This includes the pit floor, benches and blast damaged fractured rock. Pit walls are expected to be fractured as a result of blasting operations. Fracturing and slope ravelling of the pit walls exposes a greater proportion of the wall rock to weathering. Wall rock drainage chemistry will vary depending on the rock type exposed rock type. Pit wall rock will be composed of a combination of waste rock and ore, with the same associations between lithology and pit as described for waste rock and ore. A summary of the estimated percentages of different pit wall types that compose the pit walls at full exposure is provided in Table 5-11 below.

Table 5-11:
Plan view surface areas of wall rock exposed in mine pit. Maximum values show peak wall rock surface areas exposed during mine life, final values are wall rock exposures at the end of mine life

Pits	Primary	Ore		Waste		
	Lithology	Oxide	Transition	Oxide	Transition	Fresh
Supremo	Gneiss	12%	2%	6%	49%	32%
Double Double[1]	Gneiss	4%	8%	4%	21%	62%
Kona[1]	Granite	10%	11%	16%	21%	42%
Latte	Schist	4%	21%	12%	21%	41%

Notes: **1**. Double Double and Kona pits are entirely backfilled with waste rock by the end of mine life

5.2.1 Data Sources

Pit wall source terms are calculated by scaling laboratory kinetic test work. A list of the kinetic tests and cycles used in development of pit wall source terms is presented in Table 5-12 below. The loading rates used are the median and 75th percentile measured after the first 10 cycles of testing for the base case and upper case source terms, respectively. Kinetic test loading rates are presented in Section 4.1.5.3 and 4.2.5.3 for waste rock and ore, respectively. The volume of runoff from pit wall is estimated based on an MAP of 485 mm, and a runoff coefficient of 0.65 (Appendix 12-C).

Table 5-12:
Overview of Kinetic Tests Used for Pit Wall Source Term Calculation

Kinetic Test ID	Mineralization	Lithology	Material Type	Cycles/Weeks
Col 3	Oxide	Schist	Waste	10-44
Col 4	Transition	Schist	Waste	10-44
Col 5	Oxide	Gneiss	Waste	10-44
Col 6	Transition	Gneiss	Waste	10-44
Col 7	Oxide	Granite	Ore	10-22
Col 8	Transition	Granite	Ore	10-22
Col 9	Oxide	Schist	Ore	10-23
Col 10	Transition	Schist	Ore	10-23
Col 11	Oxide	Gneiss	Ore	10-23
Col 12	Transition	Gneiss	Ore	10-23
Col 13	Transition	Granite	Waste	10-21
HC6	Fresh	Granite	Waste	10-42
HC2	Fresh	Schist	Waste	10-87
HC4	Fresh	Gneiss	Waste	10-87

Note: Median loading rates used for base case, and 75th percentile loadings used for upper case source terms.

5.2.2 Data Scaling

The loading rates measured in the laboratory kinetic tests were scaled to address the differences between laboratory and field conditions. Laboratory rates were adjusted to account for the expected flushing rate, fractures associated with blasting, and grain size distribution. A summary of scaling factors used to develop the source terms is provided below in Table 5-13. The assumptions used in developing these scaling factors are described below.

Table 5-13:
Pit Wall Physical Scaling Factors

Scaling Factors	Unit	Blast Damaged	Blast Fractured
Thickness (m)	m	0.9	2.9
Average Wall Slope	degree	45	45
Mass	t/m^2	3.2	10.3
Grain Size Correction	-	20%	5%
% of Material Flushed	-	75%	50%
% of Year Frozen	-	42%	42%

Geochemical loading from the pit wall is influenced by the fracture intensity of the walls induced by blasting. The blast effects in the pit wall can be subdivided into two zones; a blast influenced zone and a blast damaged zone. The blast damaged zone consists of highly fractured pit wall rock exposed on the pit wall face or ravel collected on benches. The blast influenced zone consists of more widely spaced fractures in to the pit wall behind the blast damaged zone that will become progressively more fractured over time. The blast damaged zone is estimated to extend 0.9 m into the final pit wall, and the blast influenced zone is estimated to extend another 2.9 m into the pit wall. The effective volume of material in a planar unit area of 1 m^2 is increased by a factor 1.41 to account for the average pit wall slope of 45 degrees. Finally, the mass of rock in each unit area is determined by multiplying the effective volume by density of 2.6 $tonne/m^3$. Based on these estimates, the blast damaged zone contains 3.2 tonnes and the blast fractured zone contains 10.3 tonnes of rock per m^2 (Table 5-13). The surface area associated with these masses of wall rock is described below.

Humidity cells and unsaturated columns contain relatively fine grained particles (<10 mm), hence, material used in humidity cells have a greater surface area to mass ratio than material in the blast damaged zone and blast influenced zone of the pit wall. Estimated grain size correction factors are 20% for the blast damaged zone and 5% for the blast influenced zone.

Laboratory kinetic tests are conducted at a relatively high flushing rate compared to field conditions. The high flushing rate ensures that mineral surfaces are in contact with the leachate solution, which prevents oxide weathering products from accumulating

(armoring) mineral surfaces. Furthermore, preferential flow paths will develop in the heterogeneous pit wall rock and fracture zones, circumventing a portion of the exposed surface area. To account for these changes, a flushing factor is included in the source term calculation. It is assumed that 75% of rock surfaces on the blast damaged zone are flushed, and 50% of surfaces in the blast influenced zone are flushed (Table 5-13).

It is assumed that no metal loading or acid generation takes place on any of the pit wall units for the 5 months of the year with average temperatures below freezing. No additional temperature correction was incorporated into kinetic test loading rates.

5.2.3 Solubility Controls

The pit wall source terms are calculated by upscaling kinetic test loading rates. This approach to source term calculation frequently results in predicted concentrations that exceed thermodynamic solubility controls, particularly in neutral pH environments where numerous controls on dissolved concentrations influence drainage chemistry. Solubility controls for As, U and ^{226}Ra are calculated using the same approach as that described in Section 5.1.4. Concentrations of other parameters that are based on upscaling detection limit data or for parameters that have limited solubility in neutral-alkaline pH environments are also adjusted.

The As and U solubility control is partially based on an estimate of pH and alkalinity. For pit wall source terms, these values are estimated from kinetic tests representing the different respective rock types, with the median and 75th percentile used for base case and upper case source term predictions, respectively. The estimated pH and alkalinity values are presented in Other solubility controls applied to wall rock runoff source terms are restricted to unweathered (fresh) waste rock lithologies. This is largely due to the large number of detection limit concentrations produced by the relatively small humidity cell experiments. Loading rates for Fe, Hg, P and Se incorporate detection limit concentrations. Therefore, these parameters were set to median and 75th percentile concentrations observed in field bins (schist fresh and gneiss fresh) or in unsaturated laboratory columns (granite fresh) for base case and upper case source terms, respectively. Other parameters which were adjusted include Al in all three fresh waste rock lithologies, and Cu and Sb in the schist fresh and gneiss fresh lithologies. The upscaled concentration of these parameters exceeded field bin values, which incorporate a greater mass and infiltration rate than predicted for pit wall rock exposures, hence, field bin data represents an upper limit of what can reasonably be expected from wall rock runoff. Therefore, these concentrations were adjusted to median and 75th percentile concentrations observed in field bins.

Table 5-14. Solubility controls for As and U are not applied to the granite transition ore, due to the mildly acidic pH (medium pH 4.5) expected from this unit.

Other solubility controls applied to wall rock runoff source terms are restricted to unweathered (fresh) waste rock lithologies. This is largely due to the large number of detection limit concentrations produced by the relatively small humidity cell experiments. Loading rates for Fe, Hg, P and Se incorporate detection limit concentrations. Therefore, these parameters were set to median and 75th percentile concentrations observed in field bins (schist fresh and gneiss fresh) or in unsaturated laboratory columns (granite fresh) for base case and upper case source terms, respectively. Other parameters which were adjusted include Al in all three fresh waste rock lithologies, and Cu and Sb in the schist fresh and gneiss fresh lithologies. The upscaled concentration of these parameters exceeded field bin values, which incorporate a greater mass and infiltration rate than predicted for pit wall rock exposures, hence, field bin data represents an upper limit of what can reasonably be expected from wall rock runoff. Therefore, these concentrations were adjusted to median and 75th percentile concentrations observed in field bins.

Table 5-14:
Estimates of Wall Rock Runoff pH and Alkalinity Used to Calculate Arsenic and Uranium Solubility

Ore/Waste	Lithology	Weathering	Base Case		Upper Case	
			pH	Alkalinity	pH	Alkalinity
Waste	Gneiss	Oxide	8.2	148	8.3	114
		Transition	8	97	8.1	76
		Fresh	7.9	91	8	69
	Schist	Oxide	8.1	89	8.2	85
		Transition	7.9	70	8	51
		Fresh	8.1	146	8.1	91
	Granite	Oxide	7.5	22	7.8	21
		Transition	7.5	22	7.8	21
		Fresh	8.1	109	8.2	107
Ore	Gneiss	Oxide	8	148	8.1	114
		Transition	8	97	8.1	76
	Schist	Oxide	8	89	8.2	85
		Transition	8	70	8.1	51
	Granite	Oxide	7.4	22	7.8	21
		Transition	-	-	-	-

Note: No pH or alkalinity related solubility controls applied for granite transition ore.

5.2.4 Source Term

Wall rock source terms are calculated for each waste rock and ore unit that will be exposed on the pit wall during mine life and at closure. Base case and upper case source term predictions are provided in Table 5-15 and Table 5-16 respectively. The surface area of exposures of the different rock units on pit walls is presented in Table 5-11. Source terms for composite pit wall runoff from each of the mine pits are provided in Appendix E.3.

Table 5-15:
Base Case Estimates for Pit Wall Rock Source Terms

Lithology		**Gneiss**					**Schist**					**Granite**				
Material		**Waste Rock**			**Ore**		**Waste Rock**			**Ore**		**Waste Rock**			**Ore**	
Weathering Facies		**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**	**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**	**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**
Sulphate	mg/L	6.2	20	62	18	129	12	63	62	125	369	29	29	62	11	166
Al	mg/L	0.0043	0.0060	0.0091	0.0090	0.011	0.0043	0.0048	0.0050	0.010	0.011	0.0031	0.0031	0.009	0.23	0.53
Sb	mg/L	0.0025	0.0088	0.012	0.014	0.080	0.0031	0.0019	0.034	0.0089	0.044	0.0057	0.0057	0.012	0.048	0.020
As	mg/L	0.054	0.0030	0.00089	0.14	0.16	0.0040	0.0011	0.00090	0.16	0.18	0.0020	0.0020	0.050	0.070	12
Ba	mg/L	0.070	0.054	0.14	0.15	0.014	0.050	0.032	0.14	0.054	0.023	0.0011	0.0011	0.074	0.0015	0.00080
Be	mg/L	0.0000063	0.0000063	0.00022	0.000019	0.000020	0.0000058	0.0000068	0.00022	0.000019	0.000018	0.0000053	0.0000053	0.00022	0.000019	0.0013
Bi	mg/L	0.0000063	0.0000063	0.00022	0.000019	0.000020	0.0000058	0.0000068	0.00022	0.000019	0.000018	0.0000053	0.0000053	0.00022	0.000019	0.000020
B	mg/L	0.032	0.020	0.063	0.017	0.020	0.015	0.024	0.080	0.021	0.012	0.050	0.050	0.061	0.027	0.024
Cd	mg/L	0.0000060	0.0000080	0.000093	0.0000080	0.000010	0.0000026	0.0000090	0.000090	0.000013	0.0000080	0.0000046	0.0000046	0.000090	0.0000080	0.00019
Ca	mg/L	27	31	237	63	98	31	33	293	100	178	3.1	3.1	86	6.2	44
Cr	mg/L	0.00042	0.000071	0.00093	0.00045	0.000090	0.00059	0.00045	0.00090	0.00027	0.000090	0.000028	0.000028	0.00093	0.00013	0.00017
Co	mg/L	0.000060	0.000048	0.00046	0.00014	0.00026	0.000037	0.000080	0.0013	0.00016	0.0010	0.00088	0.00088	0.0017	0.00022	0.19
Cu	mg/L	0.0012	0.00081	0.0012	0.0013	0.0013	0.00090	0.0011	0.00096	0.0019	0.0014	0.00052	0.00052	0.0080	0.0025	0.043
Fe	mg/L	0.0063	0.0063	0.020	0.019	0.020	0.0058	0.020	0.010	0.019	0.018	0.0053	0.0053	0.0070	0.032	0.33
Pb	mg/L	0.000031	0.000012	0.00031	0.000028	0.000028	0.000018	0.000038	0.00031	0.000060	0.000050	0.000033	0.000033	0.0025	0.00018	0.00020
Li	mg/L	0.0037	0.0035	0.017	0.0065	0.0069	0.0051	0.010	0.024	0.0074	0.0068	0.0041	0.0041	0.021	0.00088	0.0078
Mg	mg/L	10	15	78	17	30	13	17	90	38	46	0.76	0.76	14	1.7	11
Mn	mg/L	0.00056	0.00039	0.26	0.0021	0.051	0.00047	0.0018	0.37	0.0080	0.090	0.38	0.38	2.1	0.044	7.2
Hg	mg/L	0.0000090	0.0000090	0.0000055	0.000027	0.000028	0.0000083	0.000010	0.0000025	0.000027	0.000026	0.0000076	0.0000076	0.0000025	0.000028	0.000029
Mo	mg/L	0.020	0.028	0.021	0.025	0.038	0.0026	0.023	0.0080	0.0067	0.0078	0.0028	0.0028	0.020	0.0039	0.0010
Ni	mg/L	0.00036	0.00042	0.0031	0.00028	0.00090	0.00037	0.0013	0.013	0.0028	0.0078	0.00029	0.00029	0.0031	0.00028	0.047
P	mg/L	0.0033	0.0049	0.025	0.094	0.013	0.0025	0.0029	0.025	0.0081	0.0079	0.0023	0.0023	0.025	0.028	0.056
K	mg/L	7.0	9.5	43	9.3	13	5.7	12	51	9.6	11	5.6	5.6	30	3.6	12
Se	mg/L	0.00018	0.00016	0.0016	0.00020	0.00072	0.00033	0.00060	0.0020	0.0016	0.0027	0.000041	0.000041	0.0012	0.00017	0.0015
Si	mg/L	5.5	4.1	21	11	11	4.2	5.0	15	9.0	6.1	11	11	74	5.8	16
Ag	mg/L	0.0000019	0.0000018	0.000062	0.0000055	0.0000056	0.0000017	0.0000021	0.000062	0.0000070	0.0000053	0.0000016	0.0000016	0.000060	0.0000070	0.0000060
Na	mg/L	12	2.4	3.9	4.5	2.0	2.1	14	3.4	3.8	2.4	13	13	10	13	1.3
Sr	mg/L	0.16	0.23	1.4	0.28	0.44	0.21	3.8	18	0.65	0.90	0.014	0.014	0.21	0.040	0.22
S	mg/L	2.7	7.2	25	7.7	47	4.2	23	32	49	151	11	11	19	4.9	60
Tl	mg/L	0.000028	0.00014	0.00018	0.00031	0.00036	0.000066	0.000010	0.00019	0.00017	0.00031	0.000041	0.000041	0.00025	0.000080	0.00090
Sn	mg/L	0.00013	0.000060	0.012	0.00014	0.00016	0.000046	0.00045	0.0025	0.00016	0.00010	0.000080	0.000080	0.0019	0.00017	0.00012
Ti	mg/L	0.000070	0.000058	0.0026	0.00014	0.00014	0.000042	0.000066	0.0028	0.00014	0.00013	0.000041	0.000041	0.010	0.00060	0.00014
U	mg/L	0.085	0.060	0.060	0.083	0.061	0.0043	0.0060	0.011	0.0041	0.0060	0.00080	0.00080	0.026	0.0010	0.0034
V	mg/L	0.00016	0.00014	0.0075	0.00022	0.00021	0.00011	0.00034	0.010	0.00016	0.00030	0.00010	0.00010	0.011	0.00042	0.00029
Zn	mg/L	0.00090	0.00090	0.031	0.0027	0.0028	0.00080	0.0010	0.031	0.0027	0.0026	0.0023	0.0023	0.031	0.0028	0.28
Ra-226	Bq/L	0.035	0.018	0.013	0.060	0.0051	0.00070	0.00010	0.00070	0.00023	0.00	0.0012	0.0012	0.050	0.0040	0.0030

Table 5-16:
Upper Case Estimates for Pit Wall Rock Source Terms

Lithology		**Gneiss**					**Schist**					**Granite**				
Material		**Waste Rock**			**Ore**		**Waste Rock**			**Ore**		**Waste Rock**			**Ore**	
Weathering Facies		**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**	**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**	**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**
Sulphate	mg/L	7.2	22	63	20	143	17	74	92	155	574	33	33	62	14	181
Al	mg/L	0.0055	0.0067	0.0091	0.011	0.018	0.0049	0.0062	0.013	0.014	0.014	0.0049	0.0049	0.021	0.41	0.59
Sb	mg/L	0.0026	0.010	0.017	0.016	0.10	0.0033	0.0021	0.059	0.0097	0.046	0.0064	0.0064	0.028	0.059	0.021
As	mg/L	0.015	0.013	0.00094	0.25	0.30	0.013	0.0038	0.0017	0.33	0.35	0.016	0.016	0.060	0.33	21
Ba	mg/L	0.078	0.056	0.14	0.16	0.015	0.058	0.041	0.11	0.061	0.025	0.0012	0.0012	0.080	0.0024	0.0023
Be	mg/L	0.0000072	0.0000066	0.00022	0.000020	0.000020	0.0000061	0.0000073	0.00022	0.000019	0.000019	0.0000062	0.0000062	0.00022	0.000034	0.0014
Bi	mg/L	0.0000072	0.0000066	0.00022	0.000020	0.000020	0.0000062	0.0000073	0.00022	0.000019	0.000019	0.0000062	0.0000062	0.00022	0.000020	0.000020
B	mg/L	0.041	0.025	0.077	0.020	0.022	0.018	0.028	0.11	0.024	0.015	0.061	0.061	0.065	0.037	0.027
Cd	mg/L	0.000010	0.000014	0.000094	0.000011	0.000016	0.0000039	0.000012	0.00014	0.000020	0.000010	0.0000053	0.0000053	0.00014	0.000011	0.00022
Ca	mg/L	28	32	268	66	106	34	35	315	106	211	3.1	3.1	102	6.7	47
Cr	mg/L	0.00059	0.000091	0.00094	0.00050	0.00018	0.00074	0.00066	0.0015	0.00031	0.00012	0.000049	0.000049	0.00094	0.00018	0.00024
Cu	mg/L	0.0013	0.00096	0.007	0.0015	0.0014	0.0012	0.0017	0.011	0.0022	0.0019	0.00079	0.00079	0.011	0.0039	0.046
Fe	mg/L	0.0072	0.0066	0.012	0.020	0.020	0.0061	0.0073	0.030	0.019	0.019	0.0062	0.0062	0.030	0.071	0.43
Pb	mg/L	0.000053	0.000032	0.00062	0.000070	0.000048	0.000042	0.000096	0.00094	0.00016	0.00017	0.000069	0.000069	0.0033	0.00027	0.00077
Li	mg/L	0.0041	0.0039	0.020	0.0073	0.0075	0.0060	0.011	0.030	0.0083	0.0076	0.0044	0.0044	0.030	0.00093	0.0096
Mg	mg/L	10	16	86	19	31	14	18	108	40	55	0.81	0.81	16	1.8	12
Mn	mg/L	0.00090	0.00065	0.29	0.0034	0.059	0.00065	0.0028	0.43	0.013	0.11	0.42	0.42	2.4	0.054	7.5
Hg	mg/L	0.000010	0.0000094	0.0000055	0.000028	0.000028	0.0000088	0.000010	0.0000050	0.000028	0.000027	0.0000088	0.0000088	0.000030	0.000054	0.000029
Mo	mg/L	0.022	0.032	0.026	0.028	0.045	0.0033	0.029	0.011	0.0076	0.0088	0.0030	0.0030	0.027	0.0062	0.0016
Ni	mg/L	0.00044	0.00047	0.0031	0.00054	0.0013	0.00044	0.0016	0.016	0.0033	0.0096	0.00032	0.00032	0.0031	0.00054	0.055
P	mg/L	0.0040	0.0077	0.050	0.097	0.021	0.0026	0.0031	0.050	0.0084	0.0081	0.0045	0.0045	0.05	0.036	0.063
K	mg/L	7.6	9.7	51	9.6	14	6.2	13	64	9.9	12	6.3	6.3	40	3.8	12
Se	mg/L	0.00083	0.00087	0.0060	0.00022	0.00094	0.00079	0.00088	0.0060	0.0018	0.0030	0.000055	0.000055	0.0014	0.00024	0.0016
Si	mg/L	6.2	4.2	23	11	11	4.6	5.2	18	9.2	6.5	14	14	84	6.2	19
Ag	mg/L	0.0000022	0.0000021	0.000062	0.0000056	0.0000057	0.0000018	0.0000028	0.000063	0.000010	0.0000054	0.0000023	0.0000023	0.00011	0.000011	0.000013
Na	mg/L	29	3.7	5.5	6.2	2.7	3.8	30	4.7	5.3	3.3	14	14	12	15	1.7
Sr	mg/L	0.17	0.24	1.5	0.29	0.46	0.25	4.6	20	0.67	1.1	0.014	0.014	0.24	0.042	0.23
S	mg/L	3.0	7.8	34	8.7	53	5.6	25	47	61	199	12	12	22	6.1	62
Tl	mg/L	0.000032	0.00014	0.00028	0.00035	0.00042	0.000075	0.000015	0.00030	0.00022	0.00040	0.000050	0.000050	0.00031	0.00012	0.0011
Sn	mg/L	0.00032	0.00011	0.015	0.00019	0.00026	0.000094	0.00057	0.0044	0.00024	0.00011	0.00012	0.00012	0.0024	0.00040	0.00016
Ti	mg/L	0.00011	0.000082	0.0040	0.00016	0.00017	0.000069	0.000082	0.0053	0.00017	0.00014	0.000058	0.000058	0.019	0.0019	0.00016
U	mg/L	0.091	0.18	0.17	0.086	0.074	0.0047	0.029	0.060	0.0055	0.020	0.00087	0.00087	0.030	0.0020	0.0036
V	mg/L	0.00017	0.00016	0.0082	0.00025	0.00023	0.00011	0.00036	0.013	0.00022	0.00035	0.00012	0.00012	0.014	0.00052	0.00036
Zn	mg/L	0.0011	0.0010	0.031	0.0028	0.0029	0.0013	0.0012	0.031	0.0031	0.0031	0.0031	0.0031	0.031	0.0053	0.30
Ra-226	Bq/L	0.074	0.053	0.066	0.10	0.0072	0.0032	0.0010	0.0027	0.00030	0.011	0.0054	0.0054	0.10	0.011	0.046

5.3 Heap Leach Facility

A cyanide heap leaching facility is planned for extraction and recovery of Au from oxide and transition ore. The ore will be crushed to 80% - 50 mm and stacked on the lined HLF pad using haul trucks in nominal 10 m lifts. The facility will reach a maximum mass (60 Mt) in year 11 of mine life and occupy a footprint of 109 ha. Ore will be leached with lime buffered NaCN solution applied with drip emitters. The leach solution will drain into collection pipes that will direct the pregnant solution to the process plant where precious metals will be recovered. The resulting barren solution will be amended with additional lime and NaCN as required and then recirculated to the heap to continue the leaching cycle. The mass and geologic composition of ore on the HLF at the end of operations is provided in Table 5-17.

Table 5-17:
Lithology, oxidation and source of ore stockpiled in the Heap Leach Facility.

Lithology	Facies	Deposit				
		Latte	Double Double	Kona	Supremo	Total
Gneiss	Oxide (Mt)	0.39	0.53	0.00	37.36	**38.29**
	Transition (Mt)	0.01	0.87	0.00	4.46	**5.34**
	Total	**0.41**	**1.40**	**0.00**	**41.82**	**43.63**
Metabasalt	Oxide (Mt)	0.08	0.03	0.00	0.09	**0.20**
	Transition (Mt)	0.00	0.07	0.00	0.02	**0.09**
	Total	**0.08**	**0.10**	**0.00**	**0.11**	**0.29**
Schist	Oxide (Mt)	8.87	0.00	0.00	0.07	**8.93**
	Transition (Mt)	5.67	0.00	0.00	0.00	**5.68**
	Total	**14.54**	**0.00**	**0.00**	**0.07**	**14.61**
Granite	Oxide (Mt)	0.00	0.00	1.24	0.00	**1.24**
	Transition (Mt)	0.00	0.00	0.38	0.00	**0.38**
	Total	**0.00**	**0.00**	**1.63**	**0.00**	**1.63**
All	**Total**	**15.03**	**1.50**	**1.63**	**42.00**	**60.15**

Following final leaching for gold recovery, heap closure will be initiated which involves the following steps:

- Recirculation rinsing leached ore with barren solution to facilitate CN volatilization and export in drainage;

- Capping of the HLF with geosynthetic clay liner (GCL) and a store-and-release component overlying the GCL for the flat surfaces of the heap and a store-and-release cover for the slopes;
- Passive treatment of drainage to serve as a final polishing step of HLF drainage as contingency (*e.g.,* zero valent iron, coarse organic composted wood chips from tree clearing, suitable geologic material).

During operations and early closure, discharge of any excess HLF solution will undergo active treatment prior to release to the Alpha Pond and ultimately, Halfway Creek. Active treatment will include cyanide destruction, physico-chemical treatment and nitrate removal and final metal polishing using a biological system termed the Electrochemical Biological Reactor (EBR) system. Once active treatment is terminated and closure of the HLF is completed and stabilized, it may be necessary to direct residual HLF seepage waters through the events ponds converted to passive systems prior to discharge to Halfway Creek.

The chemistry of HLF pore water and drainage will vary depending on the stage of mine life. To reflect this, geochemical source terms have been developed over the life of operations.

5.3.1 Process Water

5.3.1.1 Approach

During mine operations, HLF solution will be dominantly pregnant/barren solution with some amount of meteoric water. Later in the mine life the HLF pore water will be a combination of pregnant solution and rinse water from areas where recirculation rinsing has been initiated. For the purpose of predicting an operations source term, it is assumed that all HLF pore water is barren solution during operations. The processing of heap leach ore for the Project will entail the use of cyanide solutions under pH conditions ranging between pH 10.0 and 11.0. While the dissolution of gold is the primary objective during cyanide leaching, other metals are liberated during the leaching process, both as a result of complexation reactions with cyanide (*e.g.* Cu-CN, Cd-CN, Zn-CN) and increased solubility under elevated pH conditions (*e.g.* As and U). The chemistry of barren solutions is estimated based on the final water quality measured in metallurgical cyanide leach columns (Table 4-56). The HLF solution chemistry representing different ore types is weighted proportional to the mass of the different ore types that will be in the HLF in the final year of mine life (Table 5-17).

5.3.1.2 Data Sources

The composition of process water is estimated based on water quality samples collected from 26 metallurgical columns. These tests are described in Section 3.2.7 and water quality results are provided in section Table 4-56.

5.3.1.3 Data Scaling

The chemistry observed in metallurgical columns are weighted based on the proportion of ore types in the HLF in a given year (Figure 5-12). For instance, in transition material from the Supremo pit constitutes approximately 7.5% of the ore in the HLF, hence, the chemistry observed in CN leach columns (columns 73040 and 73037). In this way, the operations source term for the HLF evolves as the composition of ore on the pad changes with time. For the purpose of water quality predictions, the maximum concentration observed for a given lithology or weathering type is used in the upper source term and the mean concentration is used for the base case source term.

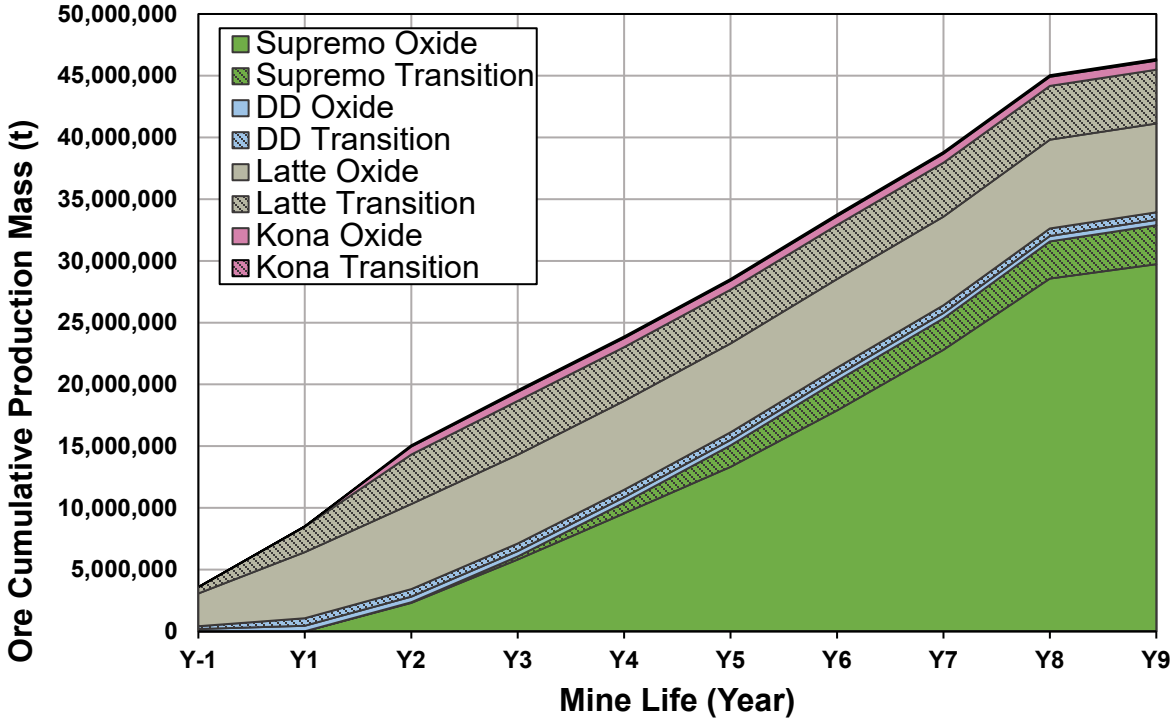


Figure 5-12: Mass and geologic composition of HLF over mine life

5.3.1.4 Solubility Controls

The operations source term is based on concentrations measured in metallurgical leach column tests. Since this source term is based on averaging measured concentrations rather than upscaling kinetic test loading rates, concentrations generally do not exceed

thermodynamic solubility constraints. The only parameter predicted based on a solubility calculation is ^{226}Ra as it was only measured in 2 of the 26 metallurgical columns (See Table 4-56). Therefore, the concentration of ^{226}Ra is calculated using the same approach described in Section 5.1.4.3.

5.3.2 Source Term

The operations source term representing process water that will be present in the HLF for years 1 through 9 are shown in Table 5-18 and Table 5-19 for the upper case and base case scenarios. This source term is based on water quality data collected in metallurgical column tests.

Table 5-18:
Base Case Source Term Predictions for HLF During Operations

	Year	1	2	3	4	5	6	7	8	9
T-CN	mg/L	132	134	134	135	136	136	136	136	136
Sulphate	mg/L	1245	1121	933	783	677	587	516	455	444
P	mg/L	0.12	0.17	0.21	0.24	0.27	0.28	0.29	0.31	0.31
WAD-CN	mg/L	127	128	129	130	131	131	132	132	132
Al	mg/L	0.054	0.089	0.10	0.11	0.12	0.13	0.13	0.13	0.14
Ag	mg/L	0.00056	0.00045	0.00041	0.00038	0.00035	0.00033	0.00032	0.00031	0.00031
As	mg/L	3.4	5.4	5.0	4.7	4.5	4.3	4.0	3.8	3.8
Ca	mg/L	77	75	64	54	46	40	36	32	31
Cd	mg/L	0.0031	0.0036	0.0043	0.0047	0.0050	0.0052	0.0055	0.0057	0.0058
Co	mg/L	0.59	0.58	0.57	0.56	0.55	0.55	0.54	0.53	0.53
Cr	mg/L	0.0053	0.0077	0.010	0.012	0.013	0.014	0.015	0.016	0.016
Cu	mg/L	2.2	2.0	1.8	1.6	1.5	1.3	1.3	1.2	1.2
Fe	mg/L	2.0	2.3	2.1	1.8	1.7	1.6	1.5	1.4	1.4
Hg	mg/L	0.0046	0.0051	0.0058	0.0063	0.0065	0.0068	0.0071	0.0073	0.0073
Mg	mg/L	2.2	2.1	1.8	1.6	1.4	1.2	1.1	1.0	1.0
Mn	mg/L	0.30	0.27	0.24	0.22	0.21	0.19	0.18	0.17	0.17
Mo	mg/L	0.11	0.12	0.15	0.17	0.18	0.19	0.20	0.21	0.21
Ni	mg/L	0.019	0.019	0.019	0.020	0.020	0.020	0.020	0.021	0.021
Pb	mg/L	0.00022	0.00022	0.00021	0.00020	0.00019	0.00018	0.00017	0.00017	0.00017
Sb	mg/L	0.078	0.086	0.081	0.079	0.078	0.076	0.072	0.070	0.070
Se	mg/L	0.0078	0.0072	0.0063	0.0056	0.0052	0.0047	0.0044	0.0041	0.0040
Tl	mg/L	0.000046	0.000048	0.000047	0.000045	0.000044	0.000043	0.000043	0.000042	0.000042
U	mg/L	0.0050	0.088	0.13	0.16	0.18	0.19	0.21	0.22	0.22
Zn	mg/L	0.80	0.74	0.69	0.64	0.60	0.58	0.56	0.54	0.54
Ra-226	Bq/L	0.0043	0.0084	0.011	0.014	0.016	0.018	0.020	0.022	0.023

Table 5-19:
Upper Case Source Term Predictions for HLF During Operations

	Year	1	2	3	4	5	6	7	8	9
T-CN	mg/L	152	157	160	161	163	164	165	166	166
Ammonia-N	mg/L	86	86	85	84	83	82	82	82	82
Nitrate-N	mg/L	0.60	0.76	0.90	0.98	1.0	1.1	1.2	1.2	1.2
Nitrite-N	mg/L	1.2	1.1	1.0	0.99	0.95	0.93	0.90	0.89	0.88
Sulphate	mg/L	1407	1272	1065	900	784	686	607	539	528
P	mg/L	0.16	0.30	0.43	0.53	0.61	0.67	0.72	0.76	0.77
WAD-CN	mg/L	149	153	156	158	159	161	162	163	163
Al	mg/L	0.072	0.14	0.18	0.21	0.23	0.24	0.26	0.27	0.27
Ag	mg/L	0.00090	0.00085	0.00089	0.00092	0.00093	0.00095	0.00097	0.00099	0.00099
As	mg/L	5.1	7.5	7.3	7.2	7.1	6.9	6.7	6.6	6.6
Ca	mg/L	100	105	96	87	80	75	72	69	68
Cd	mg/L	0.0059	0.010	0.015	0.018	0.020	0.022	0.024	0.025	0.026
Co	mg/L	0.76	0.83	0.89	0.92	0.95	0.97	0.99	1.0	1.0
Cr	mg/L	0.0063	0.013	0.019	0.024	0.027	0.030	0.033	0.035	0.035
Cu	mg/L	3.4	3.2	3.0	2.7	2.6	2.4	2.4	2.3	2.3
Fe	mg/L	2.4	2.9	2.7	2.5	2.3	2.2	2.1	2.0	2.0
Hg	mg/L	0.0060	0.014	0.022	0.027	0.031	0.034	0.037	0.040	0.040
Mg	mg/L	3.3	3.3	2.8	2.5	2.2	2.0	1.8	1.7	1.7
Mn	mg/L	0.67	0.64	0.59	0.55	0.52	0.49	0.47	0.45	0.45
Mo	mg/L	0.13	0.17	0.21	0.25	0.27	0.29	0.31	0.32	0.32
Ni	mg/L	0.025	0.044	0.063	0.075	0.084	0.092	0.099	0.11	0.11
Pb	mg/L	0.00033	0.00034	0.00033	0.00031	0.00030	0.00030	0.00029	0.00028	0.00028
Sb	mg/L	0.13	0.14	0.14	0.14	0.15	0.15	0.14	0.14	0.14
Se	mg/L	0.0093	0.0091	0.0084	0.0078	0.0074	0.0071	0.0068	0.0066	0.0065
Tl	mg/L	0.000066	0.000077	0.000083	0.000086	0.000089	0.000091	0.000093	0.000095	0.000095
U	mg/L	0.0074	0.17	0.28	0.36	0.41	0.46	0.49	0.52	0.53
Zn	mg/L	1.5	1.4	1.4	1.3	1.3	1.2	1.2	1.2	1.2
Ra-226	Bq/L	0.0086	0.015	0.018	0.021	0.024	0.027	0.029	0.032	0.032

5.4 Mine Facilities Area

The mine facilities area will be constructed using inorganic overburden excavated from within or near the mine facilities area footprint. This pad has a footprint of approximately 7 ha, and will host the plant site area, mine camp and other mine infrastructure. The mine facilities area will be reclaimed at the end of active closure, hence, the source term only exists during operations and active closure time periods.

5.4.1 Approach

Overburden from the mine facilities areas has been characterized by ABA, SFE and total metals analysis, as described in Section 4.4. The ABA results demonstrate that the mine site overburden is highly weathered. This is shown by the relative absence of carbonate or sulphide mineralization, and the circumneutral to mildly acidic rinse-pH values ($5.2 \leq$ pH ≤ 8.9; median = 7.2), which is slightly higher than the pH of rainwater (~pH 5.6). Due to the overall general lack of neutralizing or acid generating minerals in the samples, mine site overburden can be classified as non-PAG. The absence of sulphide mineralization shows that oxidation of the overburden material will not lead to release of metals or acidity, however, exposure of previously buried mineral surfaces may lead to rinsing of soluble metals by infiltrating meteoric waters.

5.4.2 Data Sources

The potential for metal leaching from rinsing of freshly exposed surfaces is measured by SFE testwork. Specifically, SFE tests conducted on 11 overburden samples collected from test pits on the plantsite and HLF area, as show in Figure 3-1. These samples include (test pit IDs) SRK-15TP-03, SRK-15TP-05, SRK-15TP-11, SRK-15TP-14, SRK-15TP-15, SRK-15TP-17, SRK-15TP-22, SRK-15TP-24, SRK-15TP-41, SRK-15TP-43 and SRK-15TP-46.

5.4.3 Solubility Controls

The minesite area source term is based on measured concentrations and not upscaled form kinetic test data, hence, thermodynamic solubility controls are generally not exceeded, and few solubility controls are required. The solubility of ^{226}Ra was calculated for the mine facilities area using the approach described in Section 5.1.4.3. The only other parameters which were set to solubility controls are Al and Fe. Iron and Al are sparingly water soluble under neutral pH and aerobic conditions but were observed in relatively high values in SFE tests (median of 0.505 mg/L and 0.715 mg/L, respectively). Accordingly, the high Al and Fe values are likely caused by fine suspended solids carried through the 0.45µm filter during the extraction experiment. The concentration of these elements was set to the

median and 75th percentile observed in gneiss oxide field bin for the base case and upper case source terms.

5.4.4 Source Term

The upper case and base case source terms for the mine facilities is presented in Table 5-20 below. The mine facilities area source term is constant throughout life of mine (LOM).

Table 5-20:
Base Case and Upper Case Source Term Predictions for Mine Facilities Area

Parameter	Units	Base Case	Upper Case
Sulphate	mg/L	0.25	0.86
P	mg/L	0.025	0.025
Al	mg/L	0.017	0.048
Ag	mg/L	0.000025	0.000061
As	mg/L	0.0023	0.0034
Ca	mg/L	0.94	1.4
Cd	mg/L	0.000025	0.000050
Cr	mg/L	0.0029	0.0035
Cu	mg/L	0.0052	0.0074
Fe	mg/L	0.030	0.044
Hg	mg/L	0.000025	0.000050
Mg	mg/L	0.35	0.51
Mn	mg/L	0.054	0.081
Mo	mg/L	0.0011	0.0015
Ni	mg/L	0.0022	0.0031
Pb	mg/L	0.00070	0.0011
Sb	mg/L	0.00025	0.00027
Se	mg/L	0.00025	0.00050
Tl	mg/L	0.000050	0.00010
U	mg/L	0.0016	0.0024
Zn	mg/L	0.0050	0.010
Ra-226	Bq/L	0.012	0.018

6. Closure

We trust that this Report meets your present requirements. Please let us know if you have any questions or comments.

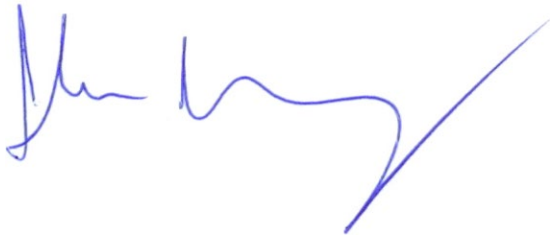
Respectfully submitted,
Lorax Environmental Services Ltd.

Authored By:



Stephanie Simpson, M.Sc.
Environmental Geoscientist

Authored and Reviewed By:



John Dockrey, M.Sc., P.Geo.
Environmental Geochemist

References

Abdelouas, A., Lutze, W., & Nuttall, E. (1998). Chemical reactions of uranium in ground water at a mill tailings site. *Journal of Contaminant Hydrology*, *34*(4), 343-361.

BC MOE (2015). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report. Ministry of Environment, Water Protection & Sustainability Branch, May 2015.

Birkham, T. K., Hendry, M. J., Wassenaar, L. I., Mendoza, C. A., & Lee, E. S. (2003). Characterizing geochemical reactions in unsaturated mine waste-rock piles using gaseous O2, CO2, 12CO2, and 13CO2. *Environmental science & technology*, *37*(3), 496-501.

CCME (2007). Canadian Council Ministers of the Environment Canadian Water Quality Guidelines for the Protection of Aquatic Life. September 2007. Guidelines sourced from http://st-ts.ccme.ca/en/index.html, March 2016

Davis, J. A., & Curtis, G. P. (2003). *Application of surface complexation modeling to describe uranium (VI) adsorption and retardation at the uranium mill tailings site at Naturita, Colorado*. Division of Systems Analysis and Regulatory Effectiveness, Office of Nuclear Regulatory Research, US Nuclear Regulatory Commission.

Dittrich, T. M., & Reimus, P. W. (2015). Uranium transport in a crushed granodiorite: Experiments and reactive transport modeling. *Journal of contaminant hydrology*, *175*, 44-59.

Giménez, J., Martinez, M., de Pablo, J., Rovira, M., & Duro, L. (2007). Arsenic sorption onto natural hematite, magnetite, and goethite. *Journal of Hazardous Materials*, *141*(3), 575-580.

Goldberg, S. (2002). Competitive adsorption of arsenate and arsenite on oxides and clay minerals. *Soil Science Society of America Journal*, *66*(2), 413-421.

Grandia, F., Merino, J., & Amphos, J. B. (2008). *Assessment of the radium-barium co-precipitation and its potential influence on the solubility of Ra in the near-field*. Stockholm, Sweden: SKB.

Health Canada (2011). *Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM). (Revised)* Available at http://www.hc-sc.gc.ca/ewhsemt/pubs/contaminants/norm-mrn/index-eng.php

Hemmera (2017). Coffee Gold Mien YESAB Project Proposal Section 2.0 Project Description-DRAFT. Prepared for: Kaminak Gold Corporation, a subsidiary of Goldcorp Inc. March 2017.

Jambor, J., Dutrizac, J., Groat, L., & Raudsepp, M. (2002). Static tests of neutralization potentials of silicate and aluminosilicate minerals. *Environmental Geology*, *43*(1-2), 1-17.

JDS (2016). Feasibility Study Report for the Coffee Gold Project, Yukon Territory, Canada. Prepared for: Kaminak Gold Corp. February 18, 2016.

Kappes, Cassiday & Associates (2015). Coffee Project Report of Metallurgical Test Work. Report I.D.: KCA0140138_COF04_03. Prepared for Kaminak Gold Corporation, June, 2015.

Kulik, D. A., Berner, U., & Curti, E. (2003). Modelling chemical equilibrium partitioning with the GEMS-PSI code. *PSI Scientific Report*, *4*, 109-122.

Langmuir, D., Mahoney, J., MacDonald, A., & Rowson, J. (1999). Predicting arsenic concentrations in the porewaters of buried uranium mill tailings. *Geochimica et Cosmochimica Acta*, *63*(19), 3379-3394.

Lorax (2011). Mount Nansen Mine Geochemical Assessment in Support of Evaluating Closure Plan Options. Technical report prepared for Assessment and Abandoned Mines Branch, Department of Energy, Mines and Resource, Yukon. Prepared by Lorax Environmental Services Limited. July, 2011.

Lottermoser, B. (2007). *Mine wastes: Characterization, treatment and environmental impacts* (2nd ed.). Berlin: Springer.

Martin, A. J., Crusius, J., McNee, J. J., & Yanful, E. K. (2003). The mobility of radium-226 and trace metals in pre-oxidized subaqueous uranium mill tailings. *Applied Geochemistry*, *18*(7), 1095-1110.

Martin, P., & Akber, R. A. (1999). Radium isotopes as indicators of adsorption–desorption interactions and barite formation in groundwater. *Journal of Environmental Radioactivity*, *46*(3), 271-286.

Metal Mining Effluent Regulations (2002). Analytical Requirements for Metal Mining Effluent, Schedule 3, Subsections 1(1), 12(2) and 20(5), Fisheries Act, Department of Justice Canada, Registration June 6, 2002.

Mortensen J.K., (1992). Pre-mid-Mesozoic tectonic evolution of the Yukon-Tanana Terrane, Yukon and Alaska. *Tectonics*, *11*, p.836–853.

O'Day, P. A. (2006). Chemistry and mineralogy of arsenic. *Elements*, *2*(2), 77-83.

Parkhurst, D. L., & Appelo, C. A. J. (1999). User's guide to PHREEQC (Version 2): A computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations.

Pierce, M. L., & Moore, C. B. (1982). Adsorption of arsenite and arsenate on amorphous iron hydroxide. *Water Research*, *16*(7), 1247-1253.

Porcelli, D., & Swarzenski, P. W. (2003). The behavior of U-and Th-series nuclides in groundwater. *Reviews in Mineralogy and Geochemistry*, *52*(1), 317-361.

Price, W.A. (1997). Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. Reclamation Section, Energy and minerals Division, British Columbia Ministry of Employment and Investment.

Price, W. A. (2009). Prediction manual for drainage chemistry from sulphidic geologic materials. *MEND report, 1*(1), 579.

Sharma, V. K., & Sohn, M. (2009). Aquatic arsenic: toxicity, speciation, transformations, and remediation. *Environment international*, *35*(4), 743-759.

Skousen, J., Renton, J., Brown, H., Evans, P., Leavitt, B., Brady, K. and Ziemkiewicz, P. (1997). Neutralization potential of overburden samples containing siderite. *Journal of Environmental Quality*, *26*(3), 673-681.

Sobek, A.A., Schuller, W. A., Freeman, J.R. and Smith, R.M. (1978) Field and Laboratory Methods Applicable to Overburdens and Minesoils. Report EPA-600/2-78-054, U.S. National Technical Information Report PB-280 495.

SRK Consulting. 2015. Metal Leaching and Acid Rock Drainage Characterization Harper Creek Project. Report prepared for Harper Creek Mining Corp, January 2015.

Waite, T. D., Davis, J. A., Payne, T. E., Waychunas, G. A., & Xu, N. (1994). Uranium (VI) adsorption to ferrihydrite: Application of a surface complexation model. *Geochimica et Cosmochimica Acta*, *58*(24), 5465-5478.

Appendix A: Geological Cross Sections

GOLDCORP

582,000
583,000
584,000
585,000
6,975,000
6,974,000
6,973,000

N

18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

North WRSF
West WRSF
Supremo Pit
Latte Pit
Double Double Pit
South WRSF

LEGEND

- Drill Collars
- Section Lines

Proposed Mine Infrastructure

- Pits
- WRSF
- Watercourses
- Waterbodies
- Surface Contours (20m)

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:12,500

0 200 400 Meters

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

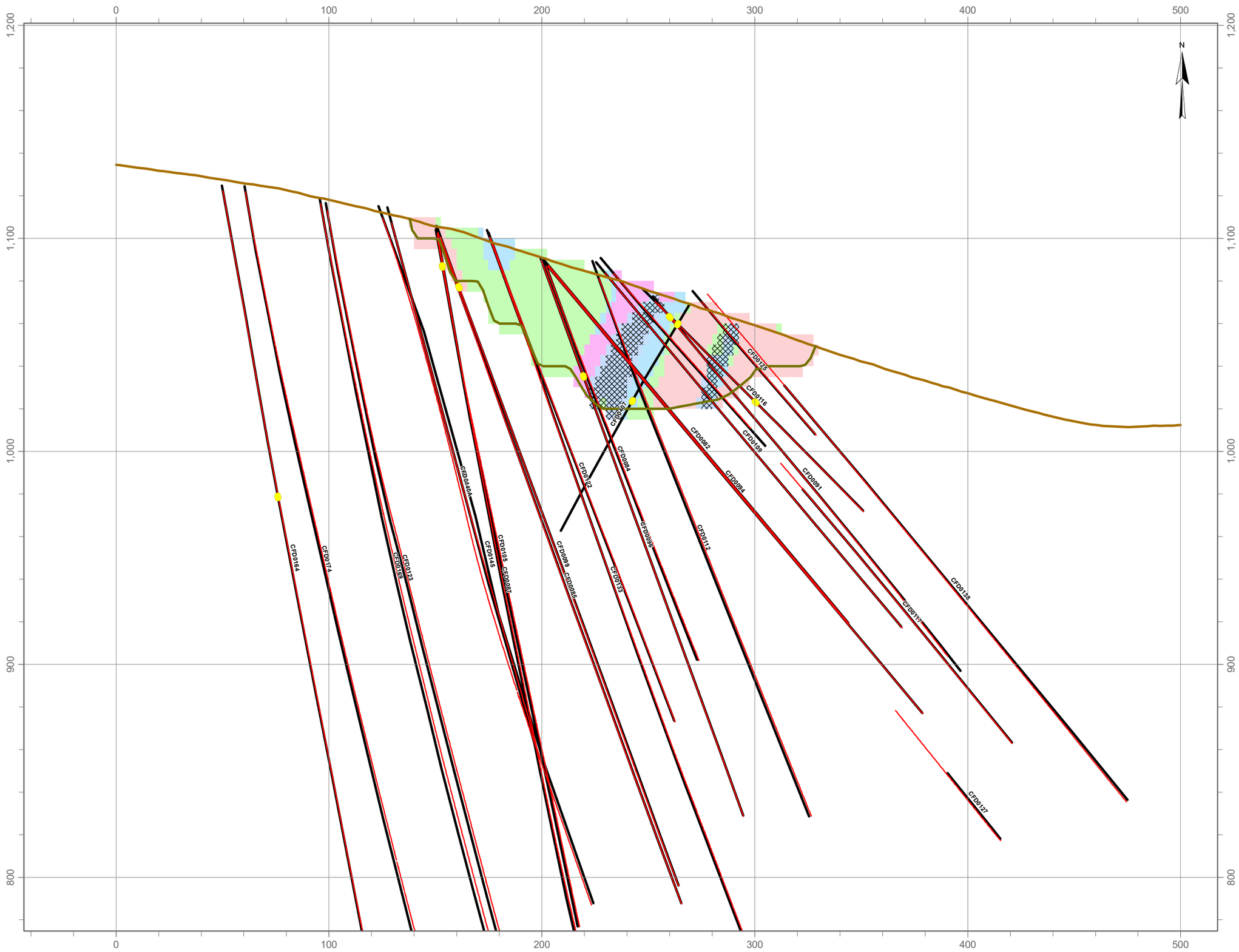
Coffee Gold Project

TITLE:

Plan View

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Plan View_20160216.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

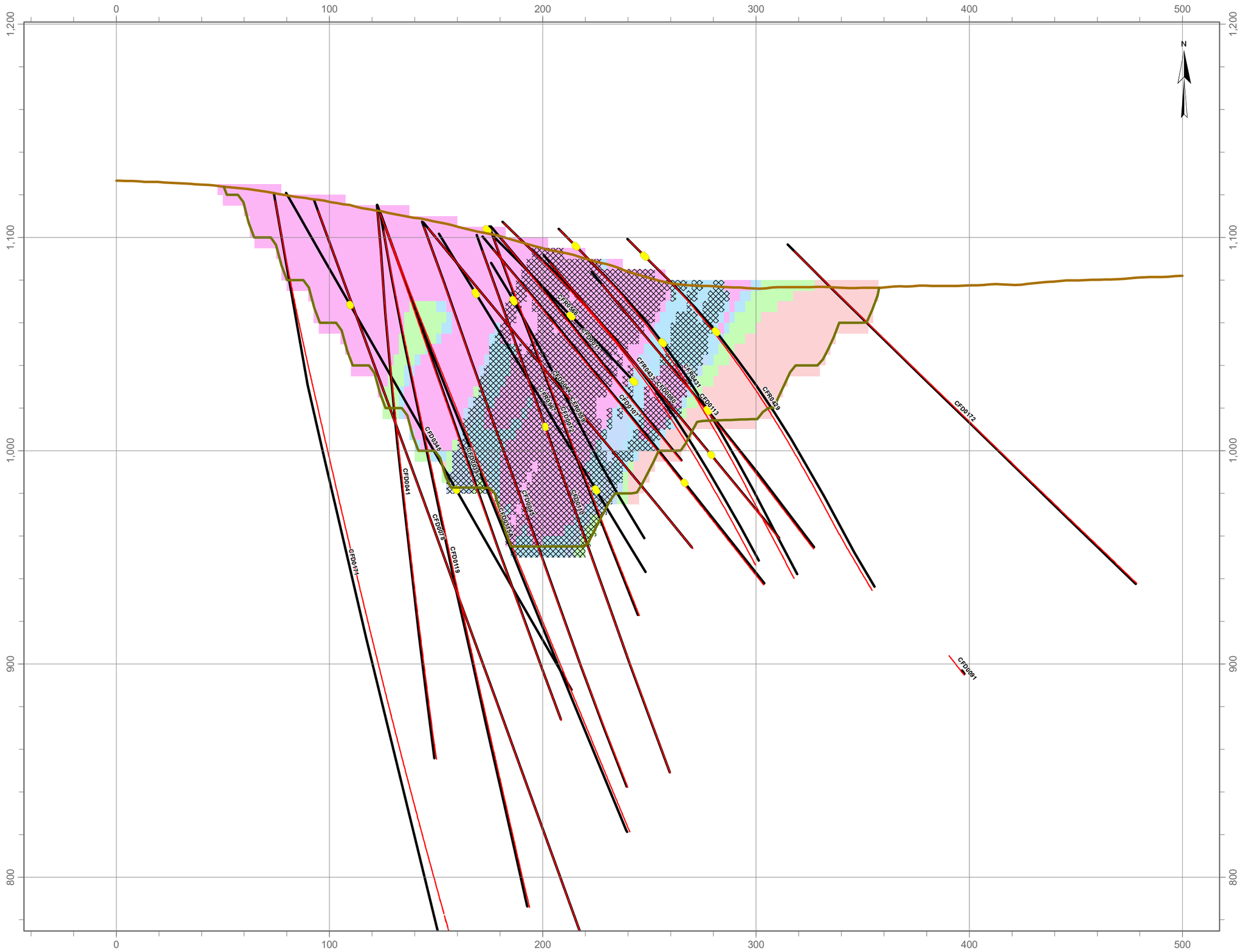
Coffee Gold Project

TITLE:

Section 1

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 1_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

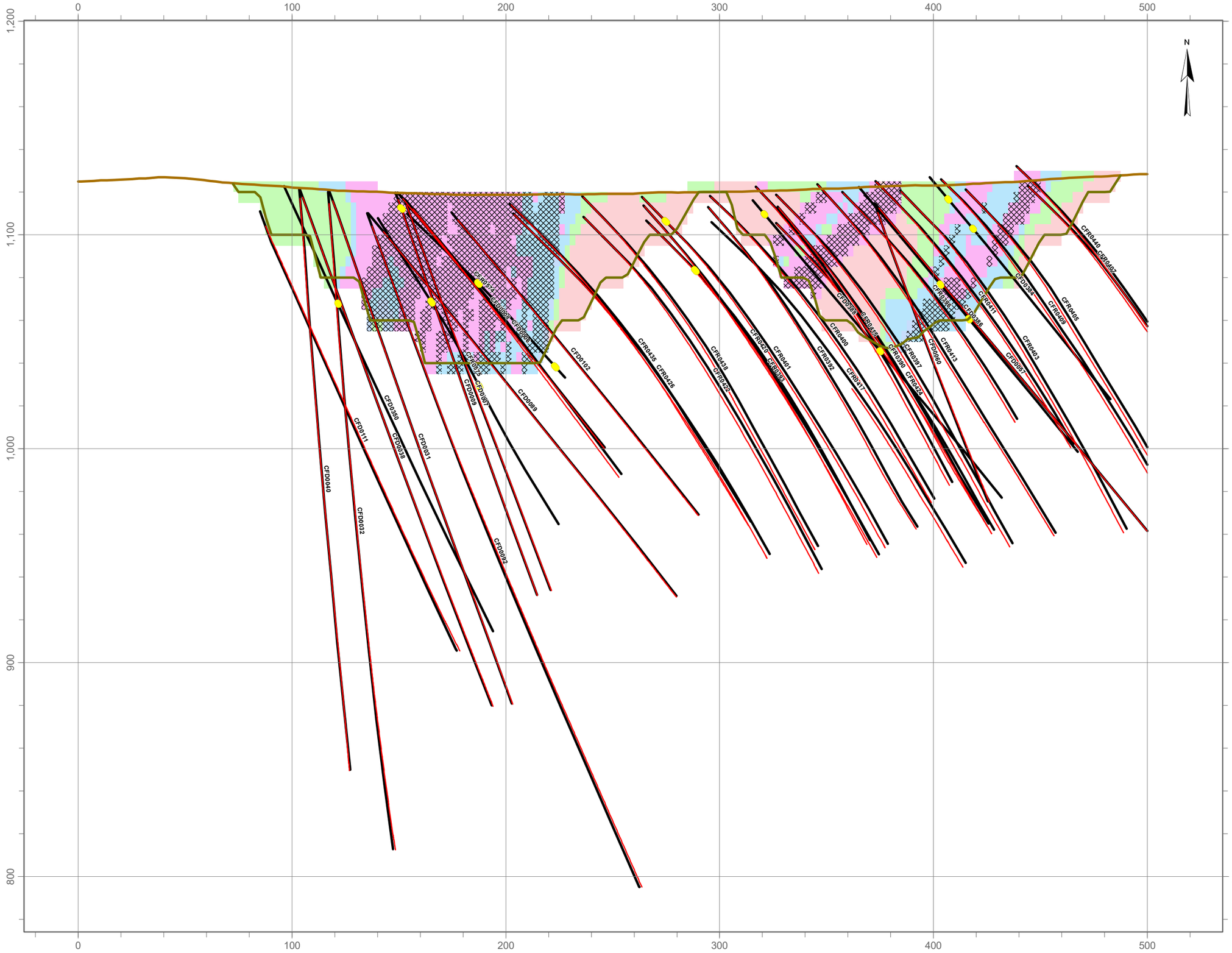
Coffee Gold Project

TITLE:

Section 2

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 2_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

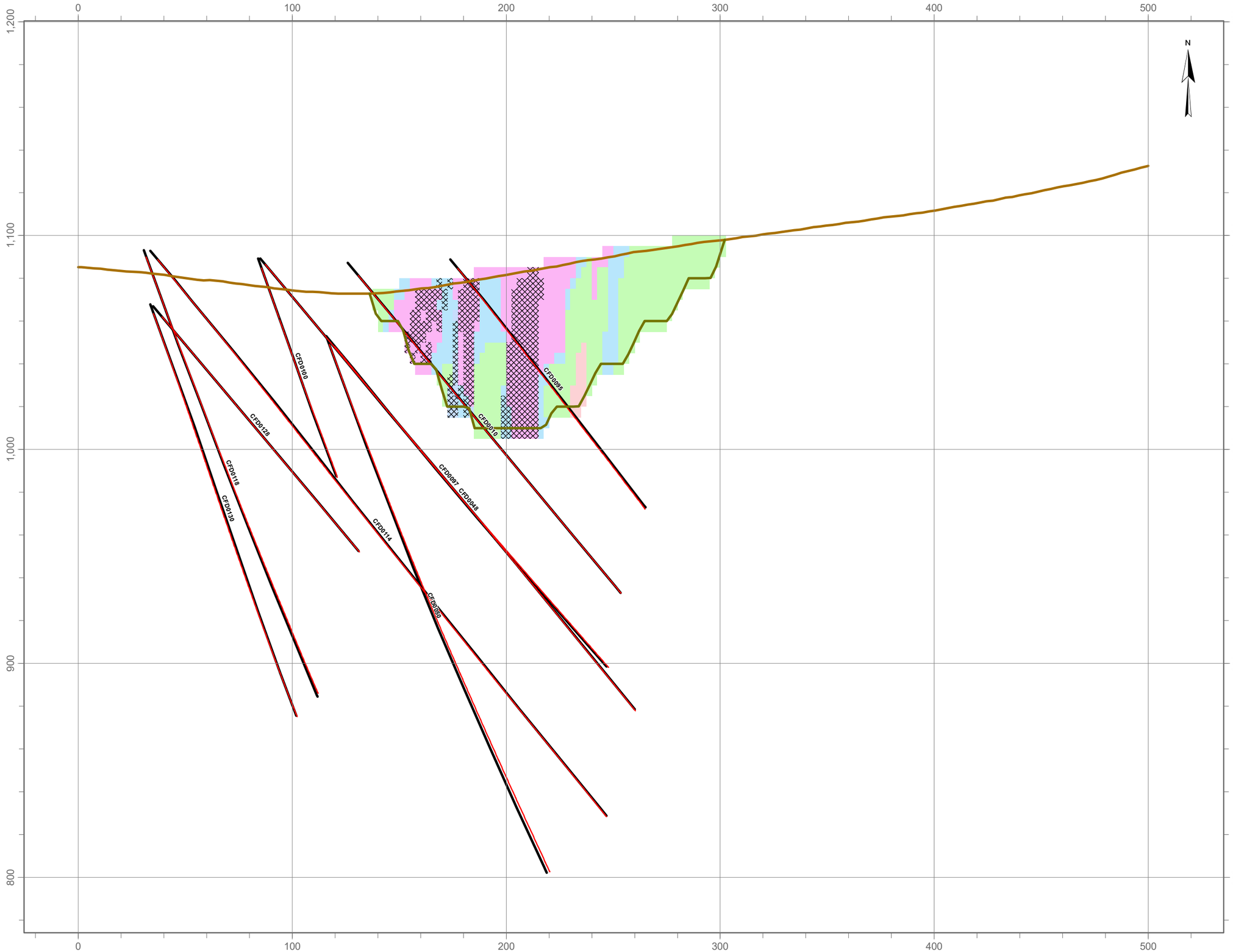
Coffee Gold Project

TITLE:

Section 3

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 3_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

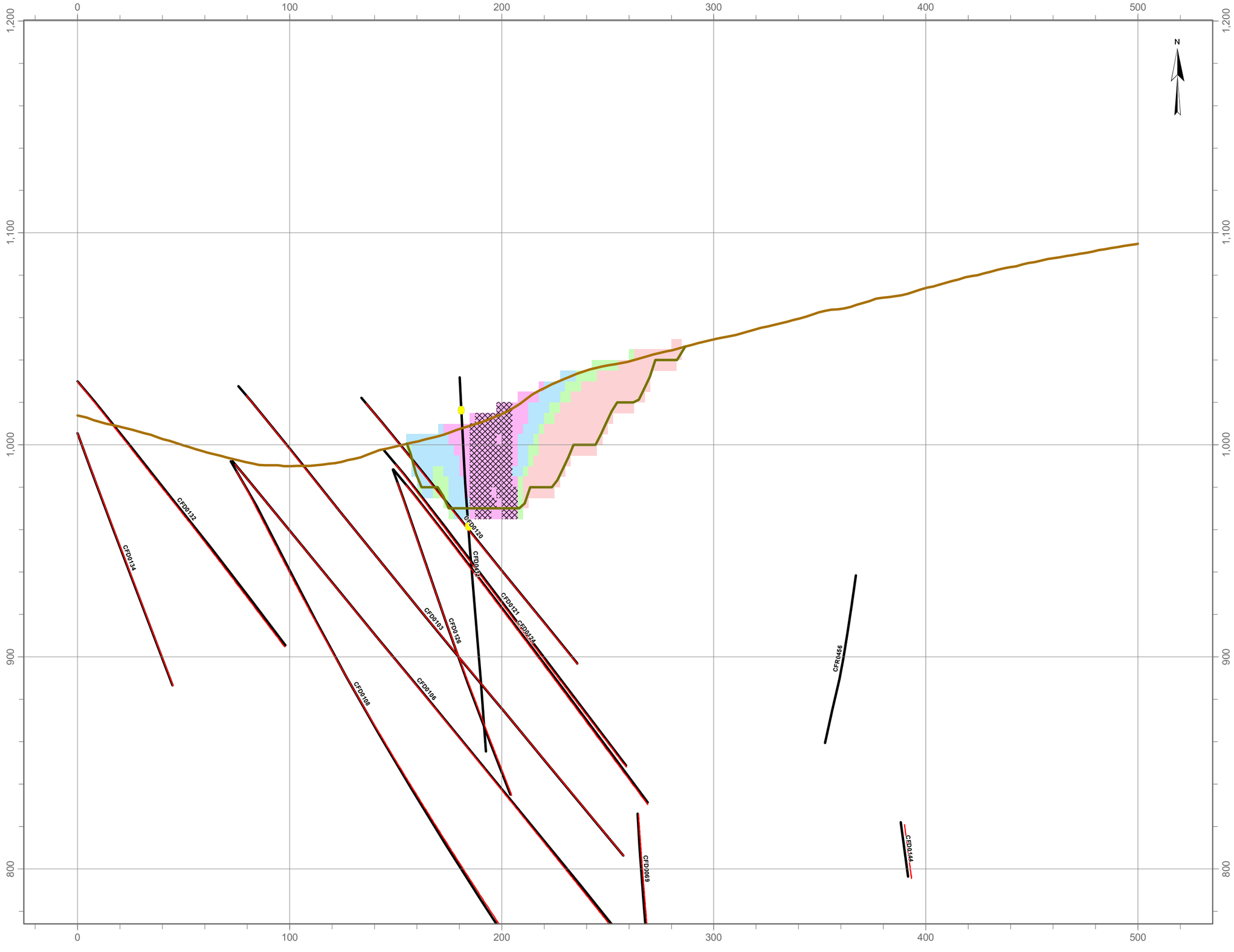
Coffee Gold Project

TITLE:

Section 4

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 4_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

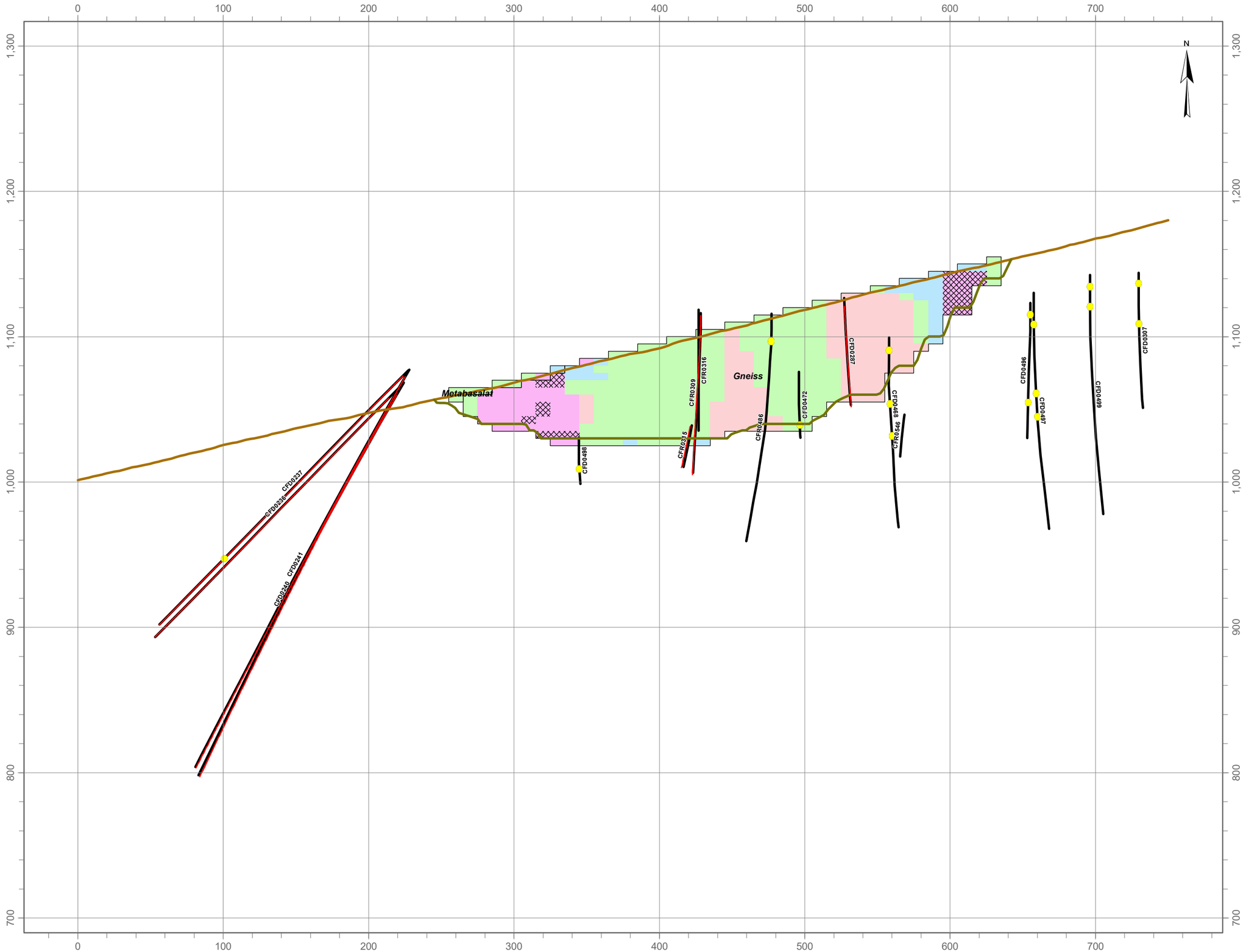
Coffee Gold Project

TITLE:

Section 5

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 5_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone
- Lithology Boundary

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:2,500

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

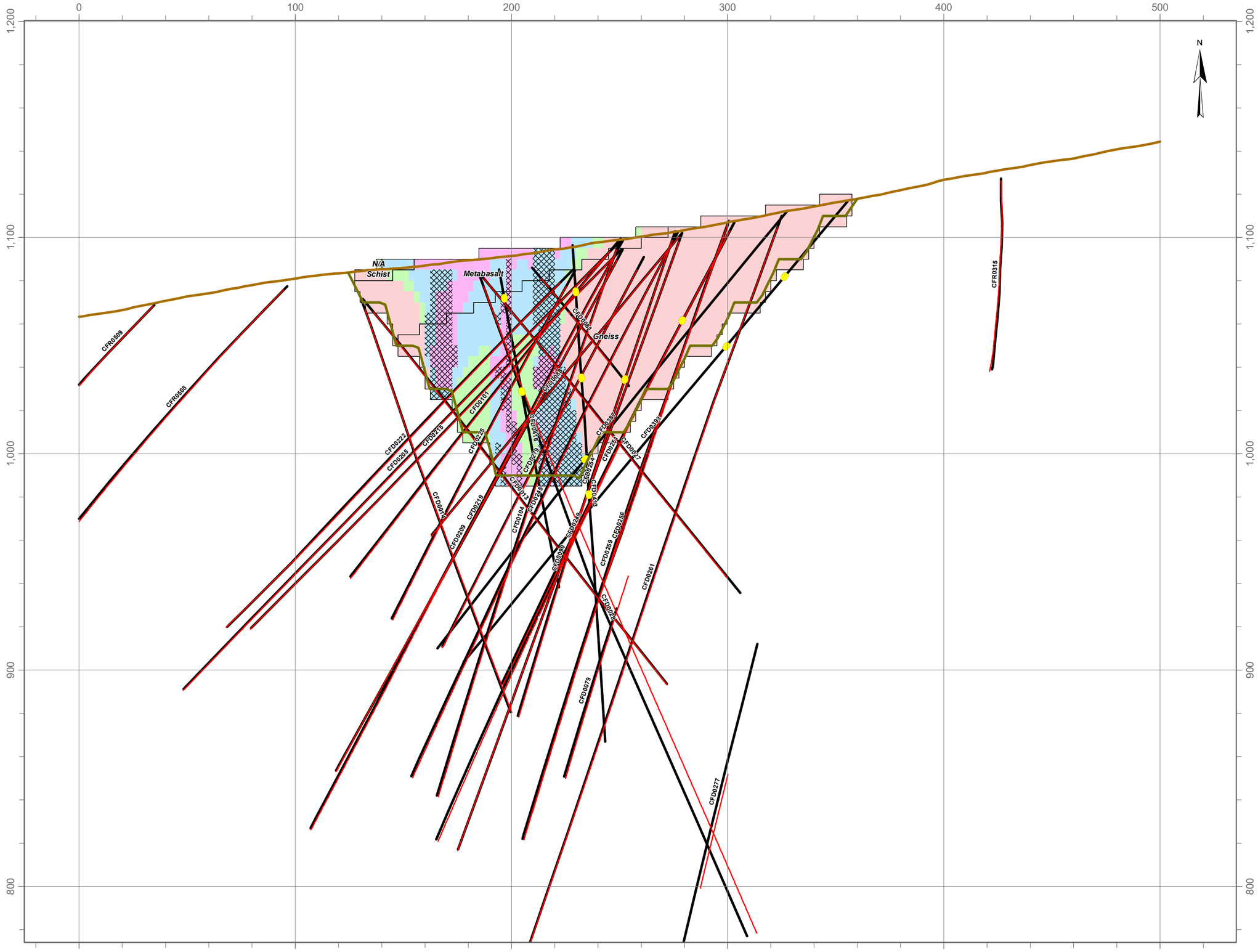
Coffee Gold Project

TITLE:

Section 6

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 6_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone
- Geology Boundary

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	May 10, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

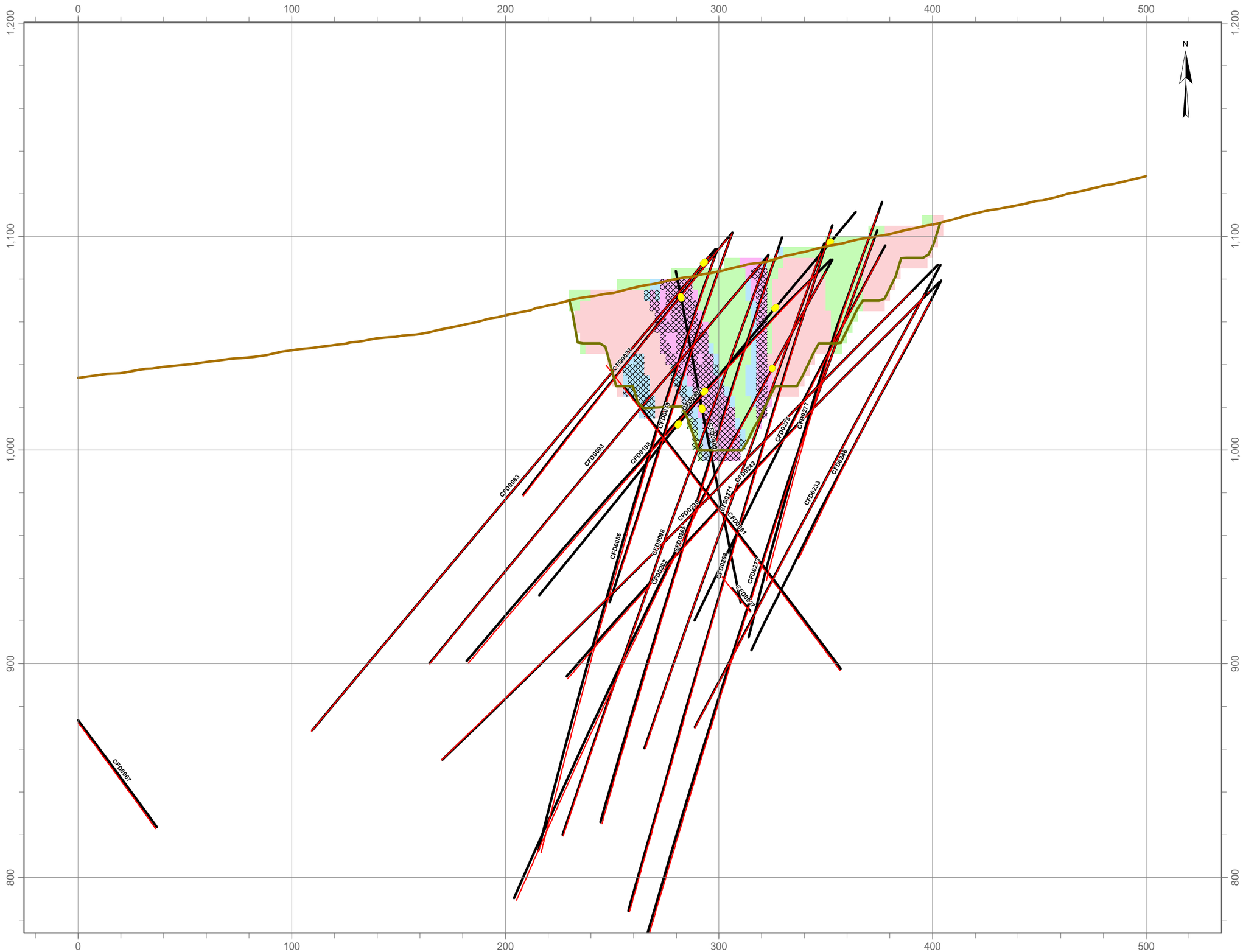
Coffee Gold Project

TITLE:

Section 7

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 7_20160510.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	May 10, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

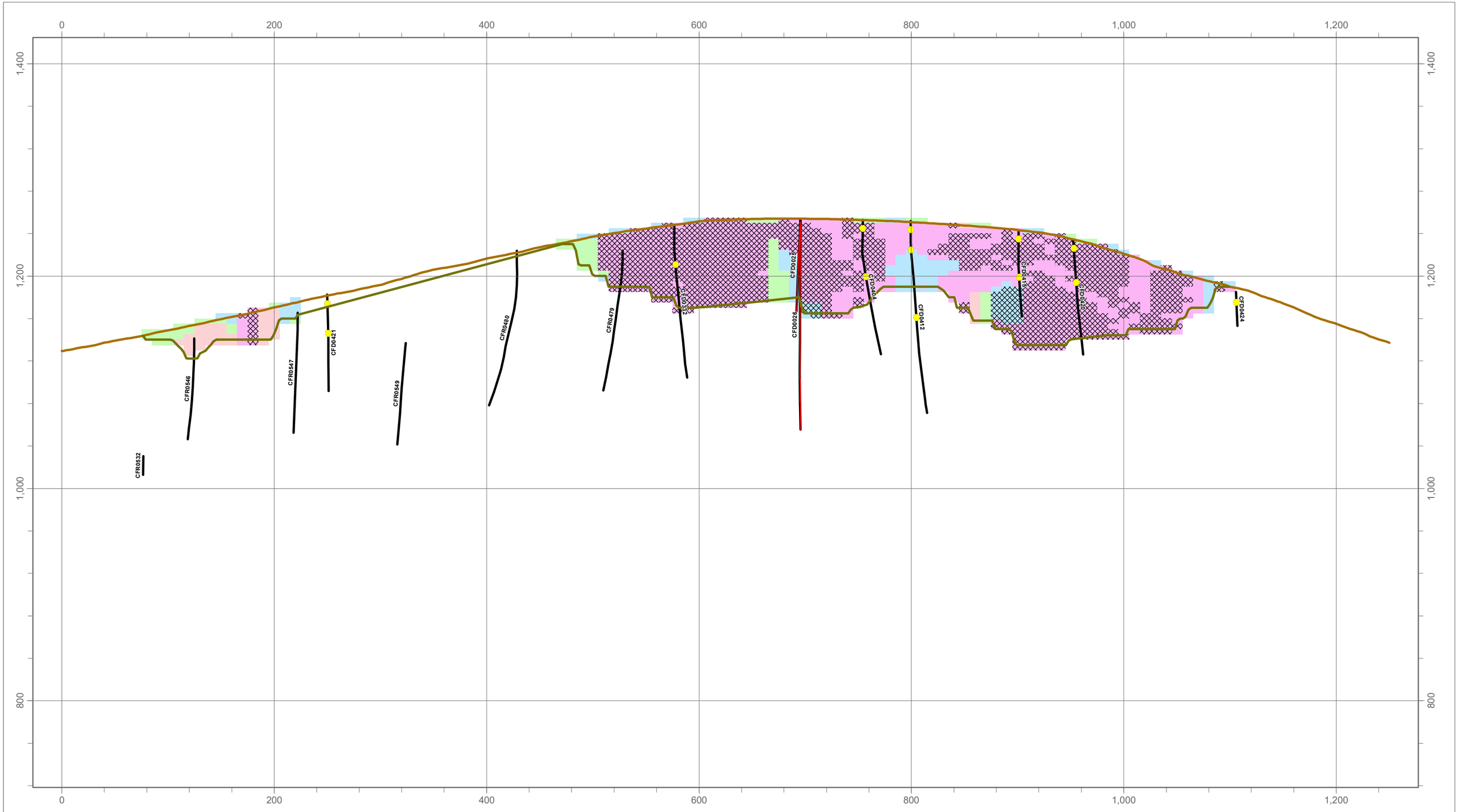
Coffee Gold Project

TITLE:

Section 8

PROJECT #: A362-4

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 8_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:3,250

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

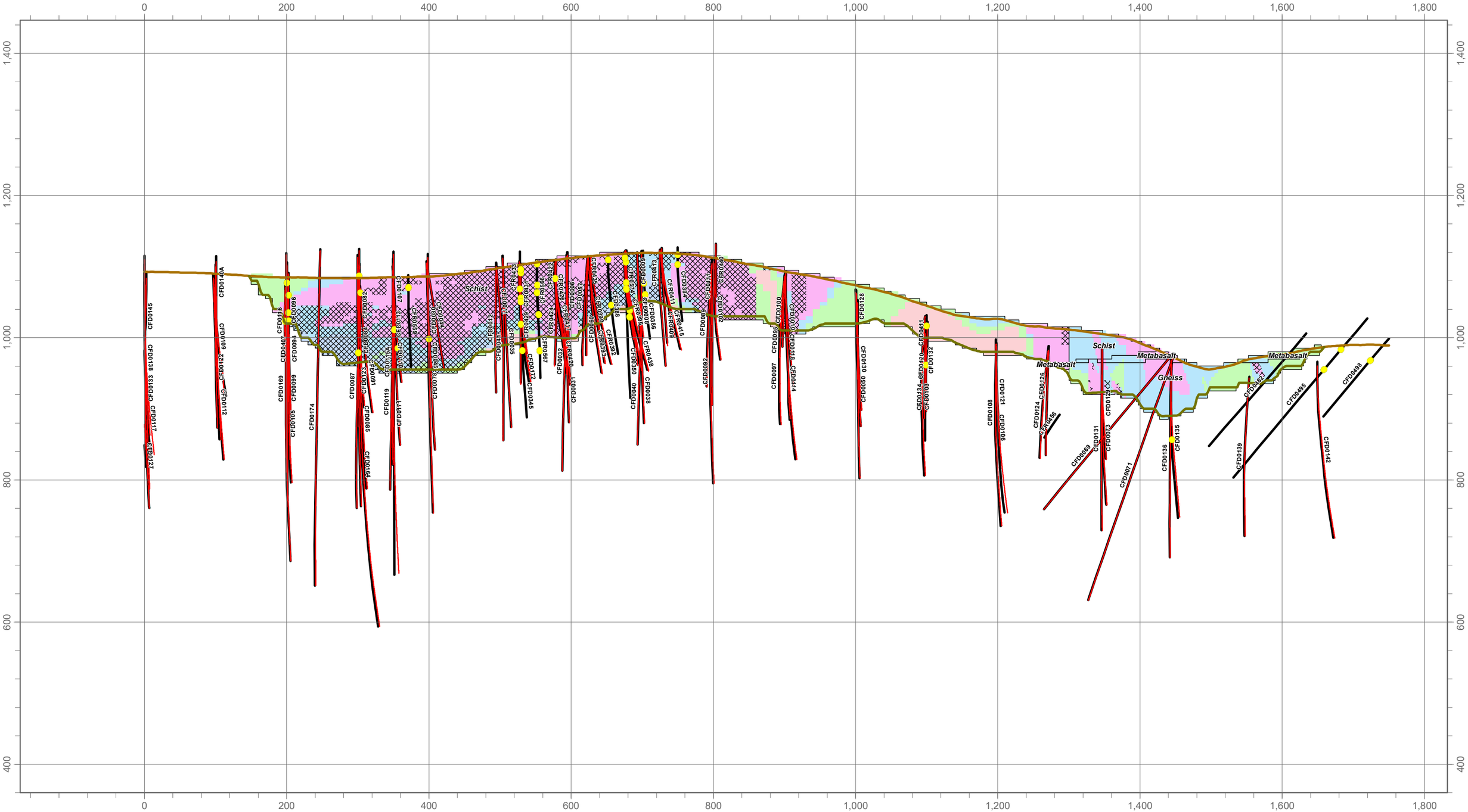
LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 09

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 9_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Lithology Boundary
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:5,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

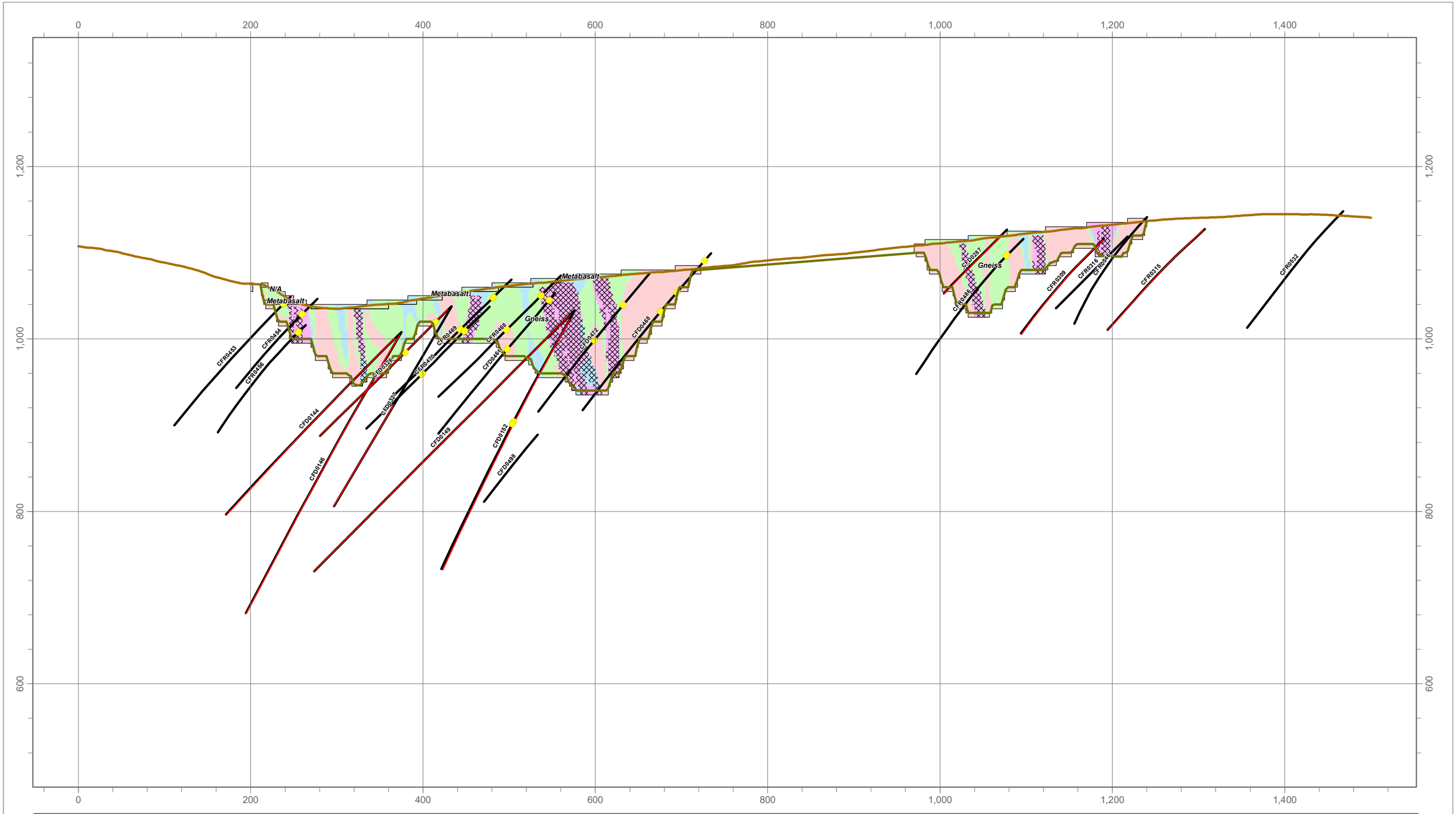
LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 10

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 10_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone
- Geology Boundary

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

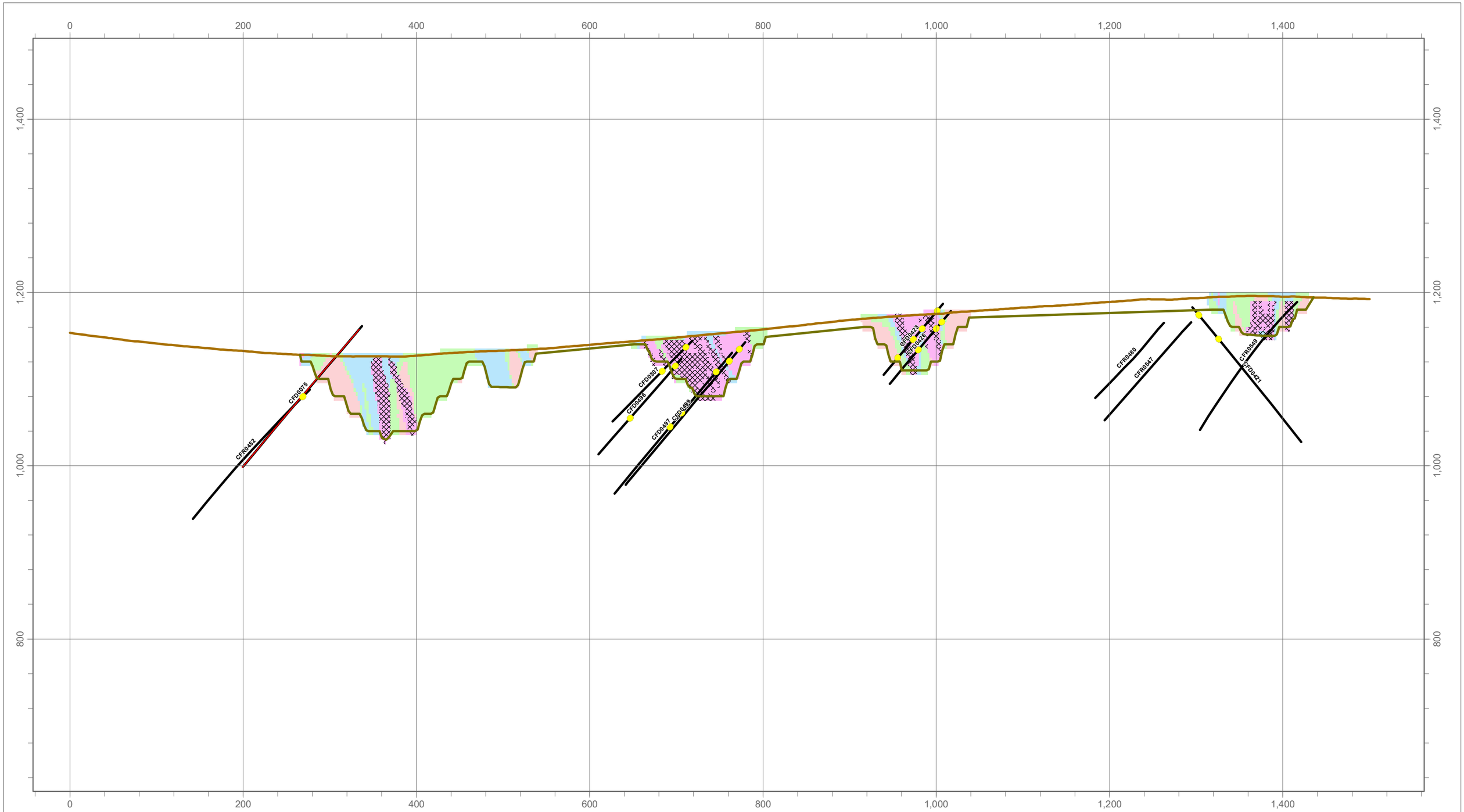
LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 11

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 11_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

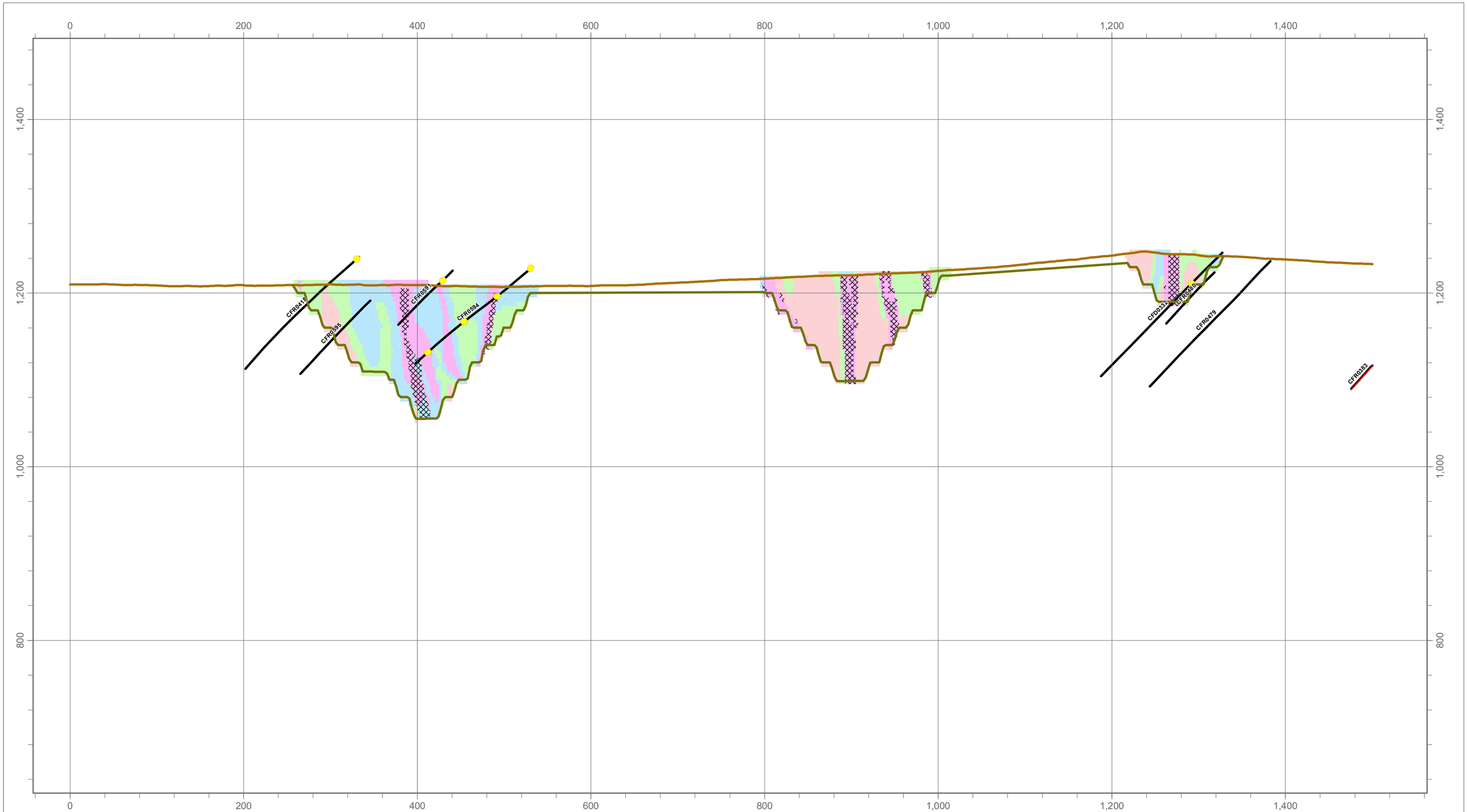
LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 12

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 12_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

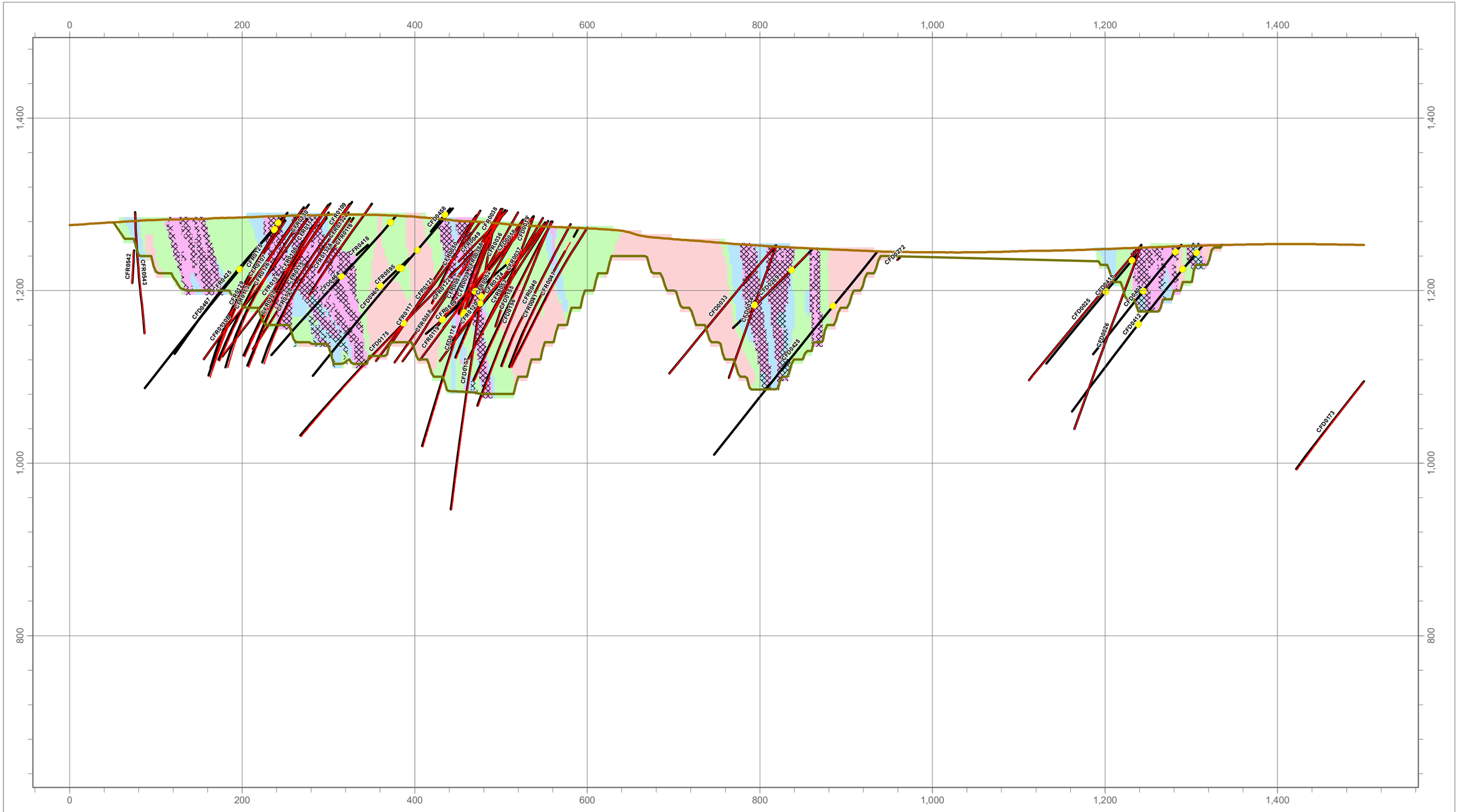
LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 13

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 13_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

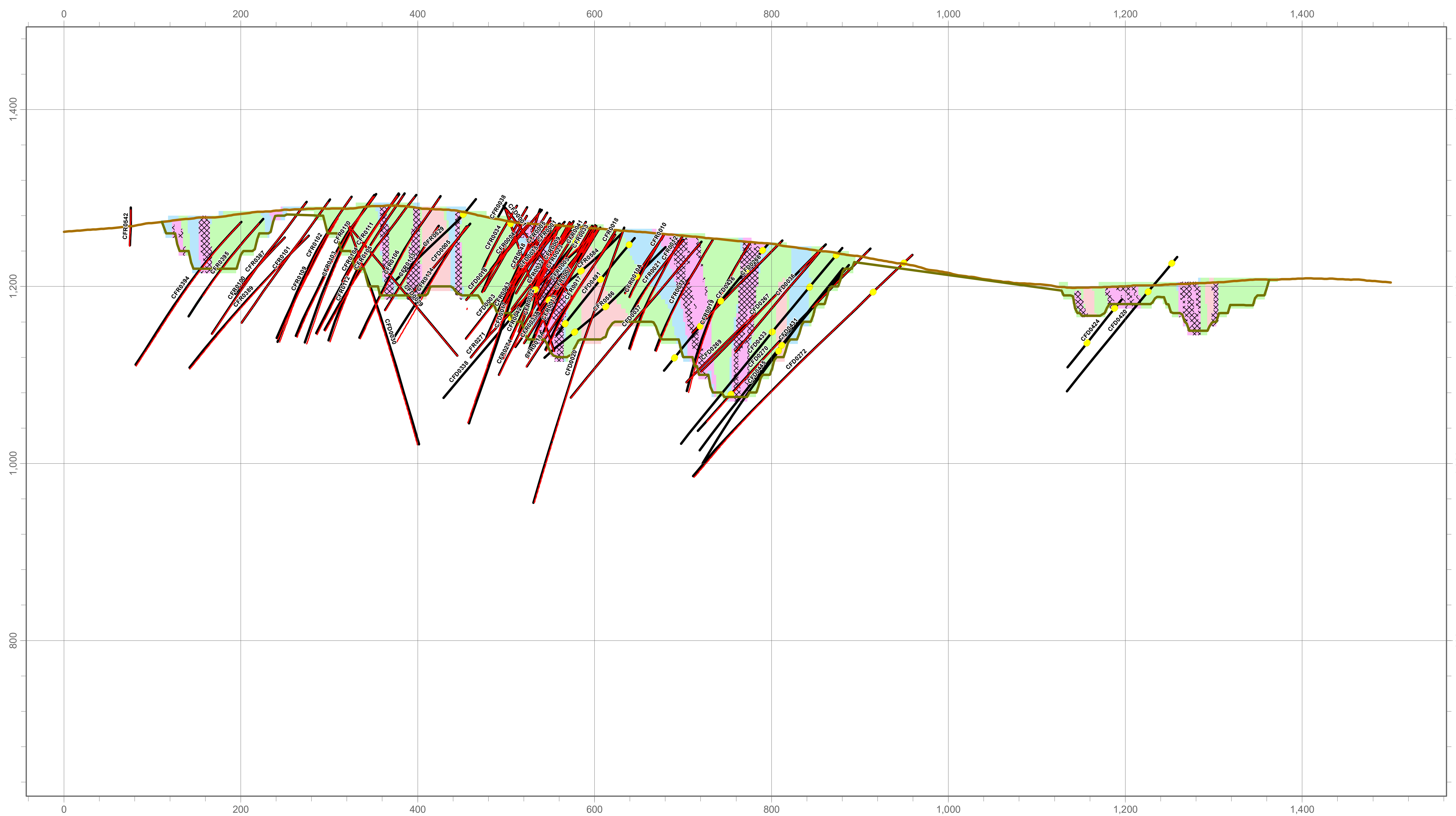
LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 14

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 14_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

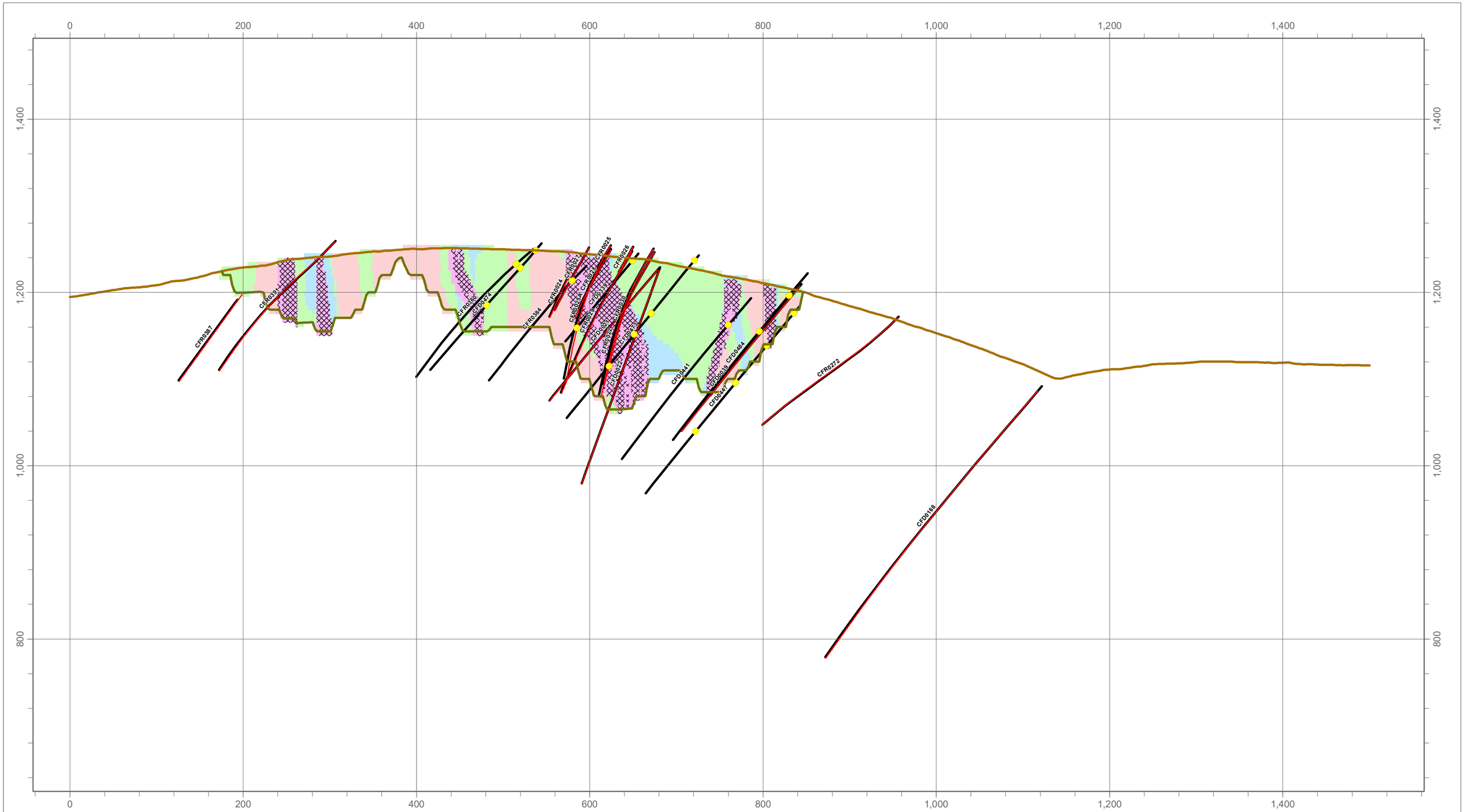
Coffee Gold Project

TITLE:

Section 15

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 15_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

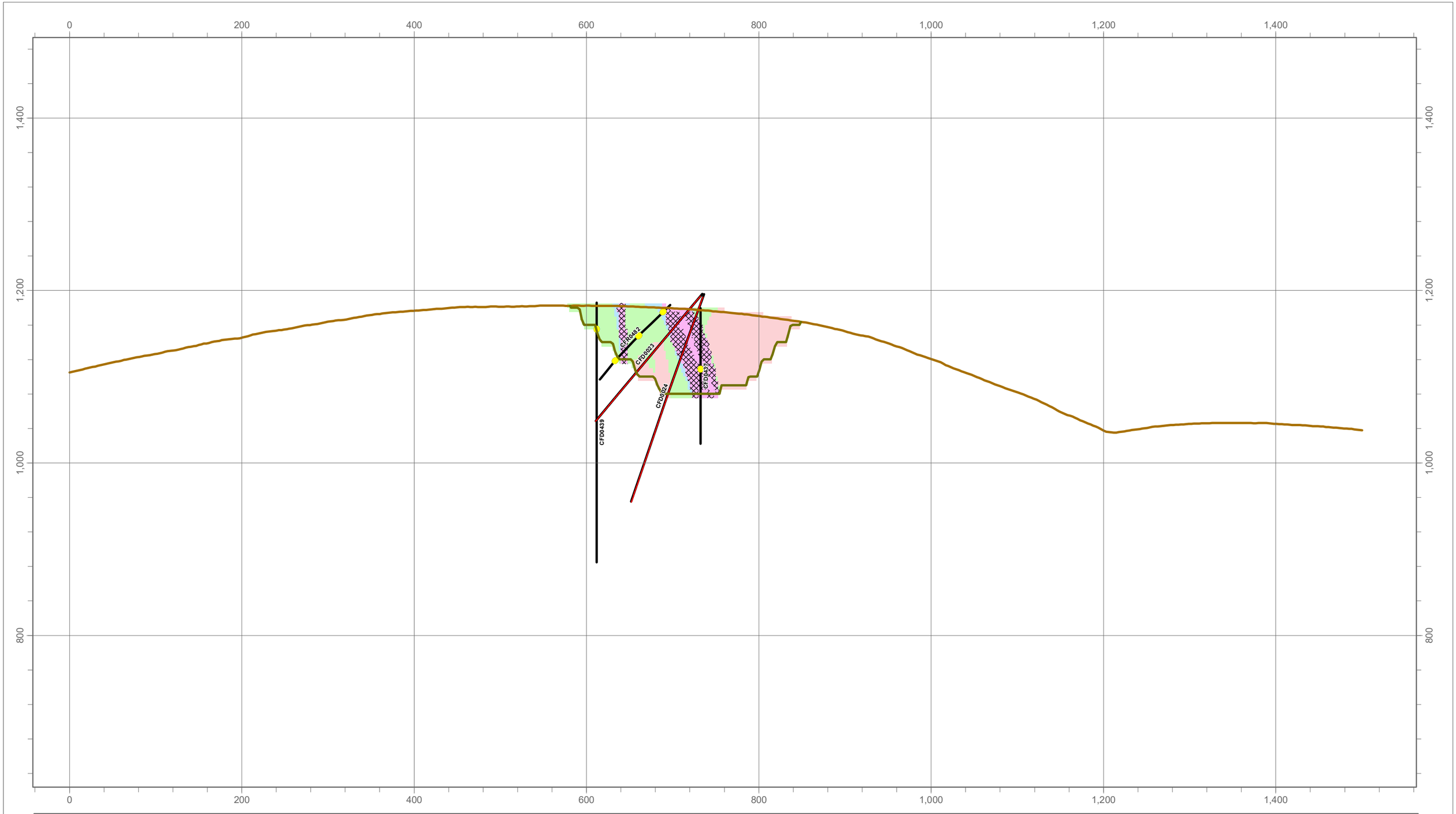
LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 16

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 16_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

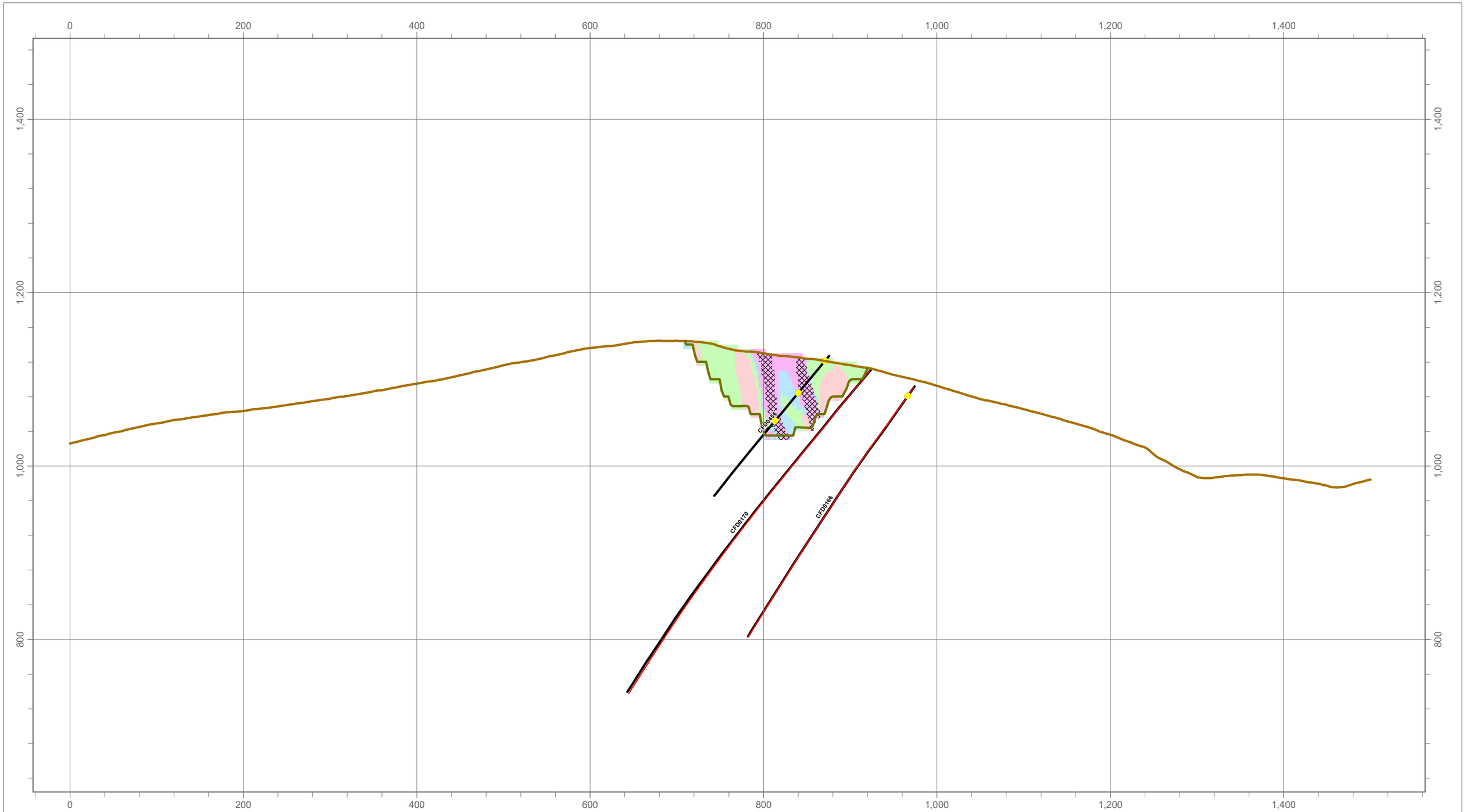
LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 17

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 17_20160218.mxd



LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 18

PROJECT #: A362-1

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Geochem Cross Sections\Section 18_20160218.mxd

Appendix B: Mineralogy Reports

GOLDCORP

APPENDIX B.1: X-RAY DIFFRACTION ANALYSES

QUANTITATIVE PHASE ANALYSIS OF TEN POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: Kaminak #A362-1

John Dockrey, M.Sc.
Lorax Environmental Services Ltd.
2289 Burrard Street
Vancouver, BC V6J 3H9

Mati Raudsepp, Ph.D.
Elisabetta Pani, Ph.D.
Edith Czech, M.Sc.
Jenny Lai, B.Sc.
Lan Kato, B.A.

Dept. of Earth & Ocean Sciences
The University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4

January 14, 2015

EXPERIMENTAL METHOD

The ten samples of **Project Kaminak #A362-1** were reduced into fine powder to the optimum grain-size range for X-ray analysis (<10µm) by grinding under ethanol in a vibratory McCrone Micronising Mill for 10 minutes. Step-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1 (separate file, ***Lorax Environmental Results Jan 14 2015 – Proj Kaminak A362-1.xlsx***). These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 to 10. The ideal formulae of phases present are given in Table 2.

In samples 1, 2, 4, 7, 8 and 9 the kaolinite is highly disordered and its contribution to the diffraction pattern was estimated with a model structure. Consider the results approximate.

Table 2. List and ideal formulae of present phases.

Mineral	**Ideal Formula**
Analcime	$Na[AlSi_2O_6]\cdot H_2O$
Anatase	TiO_2
Ankerite/Dolomite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2/CaMg(CO_3)_2$
Biotite	$K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH)_2$
Cristobalite	SiO_2
Gorceixite	$BaAl_3(PO_4)(PO_3OH)(OH)_6$
Hematite	α-Fe_2O_3
Hydrocalumite	$Ca_4Al_2(OH)_{12}(Cl,CO_3,OH)_{2-x}\cdot 4H_2O$
Jarosite	$K_2Fe_6^{3+}(SO_4)_4(OH)_{12}$
Kaolinite	$Al_2Si_2O_5(OH)_4$
K-feldspar	$KAlSi_3O_8$
Muscovite/Illite	$KAl_2(AlSi_3O_{10})(OH)_2/ K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$
Pyrite	FeS_2
Quartz	SiO_2
Rutile	TiO_2
Siderite	$Fe^{2+}CO_3$

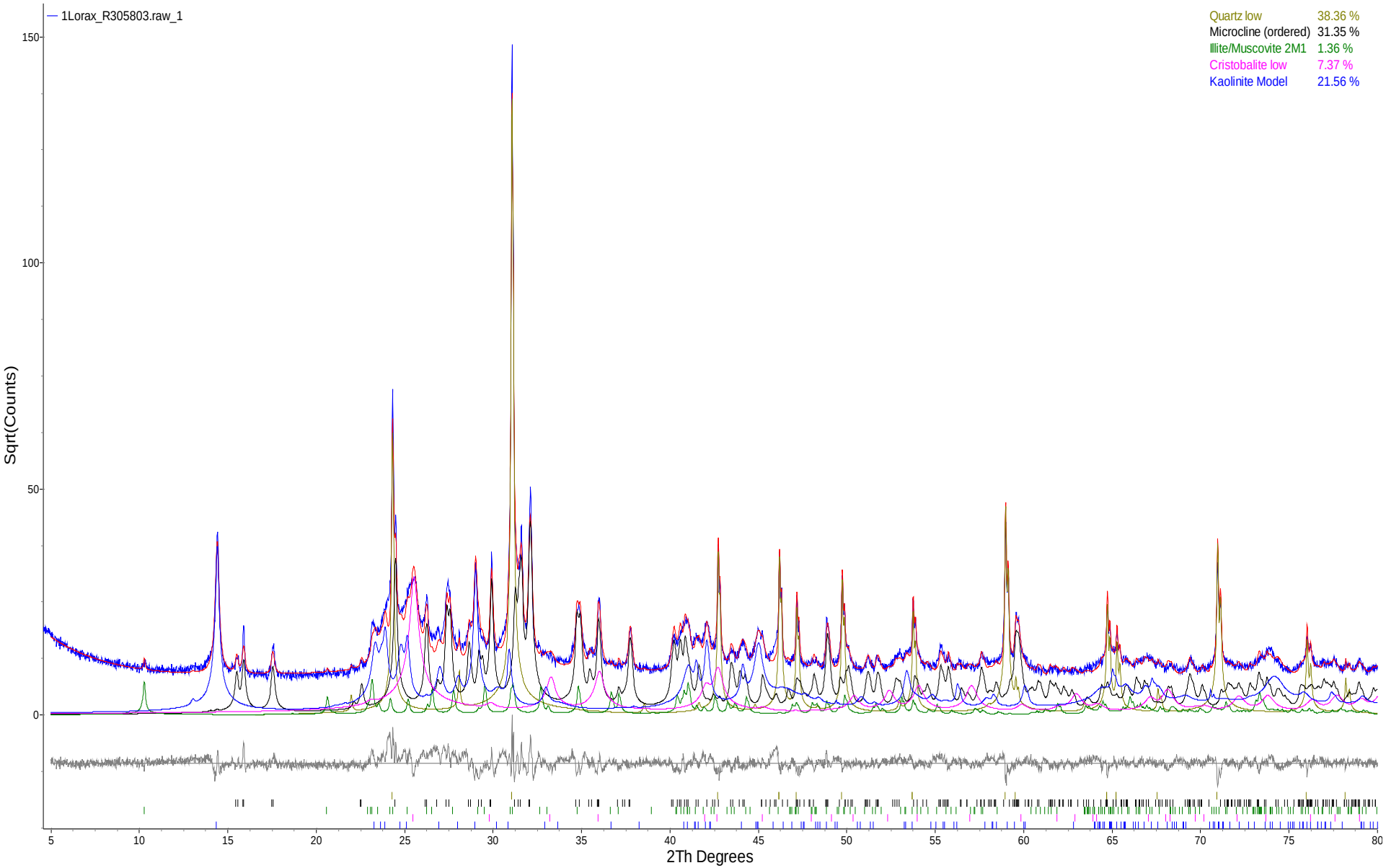


Figure 1. Rietveld refinement plot of sample **Lorax Environmental "R305803"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

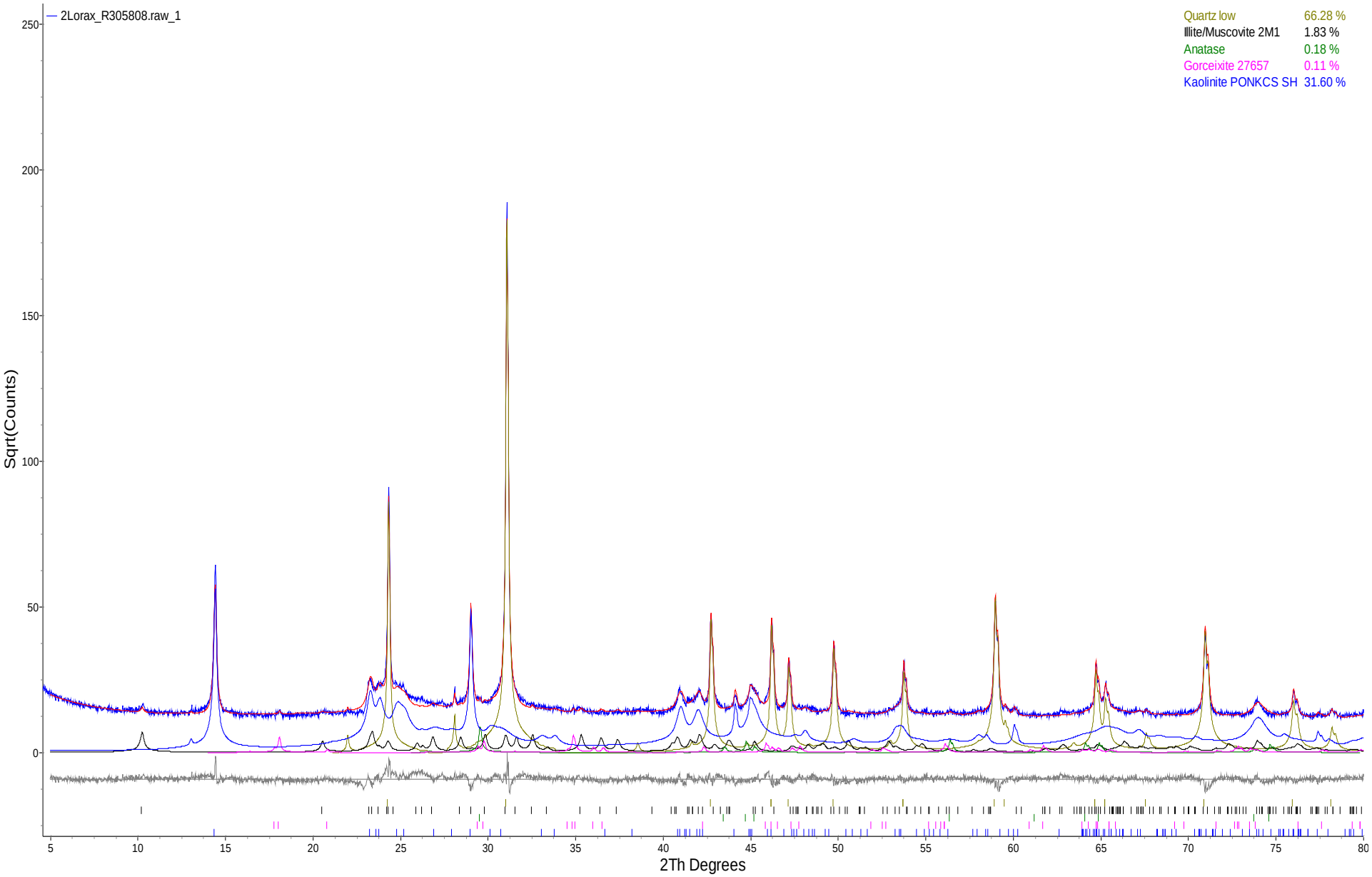


Figure 2. Rietveld refinement plot of sample **Lorax Environmental "R305808"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

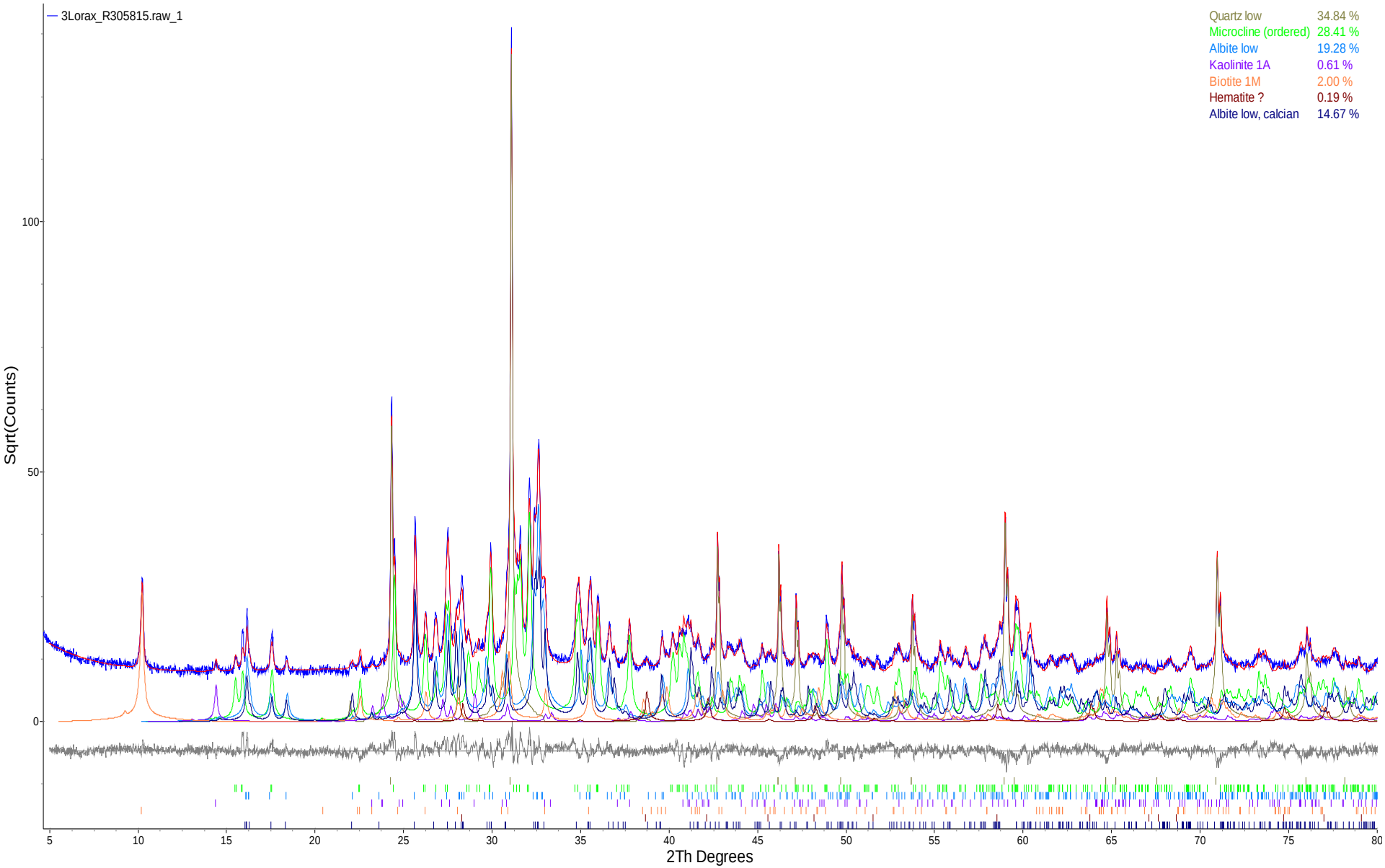


Figure 3. Rietveld refinement plot of sample **Lorax Environmental "R305815"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

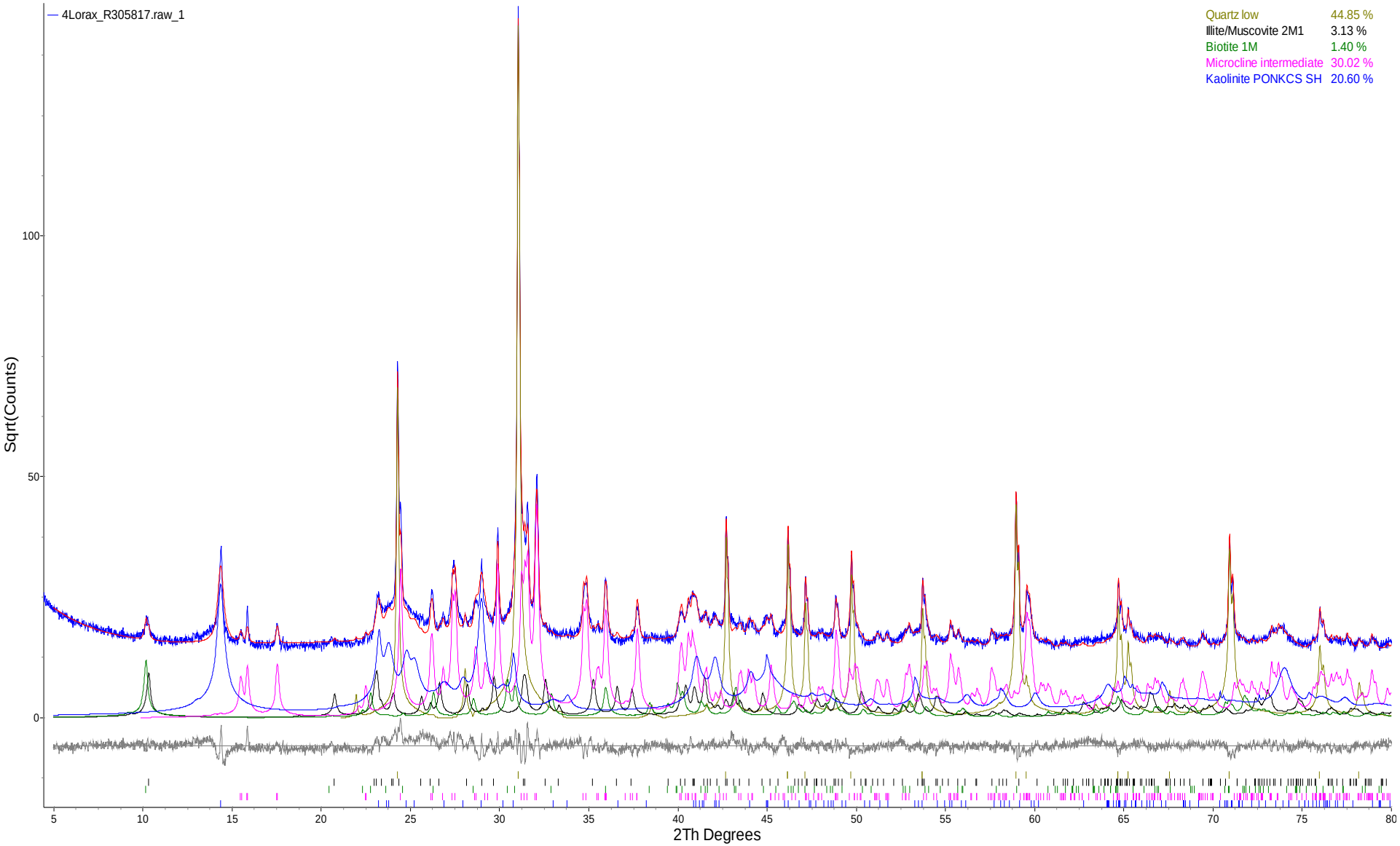


Figure 4. Rietveld refinement plot of sample **Lorax Environmental "R305817"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

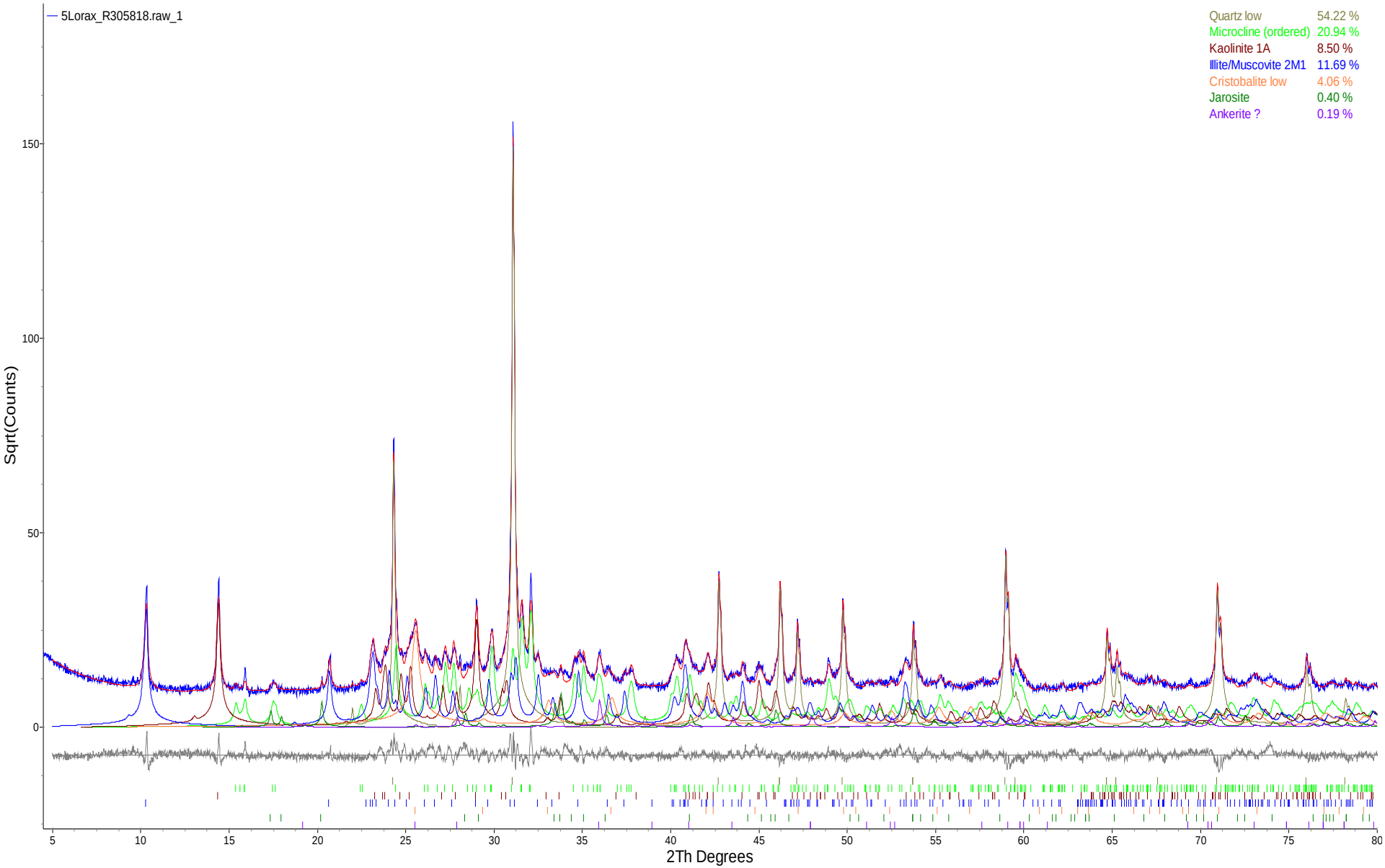


Figure 5. Rietveld refinement plot of sample **Lorax Environmental "R305818"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.



Figure 6. Rietveld refinement plot of sample **Lorax Environmental "R305821"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

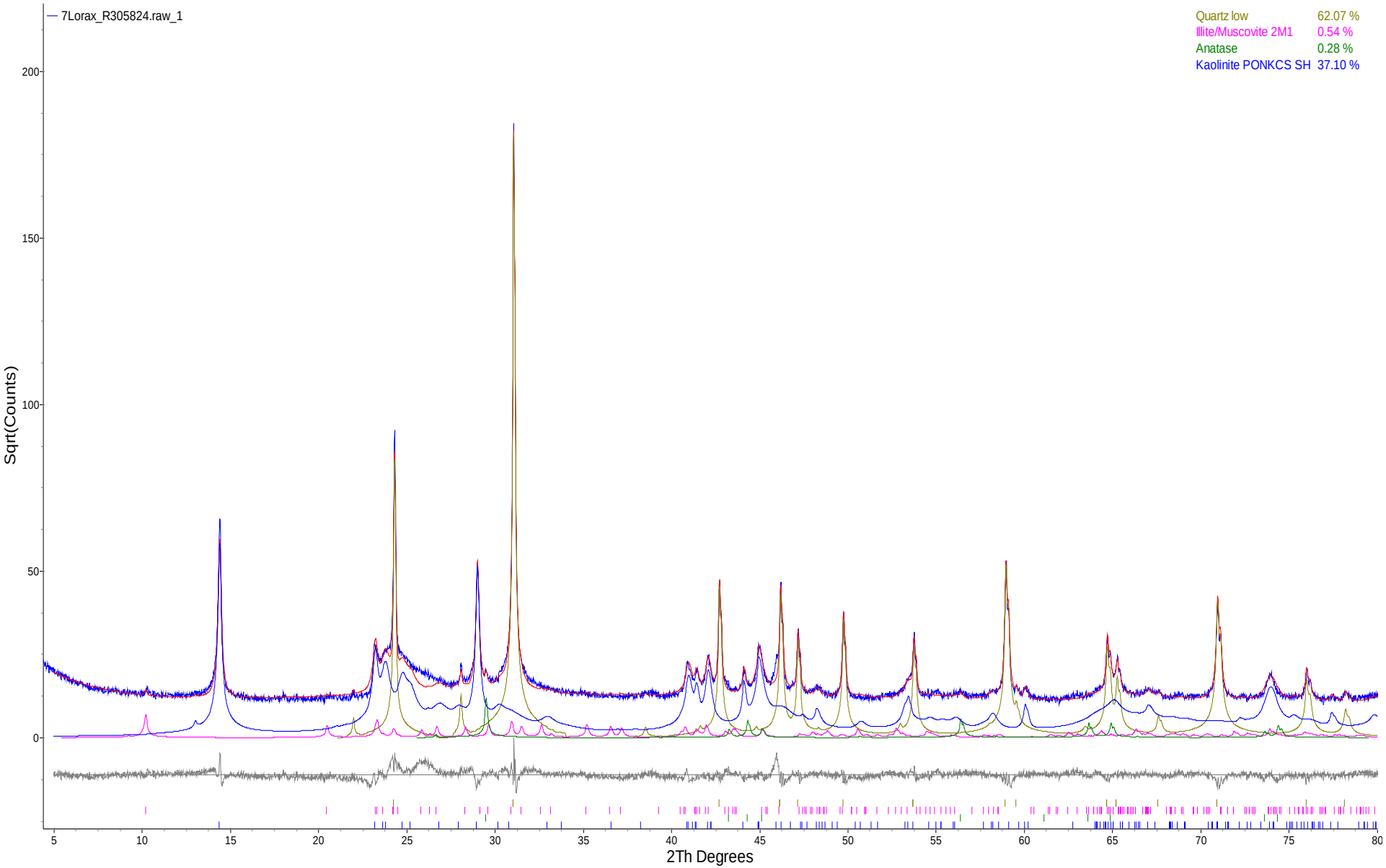


Figure 7. Rietveld refinement plot of sample **Lorax Environmental "R305824"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

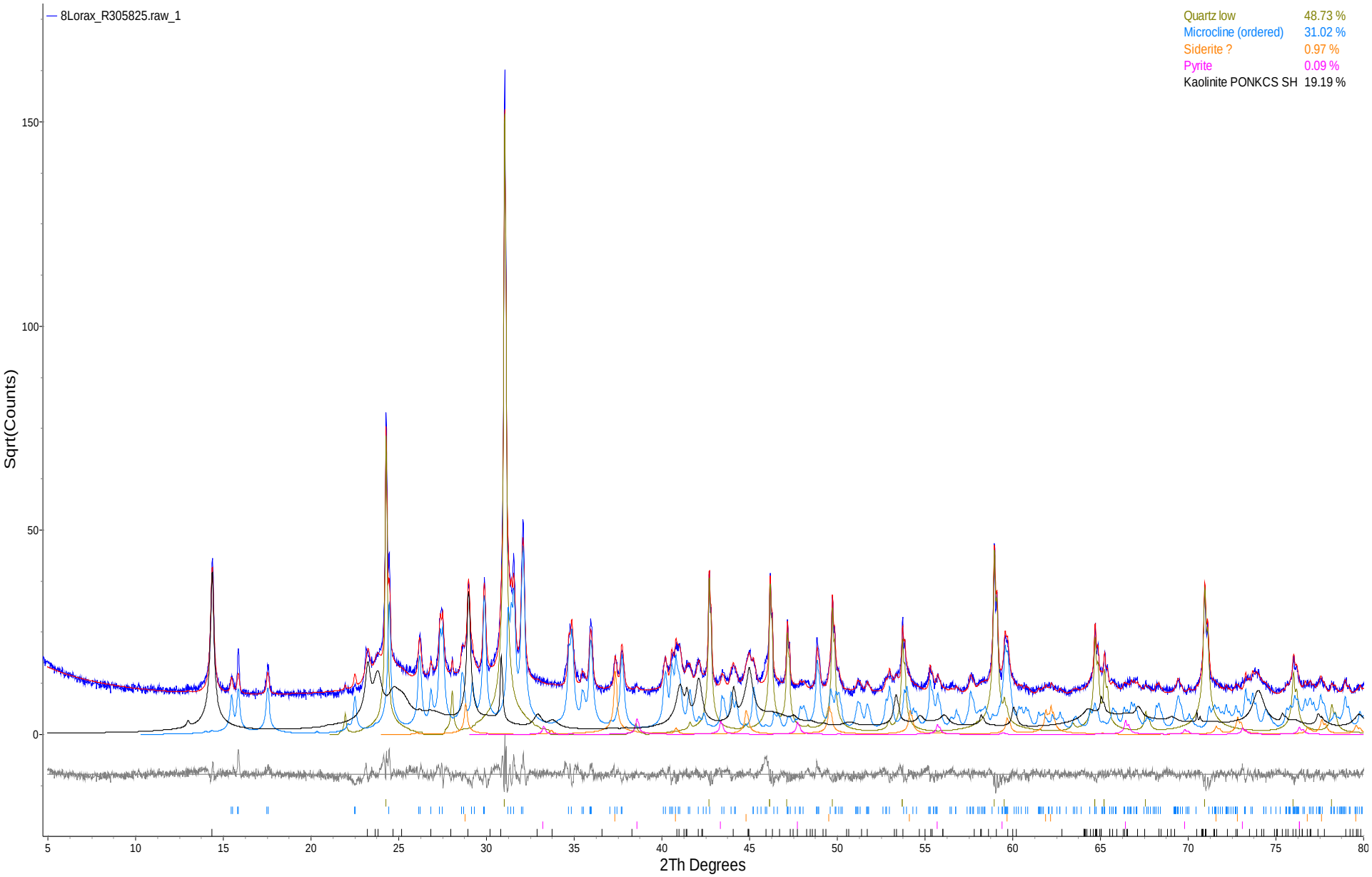


Figure 8. Rietveld refinement plot of sample **Lorax Environmental "R305825"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

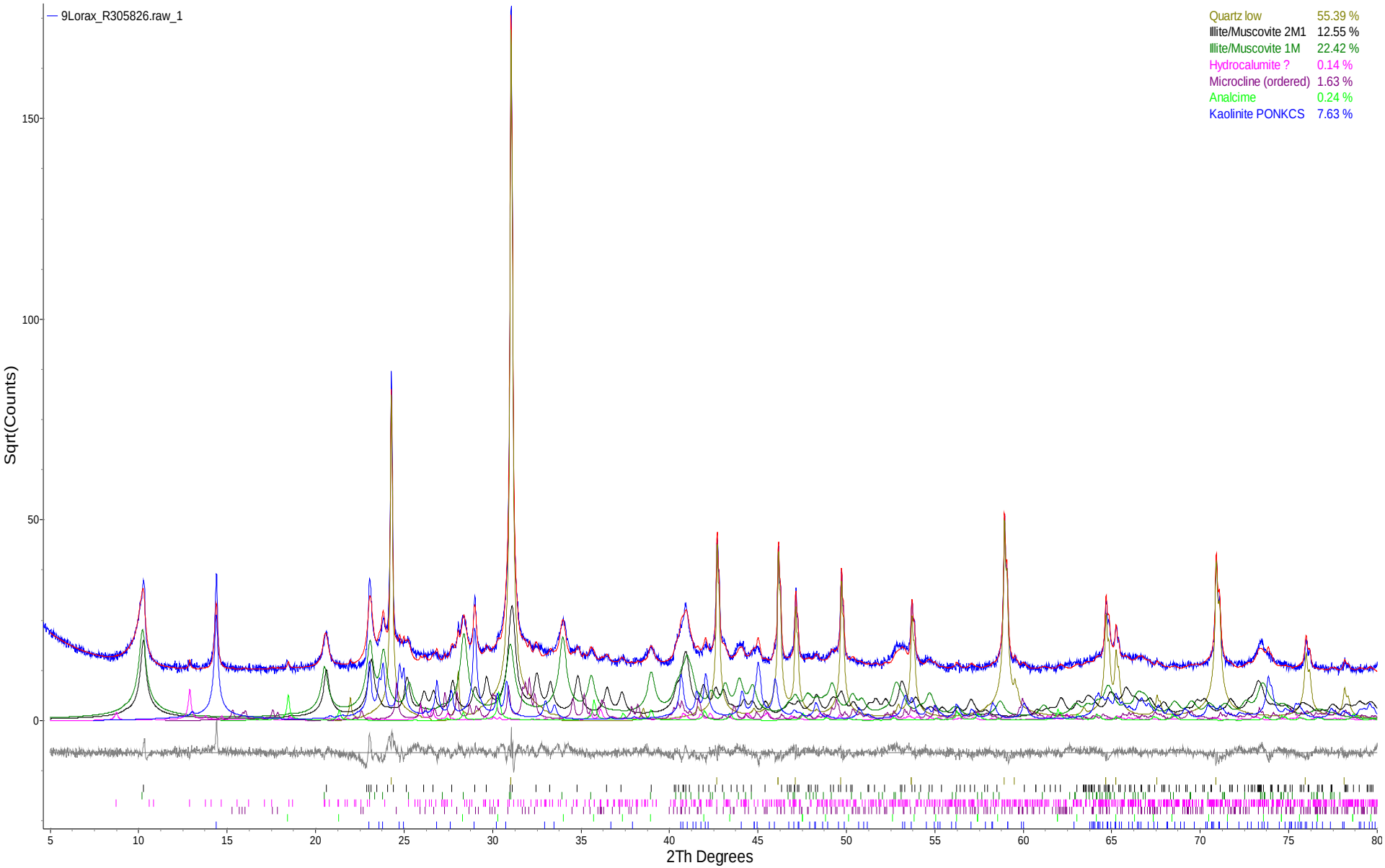


Figure 9. Rietveld refinement plot of sample **Lorax Environmental "R305826"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

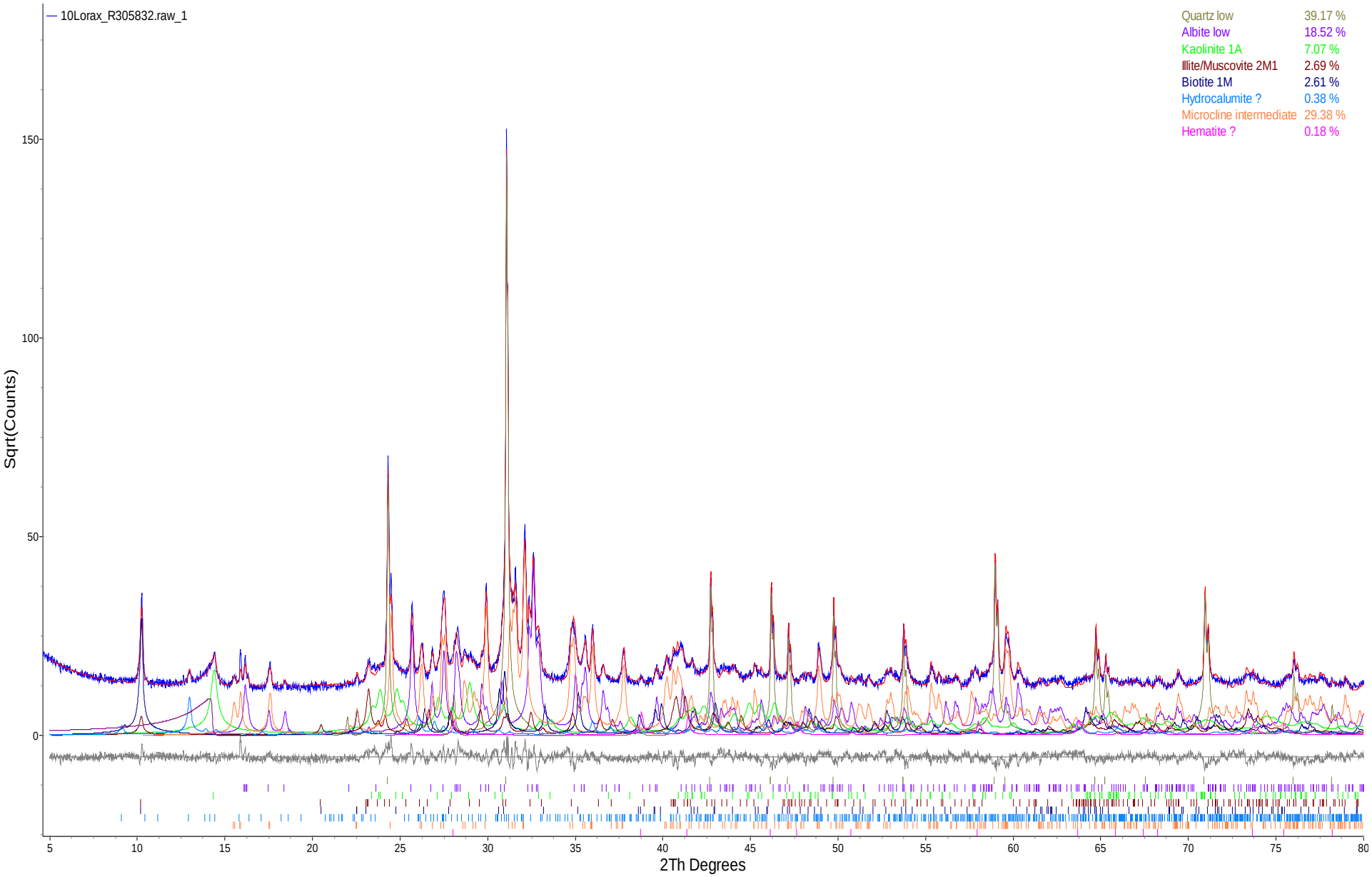


Figure 10. Rietveld refinement plot of sample **Lorax Environmental "R305832"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

QUANTITATIVE PHASE ANALYSIS OF TWENTY TWO POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: Coffee Gold A362-1

John Dockrey, M.Sc.
Lorax Environmental Services Ltd.
2289 Burrard Street
Vancouver, BC V6J 3H9

Mati Raudsepp, Ph.D.
Elisabetta Pani, Ph.D.
Edith Czech, M.Sc.
Lan Kato, B.A.

Dept. of Earth & Ocean Sciences
The University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4

May 1, 2014

EXPERIMENTAL METHOD

The twenty two samples of **Project Coffee Gold A362-1** were reduced into fine powder to the optimum grain-size range for X-ray analysis (<10µm) by grinding under ethanol in a vibratory McCrone Micronising Mill for 7 minutes. Step-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1 (separate file, ***Lorax Environmental Results May 1 2014 - proj Coffee Gold A362-1.xlsx***). These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 to 22. The ideal formulae of phases present are given in Table 2.

In samples 5, 9, 10, 13, 21 and 22 the kaolinite is disordered and its contribution to the diffraction pattern was estimated with a model structure made from a 50:50 weighed standard mixture of kaolinite and quartz. Consider the results semi-quantitative.

Table 2. List and ideal formulae of present phases.

Mineral	**Ideal Formula**
Actinolite	$Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$
Alunite	$K_2Al_6(SO_4)_4(OH)_{12}$
Anatase	TiO_2
Ankerite/Dolomite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2/CaMg(CO_3)_2$
Augite	$(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$
Calcite	$CaCO_3$
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$
Clinozoisite	$Ca_2Al_3(SiO_4)_3(OH)$
Dawsonite	$NaAlCO_3(OH)_2$
Goethite	α-$Fe^{3+}O(OH)$
Grossular	$Ca_3Al_2(SiO_4)_3$
Hematite	α-Fe_2O_3
Iron	α-Fe
Jarosite	$K_2Fe_6^{3+}(SO_4)_4(OH)_{12}$
Kaolinite	$Al_2Si_2O_5(OH)_4$
K-feldspar	$KAlSi_3O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Muscovite/Illite	$KAl_2(AlSi_3O_{10})(OH)_2$/ $K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$
Pyrite	FeS_2
Pyrrhotite	$Fe_{1-x}S$
Quartz	SiO_2
Rutile	TiO_2
Siderite	$Fe^{2+}CO_3$

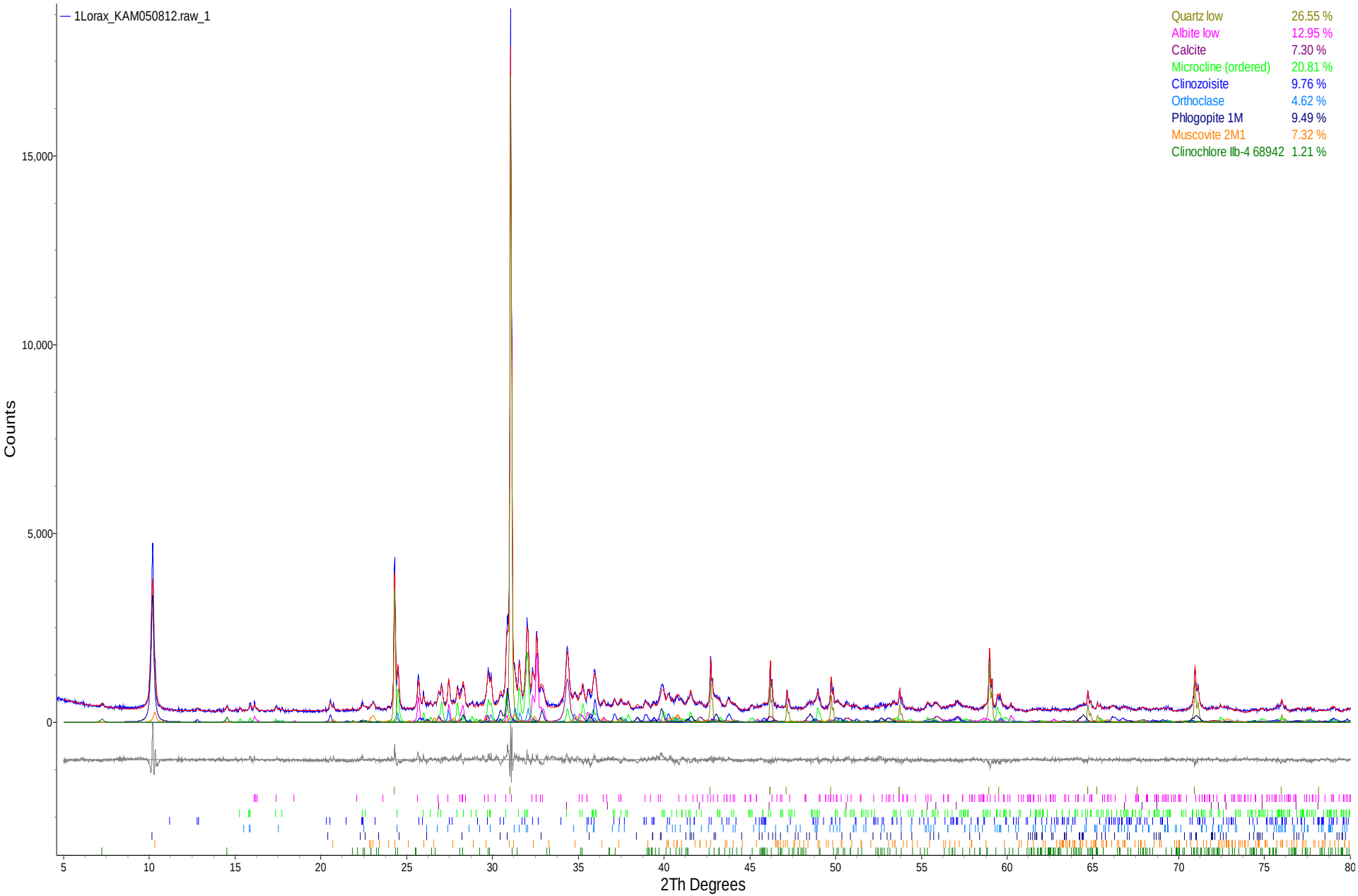


Figure 1. Rietveld refinement plot of sample **Lorax Environmental "KAM050812"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

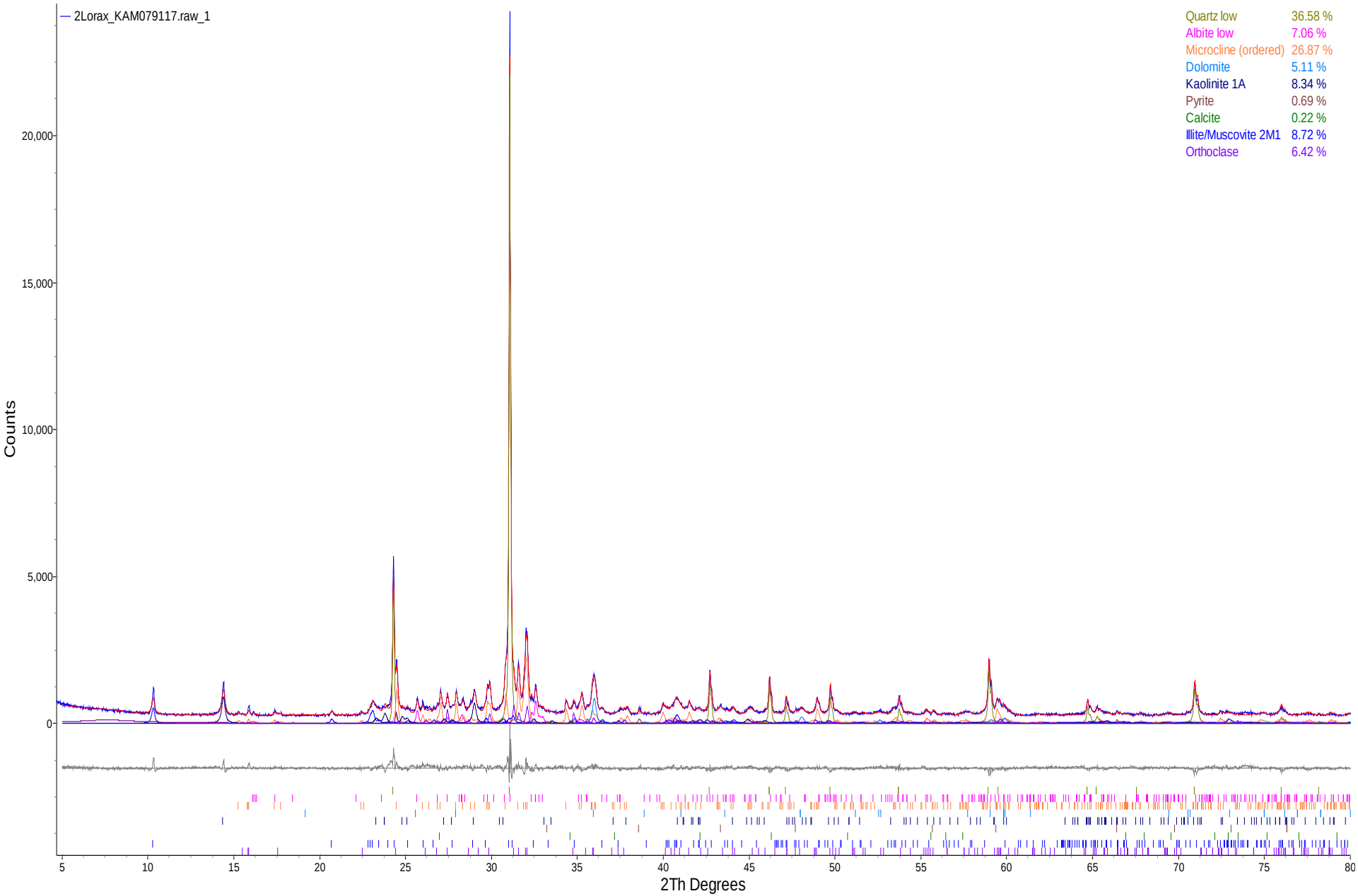


Figure 2. Rietveld refinement plot of sample **Lorax Environmental "KAM079117"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

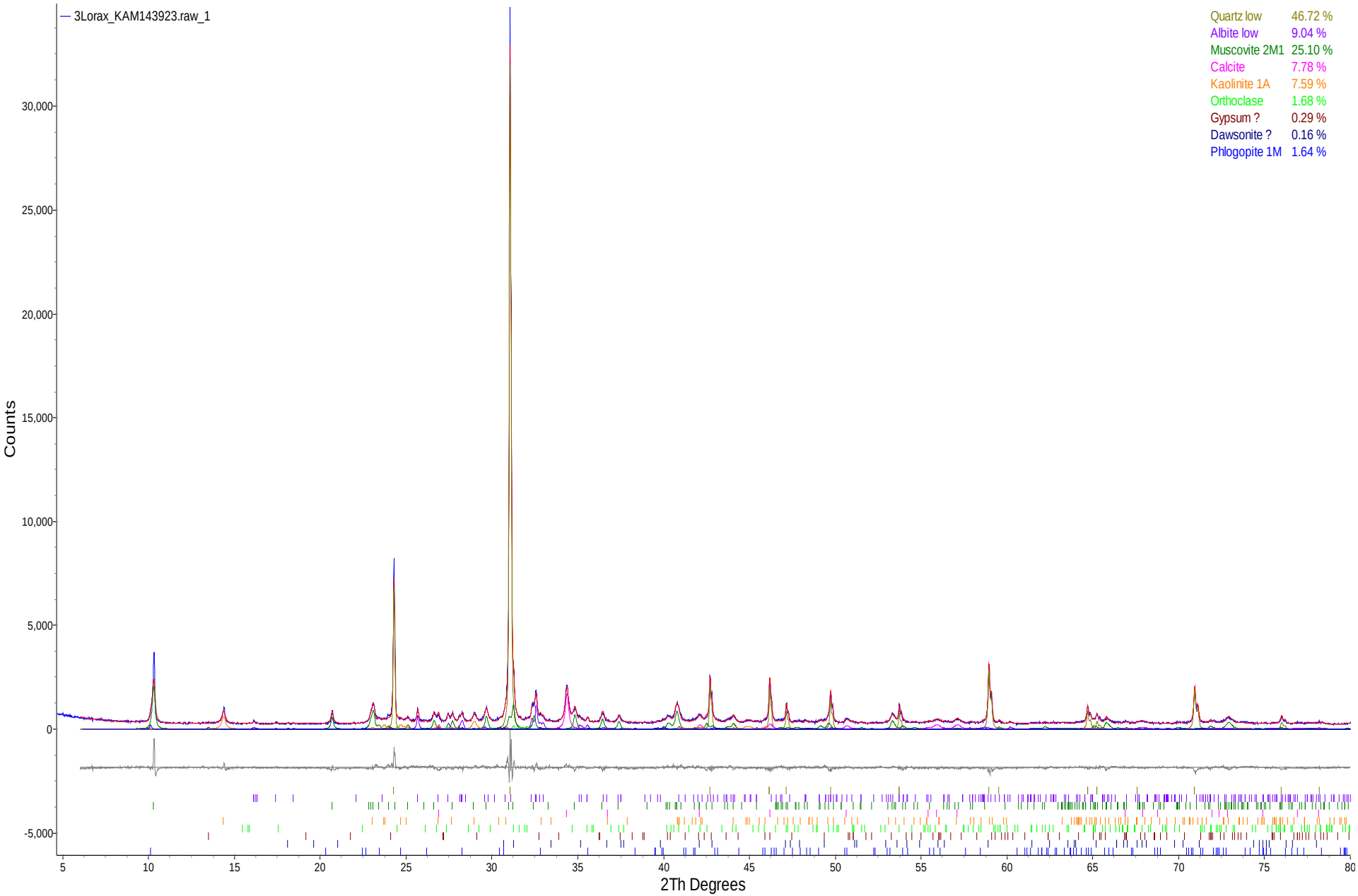


Figure 3. Rietveld refinement plot of sample **Lorax Environmental "KAM143923"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

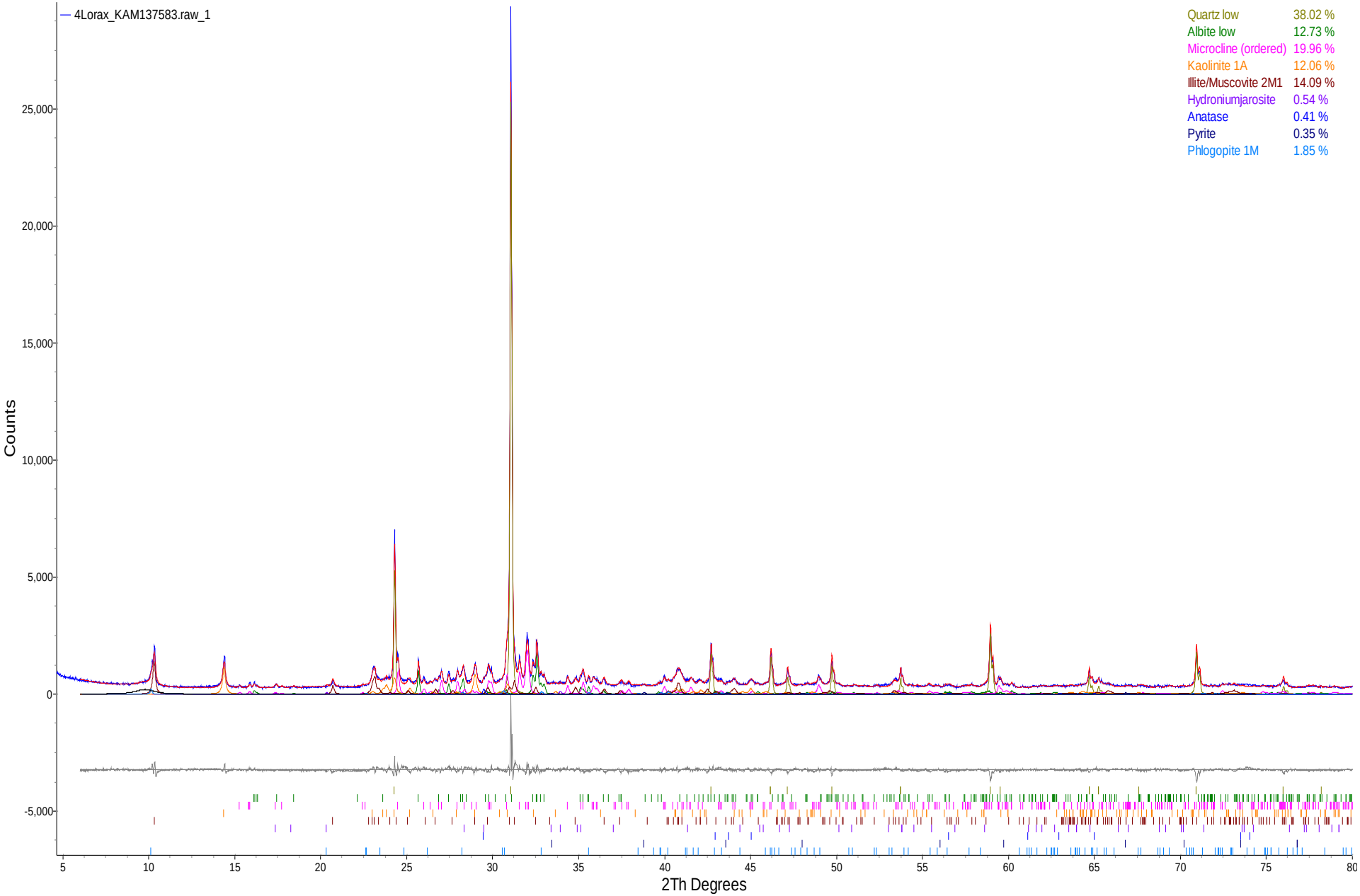


Figure 4. Rietveld refinement plot of sample **Lorax Environmental "KAM137583"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

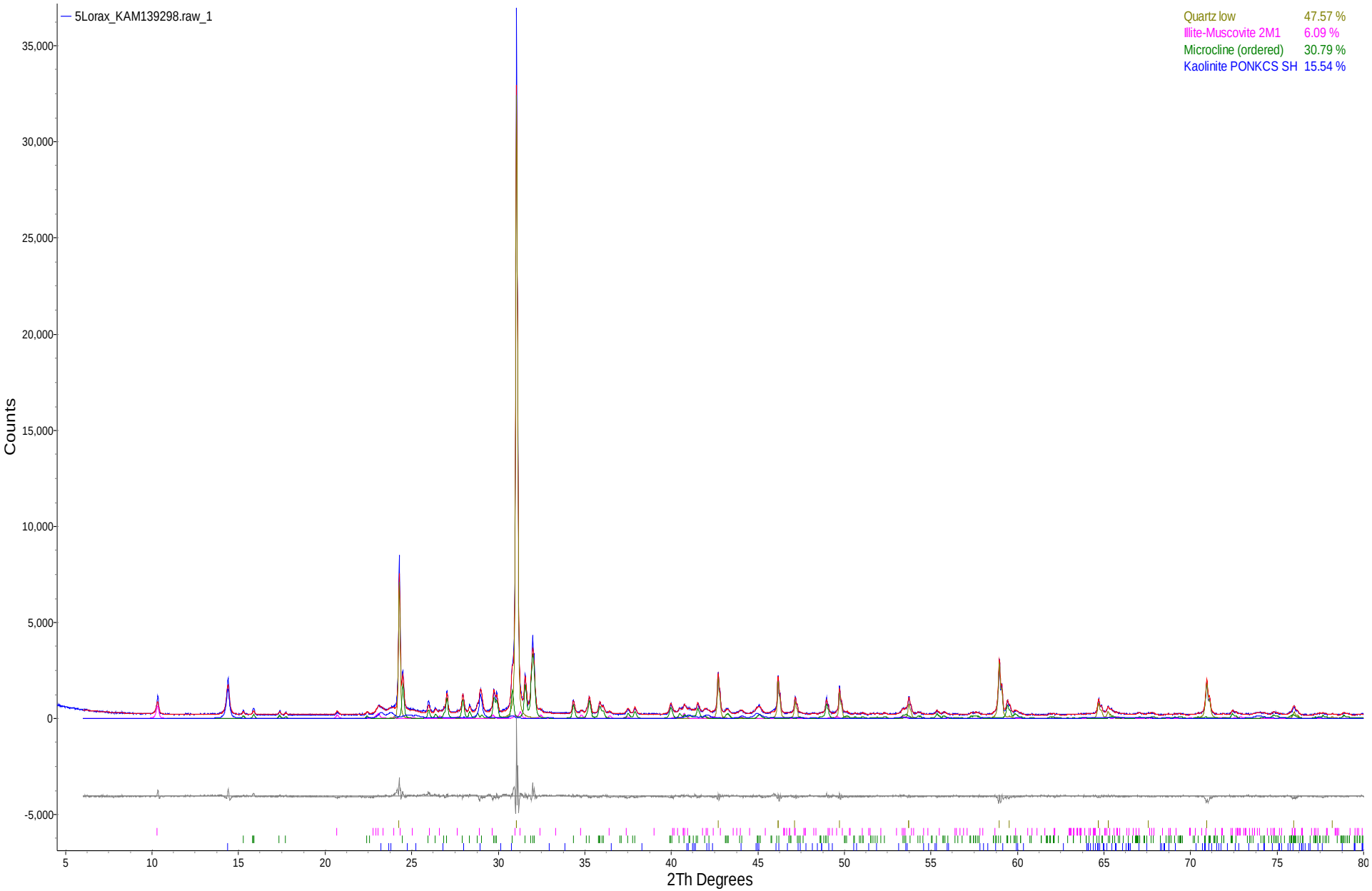


Figure 5. Rietveld refinement plot of sample **Lorax Environmental "KAM139298"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

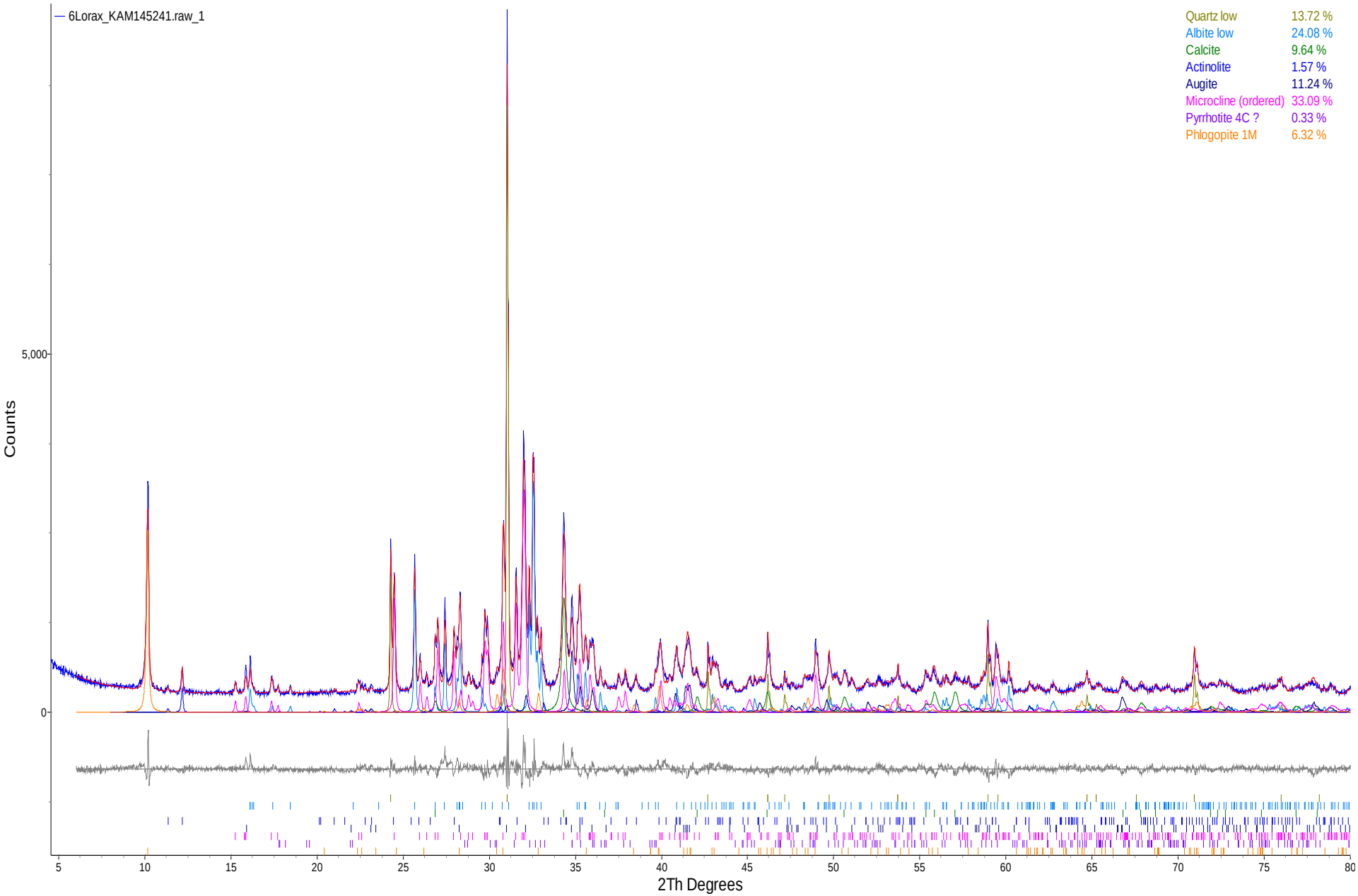


Figure 6. Rietveld refinement plot of sample **Lorax Environmental "KAM145241"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

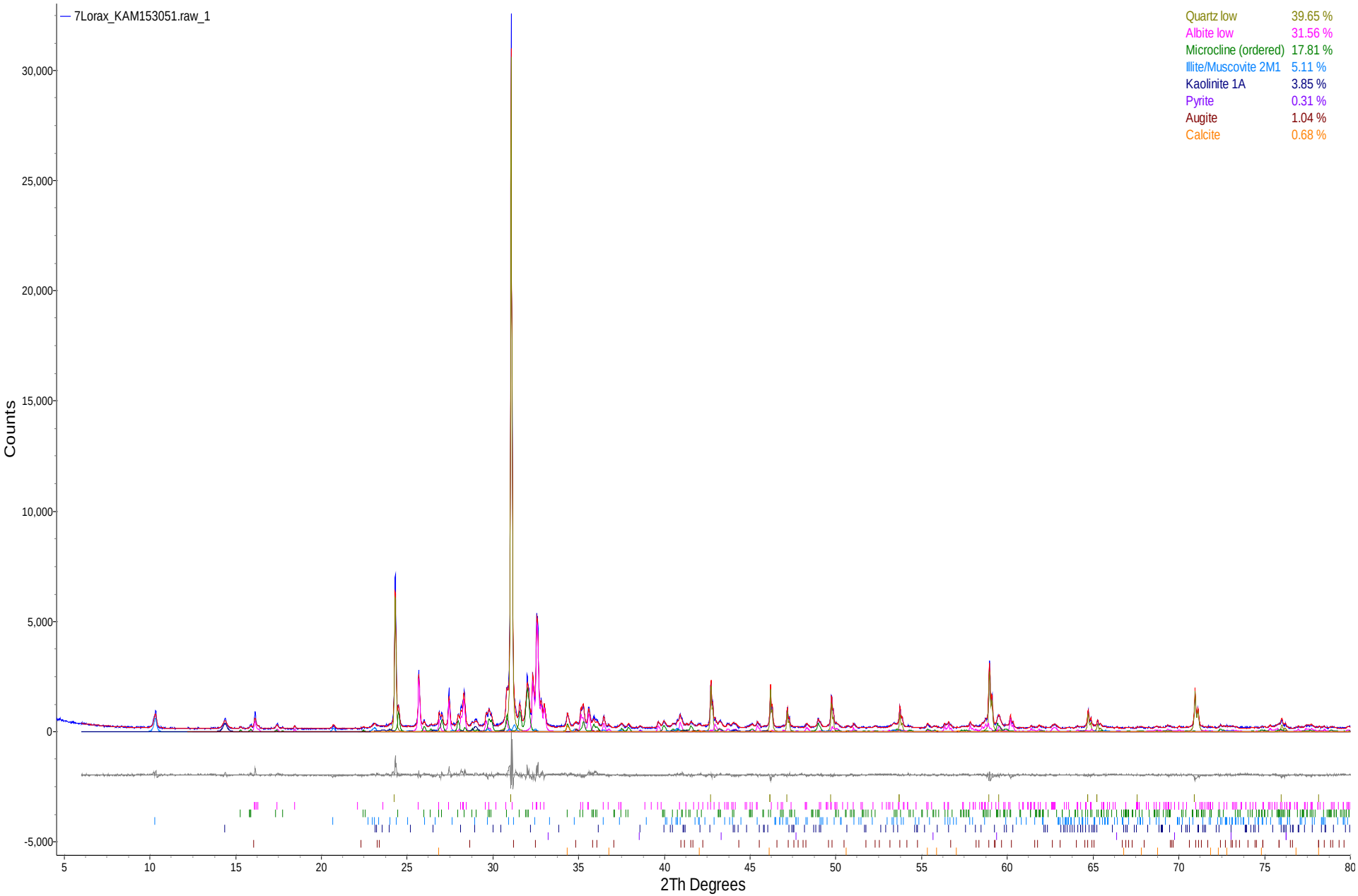


Figure 7. Rietveld refinement plot of sample **Lorax Environmental "KAM153051"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

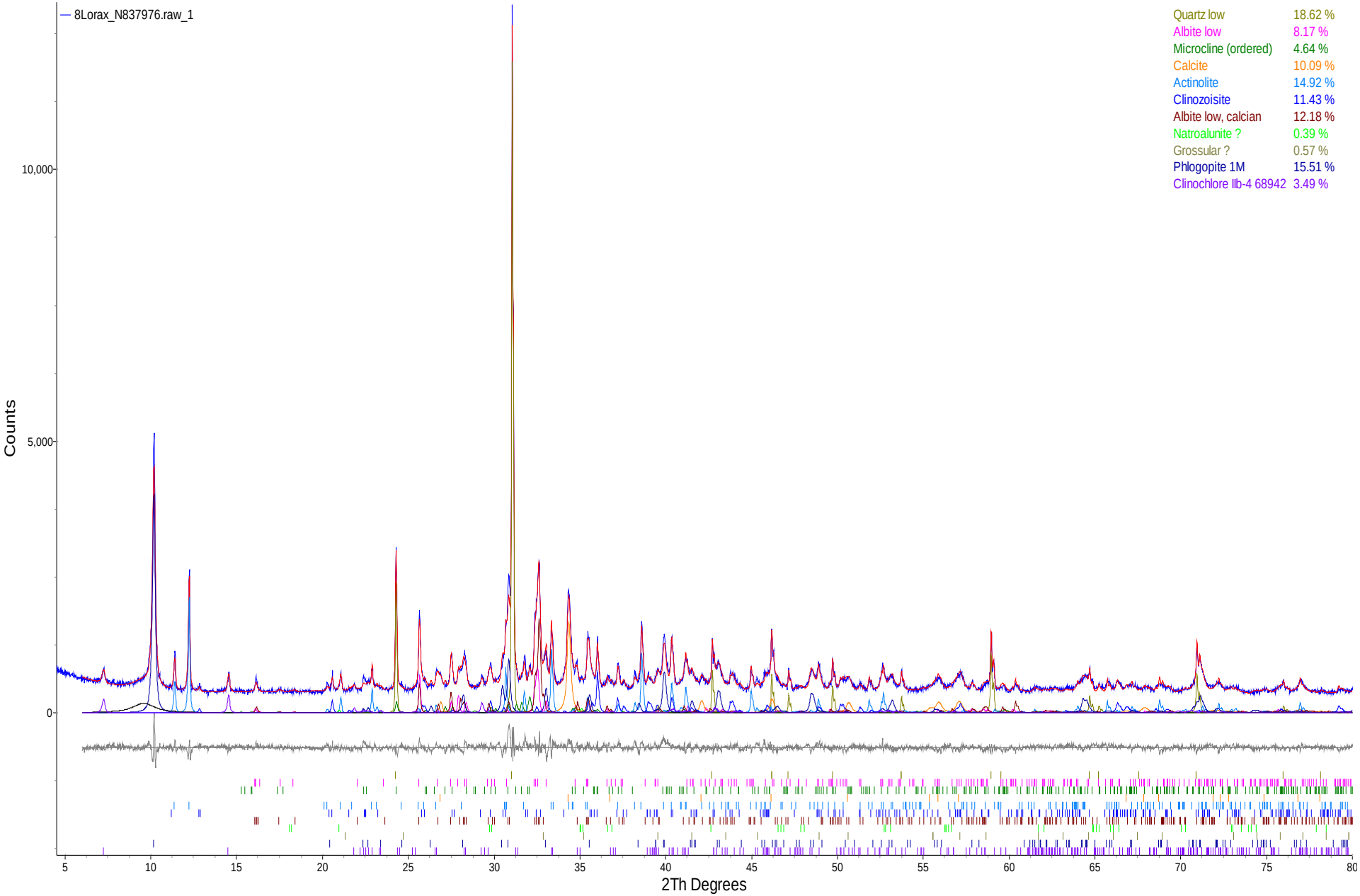


Figure 8. Rietveld refinement plot of sample **Lorax Environmental "N837976"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

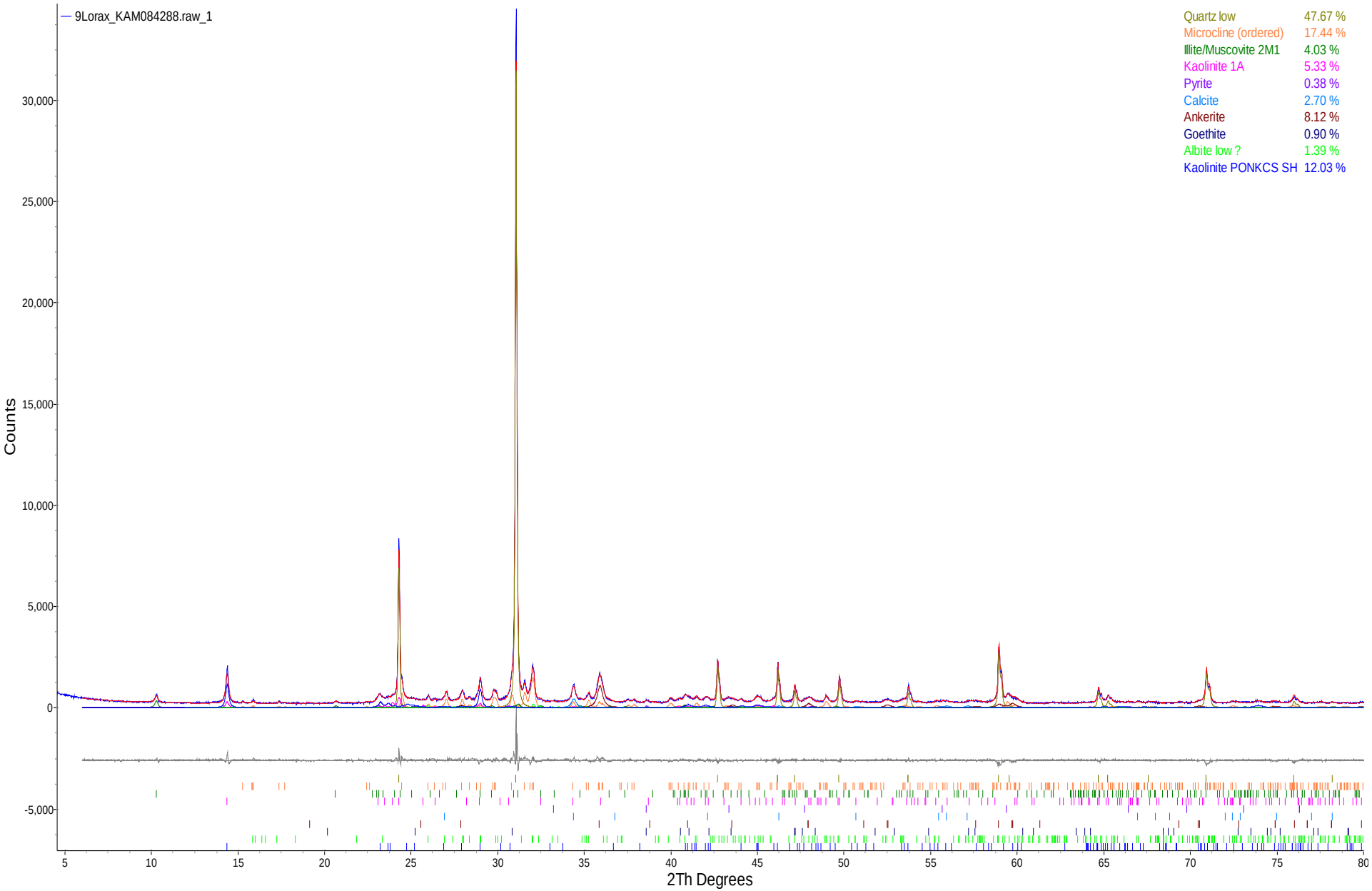


Figure 9. Rietveld refinement plot of sample **Lorax Environmental "KAM084288"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

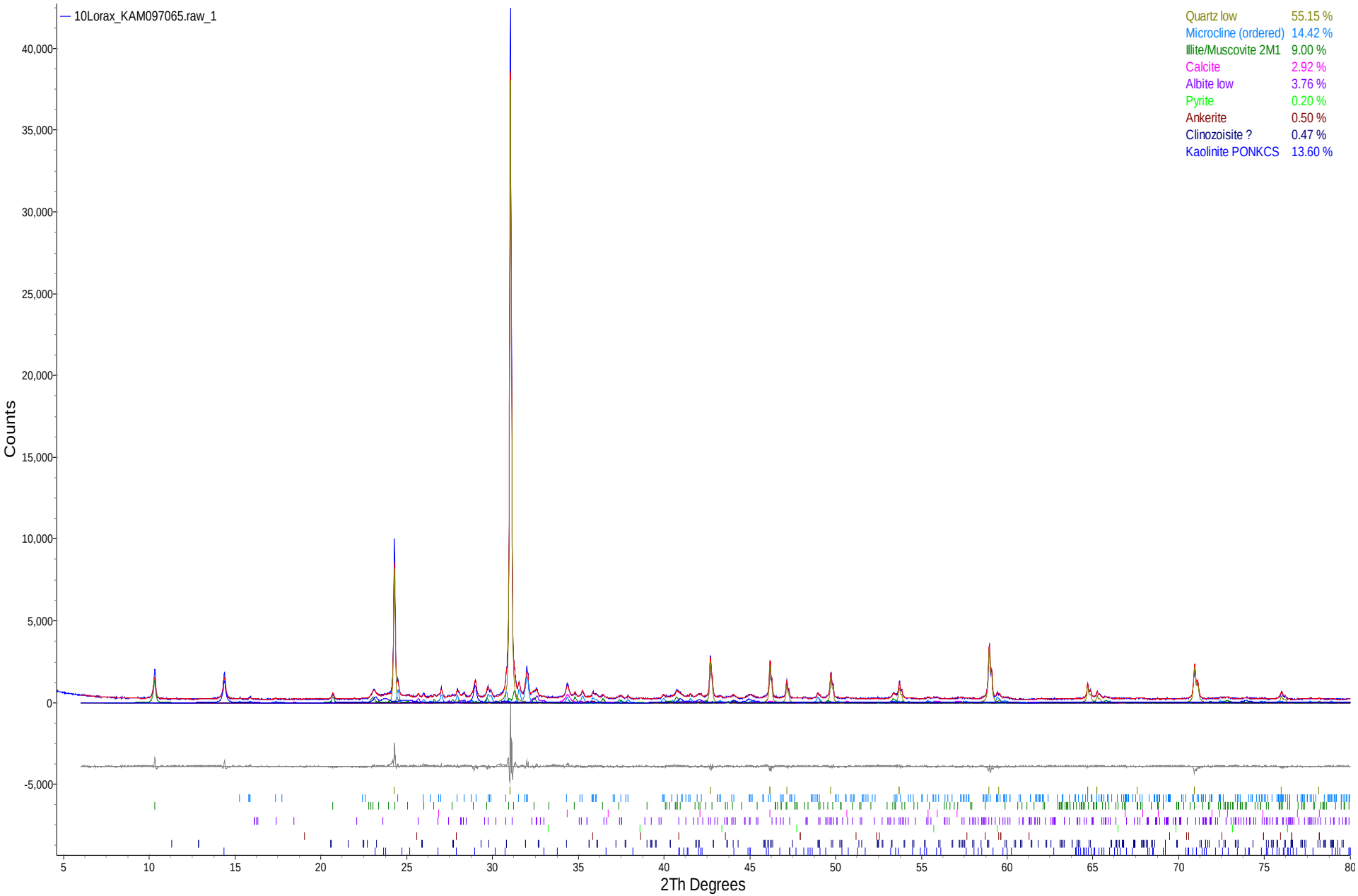


Figure 10. Rietveld refinement plot of sample **Lorax Environmental "KAM097065"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

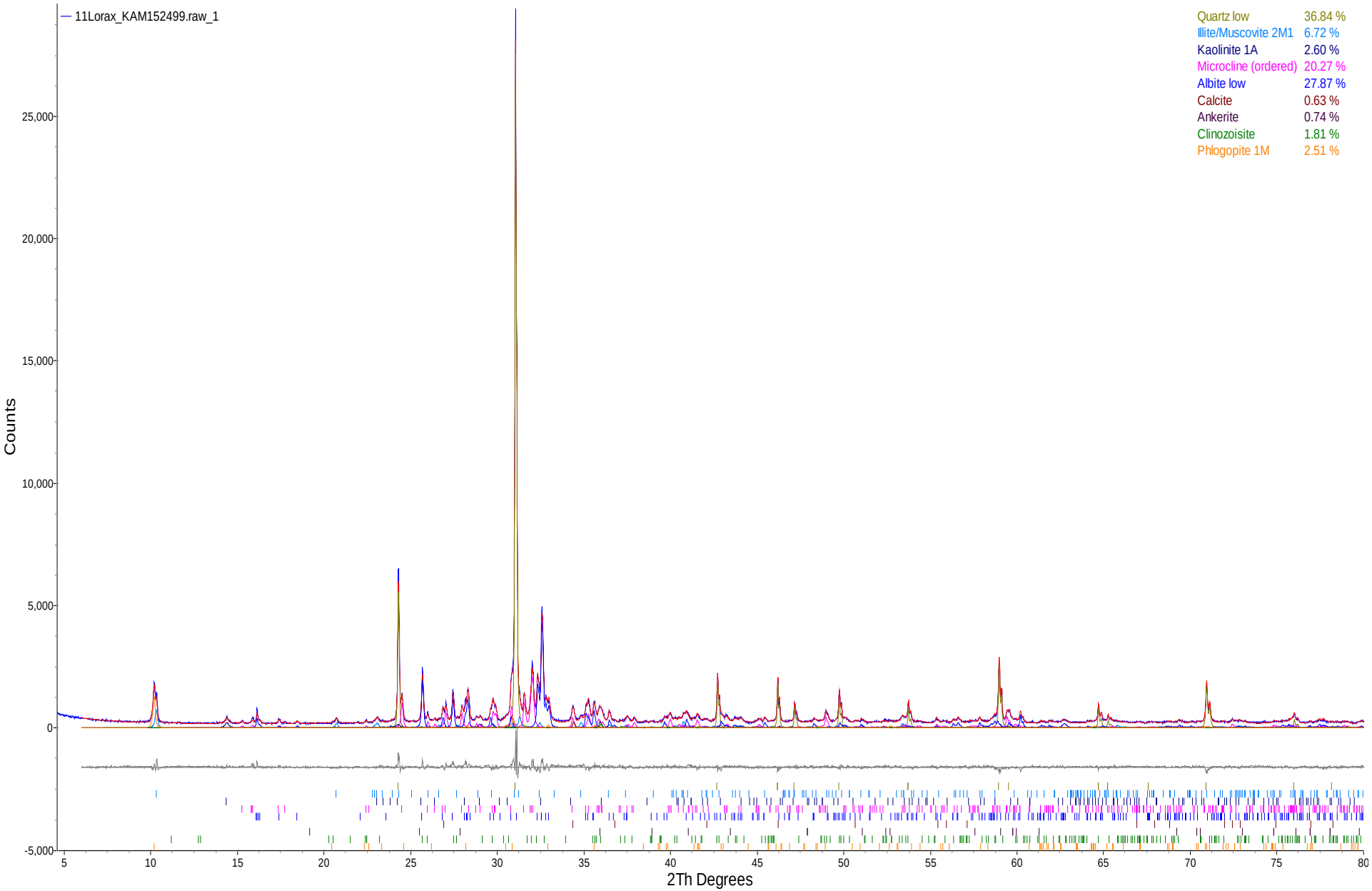


Figure 11. Rietveld refinement plot of sample **Lorax Environmental "KAM152499"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

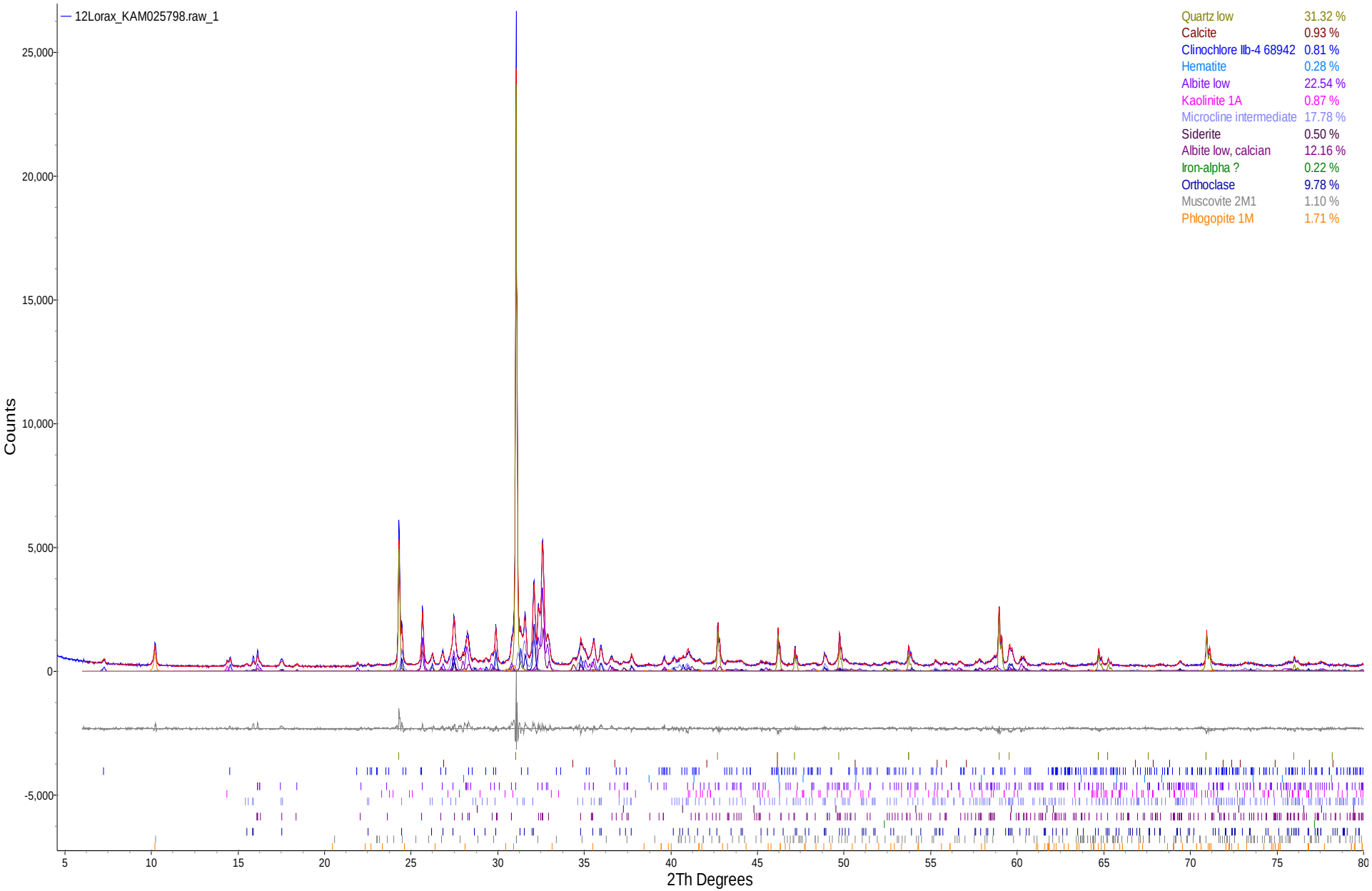


Figure 12. Rietveld refinement plot of sample **Lorax Environmental "KAM025798"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

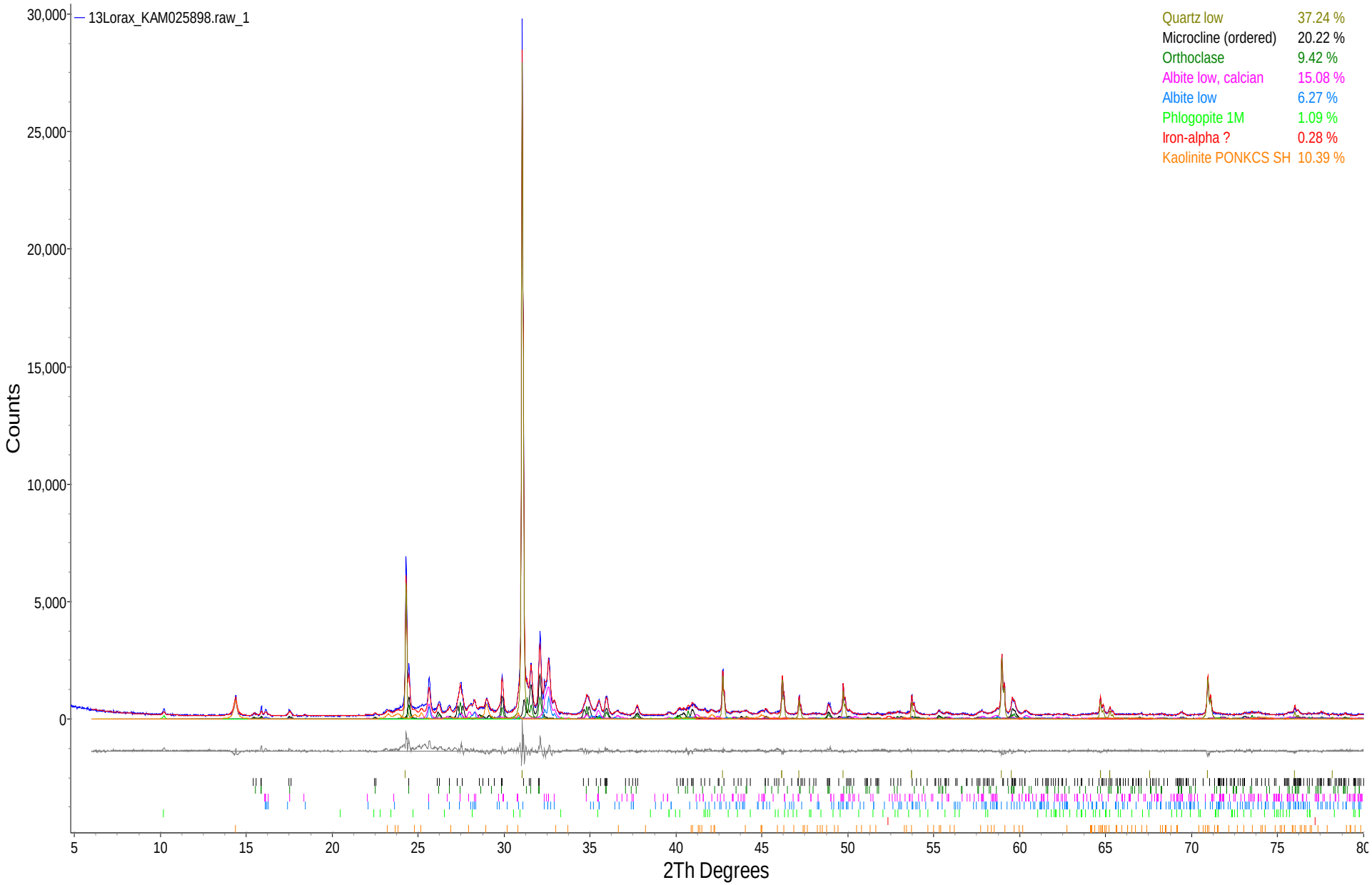


Figure 13. Rietveld refinement plot of sample **Lorax Environmental "KAM025898"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

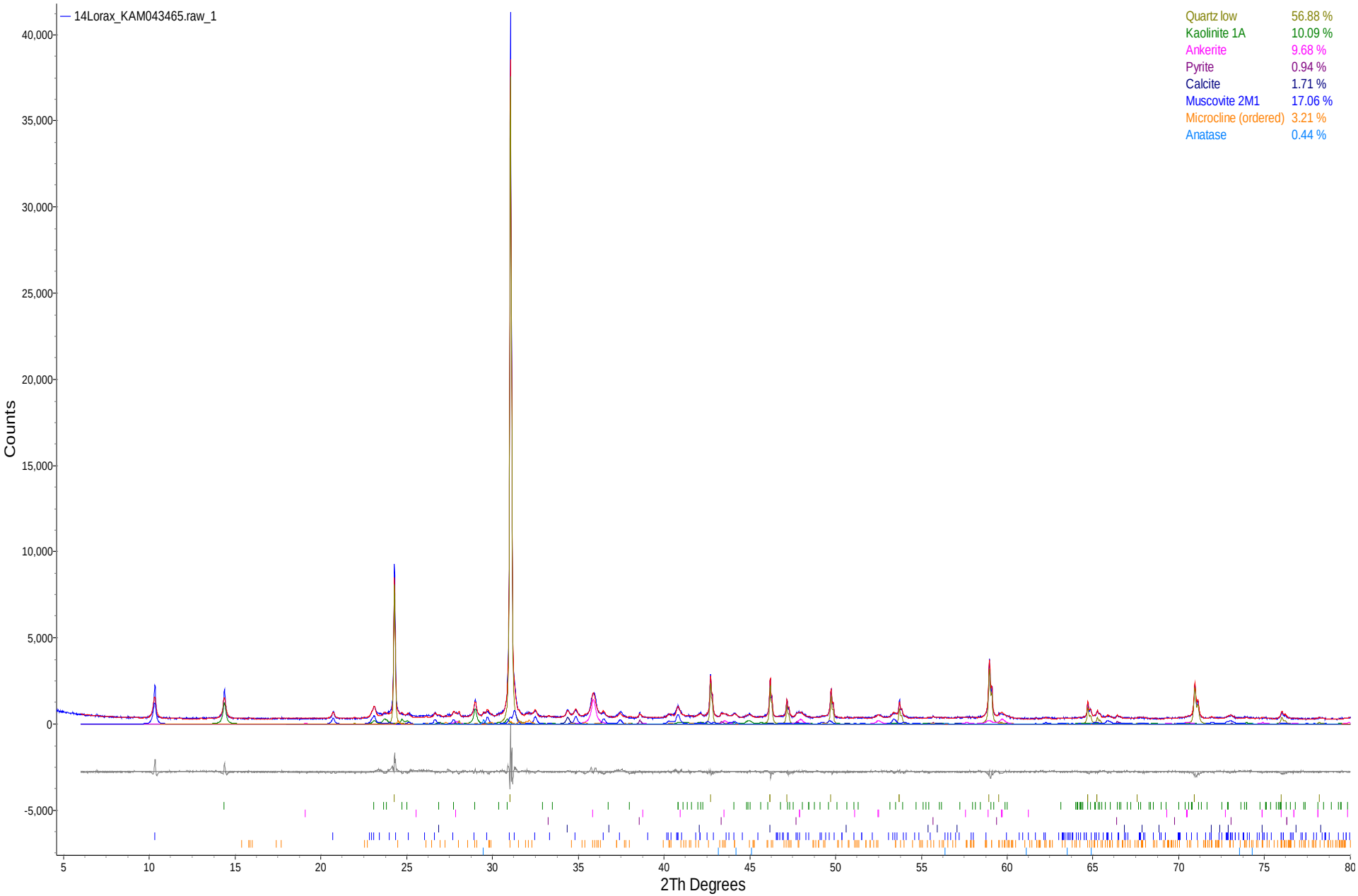


Figure 14. Rietveld refinement plot of sample **Lorax Environmental "KAM043465"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

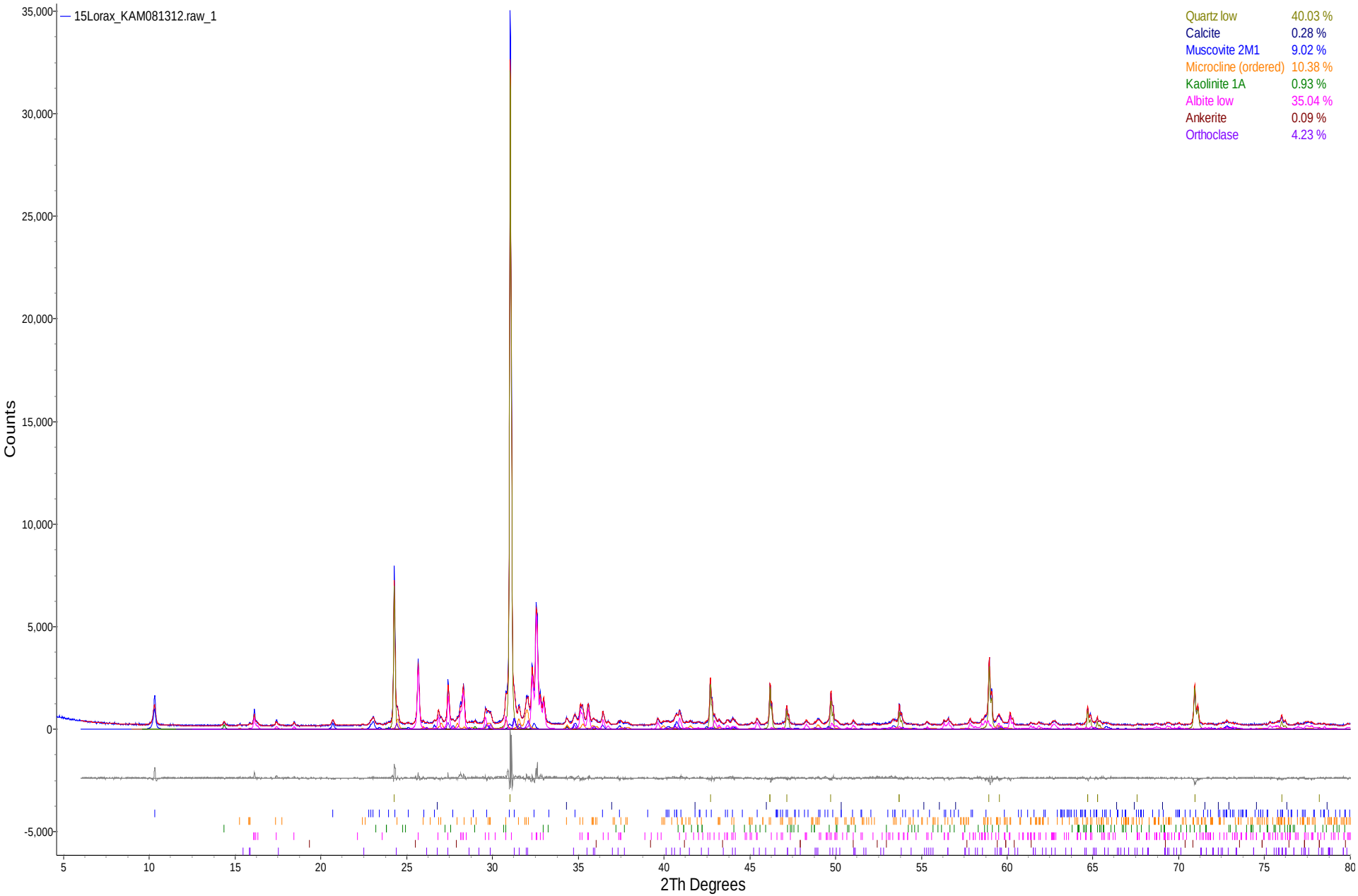


Figure 15. Rietveld refinement plot of sample **Lorax Environmental "KAM081312"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

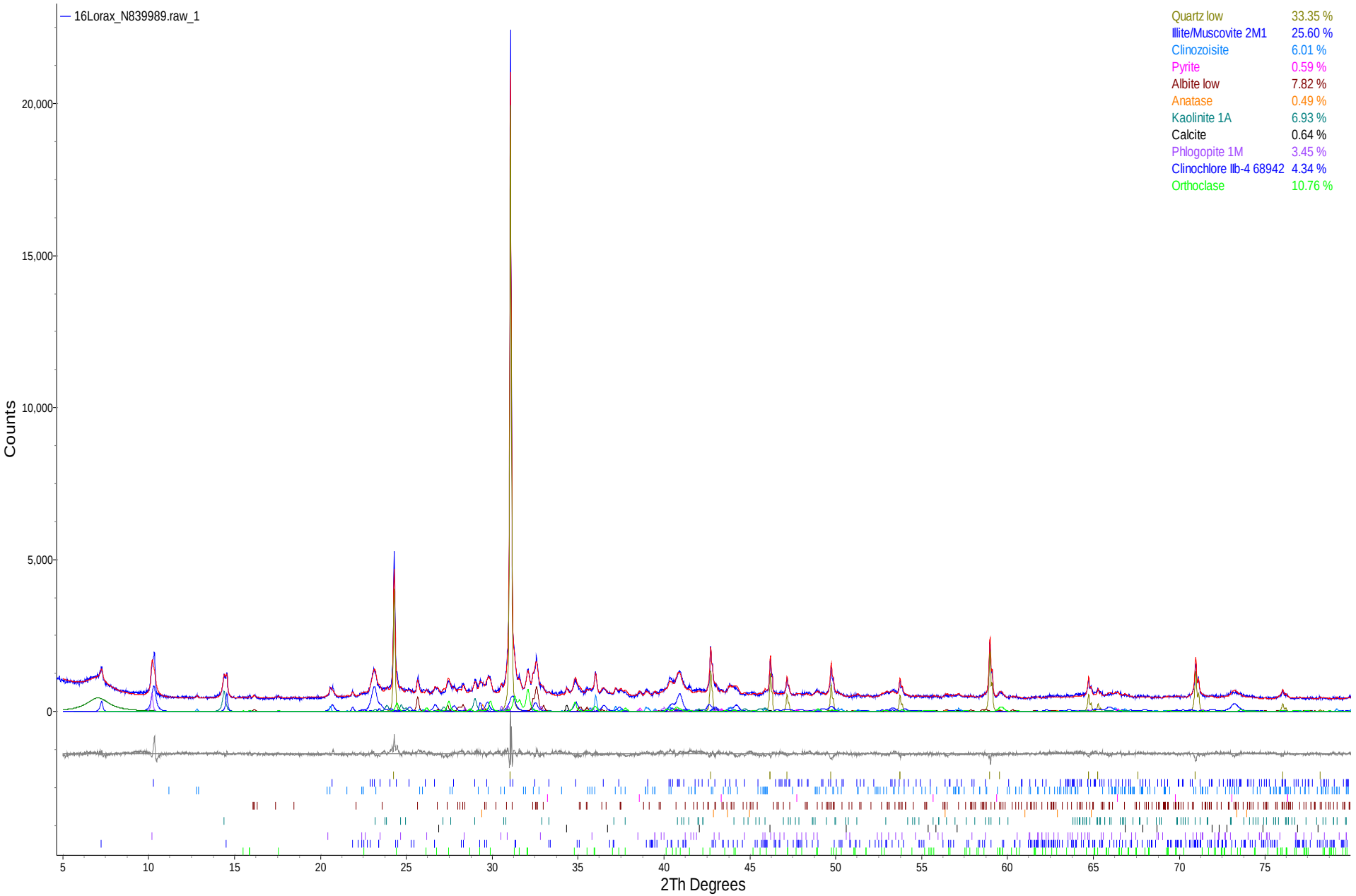


Figure 16. Rietveld refinement plot of sample **Lorax Environmental "N839989"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

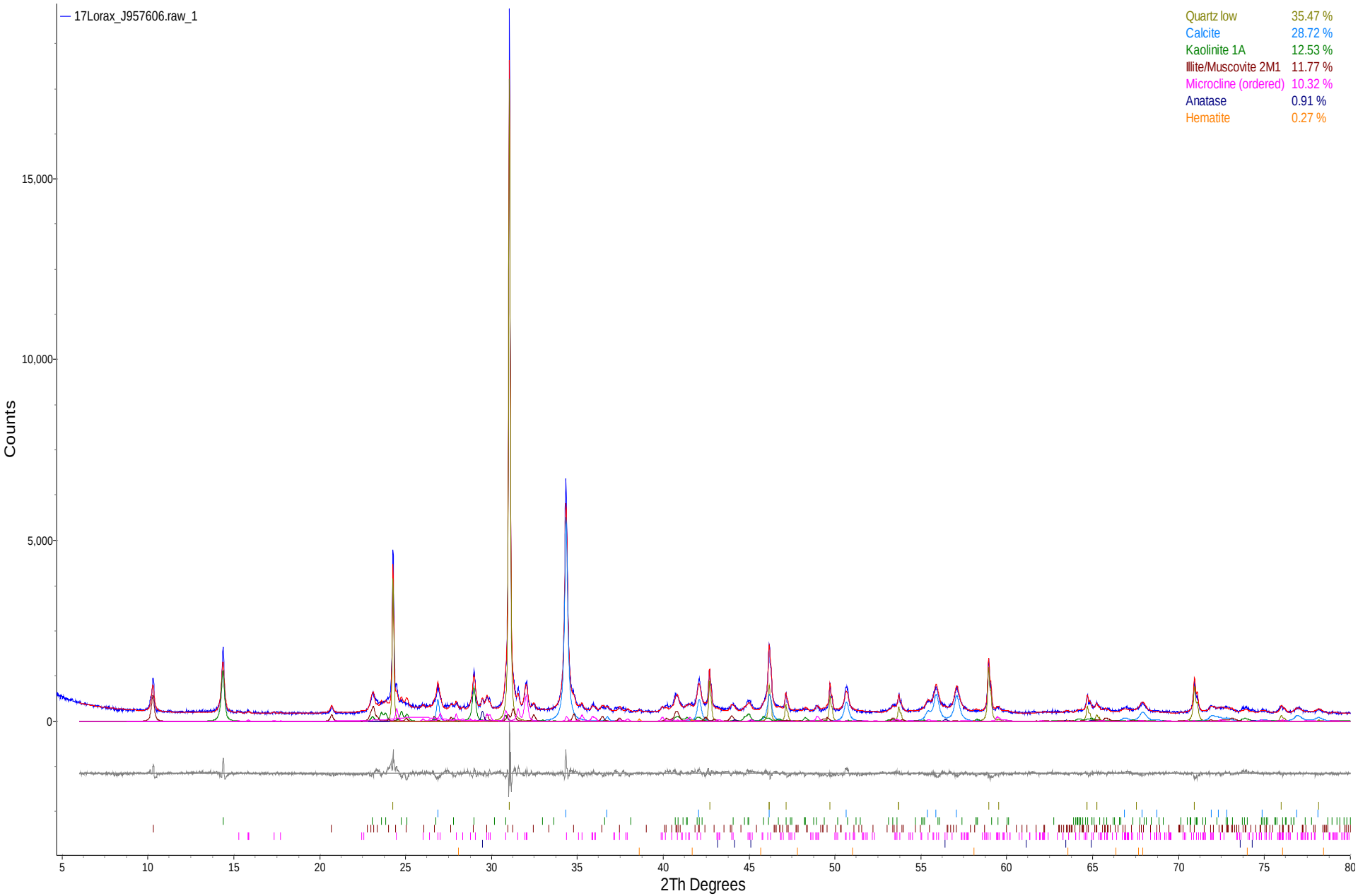


Figure 17. Rietveld refinement plot of sample **Lorax Environmental "J957606"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

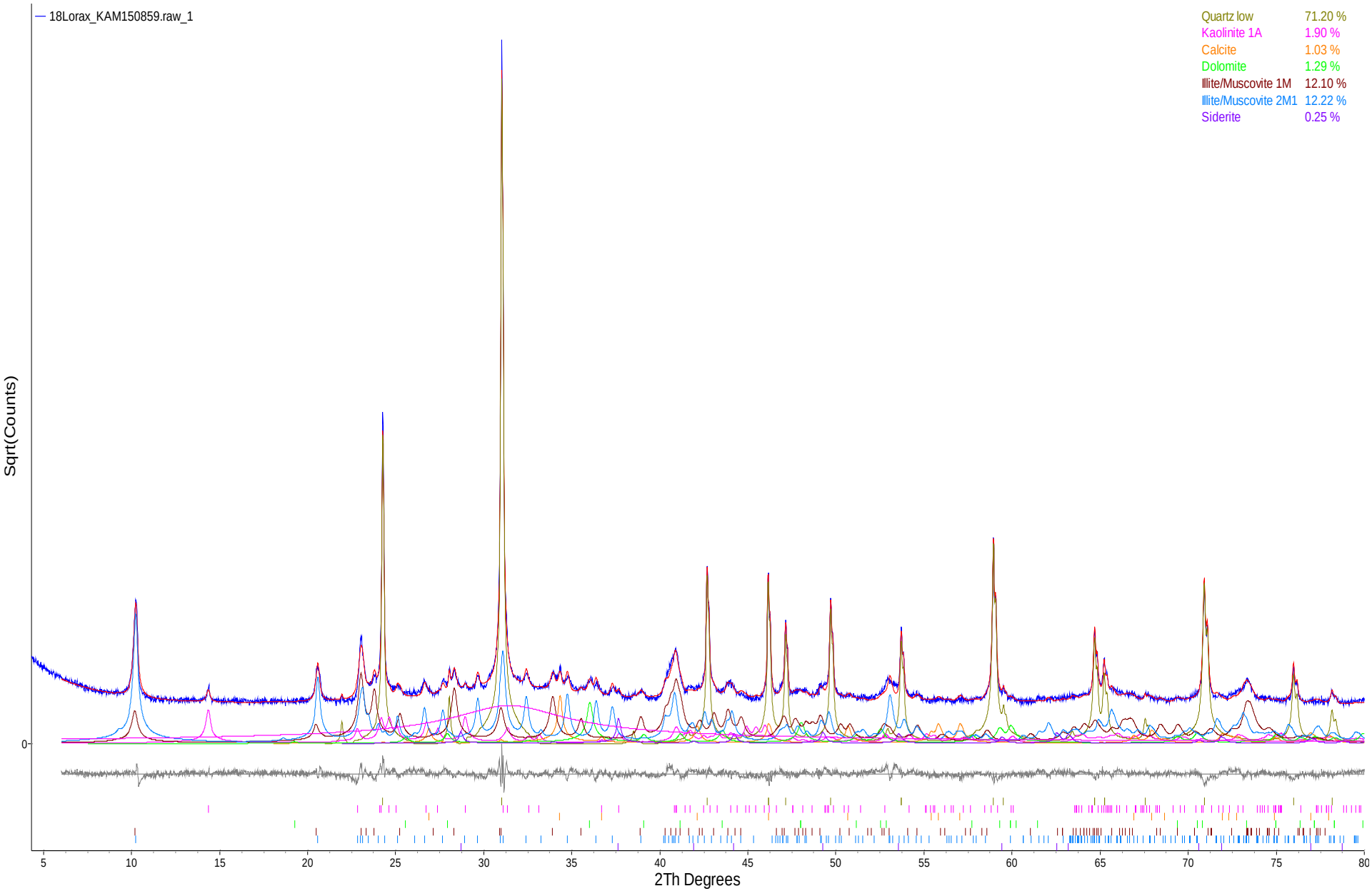


Figure 18. Rietveld refinement plot (y in sqrt) of sample **Lorax Environmental "KAM150859"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

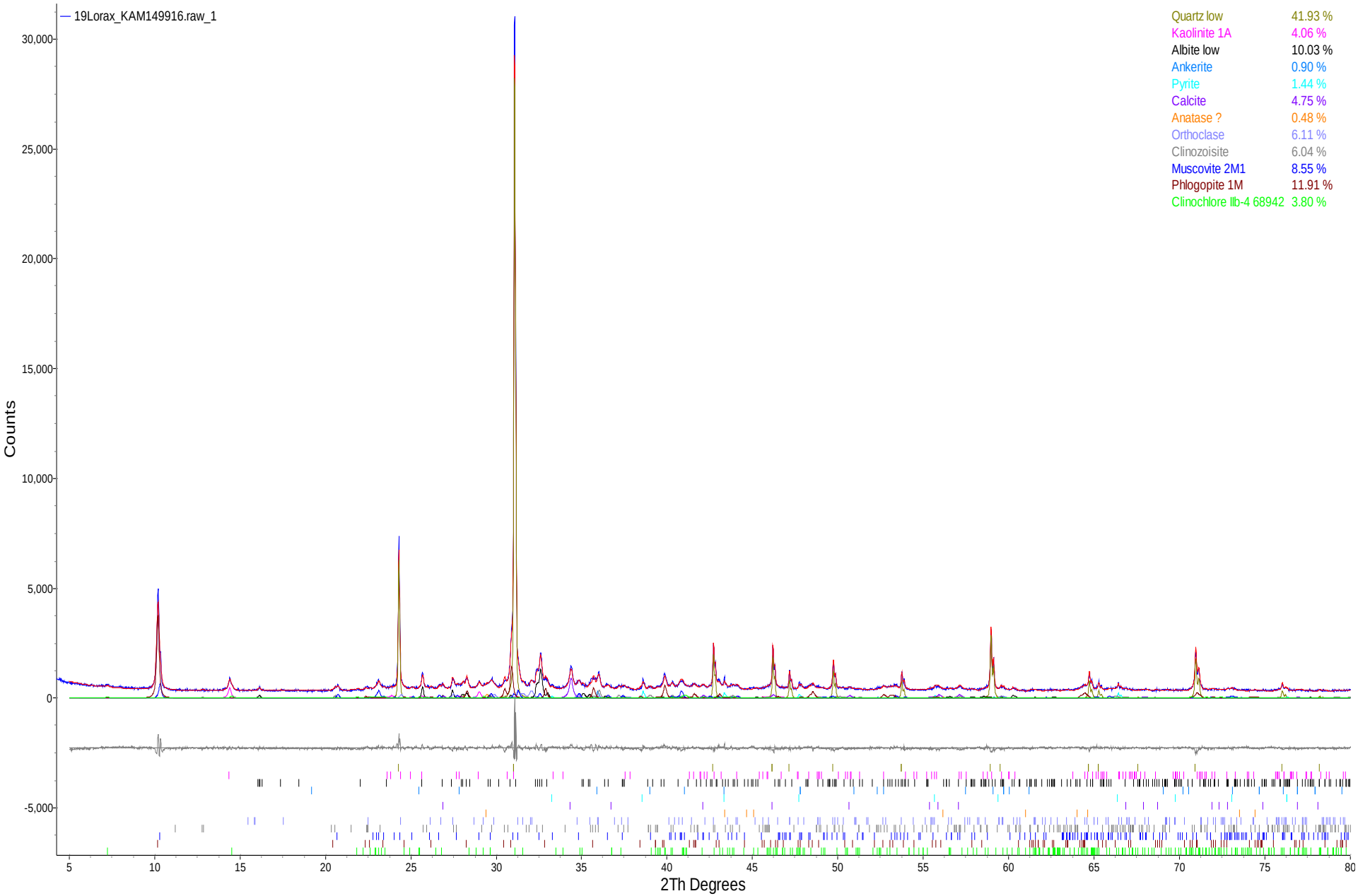


Figure 19. Rietveld refinement plot of sample **Lorax Environmental "KAM149916"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

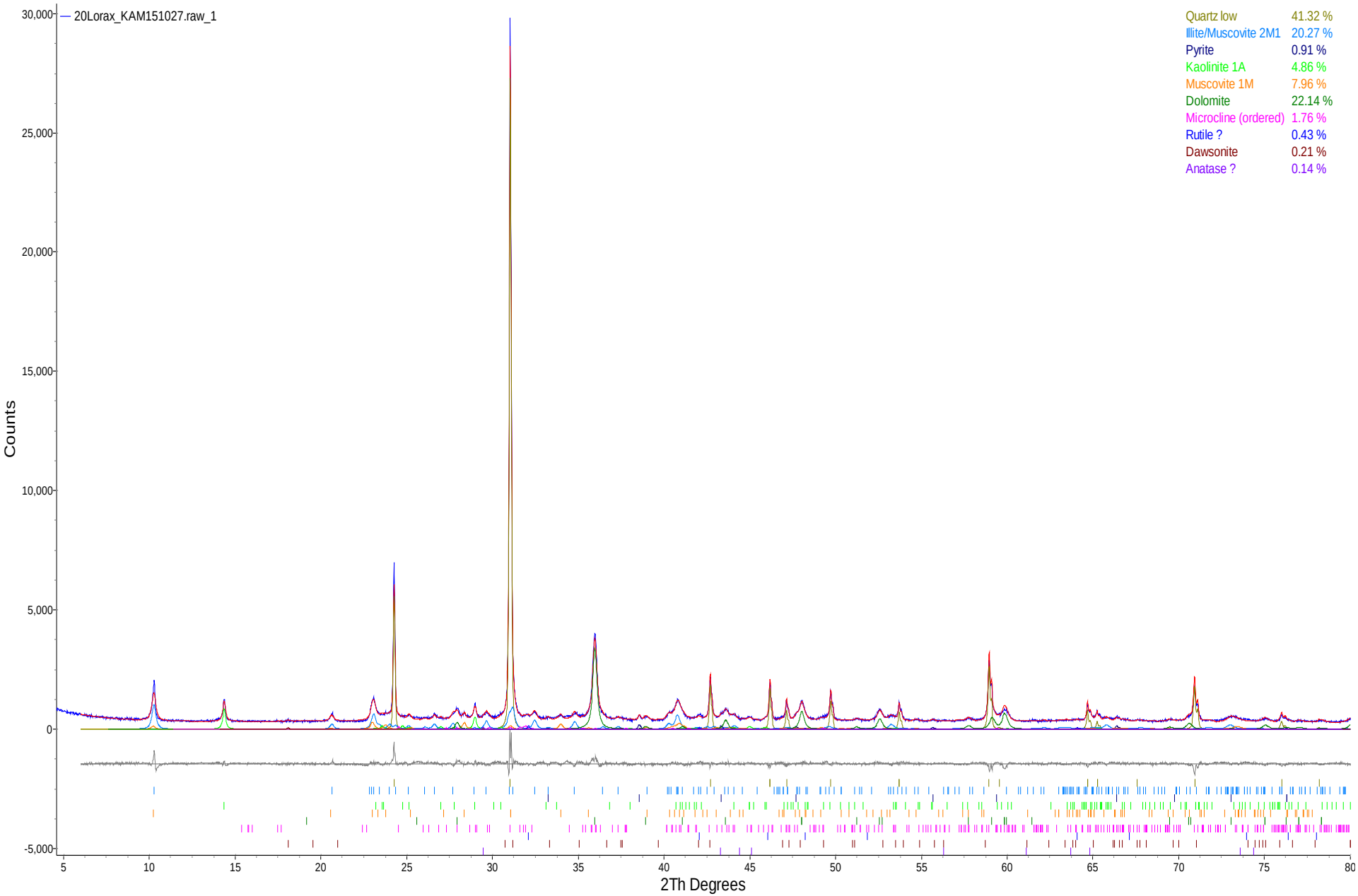


Figure 20. Rietveld refinement plot of sample **Lorax Environmental "KAM151027"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

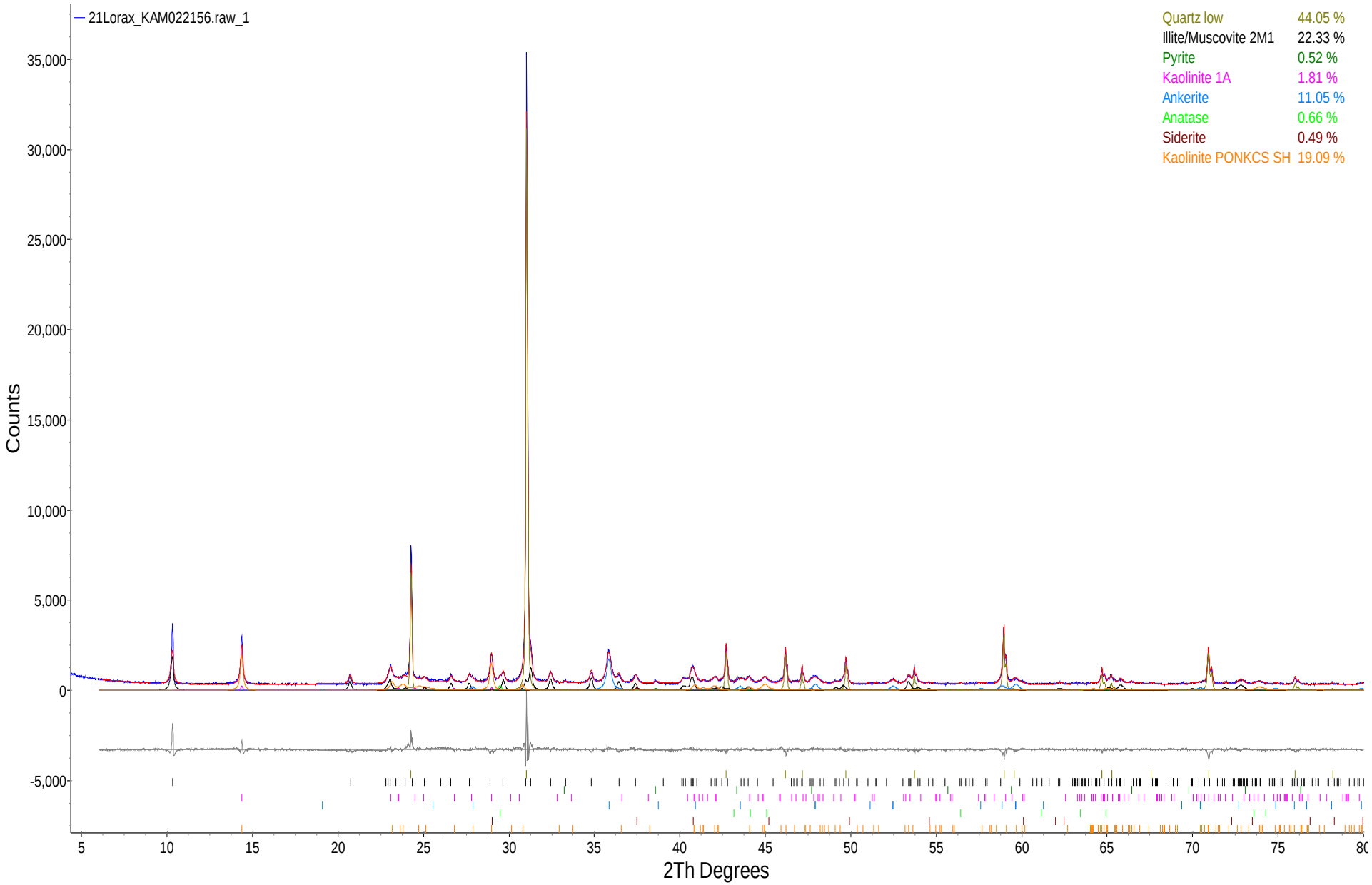


Figure 21. Rietveld refinement plot of sample **Lorax Environmental "KAM022156"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

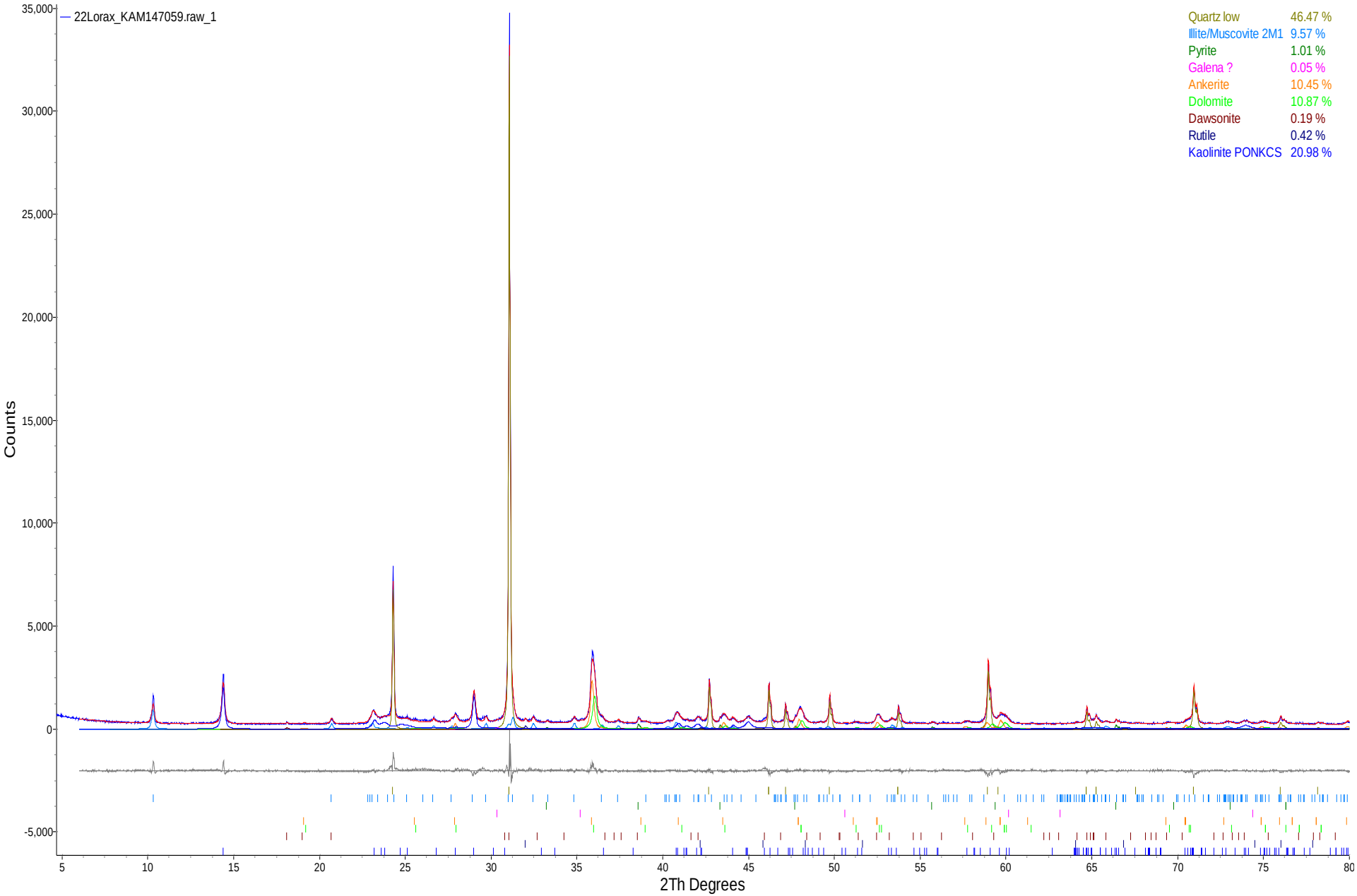


Figure 22. Rietveld refinement plot of sample **Lorax Environmental "KAM147059"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Appendix B.2: Mineralogical Assessments Completed at the Canadian Light Source

Report: Kaminak sample analyses at the Canadian Light Source

Prepared by: Viorica (Ibi) Bondici, Peter Blanchard, Samira Sumaila, and Joyce McBeth

Contact emails: joyce.mcbeth@usask.ca, vfb326@mail.usask.ca

Contact phone: 306-966-5764 (J. McBeth)

Version: 1.7 (final report)

1 Contents

2 PROJECT OBJECTIVES 4
3 BACKGROUND AND METHODS 4
3.1 Powder X-ray Diffraction (PXRD) 5
3.2 µ-X-ray fluorescence mapping (µXRF) mapping 6
3.3 X-ray absorption near-edge spectroscopy (XANES) 7
4 RESULTS AND INTERPRETATION 8
4.1 PXRD data 8
4.1 µXRF maps 12
4.1.1 Uranium in µXRF maps 12
4.1.2 Tri-colour µXRF maps 20
4.2 Arsenic µXANES data 28
4.3 Uranium XANES data 31
5 Findings 37
6 Considerations for future analyses 38
7 Appendix 40

List of Figures

Figure 3.1 Schematic diagram of PXRD using Debye-Scherrer geometry 6

Figure 4.1 XRF elemental distribution maps of 72144B sample..... 13

Figure 4.2 XRF elemental distribution maps of GS waste 15

Figure 4.3 XRF elemental distribution maps of KAM078808 sample..... 16

Figure 4.4 Verified U hotspots and corresponding spectra identified on the U/Rb XRF maps. These regions are marked with purple boxes. 18

Figure 4.5 Verified U hotspot regions and corresponding spectra identified on the U/Rb XRF maps. These regions are marked with purple boxes. 20

Figure 4.6 Tri-colour mapping plot of U, As and Fe 24

Figure 4.7 Colour map of U-Th and U-Ti..... 25

Figure 4.8 Tri-colour mapping plot of As, Fe and Ca 26

Figure 4.9 Colour map and scatter plot of As and Fe 26

Figure 4.10 Tri-color and scatter plot of As, Ca and Fe 28

Figure 4.11 Arsenic K-edge μXANES spectra..... 28

Figure 4.12 Arsenic spectra of samples compared to spectra calculated from linear combination fitting of the standards 30

Figure 4.13 Spatial overlap of verified U spots with a range of elements that can be found in various U-bearing mineral phases (Red=U, Ti=green, Fe, Ca, Cu=green). 33

Figure 4.13 Spatial overlap of verified U spots with a range of elements that are that can be found in various U-bearing mineral phases (Red=U, Ti=green, Fe, Ca, Cu=green). 34

Figure 4.14 Uranium L_3-edge XANES spectra..... 35

Figure 7.1 Verified U hotspot regions and corresponding spectra identified on the U/Rb XRF maps..... 41

Figure 7.2 Tri-color mapping plot of U, As and Fe (Red=U, Green=As, Blue=Fe) 42

Figure 7.4 Colour map and scatter plot of As and Fe..... 45

Figure 7.5 Uranium L_3-edge XANES spectra..... 47

Figure 7.6 Linear combination fitting of Uranium..... 48

Figure 7.7 Uranium microXANES spectra..... 49

List of Tables:

Table 3.1 Sample ID and description..... 4

Table 4.1 Identified mineral phase in the ore samples..... 8

Table 4.2 Identified mineral phases in the waste samples..... 9

Table 4.3 Identified mineral phases in the-high uranium waste rock (KAM) samples 10

Table 4.4 Summary table of As and U microXRF analyses..... 21

Table 4.5 Relative abundance of As species estimated from the linear combination fits 31

Table 4.6 Relative abundance of U species estimated from the linear combinations fits. 37

Table 6.1 Summary table of the completed sample analyses..... 39

2 PROJECT OBJECTIVES

The main objective of this project was to evaluate uranium (U), arsenic (As) and antimony (Sb) in Yukon gold mine ore using synchrotron-based techniques.

To achieve these objectives, the following analyses have been conducted:

1. Crystalline phase identification with powder X-ray diffraction (PXRD) for 18 Yukon gold mine waste rock and ore samples.
2. Oxidation state analysis with X-ray absorption near-edge structure (XANES) spectroscopy of U and As in the waste rock and ore samples.
3. Micro X-ray fluorescence (μ-XRF) mapping of various elements of interest.

3 BACKGROUND AND METHODS

Table 3.1 Sample ID and description

Sample ID	Lithology	Oxidation	Waste rock/Ore	[U] (ppm)*	[As] (ppm)*
SO waste	Schist	Oxide	Waste Rock	2.55	369
ST waste	Schist	Transition	Waste Rock	2.7	67
SS waste	Schist	Sulfide	Waste Rock	3.2	30
GO waste	Gneiss	Oxide	Waste Rock	5.5	218
GT waste	Gneiss	Transition	Waste Rock	6.3	182
GS waste	Gneiss	Sulfide	Waste Rock	6.1	86
72139B GRO ore	Granite	Oxide	Ore	9.6	3080
72140B GRT ore	Granite	Transition	Ore	9.7	5770
72135B	Schist	Oxide	Ore	2.6	1430
72137B	Schist	Transition	Ore	2.6	1340
72144B	Gneiss	Oxide	Ore	13.1	789
72146B GT ore	Gneiss	Transition	Ore	11	1700
KAM029385	Schist	Oxide	High U Waste Rock	25.4	1150
KAM079346	Schist	Transition	High U Waste Rock	22.2	130
KAM047252	Schist	Sulfide	High U Waste Rock	40.3	288
KAM091516	Gneiss	Transition	High U Waste Rock	41	62
KAM078808	Gneiss	Sulfide	High U Waste Rock	15.1	98
KAM144308	Gneiss	Oxide	High U Waste Rock	30	469

* Uranium and arsenic measured by aqua regia digestion and ICP-MS data provided by Lorax

3.1 Powder X-ray Diffraction (PXRD)

PXRD is a powerful tool used to characterize the crystal structures of materials. Each mineral possesses a characteristic X-ray diffraction pattern that can be matched against a database of recorded phases. PXRD data is produced when a monochromatic beam is projected onto a sample at an angle; this produces diffraction pattern peaks, which can be used as "fingerprints" to identify the mineral phases present. In this work synchrotron powder diffraction was performed using Debye-Scherrer transmission geometry and an area detector (Figure 3.1).

High-energy synchrotron powder diffraction measurements were conducted using the Macromolecular Crystallography beamline (CMCF2) at the Canadian Light Source. CMCF2 is a bending magnet beamline with a Si (111) double crystal monochromator. The samples were ground and loaded into 1.5 cm long 0.032 inch polyimide capillary tubes and sealed at both ends with Loctite 454 gel epoxy. The samples and a lanthanum hexaboride (LaB_6) standard were analysed on CMCF2 at a wavelength of 0.68878Å (energy: 18 KeV). 2D diffraction patterns were collected on a Rayonix MX300HE detector at a distance of 200 mm. The 2D X-ray diffraction patterns were calibrated and integrated using GSASII software (Toby and Von Dreele, 2013). The LaB_6 was used to calibrate the sample-detector distance, detector centering, and detector tilt. The calibration parameters obtained were applied to the entire pattern before integration. Mineral phases were identified by matching the diffraction patterns of the samples to the patterns of reference single-phase mineral. The Inorganic Crystal Structure Database was used in combination with X'Pert HighScore Plus (PW3212) software. Elemental abundance ICP-MS data (provided by Lorax) were taken into consideration for the identification of the main phases present in the samples. Quantitative Reitveld refinement calculations were conducted on the data to provide quantitative estimates of identified mineral abundances in the samples. The synchrotron-based PXRD detection limit can be as low as 0.1% of total mineral phases; however, proportions of minor phases (1 % or

less) are generally interpreted to be semi-quantitative, due to the influence of factors such as differing amorphous content between samples and sample inhomogeneity.

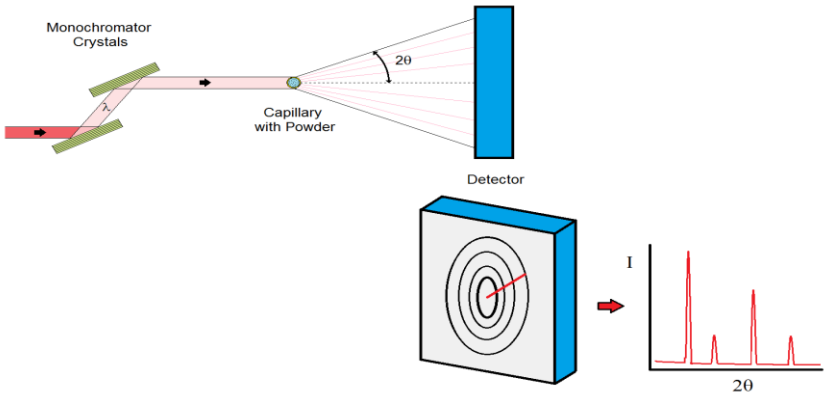


Figure 3.1 Schematic diagram of PXRD using Debye-Scherrer geometry

3.2 µ-X-ray fluorescence mapping (µXRF) mapping

Synchrotron X-ray fluorescence is a powerful approach for probing and mapping the distribution of a range of elements in a given sample. The principle of XRF is based on the detection of X-ray photons emitted from elements irradiated with X-rays. The emitted X-ray photon energies are element specific, providing a unique identification pattern for each element.

µ-XRF maps were collected on the Very Sensitive Elemental and Structural Probe Employing Radiation from a Synchrotron (VESPERS) beamline at the Canadian Light Source. Maps were collected using a pink beam (meaning the photon beam consists of a wide range of energies, max 20 keV) and several maps were collected monochromated for uranium (17199 eV). Maps were generally 300 x 300 µm in size (some smaller maps as well), collected with 5 x 5 um steps and a 1 s dwell time at each point. The beam spot size was on the order of 3 µm. µXRF spectra were collected for the following element regions of interest (ROIs), Ca K_α, Ti K_α, V K_α, Cr K_α, Mn K_α, Fe K_α – K_β, Ni K_α, Cu K_α, Zn K_α, Ga K_α, Ge K_α, As K_α-K_β, Se K_α, Rb K_α-K_β, Sr K_α-K_β, Pb L_α-L_β, Th L_α, and U L_α-L_β.It is important to note that elements with emission spectra that fall below

the Ar emission energy (2950.7 eV), such P (2013.7 eV) cannot be detected on this beamline. The complete μ-XRF spectra were also collected for each map pixel and any additional peaks were identified in the integrated map spectrum. Antimony peaks were specifically searched manually in the integrated spectra. MicroAnalysis Toolkit (SMAK) was used for the XRF image analyses.

3.3 X-ray absorption near-edge spectroscopy (XANES)

Each element has a characteristic energy at which it absorbs X-rays, termed the X-ray absorption edge; features of this edge and the absorption features of the element on either side of the edge can provide us with information about the oxidation state and coordination environment of the element of study. X-ray absorption near-edge structure (XANES) is part of the X-ray absorption spectrum in general ranging from -50 eV and +100 eV relative to the absorption edge, and XANES provides information about the oxidation state of the element of interest.

Arsenic and uranium μXANES spectra were collected at the CLS VESPERS beamline. For arsenic, the beamline was calibrated to an arsenic foil at the arsenic K-edge (binding energy of the K-shell electrons of arsenic) (11871.7 eV). The XANES spectra were collected by scanning through the As Kα absorption edge over 3 energy regions: -100 eV to -30eV in 10 eV steps; -30 eV to +40 eV in 0.5 eV steps; and +40 eV to +5K in 0.05 K steps. The dwell time for each step was 5 s and four spectra were collected for each sample to improve the signal to noise ratio and check for beam damage of the sample (the position and morphology of the edge in consecutive scans may change if the beam damages the sample). For uranium, the beam was calibrated to a yttrium foil (17038 eV) and a small μXRF map was collected for each sample at an energy of 17166 eV to search for U hotspots. For samples where a U hotspot was identified, U L_3 data was collected over the following energy regions: -100 eV to -30eV in 10 eV steps; -30 eV to +40 eV in 0.5 eV steps; and +40 eV to +5K in 0.05 K steps. The dwell time varied between 5-30 s depending upon the intensity of the U signal in each sample. Between 3 and 5 spectra were collected for each sample.

The Hard X-ray Micro-Analysis (HXMA) beamline was also used to obtain U XANES spectra. HXMA has both a higher photon flux hitting the sample and a more sensitive detector, which generally allows detection of much lower concentrations of U and transition

elements. However HXMA is used for bulk analyses, so for very localized spots of U VESPERS may sometimes be a more sensitive tool, because the beam can be focussed on a very small region on the sample. The HXMA beamline was calibrated to a yttrium foil at the first inflection point of the K absorption edge (17038 eV) and the uranium spectra were collected at the L_3 edge (17166 eV) over 5 energy regions: -200 eV to -160 eV, 10 eV steps; 160 eV to -100 eV, 0.5 eV steps (covering the yttrium foil calibration standard); -100 eV to -30 eV, 10 eV steps; -30 eV to +40 eV, 0.5 eV steps (uranium edge); and +40 eV to 14.2K, 0.05K steps. The dwell time for each step was 1 s.

XANES data analyses were performed using the ATHENA software suite (Demeter v. 0.9.22). In general, XANES spectra analyses provide information about the oxidation state of a given element and linear combination fitting (LCF) allow us to quantify relative abundance of species in a multi-species sample; however, the mineral phase of the element cannot be determined conclusively with this method alone. The oxidation state of each spectrum was extrapolated by comparing the absorption spectra of the samples to those of standards.

4 RESULTS AND INTERPRETATION

4.1 PXRD data

Detailed Reitveld analytical data diagrams are presented in the Appendix.

Table 4.1 Identified mineral phase in the ore samples

Sample ID	**72144B**	**72146B**	**72137B**	**72139B**	**72135B**	**72140B**
Lithology	**Gneiss**	**Gneiss**	**Schist**	**Granite**	**Schist**	**Granite**
Weathering	**Oxide**	**Transition**	**Transition**	**Oxide**	**Oxide**	**Transition**
Mineral	**Quant (wt. %)**					
Quartz	54.1	47.1	45.9	54.5	48.1	55.8
Microcline	8.5	12.3	4.1	10.5	17.7	7.3
Muscovite	11.9	10.4	13.1			18.1
Kaolinite	7.2	6.3	7.9	11.7	10.3	9.3
Phengite	18.2	7.7	7.3	21.8	9.2	
Albite		7.2			9.2	

Arsenopyrite		0.9			0.8	
Dolomite		3.4	15		3.5	
Scorodite				1.3		2.1
Barite*			0.5		0.2	
Calcite		2.5	4			
Orthoclase					0.9	7.3
Biotite			1.8			
Pyrite*		0.4	0.9	0.2	0.2	
Magnesiohornblende		1.7				

*Note: The synchrotron-based PXRD detection limit can be as low as 0.1% of total mineral phases; however, proportions of minor phases (1 % or less) are generally interpreted to be semi-quantitative, due to the influence of factors such as differing amorphous content between samples and sample inhomogeneity.

Table 4.2 Identified mineral phases in the waste samples

Sample ID	**SS**	**GS**	**GT**	**GO**	**SO**	**ST**
Lithology	**Schist**	**Gneiss**	**Gneiss**	**Gneiss**	**Schist**	**Schist**
Weathering	**Fresh**	**Fresh**	**Transition**	**Oxide**	**Oxide**	**Transition**
Mineral	**Quant (wt. %)**					
Pyrite*	1.3	0.2	0.2		0.4	0.2
Dolomite	14.4		3.6		3.5	
Quartz	29.8	38.5	49.9	46.2	53.2	28.2
Microcline	11.8	14.1	16.2	22	5.1	
Barite	0.3					
Calcite	5.1	2.3				10.6
Phengite	7.2		1.9		7.3	
Magnesium calcite	4.9	0.7	0.7		3.9	
Albite	12.8	22.3	8.4	11.3		18.5
Biotite	5.7					9.1
Muscovite		12.5	9	10.4	10.9	
Kaolinite	6.8	9.3	9.6	10.2	13.3	5.1
Arsenopyrite*			0.5			
Ankerite					2.3	
Orthoclase						11.1
Magnesiohornblende						3.3
Grossular						7.8
Diopside						6.2

*Note: The synchrotron-based PXRD detection limit can be as low as 0.1% of total mineral phases; however, proportions of minor phases (1 % or less) are generally interpreted to be semi-quantitative, due to the influence of factors such as differing amorphous content between samples and sample inhomogeneity.

Table 4.3 Identified mineral phases in the high uranium waste rock (KAM) samples

Sample ID	**078808**	**091516**	**144308**	**047252**	**079346**	**029385**
Lithology	**Gneiss**	**Gneiss**	**Gneiss**	**Schist**	**Schist**	**Schist**
Weathering	**Fresh**	**Transition**	**Oxide**	**Fresh**	**Transition**	**Oxide**
Mineral	**Quant (wt. %)**					
Albite	55.9	7.3				
Quartz	29.1	15.5	55.6	41	34.9	50.2
Phengite			10.1	3.1	12.2	21
Kaolinite	1.7	12.7	9.6	10.9	21.2	20
Dolomite	4.9	6.3		7.9	11.5	
Pyrite*	0.7			0.6		
Microcline		27.9	24.4		10.4	6.5
Magnesium calcite		7.1				
Calcite	0.5	6.7		2		
Phlogopite		14.1				
Ankerite		2.4		11	9.8	
Barite*			0.2			
Muscovite	7.2			22.3		
Pyrite, arsenian				0.8		

Manganese sulfide*				0.4		
Diopside						2.2

*Note: The synchrotron-based PXRD detection limit can be as low as 0.1% of total mineral phases; however, proportions of minor phases (1 % or less) are generally interpreted to be semi-quantitative, due to the influence of factors such as differing amorphous content between samples and sample inhomogeneity.

4.1 µXRF maps

4.1.1 Uranium in µXRF maps

µXRF maps were collected using a pink beam (broad energy spectrum) for 18 samples and the distribution of 6 elements (U L_α, Zn K_α, Fe K_α, Ca K_α, As K_β, Sr K_α) is shown for each sample in Figure 4.1-4.3 and Figure 7.8- 7.23. Monochromated uranium µXRF maps were also collected prior to the µXANES analyses performed on the VESPERS beamline. It is important to note that the emission peaks of Rb L_α and U L_α partially overlap; therefore, U can be either masked or appear as a false positive when Rb is present in the sample. Potential presence of Rb is also indicated on the U XRF maps labeled as U L_α / Rb L_α. In addition, U and Rb often occur together, so each putative uranium hotspot region was inspected manually to ensure that the true uranium hotspots are correctly identified in the data. All the samples were examined, and true U hotspots were detected only in 5 KAM samples, 1 ore and 2 waste samples (Figure 4.4, 4.5, 7.1, U hotspot regions are highlighted in the U/Rb XRF maps). Though the concentration of U in the GO and GS waste samples was relatively low (5.5 and 6.1 ppm, respectively; ICP-MS data), we still observed verified U hotspots in these samples. This indicates that even though U concentrations were low, U occurred as highly concentrated particles. These particles are likely evenly dispersed in these ground samples since they were observed in duplicate XRF maps for the GS waste sample.

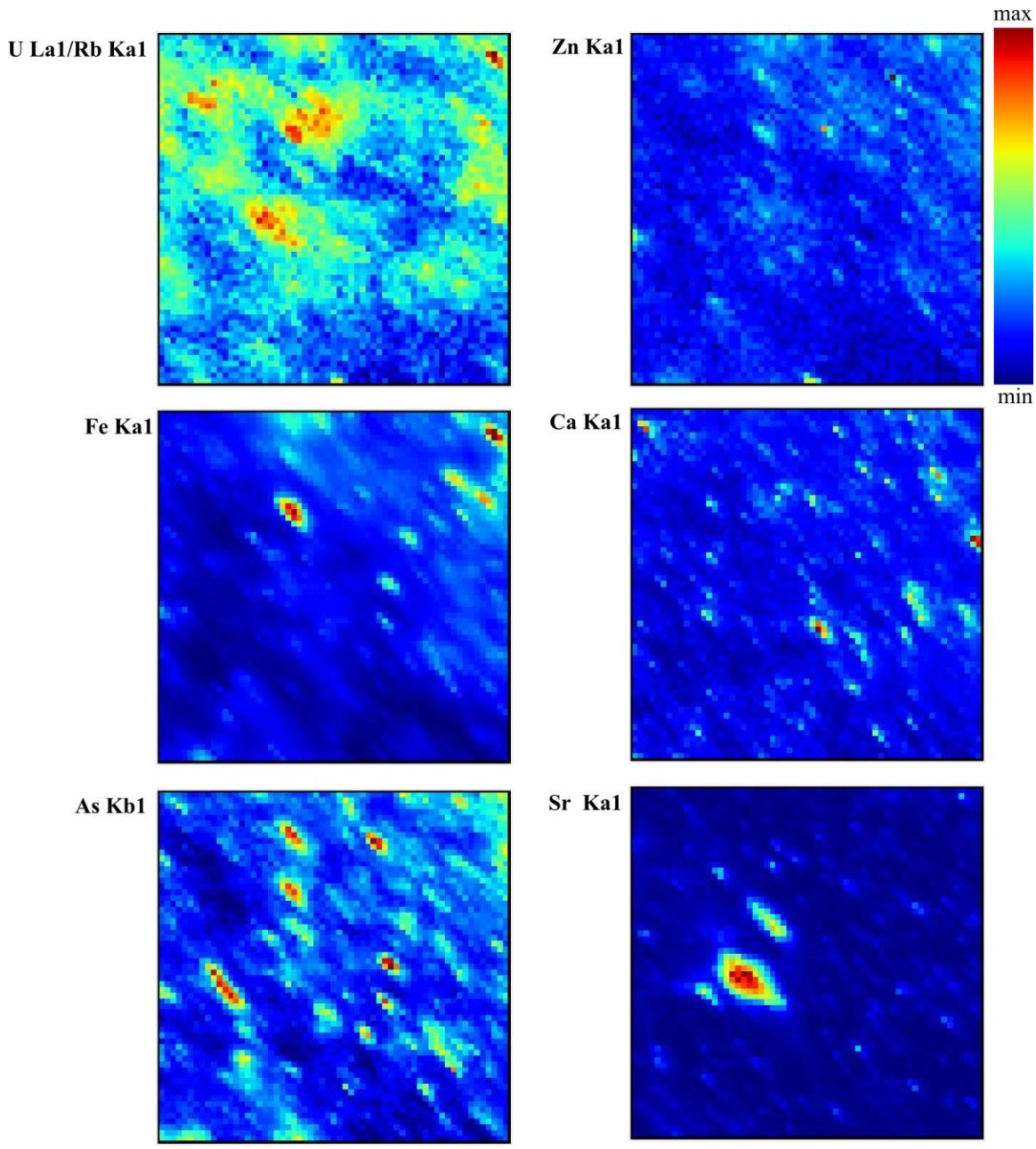


Figure 4.1 XRF elemental distribution maps of 72144B sample
X-ray fluorescence intensities of the elements are scaled between red (maximum) and blue (minimum).

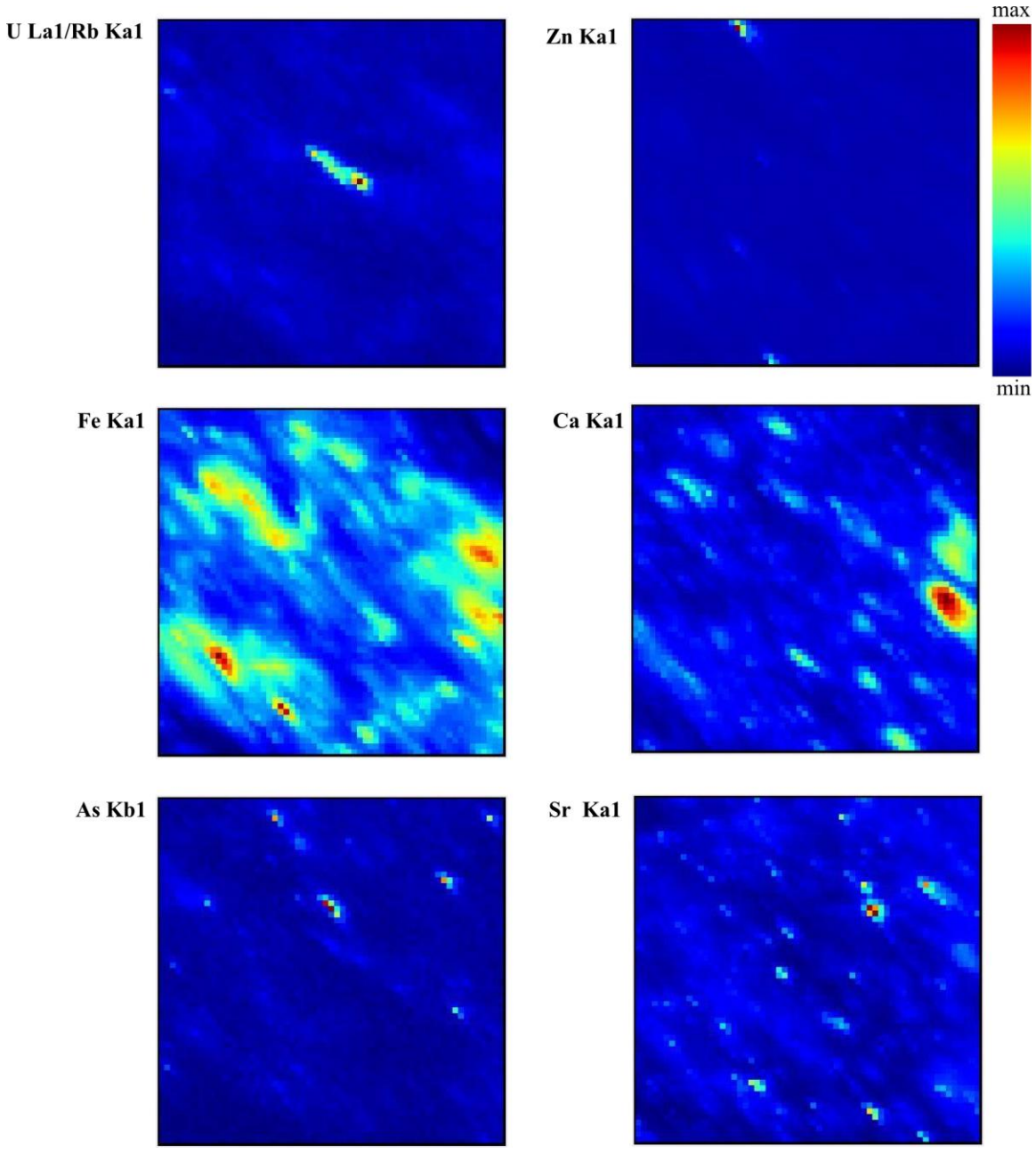

U La1/Rb Ka1
Zn Ka1
max
min
Fe Ka1
Ca Ka1
As Kb1
Sr Ka1

Figure 4.2 XRF elemental distribution maps of GS waste
X-ray fluorescence intensities of the elements are scaled between red (maximum) and blue (minimum).

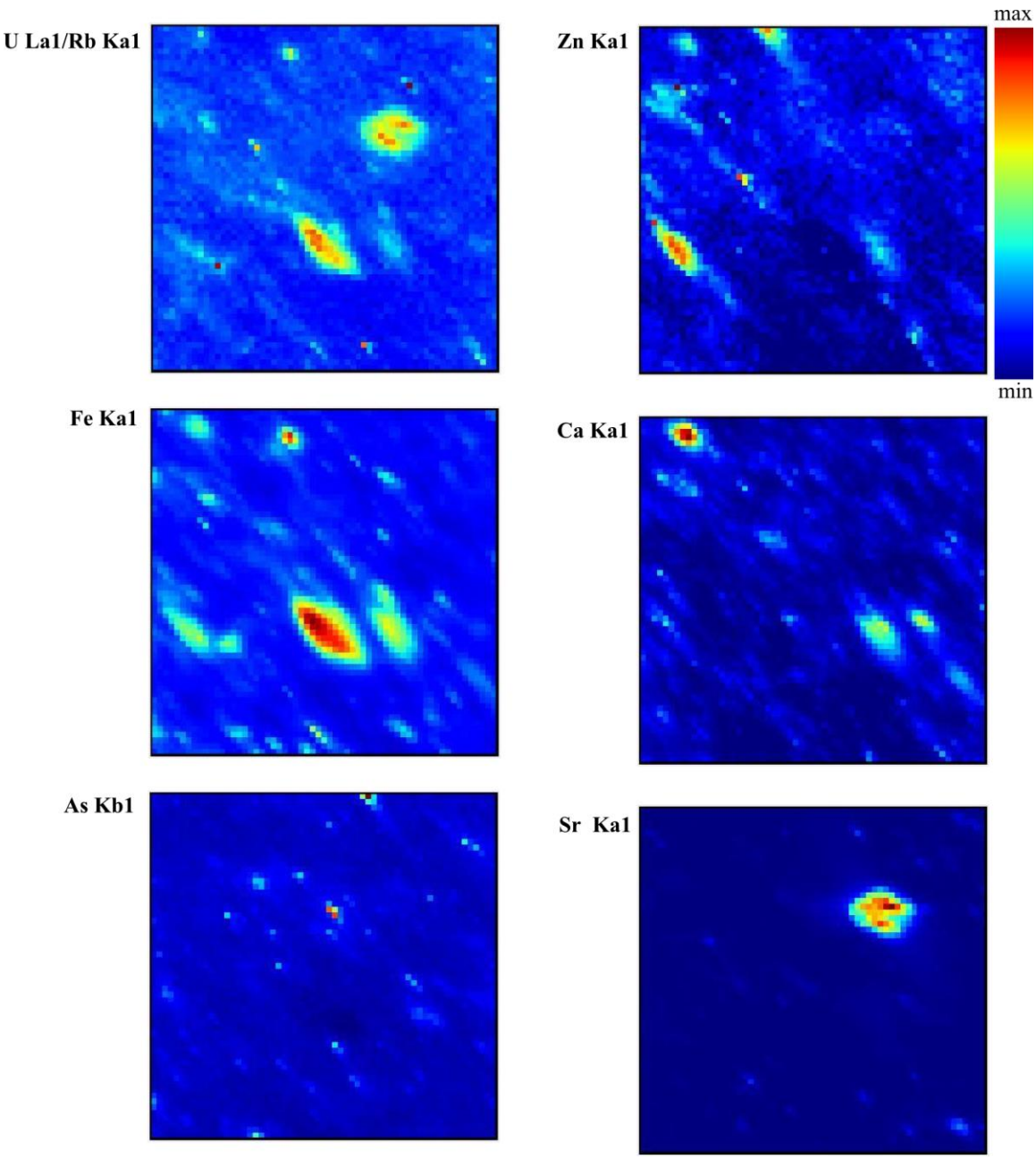
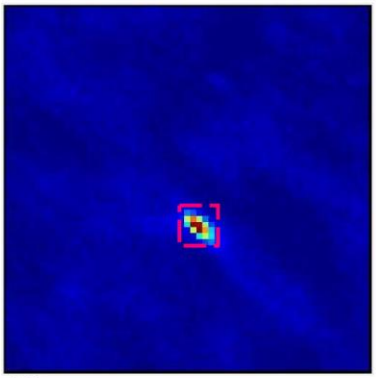
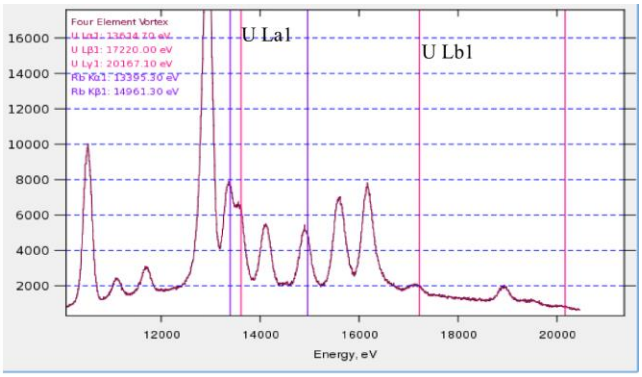
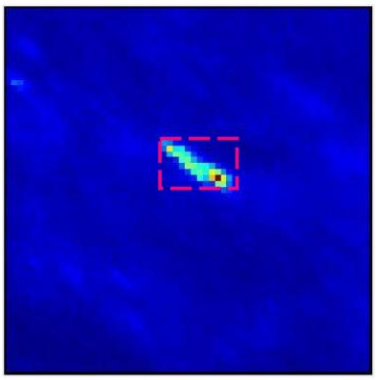


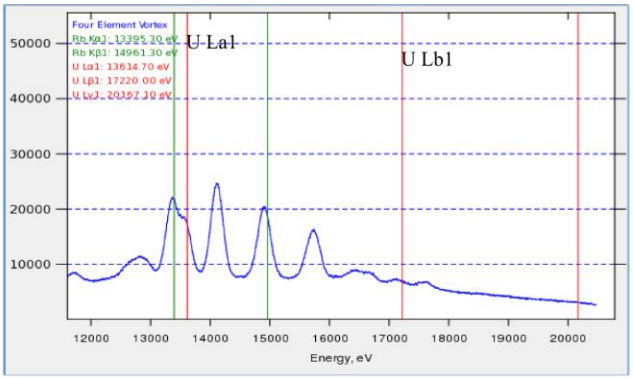
Figure 4.3 XRF elemental distribution maps of KAM078808 sample
X-ray fluorescence intensities of the elements are scaled between red (maximum) and blue (minimum).



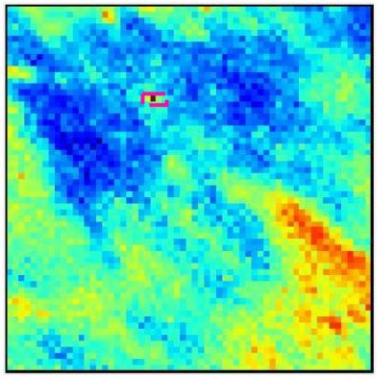


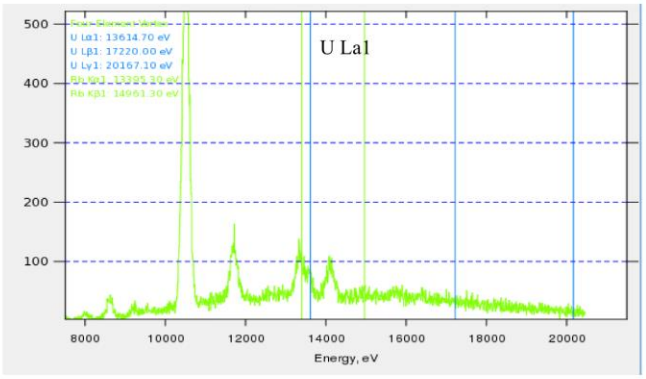
GO waste





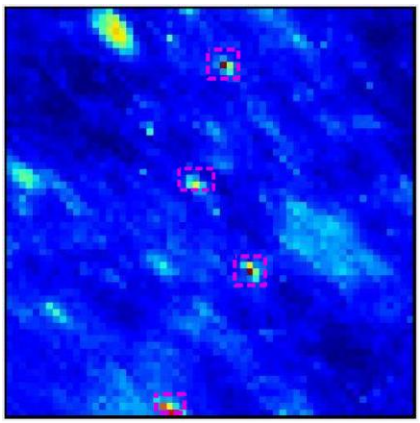
GS waste

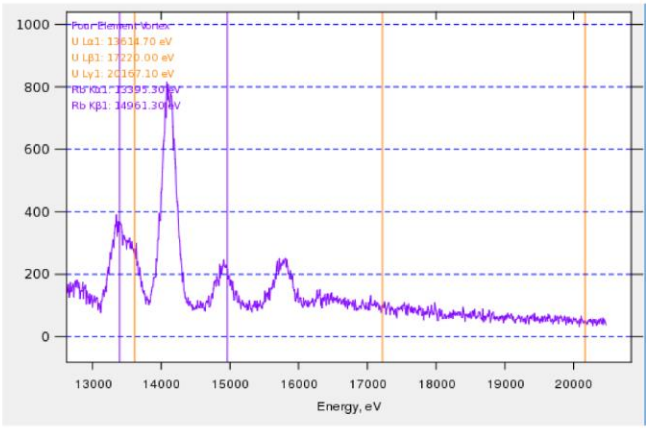




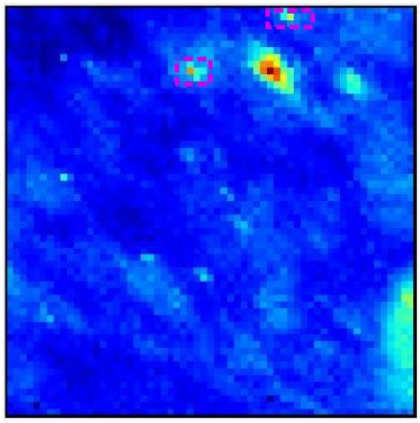
GT ore

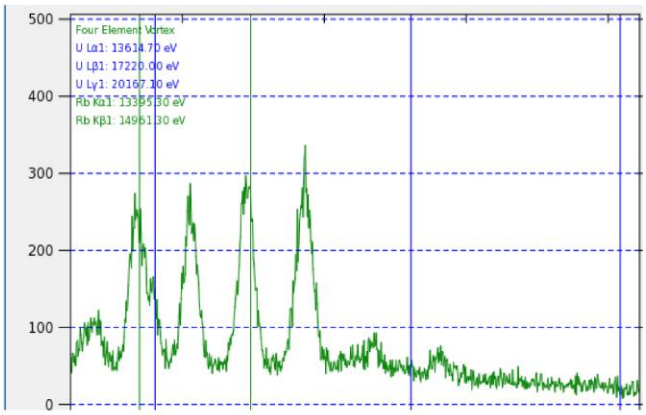
Figure 4.4 Verified U hotspots and corresponding spectra identified on the U/Rb XRF maps. These regions are marked with purple boxes**.**



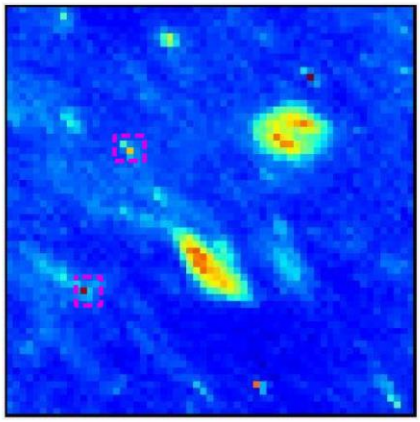


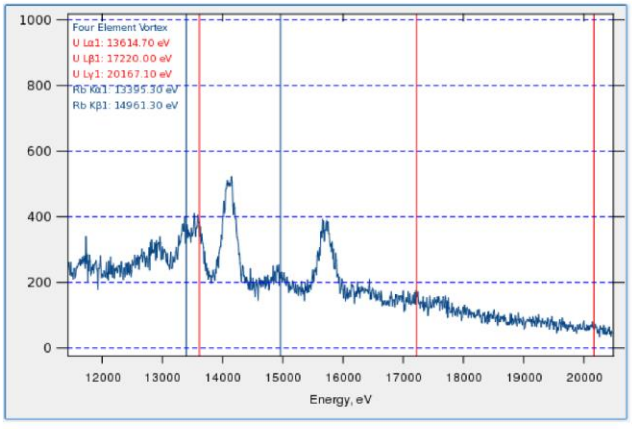
KAM047252





KAM091516





KAM078808

Figure 4.5 Verified U hotspot regions and corresponding spectra identified on the U/Rb XRF maps. These regions are marked with purple boxes.

4.1.2 Tri-colour µXRF maps

In order to investigate the presence of different types of primary (e.g. brannerite, thorite) and secondary (e.g. autunite, carnotite, torbernite, uranophane) uranium minerals in the samples, the co-occurrence of U with a range of elements (Ti, Th, V, Ca, Cu, As) was checked. Various As-bearing minerals were also checked by looking at potential association of As with Fe and Ca. Colour maps were prepared to illustrate the following co-localization patterns for elements that showed association with U and As: U/Fe/As, Ca/Fe/As, U/Th, and U/Ti.

Tri-colour plots illustrating co-localization of U with Fe and As are shown in Figure 4.6. From these images it is evident that U tends to co-occur with Fe, as indicated by purple coloured regions. Spatial overlapping of As with U and Fe is also visible (indicated with greenish/yellowish coloured regions) in GO waste and KAM047242 samples (Figure 4.6). The arsenic-bearing iron mineral phase arsenian pyrite has been identified in the KAM047242 using PXRD analysis (Table 4.3). Co-localization of U with Th and Ti is illustrated in Figure 4.7. Spatial overlap of U with Th is visible in KAM144308 and GO waste samples and of U with Ti in KAM091516 and GS waste samples.

To investigate the presence of Ca-Fe arsenate phases (such as yukonite) in the samples tri-colour plots were constructed for As, Ca and Fe (Figure 4.8; Figure 7.3). Distinct purple regions are visible in each sample, indicating that As tend to co-occur with Fe; however, distinct red regions in KAM091516, KAM078808, KAM047252, 72144B, 72135B, GS waste and GT waste samples indicate As is present at far higher concentrations than Fe in those regions (Figure 7.3). Only one whitish region was observed that indicates the co-occurrence of As, Ca, and Fe; this was in the 72137B sample (Figure 4.8). To test this apparently relationship, we sub-selected scatter-plotted data points from this map that had the following relationships: high As/high Fe, high As/high Ca, and high Fe/low Ca (Figure 4.10). This analysis confirmed that the whitish region was relatively high in Ca/Fe/As, and distinct from the surrounding region that was high in Fe but low in Ca (Figure 4.10, high Ca/Fe/As region outlined in red). For most of the samples, As was correlated with Fe.. An example of this Fe and As relationship is

presented for the GRT ore sample (Figure 4.9). This is in agreement with the PXRD analysis where scorodite was identified in the sample (Table 4.2). Overall, these findings suggest that yukonite or other Ca/Fe/As phases could be present, however they are certainly not as prevalent in the samples as Fe/As phases, such as scorodite. A summary table of μXRF map data and spatial overlap of U and As with various elements are summarized in Table 4.4.

Table 4.4 Summary table of As and U microXRF analyses

Sample ID	micro XRF map	Verified Uranium spots	SPATIAL OVERLAP**							
			U/Fe	As/U/Fe	Ca/U	Cu/U	Ti/U	Th/U	Fe/As	As/Ca/Fe
SO waste	✓	**ND**							✓	
ST waste	✓	**ND**							✓	
SS waste	✓	**ND**							✓	
GO waste	✓	✓	✓	✓	✓	✓		✓	✓	
GT waste	✓	**ND**							✓	
GS waste	✓	✓	✓			✓	✓		✓	
GRO ore	✓	**ND**							✓	
GRT ore	✓	**ND**							✓	
72135B	✓	**ND**							✓	
72137B	✓	**ND**							✓	✓
72144B	✓	**ND**							✓	
GT ore	✓	✓							✓	
KAM029385	✓	**ND**							✓	
KAM079346	✓	✓	✓		✓				✓	
KAM047252	✓	☑	✓	✓	✓				✓	
KAM091516	✓	☑	✓		✓	✓	✓		✓	
KAM078808	✓	☑	✓			✓			✓	
KAM144308	✓	☑	✓		✓	✓		✓	✓	

*pink beam – broad energy spectrum
**spatial overlap- is not necessarily correlation
blank boxes indicate a lack of co-occurrence, all possible combinations in the table have been checked
☑- indicate multiple U spots were detected

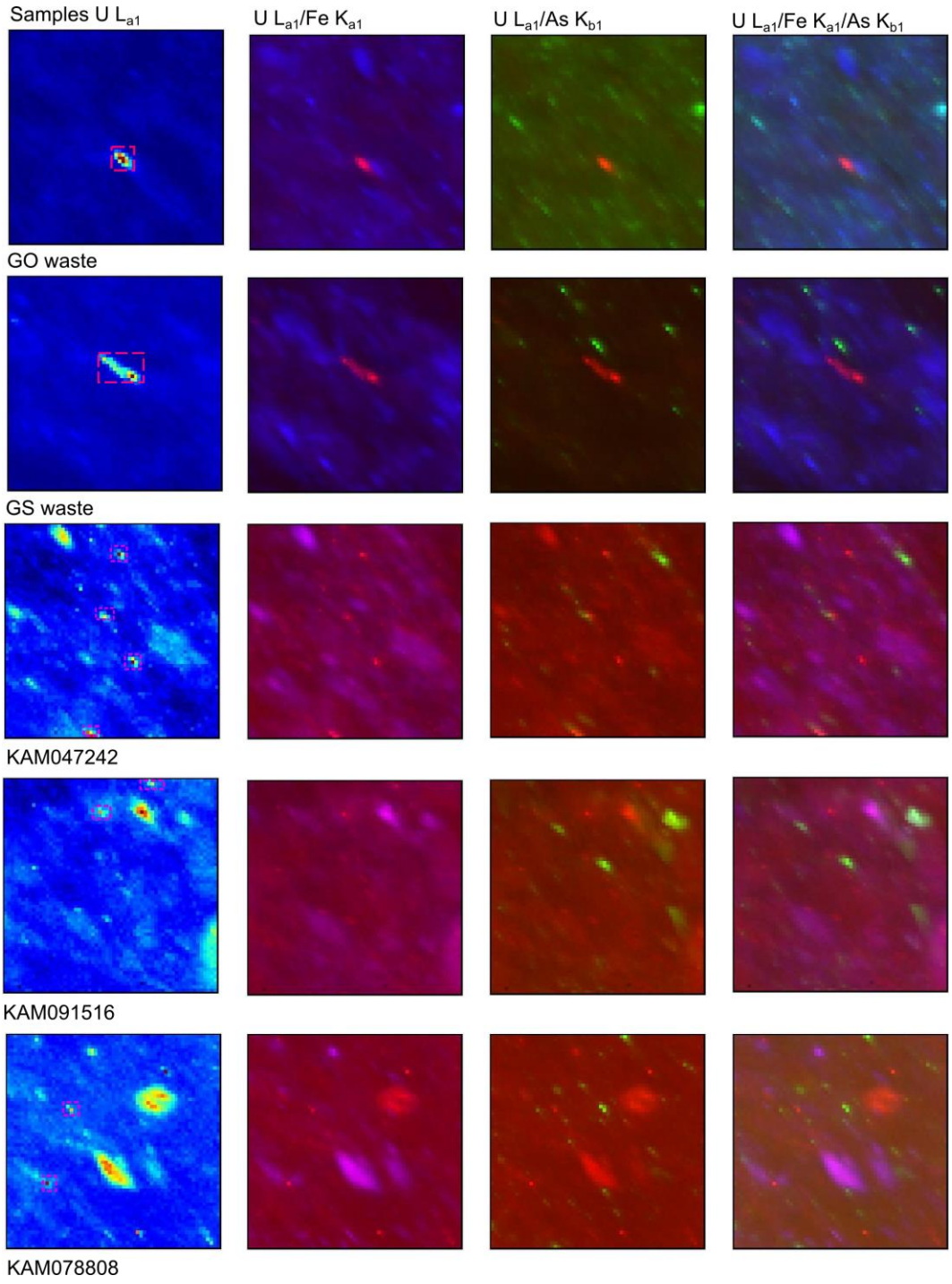

Samples U L_{a1}
U L_{a1}/Fe K_{a1}
U L_{a1}/As K_{b1}
U L_{a1}/Fe K_{a1}/As K_{b1}
GO waste
GS waste
KAM047242
KAM091516
KAM078808

Figure 4.6 Tri-colour mapping plot of U, As and Fe
(Red=U, Green=As, Blue=Fe)

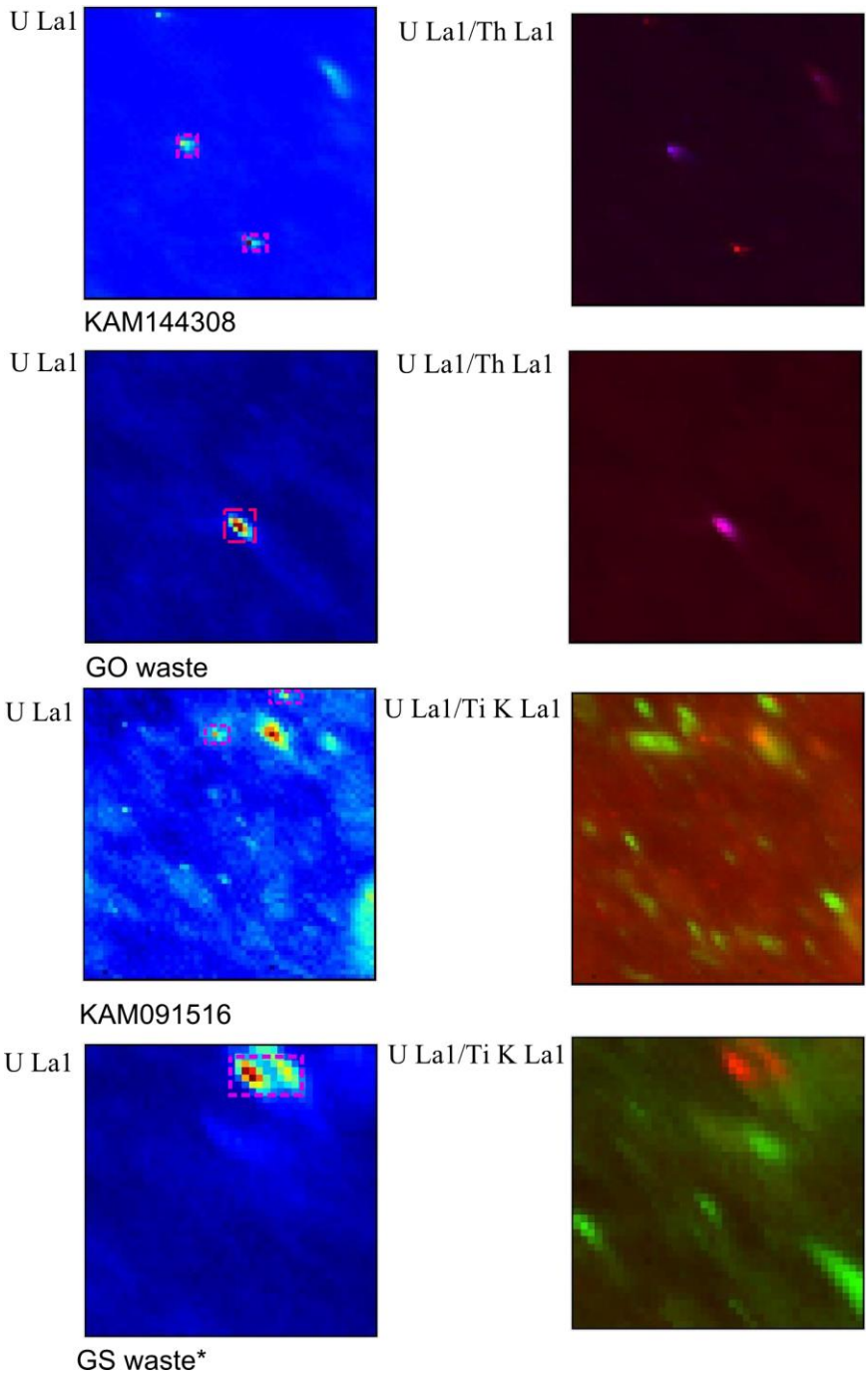
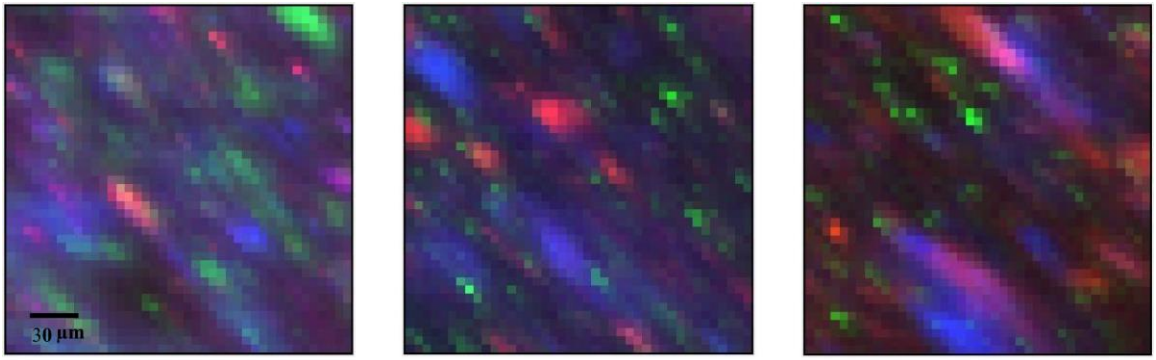


Figure 4.7 Colour map of U-Th and U-Ti

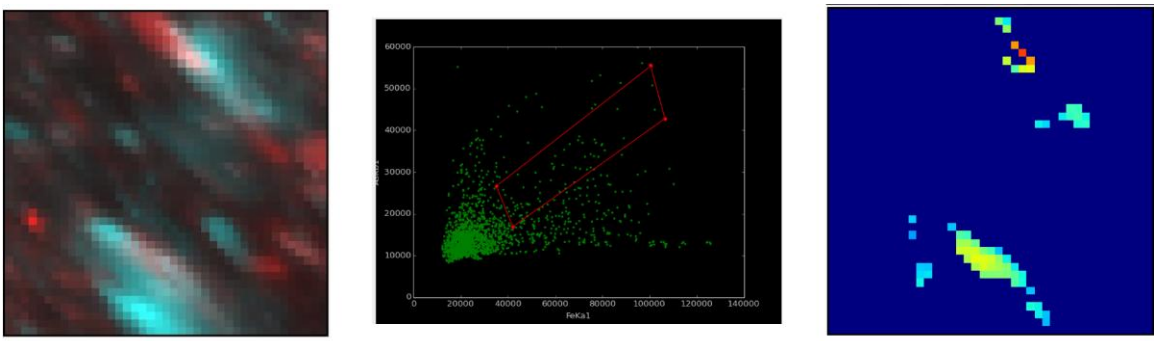
(Red=U, Blue=Th; Red=U, Green=Ti)



72137B GRO ore GRT ore

Figure 4.8 Tri-colour mapping plot of As, Fe and Ca

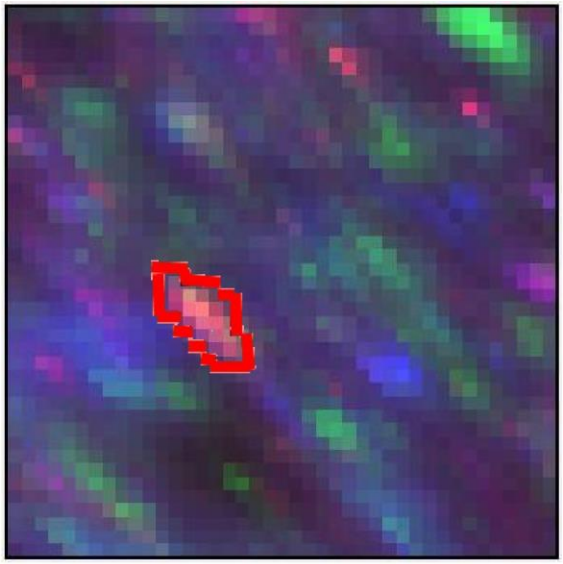
(Red=As, Green=Ca, Blue=Fe)



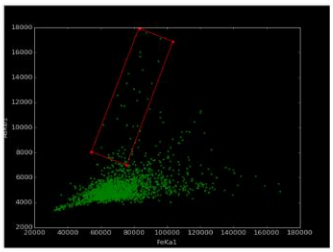
GRT ore Fe Ka1-As Kb1 scatter plot Fe Ka1-As Kb1 selected plot corresponding As region

Figure 4.9 Colour map and scatter plot of As and Fe

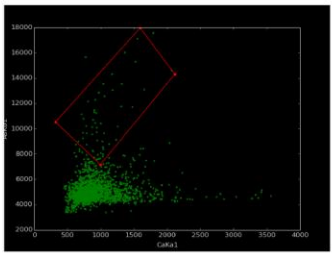
(Red=As, Cyan=Fe)



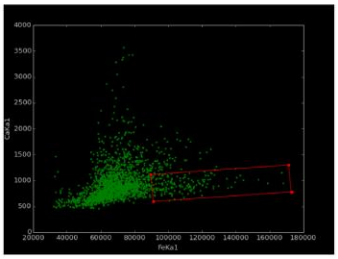
72137B



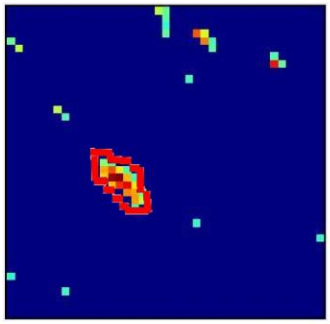
Fe Ka1-As Kb1 scatter plot



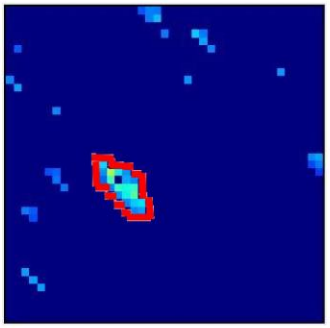
Ca Ka1-As Kb1 scatter plot



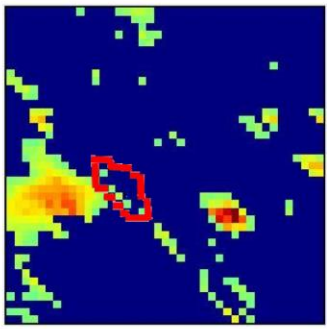
Fe Ka1-Ca Ka1 scatter plot



Fe Ka1-As Kb1 marked plot
corresponding As region



Ca Ka1-As Kb1 marked plot
corresponding Ca region



Fe Ka1-Ca Ka1 marked plot
corresponding Fe region

Figure 4.10 Tri-color and scatter plot of As, Ca and Fe

(Red=As, Green=Ca, Blue=Fe)

4.2 Arsenic µXANES data

Figure 4.11 compares the As K-edge XANES spectra of 10 samples to 5 standards with known oxidation state. To extrapolate oxidation state of As the following standards were used: scorodite ($FeAsO_4 \cdot 2H_2O$; As^{+5}), Ca-arsenate ($Ca_3(AsO4)_2$; As^{+5}), and yukonite ($Ca_3Fe(AsO_4)_2(OH)_3 \cdot 5H_2O$; As^{+5}), orpiment (As_2S_3; As^{+3}), and arsenopyrite (FeAsS; As^{-1}). Comparison of these spectra indicates that As is in oxidized form (As^{+5}) in 6 samples, (KAM144308, KAM029385; 72139B, 72144B, 72135B, 72140B, Figure 4.11A). Four samples contain both oxidized and reduced As species (72137B, 72146B, KAM078808, GS waste, figure 4.11B).

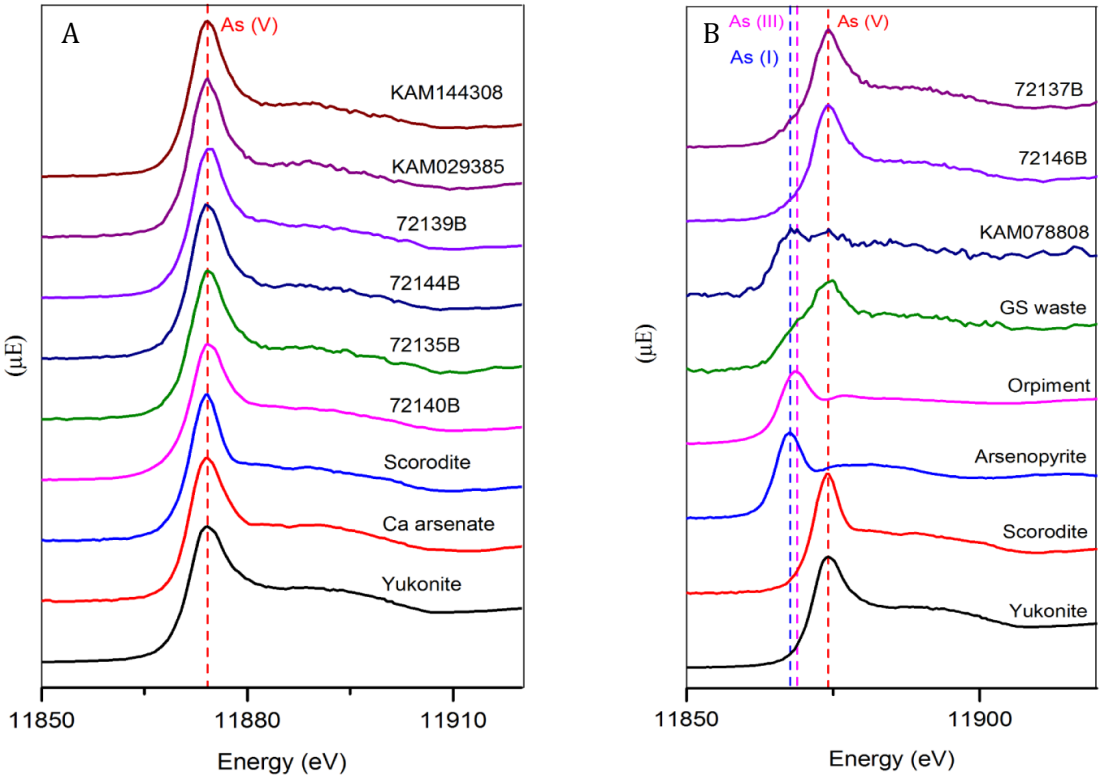


Figure 4.11 Arsenic K-edge µXANES spectra

The As K-edge spectra of the samples were further analyzed using the linear combination fitting (LCF) method. Since scorodite and arsenopyrite were identified in some of the samples using PXRD, we used these standards for the LCF analyses; orpiment was selected as the As^{3+} standard because it is a common As^{3+} mineral with a unique absorption edge energy that is different from other arsenic (III) oxides, therefore it is relatively easy to identify this oxidation state (examples of LCF results are shown in Figure 4.12). The relative abundance of As^{+5}, As^{+3}, and As^{-1} containing compounds represented by scorodite, orpiment, and arsenopyrite, respectively, are summarized in Table 4.5.

It is important to note that the XANES spectra analyses provide information about the oxidation state of As and allows quantification of relative abundance of the identified oxidation species; however, mineral phases cannot be determined unless additional complementary methods are used and there is detectable mineral phase present. Therefore, relative abundance of scorodite and arsenopyrite can be determined using XANES analyses in those samples in which these mineral phases were identified using PXRD (Table 4.5). Since orpiment was not identified by PXRD in any of the samples, and no other As^{+3} minerals were identified, orpiment was selected to represent the As^{+3} oxidation state and relative abundance of As^{+3} mineral phase.

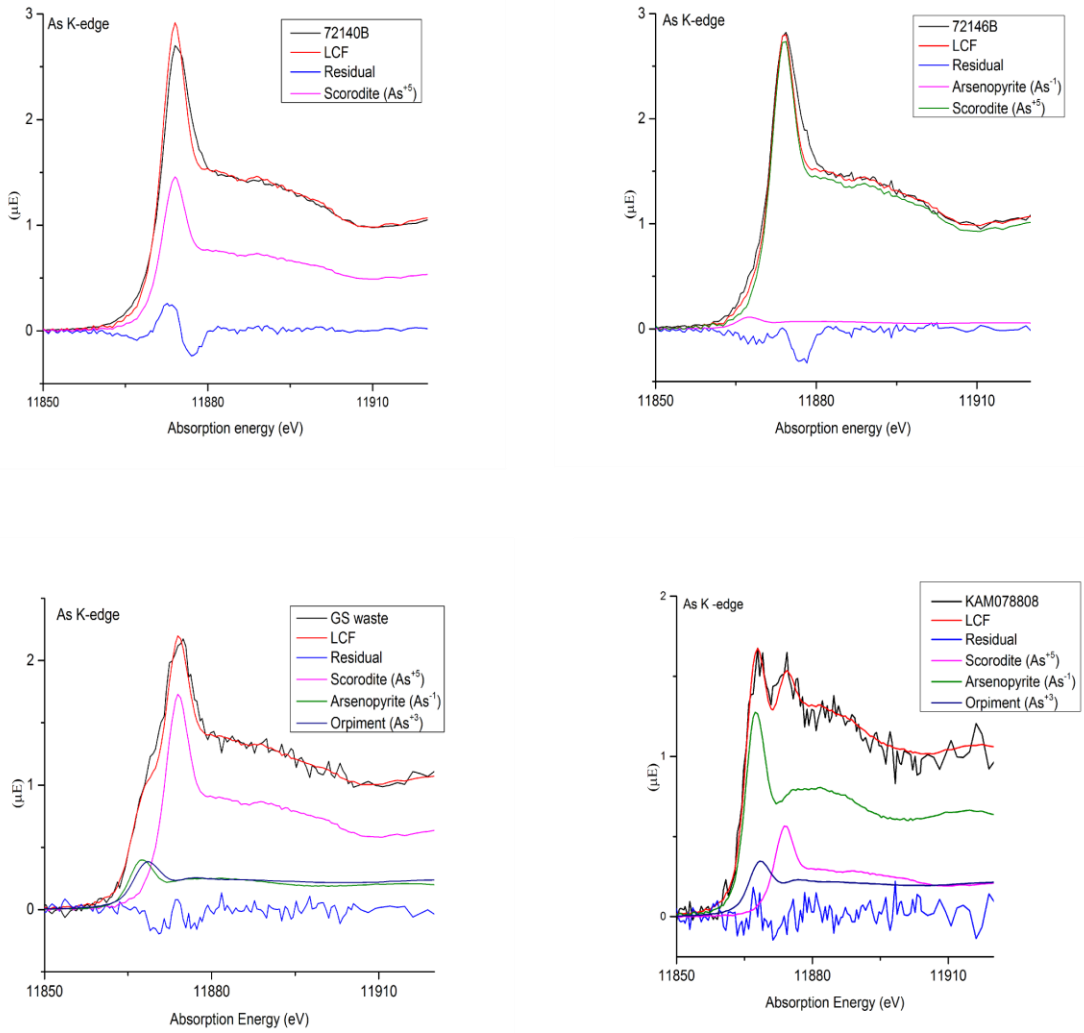


Figure 4.12 Arsenic spectra of samples compared to spectra calculated from linear combination fitting of the standards

Table 4.5 Relative abundance of As species estimated from the linear combination fits

Sample	Scorodite (As^{+5})	Arsenopyrite (As^{-1})	Orpiment (As^{+3})	R factor
GS waste	59.4	19.1	21.6	0.0087566
KAM078808	19.5	61	19.5	0.0197784
72140B*	100	-	-	0.0124062
72146B**	94.7	5.3	-	0.0133656
72137B	90.7	9.3	-	0.0188721
72135B	100	-	-	0.0147336
72144B	100	-	-	0.0170556
72139B*	100	-	-	0.0143326
KAM144308	100	-	-	0.0153481
KAM029385	100	-	-	0.0172278

* scorodite identified by PXRD

** arsenopyrite identified by PXRD

4.3 Uranium XANES data

Uranium L_3-edge XANES spectra were collected on the HXMA beamline for 8 samples (6 high uranium waste rock, 1 ore, and 1 waste rock sample). In general, all these samples are on the low end of bulk U concentrations that can be detected using the HXMA beamline (concentrations based on ICP-MS analyses provided by Lorax). To maximize the chances of obtaining U XANES spectra the high uranium waste rock samples were run first (U concentration ranging between 30 to 60 ppm). Then other samples were selected where verified U hotspots were detected with µXRF mapping; the U concentrations in these samples were between 6 and 10 ppm. U spectra were obtained for GS waste (6.1 ppm) and GT ore (11 ppm). Analyses of the GO waste sample were also attempted (5.5 ppm) however the concentration was below the detection capabilities of the beamline. Additional µXANES spectra were also collected for two of these high uranium waste rock samples (KAM091516, KAM078808) on the VESPERS beamline.

A limited number of U standards were run due to radiation regulation limitations placed on our analyses and standard acquisition. We selected a single standard for each of the two most common oxidation states observed in environmental samples: uraninite (UO_2; U^{+4}) and uranium nitrate ($UO_2(NO_3)_2$; U^{+6}). It is important to note that these standards were used to obtain spectra for the relevant oxidation states of U and it does not indicate that these phases would occur in these geological samples (the $UO_2(NO_3)_2$ is not expected to occur in a natural environment).

Note that the difference between uranium phases of similar oxidation states is minimal due to the broadness in line-shape of the U L3-edge. There is a distinct shift in the U L3-edge absorption edge energy between U^{4+} and U^{6+}, as illustrated in Figures 4.13 and 7.4. Therefore, LCF analysis can provide information on the relative amount of $U^{+4}$and U^{+6} species in each sample. For the LCF analysis, spectra were fitted to uraninite and uranyl nitrate as representatives of the U^{+4} and U^{+6} species, respectively, present in the samples. The U XANES spectra were fitted to the standards (Figure 4.14, 7.5) and the relative abundance of U^{+4} and U^{+6} species is summarized in Table 4.6.

Based on the absorption edge energy of the standards, the oxidation state of U in most of the samples analysed is between +4 and +6 (Figure 4.14). In one high uranium waste rock sample (KAM144308), uranium appears as +6 only. The predominant oxidation state of U (>50%) is +4 in most of the samples except for KAM029385 and GS waste rock samples (Table 4.6). Uranium µXANES spectra were also collected for two high uranium waste rock samples (KAM091516, KAM078808) using the VESPERS beamline, and the results were consistent with the other data (mixture of +4 and +6 oxidation states) Figure 7.7).

Visible verified U hotspots as well as U XANES data are available for a total of 6 samples: five high U waste rock and one gneiss waste rock. The fact that these samples contain U^{+6} and the spatial overlap of verified U regions with Fe (Figure 4.13) suggest that this form of U is associated with iron oxides in these samples. Distribution of P was not examined in these samples due to beamline energy limitations; however, spatial

overlap of verified U regions with Ca and/or Cu, Ti, Th as well as presence of U^{+4} suggest that other U mineral phases are also possible.

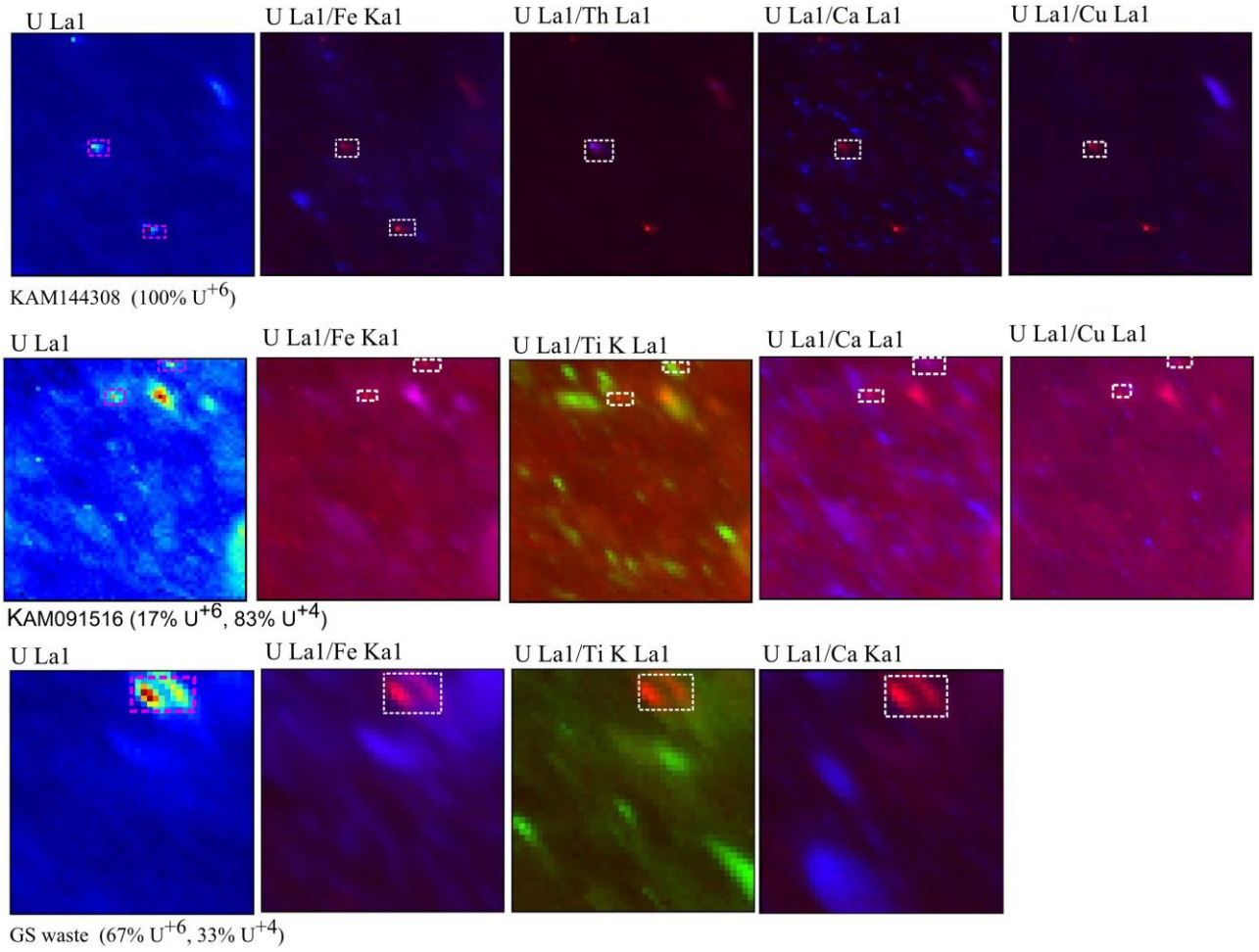


Figure 4.13 Spatial overlap of verified U spots with a range of elements that can be found in various U-bearing mineral phases (Red=U, Ti=green, Fe, Ca, Cu=green). This figure is divided in two panels for presentation purposes and it is continued on the next page.

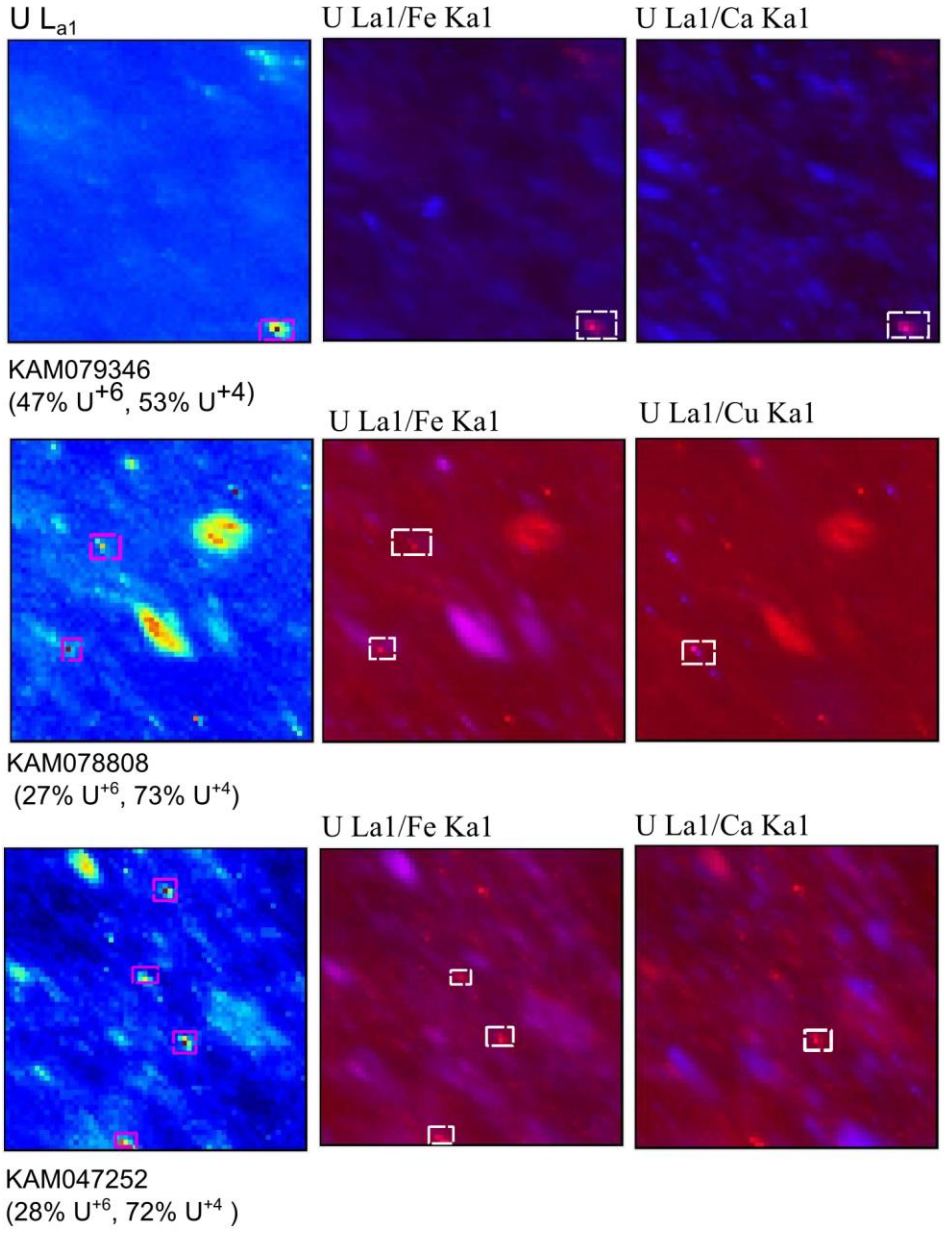


Figure 4.14 Spatial overlap of verified U spots with a range of elements that are that can be found in various U-bearing mineral phases (Red=U, Ti=green, Fe, Ca, Cu=green). This figure is divided in two panels for presentation purposes.

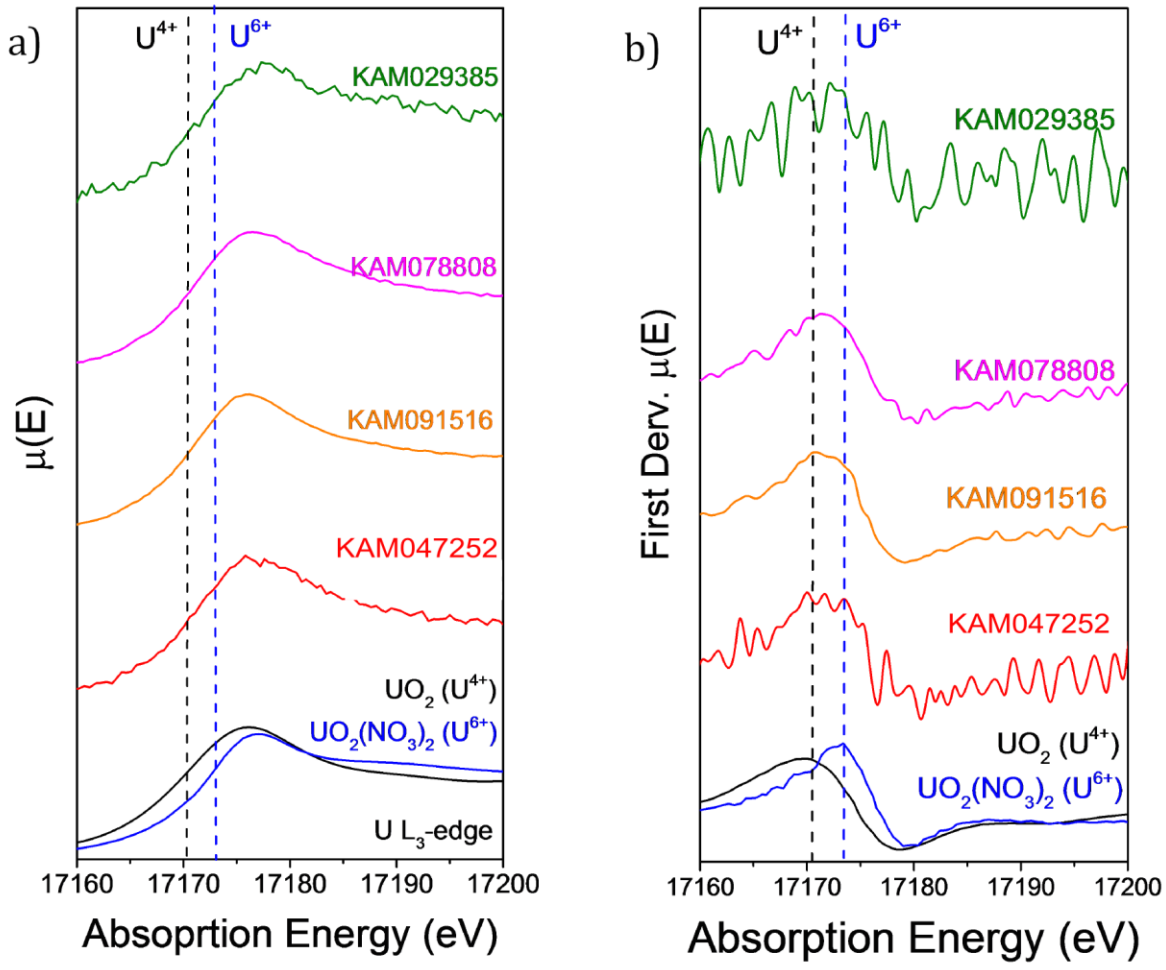


Figure 4.15 Uranium L_3-edge XANES spectra

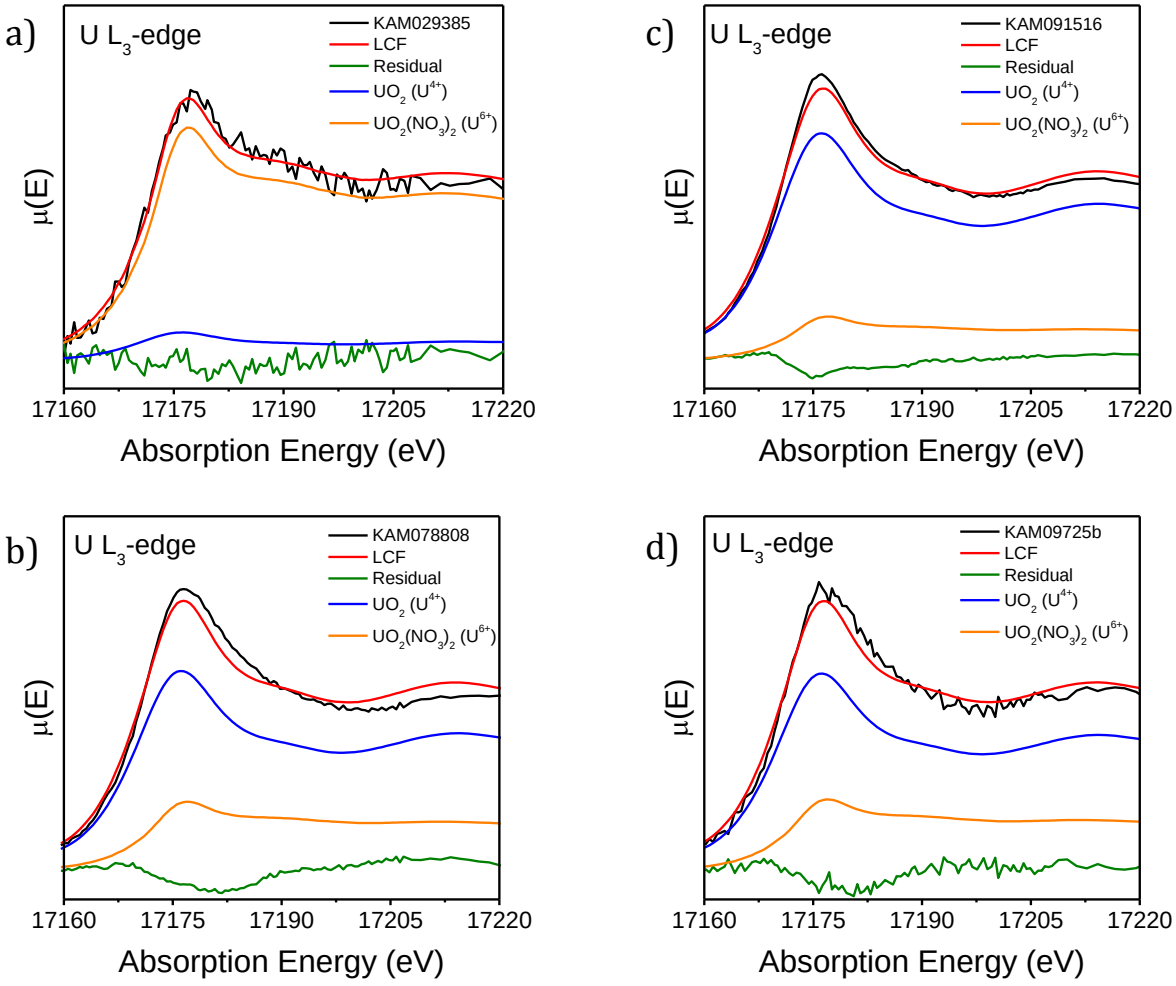


Figure 4.16 Linear combination fitting of Uranium

Table 4.6 Relative abundance of U species estimated from the linear combinations fits.

Sample	UO_2 (U^{4+}) at %	$UO+(NO_3)_2$ (U^{6+}) at %	R factor
KAM029385	11	89	0.0142021
KAM078808	73	27	0.0137348
KAM091516	83	17	0.0058184
KAM047252	72	28	0.0133641
KAM079346	53	47	0.0059290
KAM144308	0	100	0.0038118
GS waste	33	67	0.0250210
GT ore	51	49	0.0630183

5 Findings

Synchrotron-based analyses of the Yukon gold mine ore and waste rock samples revealed that the oxidation state and mineralogical phase of As vary among samples. A total of 3 oxidation states (As^{+5}, As^{+3}, As^{-1}) and 3 mineralogical phases (scorodite, arsenopyrite and arsenian pyrite) were identified in the samples using μXANES and PXRD methods, respectively. These complementary analyses further indicate that in both schist and one of the gneiss ore samples, As is a mix of the valence states As^{+5} and As^{-1}, and potentially in two mineral phases. The mineral phase containing As^{-1} is most likely arsenopyrite, since this phase was identified in one of the schist ore sample (72135B) using PXRD. All three oxidation states were found in two of the analysed waste rock samples of gneiss, however, the corresponding arsenic mineral phases cannot be extrapolated from the XANES data alone. Arsenic appeared in a single oxidation state (+5) in the granite ore samples, which was in agreement with the single mineral phase, scorodite, identified using PXRD analyses. μXRF analyses also revealed potential presence of yukonite in one of the schist ore sample (72137B). PXRD analyses cannot exclude the possibility that arsenic is present in an amorphous form in any of these samples, or in a mineral form that is below the detection limit for the method (on the order of 0.1 %).

Based on XANES analyses, the oxidation state of U in most of the samples analysed (8 in total) was between +4 and +6. The predominant oxidation state of U was +4 in all the analysed samples, except for two of the gneiss and one of the schist waste rock samples. Since no U phases were identified using PXRD, U mineral phases that could potentially be present in these samples remain highly speculative. μXRF analyses revealed that U tends to co-occur with Fe, this may indicate U^{+6} association with Fe oxides. Spatial overlap of U with Ca and/or Cu detected in the waste rock samples indicate that other U-bearing mineral phases, such as autunite, tobernite or uranophane could potentially be present. Association of U with Ti and Th was only visible in the gneiss waste rock samples; this may indicate the presence of thorite and brannerite U mineral phases, respectively. It is important to note, XANES data and spatial overlap detected by microXRF analyses are not sufficient to determine the U-bearing mineral phases with certainty.

6 Considerations for future analyses

Elucidation of the U mineral phases present in these materials is a challenge because of the low U concentrations in the samples. The detection limits of the analytical techniques such PXRD, XANES, μXRD could be improved if whole rock (unground) samples were used; unground samples could potentially be subsampled selectively to target more concentrated regions of the materials. Sequential chemical extraction of U should be also considered as an approach to investigate the U-bearing minerals present in these ore and waste rock samples.

Acknowledgments

The authors thank Drs. Renfei Feng, Ning Chen, and Weifeng Chen for assistance at the VESPER and HXMA beamlines, respectively. Industrial research scientists, Drs. Jeff Cutler and Joel Reid are also thanked for their constructive feedback on this report.

Table 6.1 Summary table of the completed sample analyses

Sample ID	PXRD	µXRF maps (pink beam – broad energy spectrum)	Arsenic-µXANES	Uranium-XANES
SO waste	✓	✓		
ST waste	✓	✓		
SS waste	✓	✓		
GO waste	✓	✓		
GT waste	✓	✓		
GS waste	✓	✓	✓	✓
GRO ore	✓	✓	✓	
GRT ore	✓	✓	✓	
72135B	✓	✓	✓	
72137B	✓	✓	✓	
72144B	✓	✓	✓	
GT ore	✓	✓	✓	✓
KAM029385	✓	✓	✓	✓
KAM079346	✓	✓		✓
KAM047252	✓	✓		✓
KAM091516	✓	✓		✓
KAM078808	✓	✓	✓	✓
KAM144308	✓	✓	✓	✓

7 Appendix

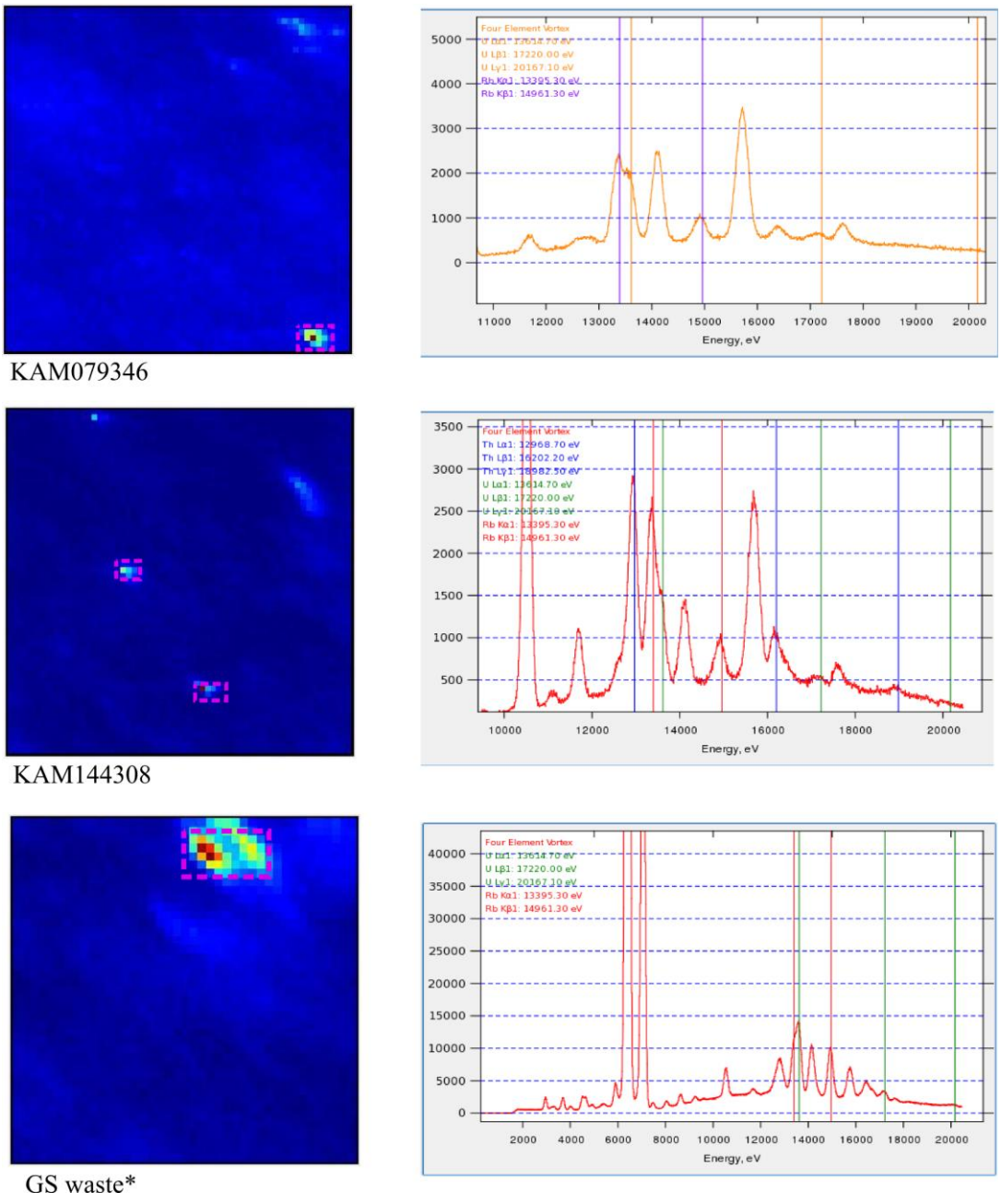


Figure 7.1 Verified U hotspot regions and corresponding spectra identified on the U/Rb XRF maps

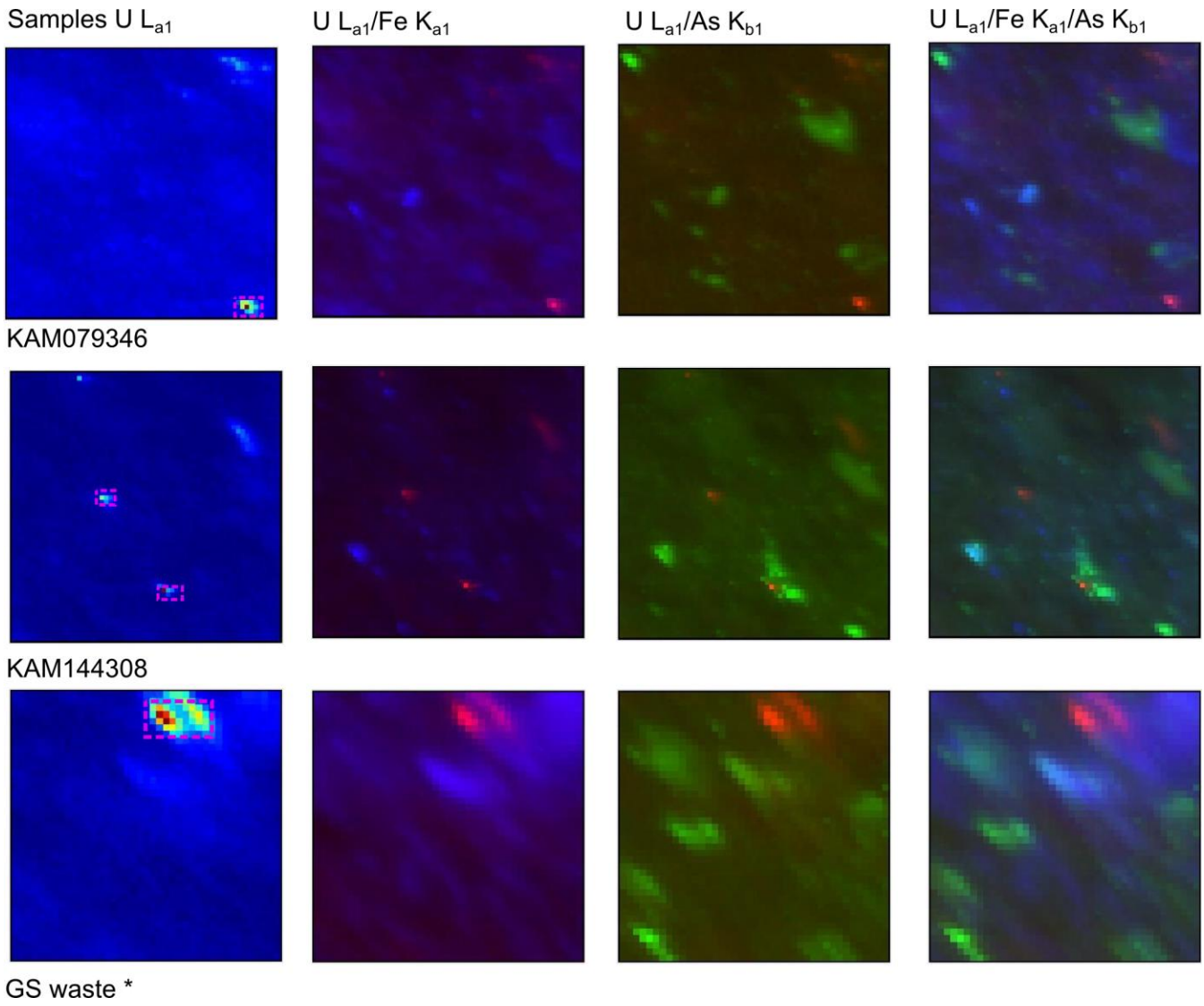
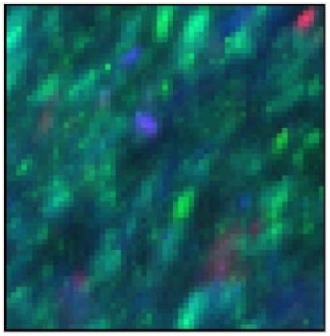
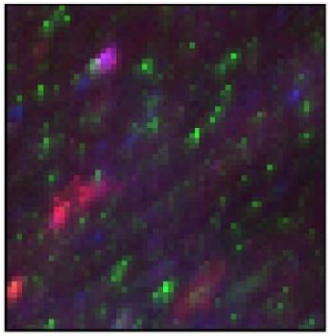


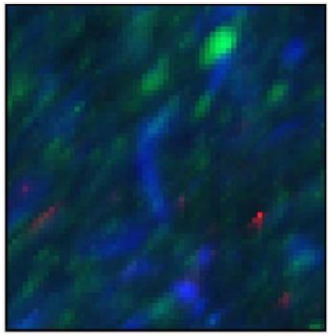
Figure 7.2 Tri-color mapping plot of U, As and Fe (Red=U, Green=As, Blue=Fe)



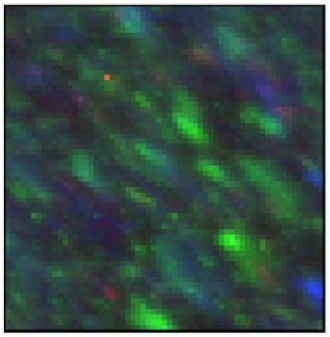
KAM07946



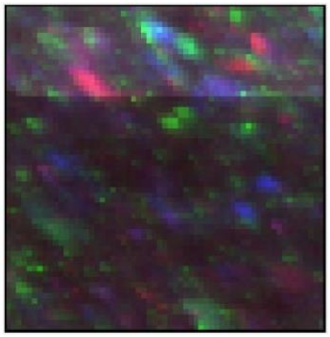
KAM144308



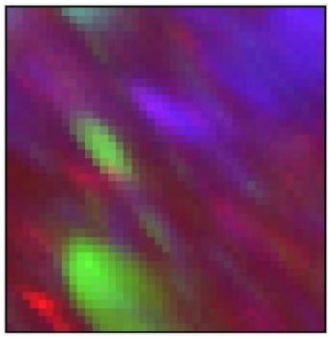
SS waste



ST waste



SO waste



GS waste*

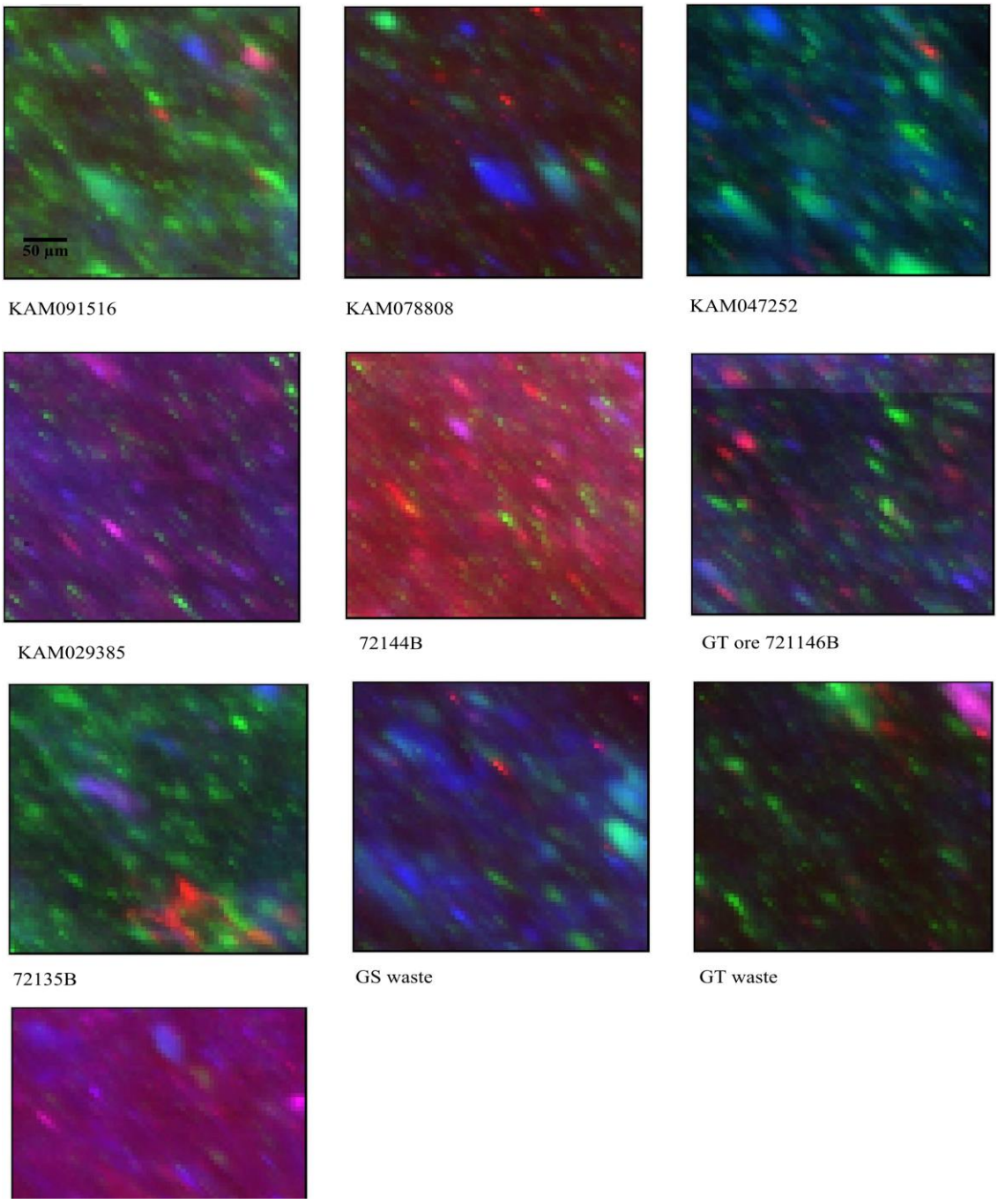
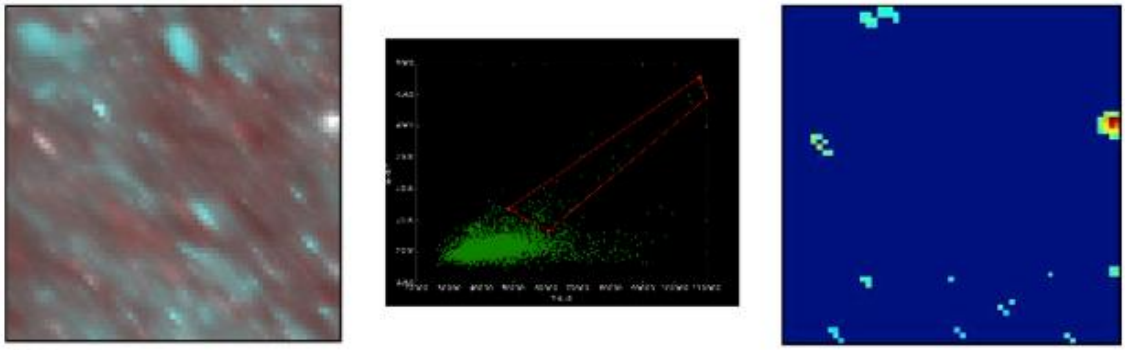


Figure 7.3 Tri-color mapping plot of As, Fe and Ca
(Red=As, Green=Ca, Blue=Fe)



GO waste

Fe Ka1-As Kb1 scatter plot

Fe Ka1-As Kb1 selected plot corresponding As region

Figure 7.4 Colour map and scatter plot of As and Fe

(Red=As, Cyan=Fe)

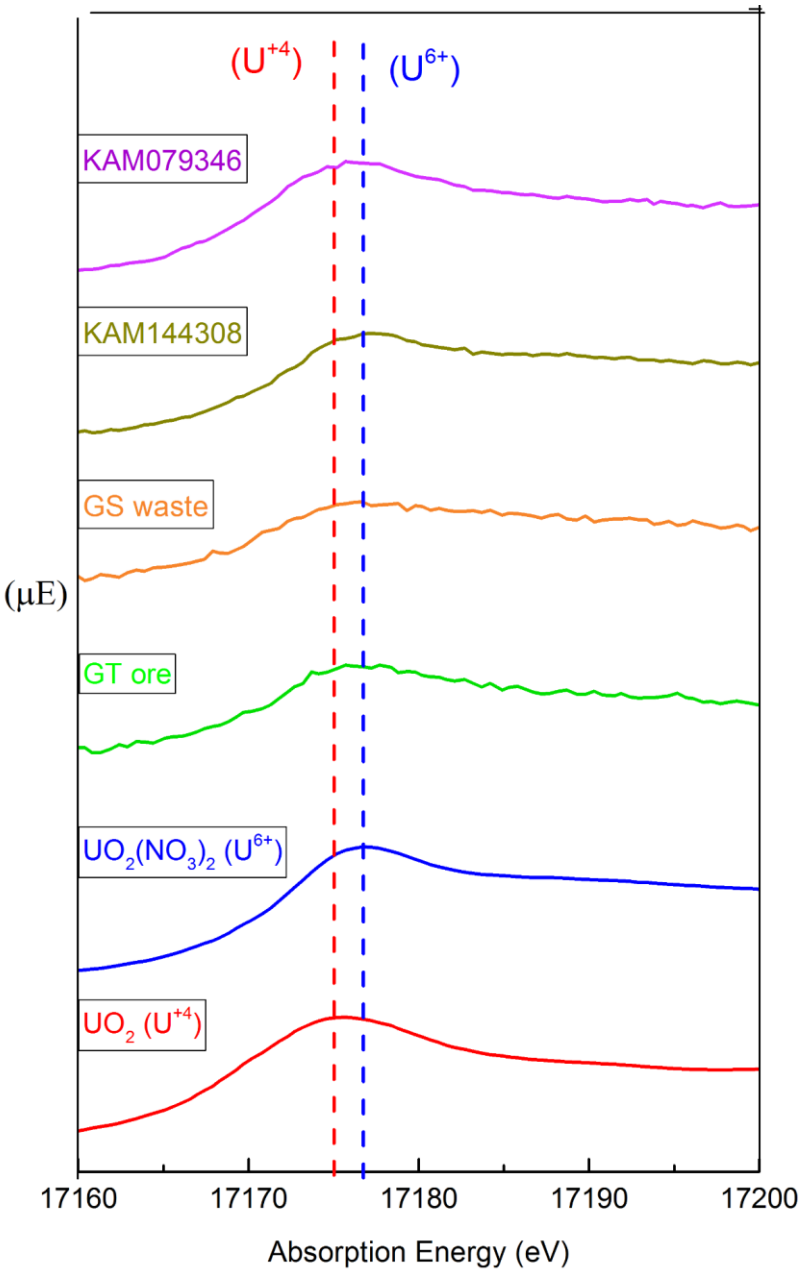


Figure 7.5 Uranium L_3-edge XANES spectra

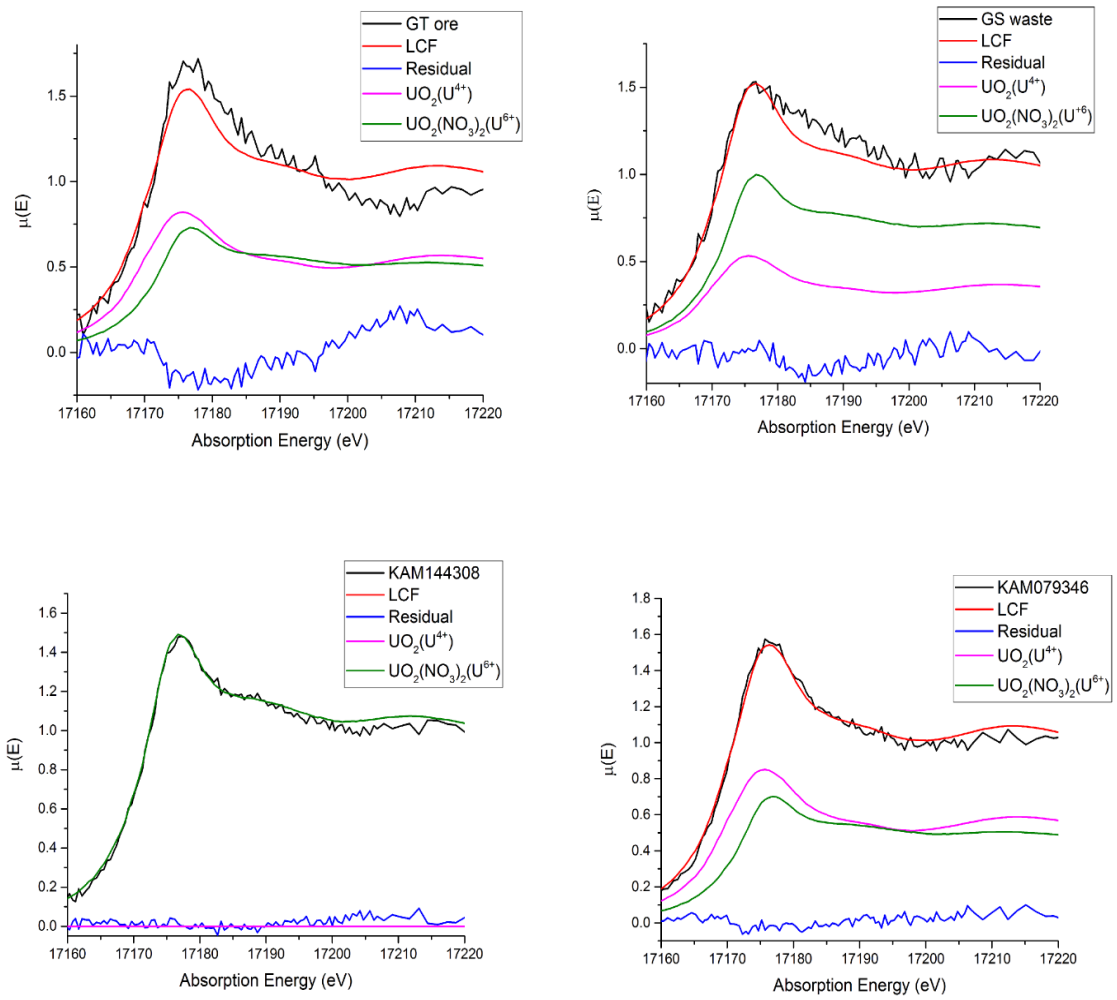


Figure 7.6 Linear combination fitting of Uranium

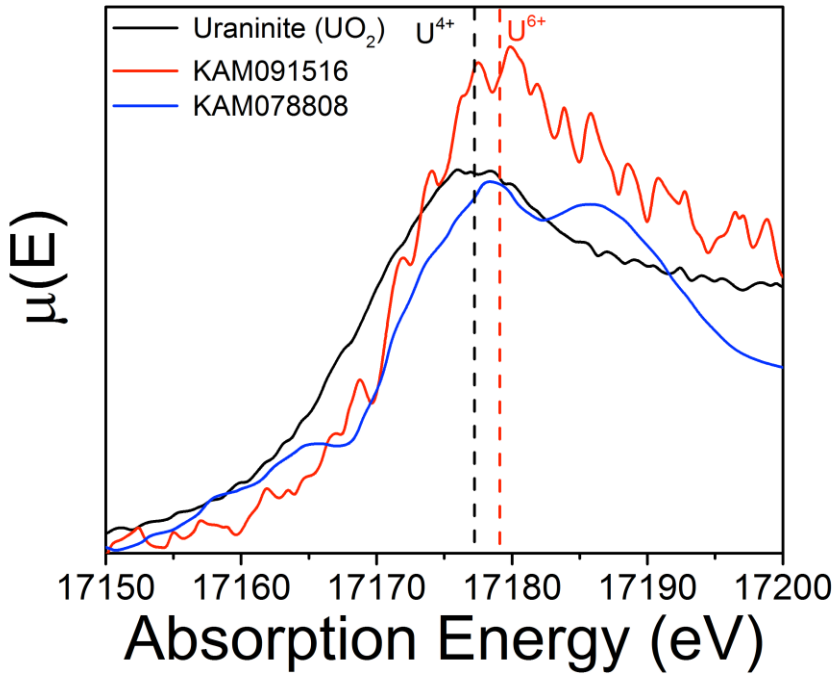


Figure 7.7 Uranium microXANES spectra

7 APPENDIX

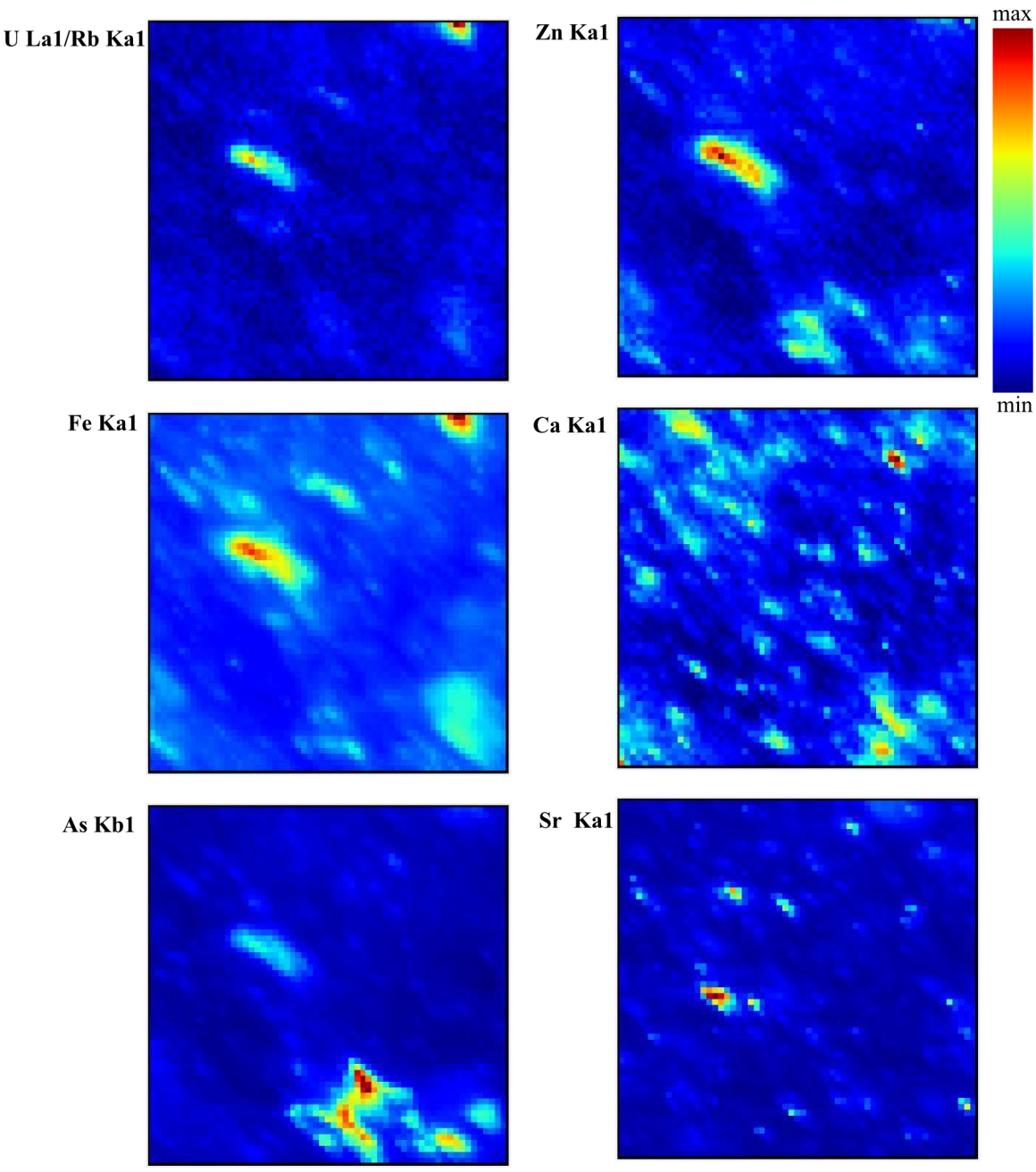


Figure 7.8 XRF elemental distribution maps of 72135B

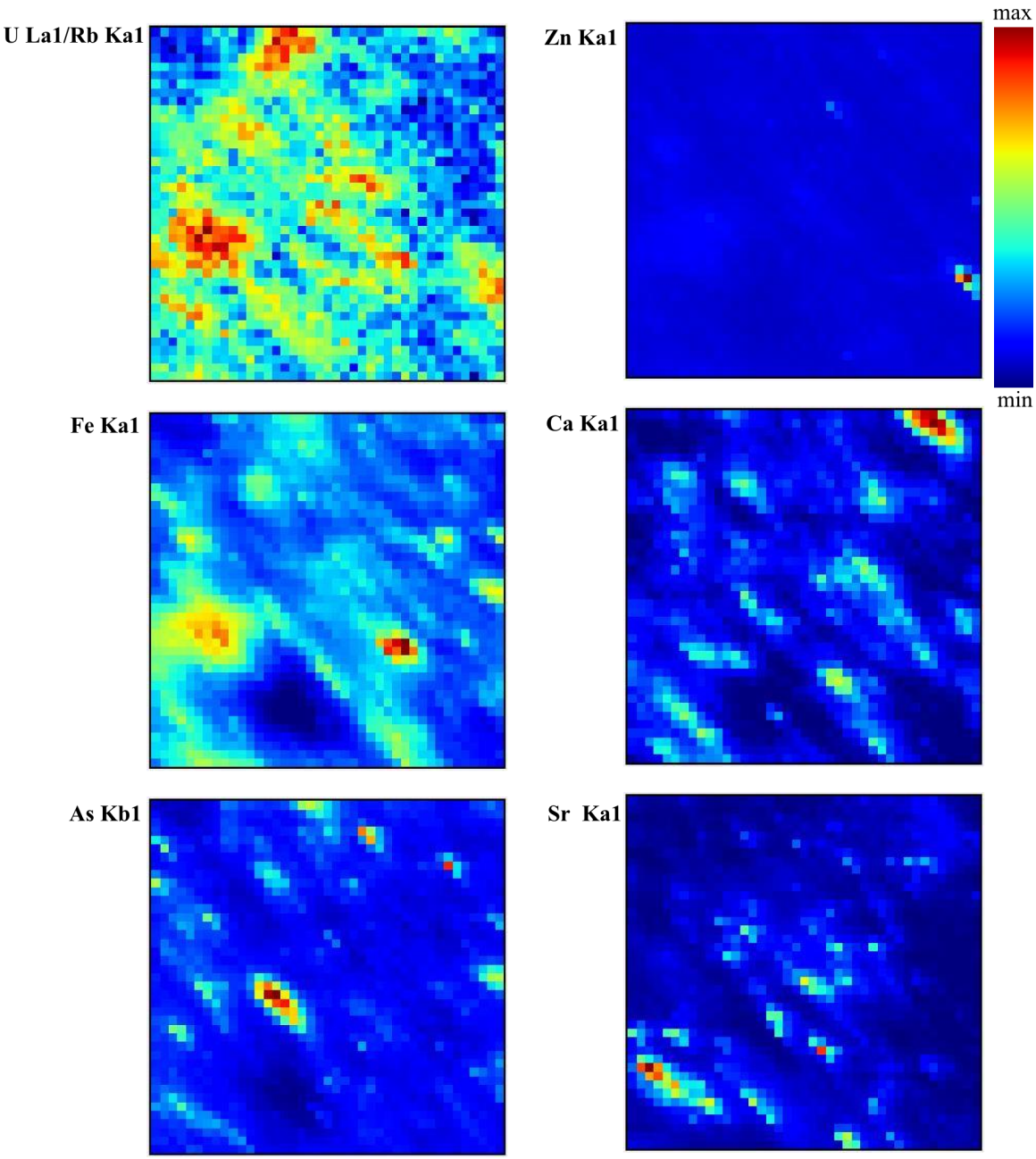


Figure 7.9 XRF elemental distribution maps of 72137B

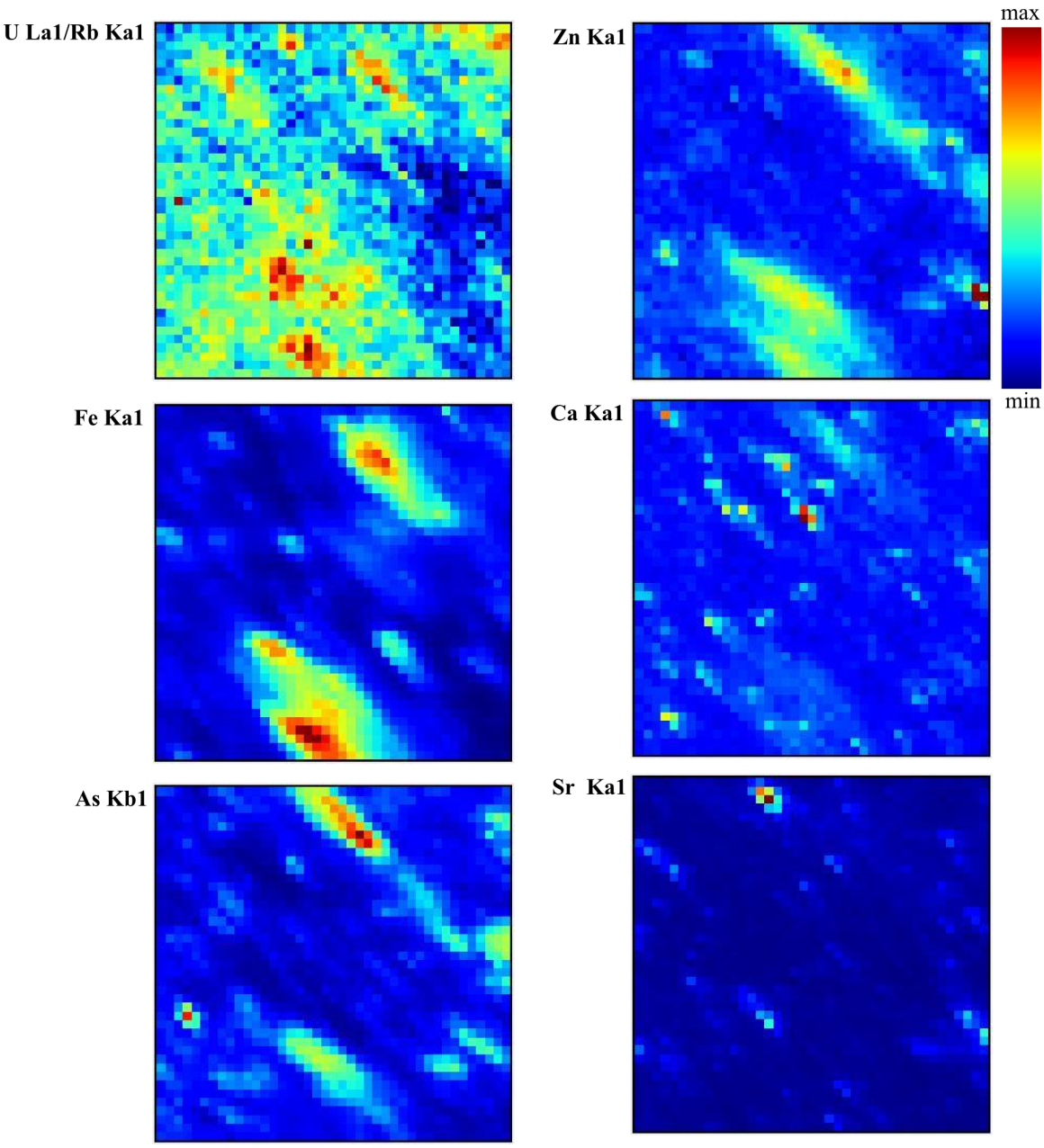


Figure 7.10 XRF elemental distribution maps of GRT

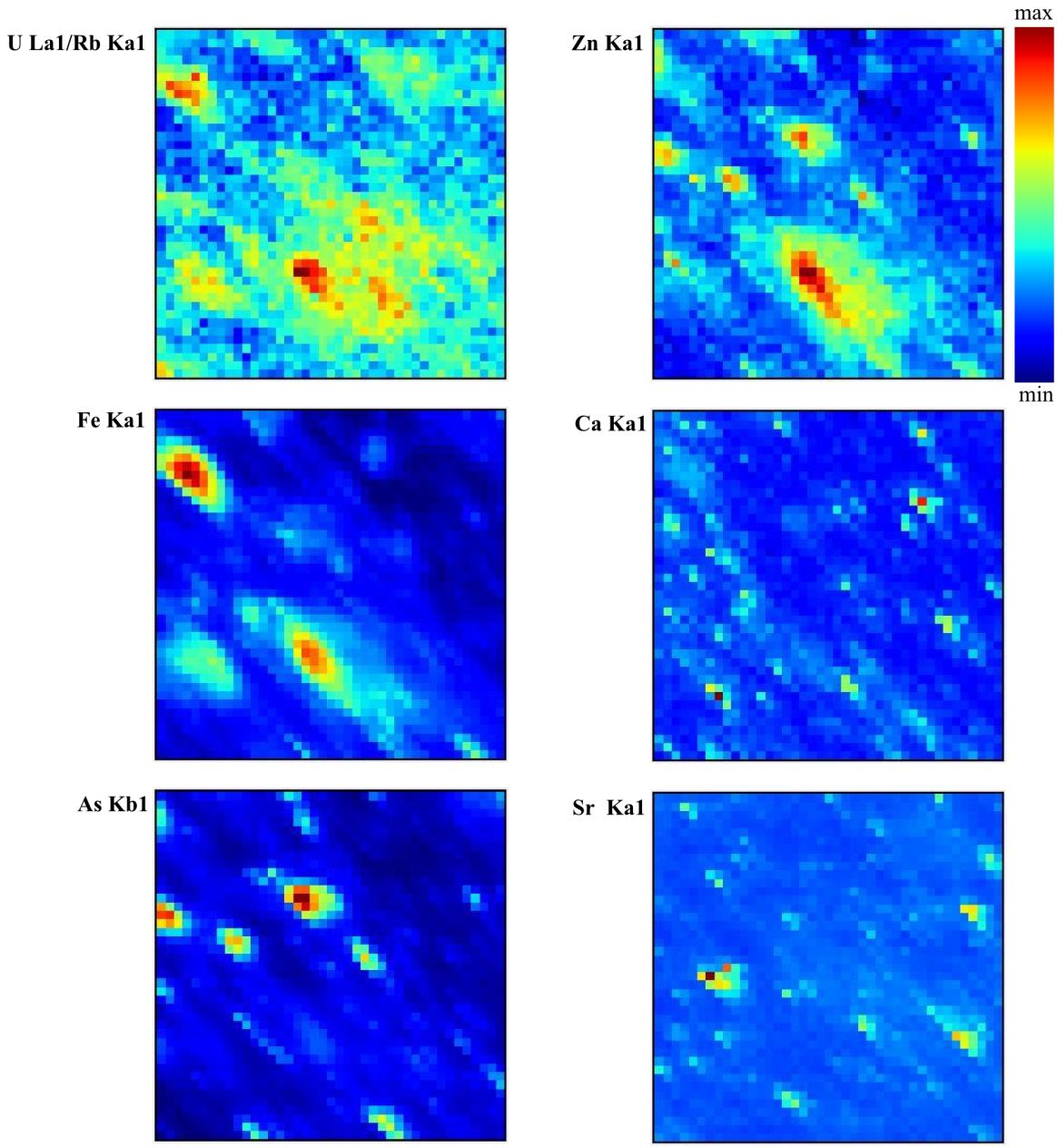


Figure 7.11 XRF elemental distribution maps of GRO ore

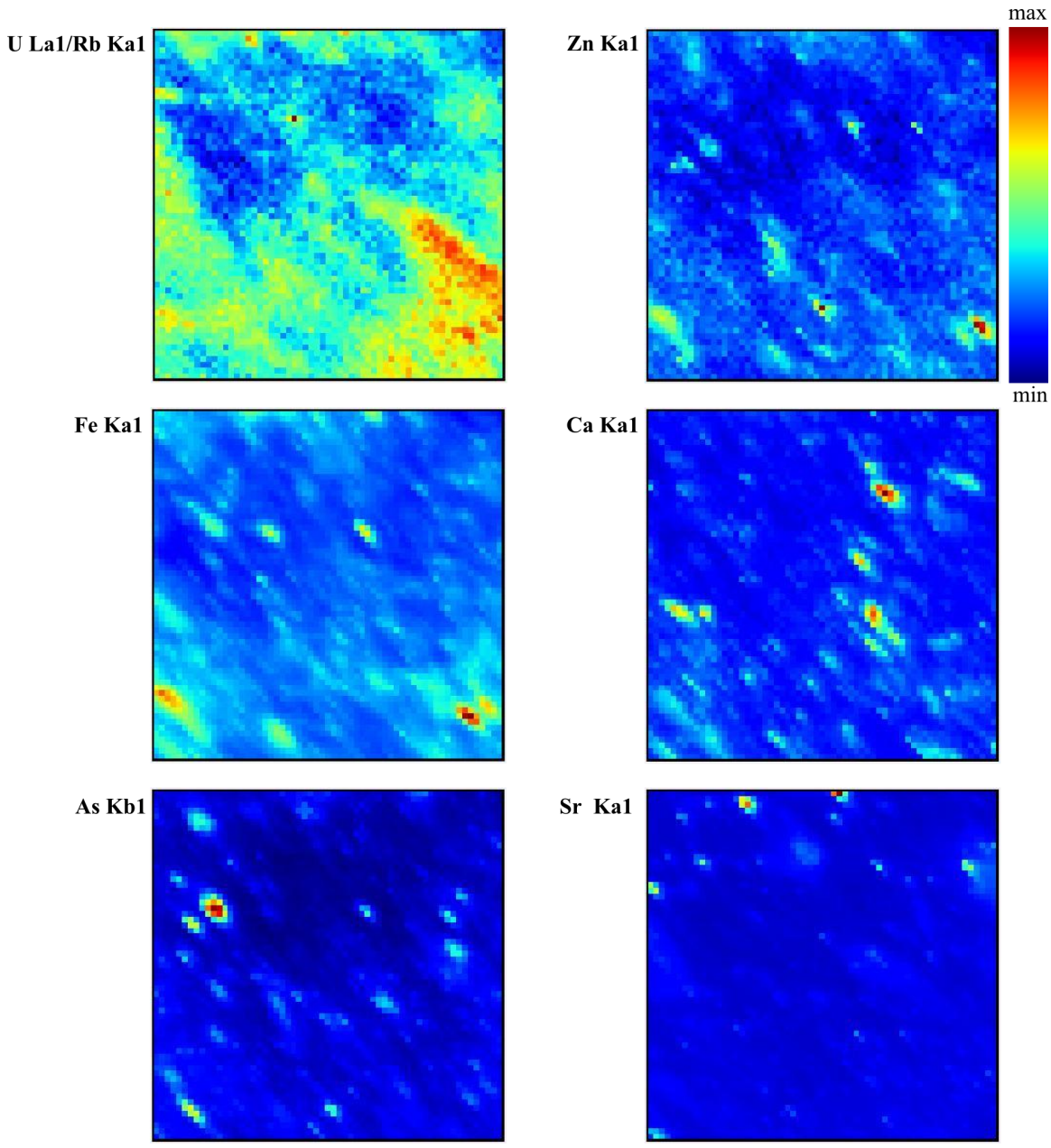


Figure 7.12 XRF elemental distribution maps of GT ore

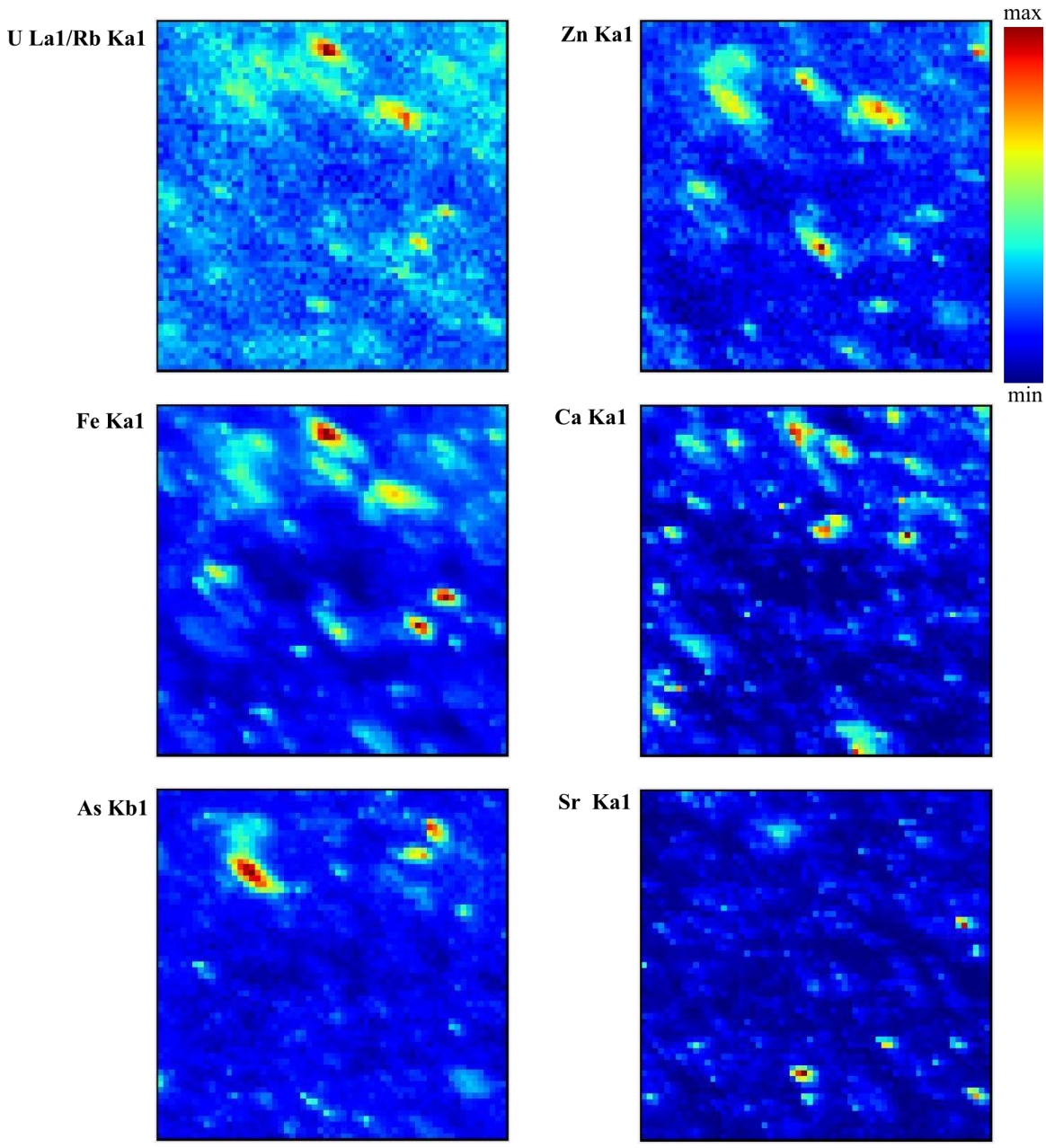


Figure 7.13 XRF elemental distribution maps of SO waste

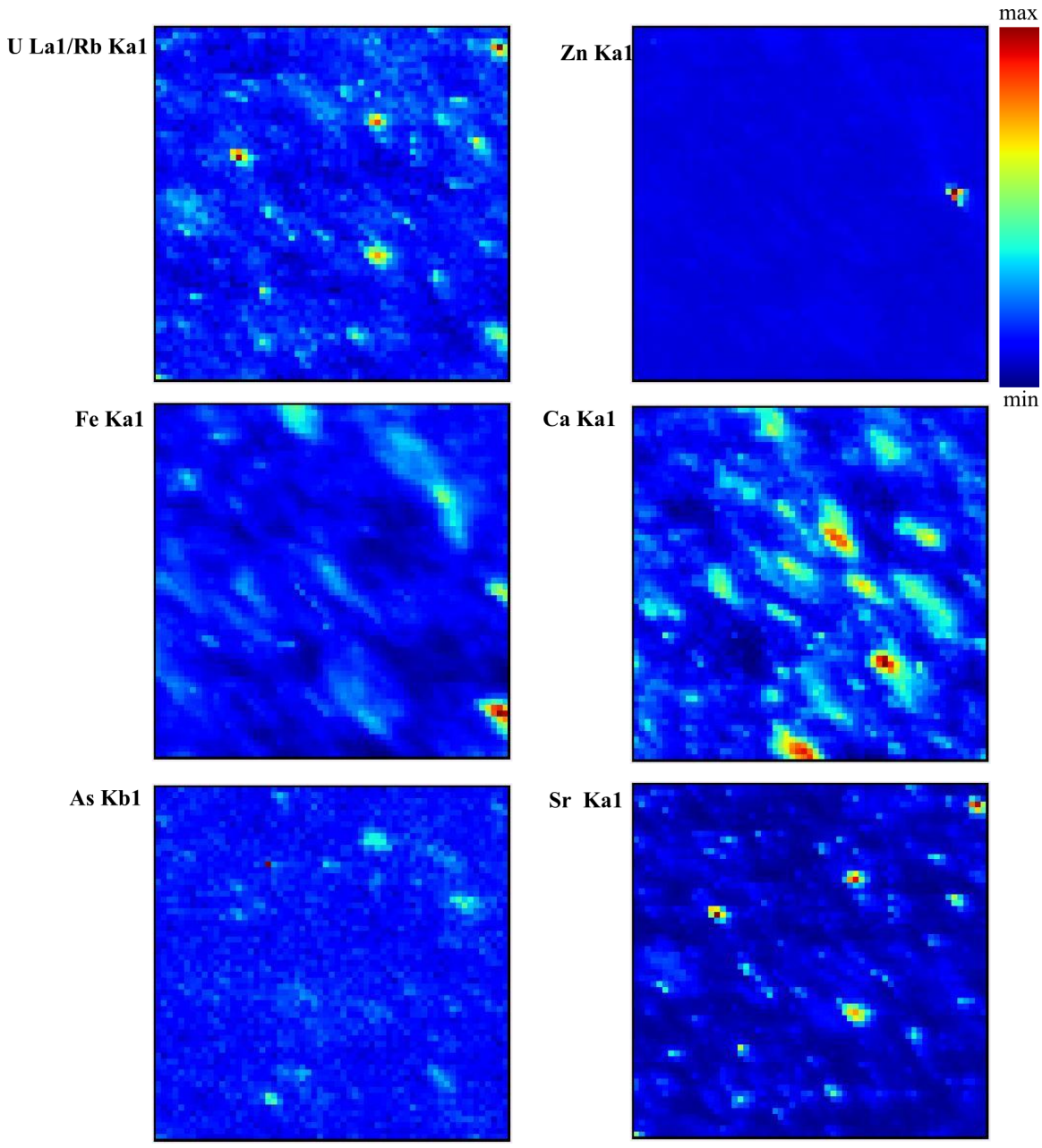


Figure 7.14 XRF elemental distribution maps of ST waste

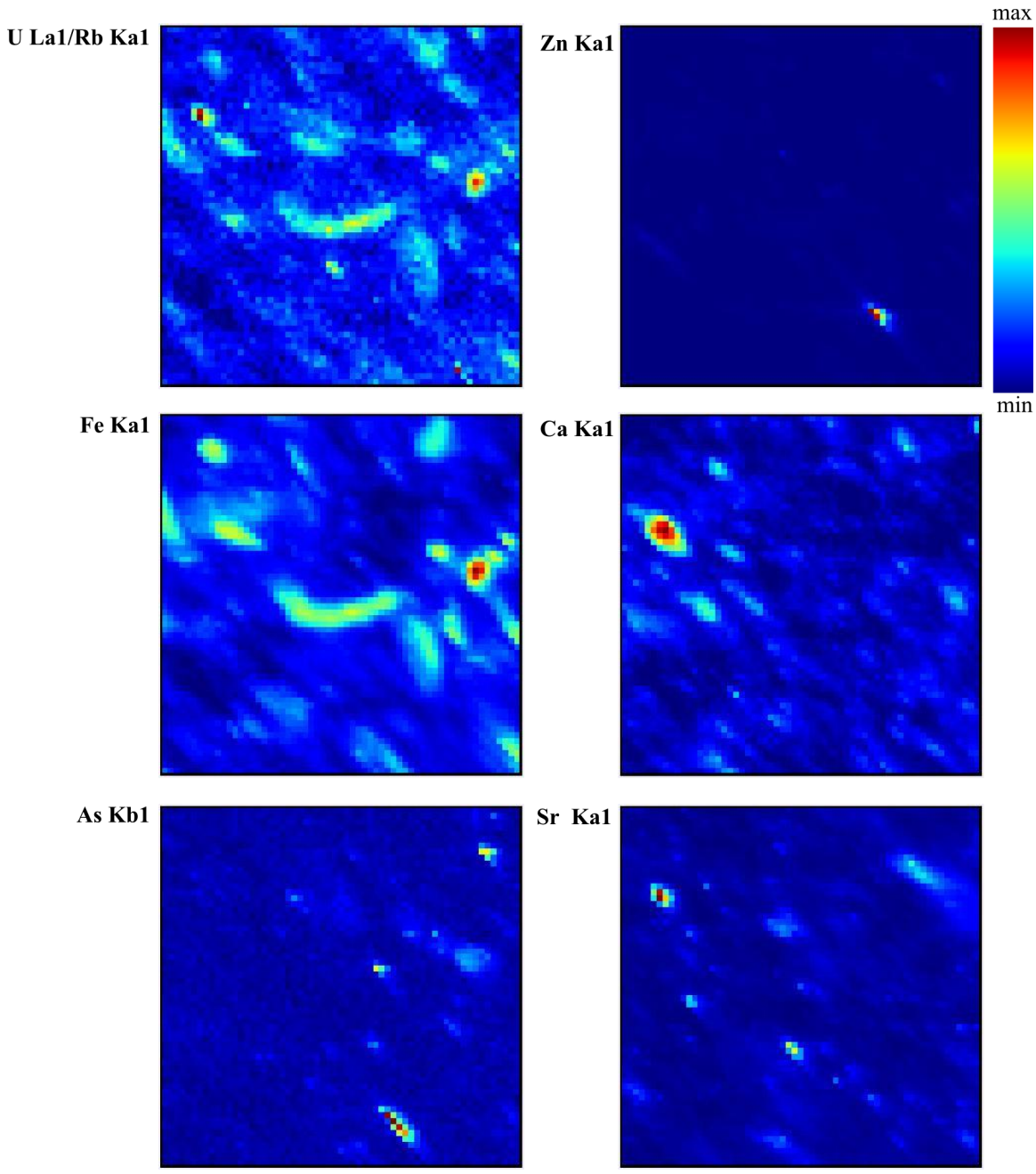


Figure 7.15 XRF elemental distribution maps of SS waste

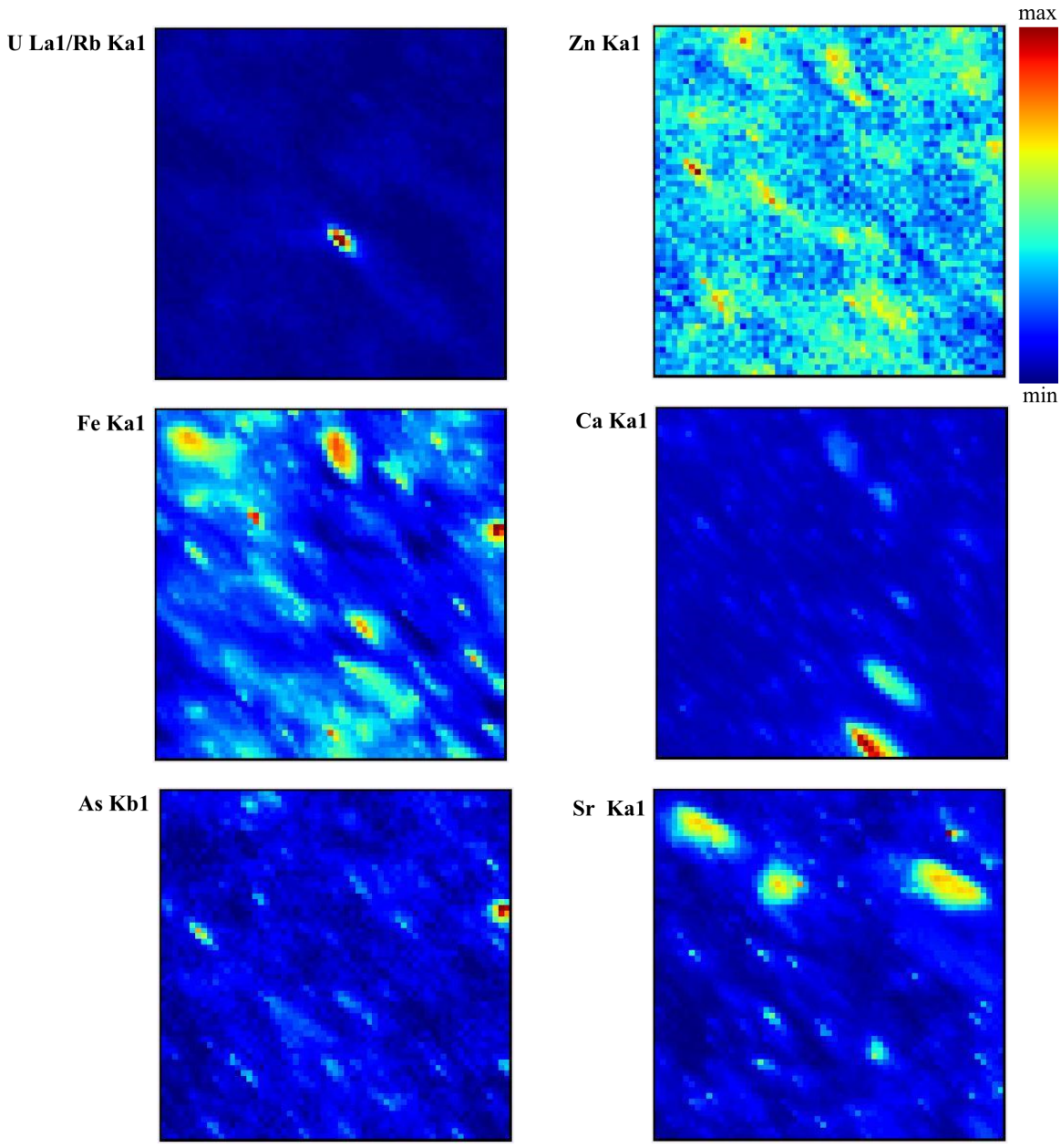


Figure 7.16 XRF elemental distribution maps of GO waste

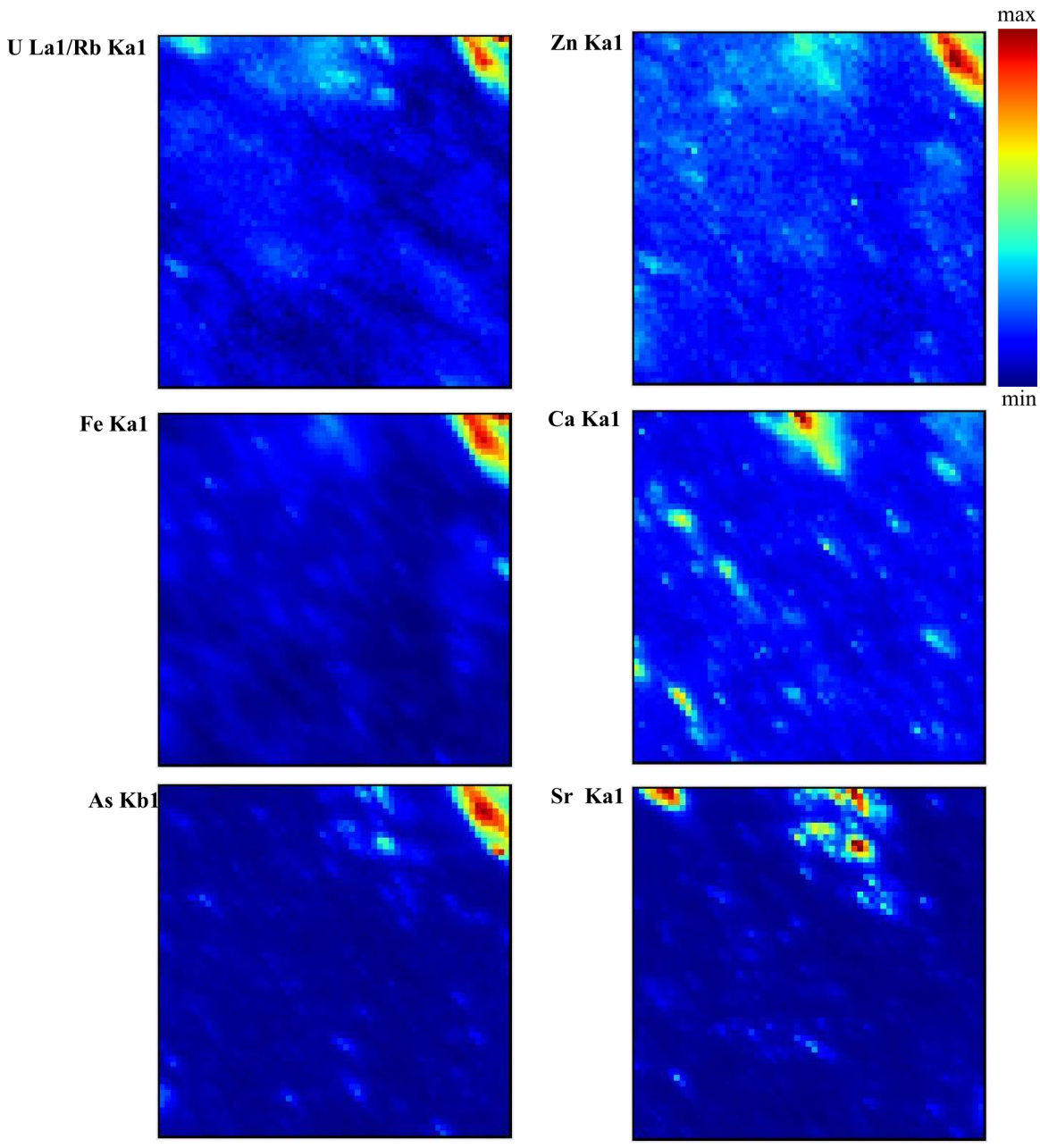


Figure 7.17 XRF elemental distribution maps of GT waste

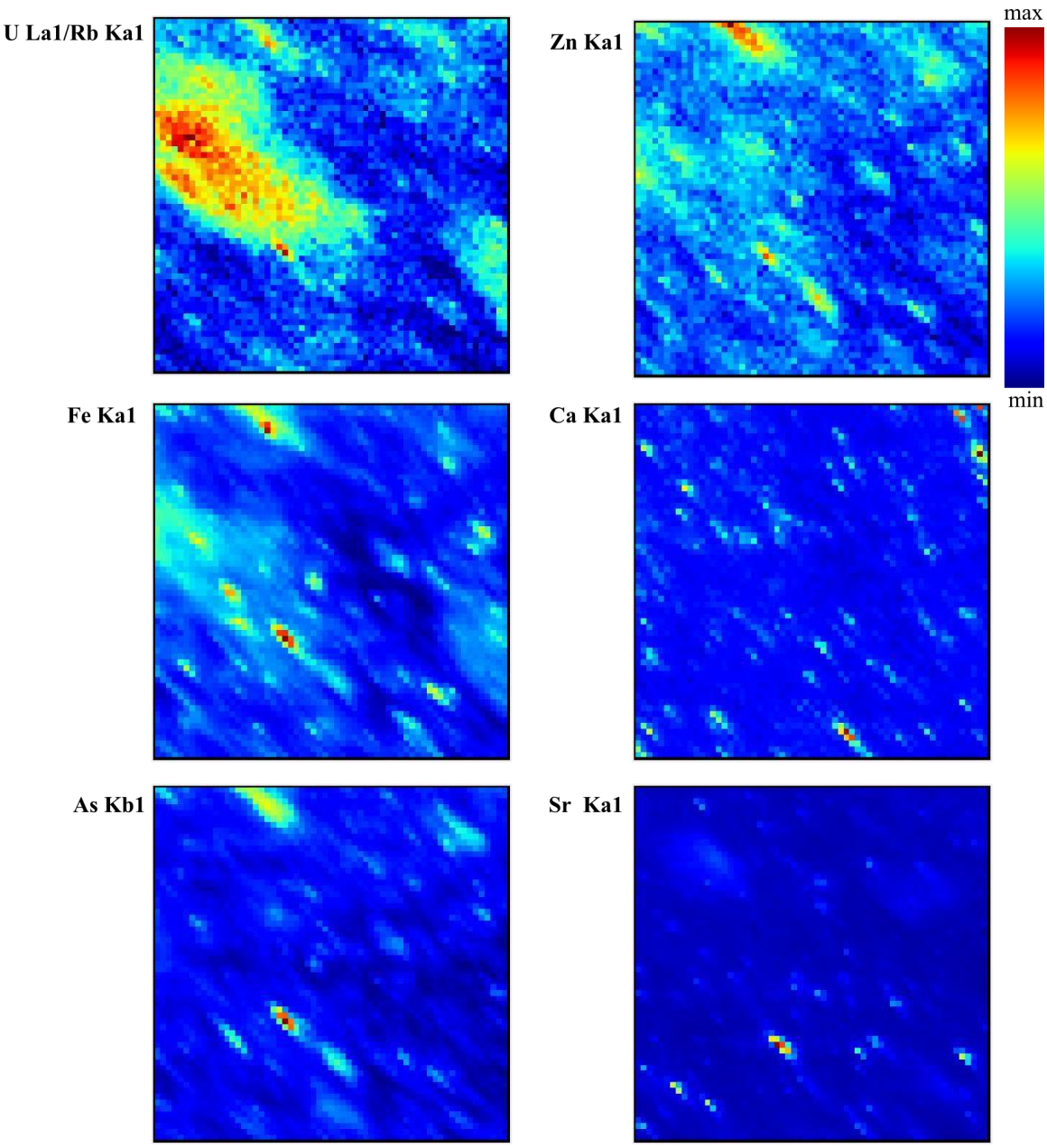


Figure 7.18 XRF elemental distribution maps of KAM029385

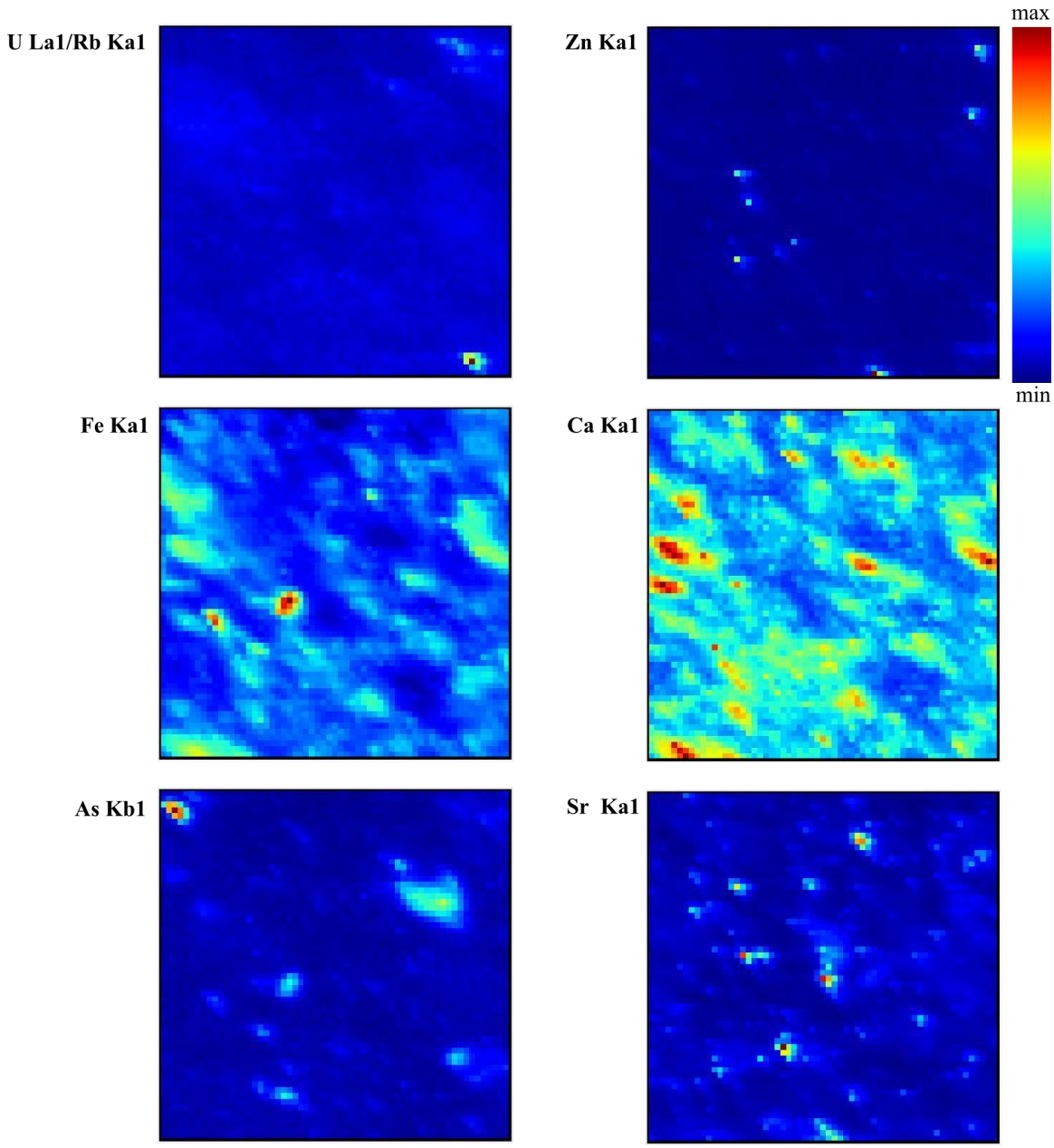


Figure 7.19 XRF elemental distribution maps of KAM079346

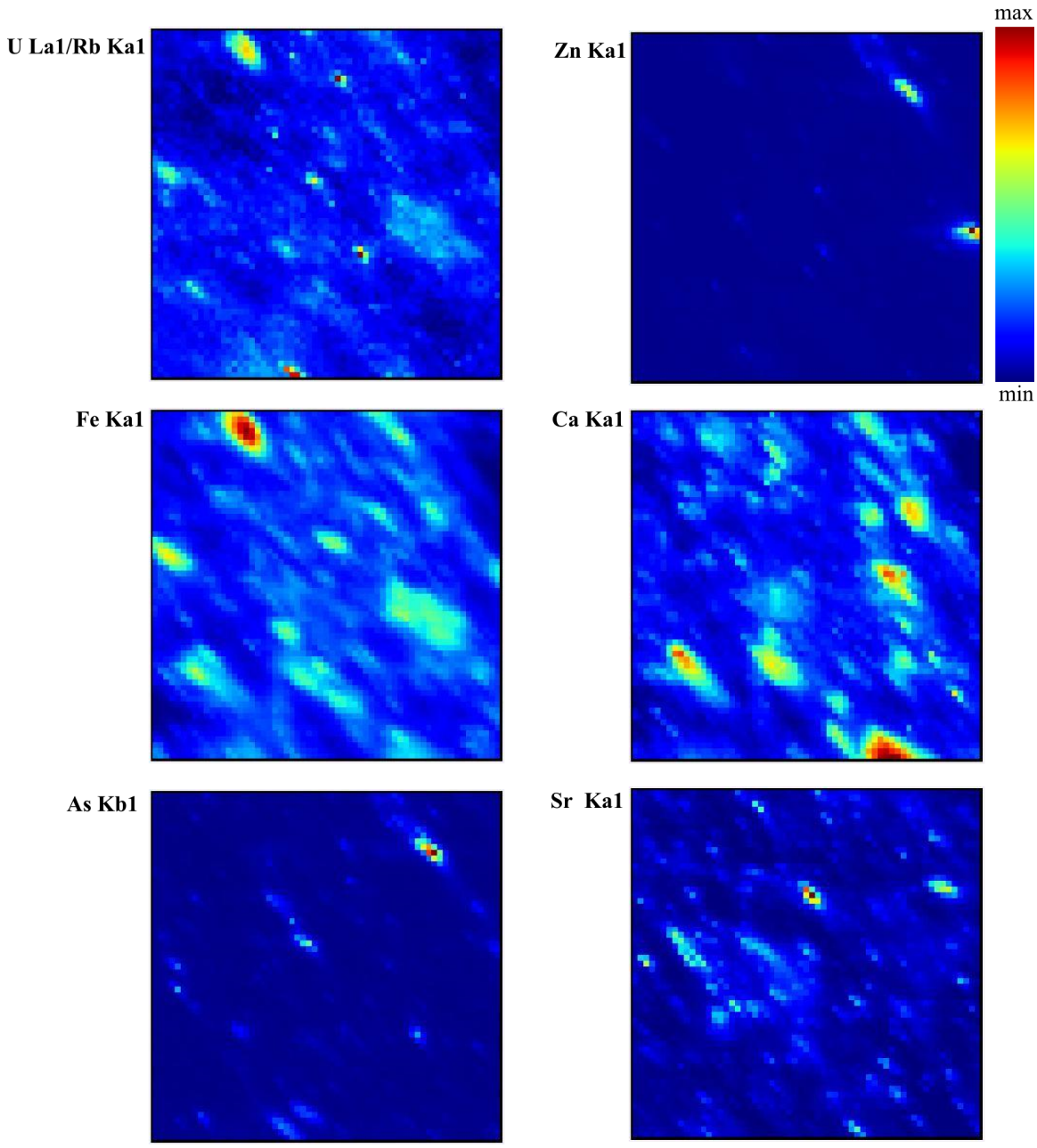


Figure 7.20 XRF elemental distribution maps of KAM047252

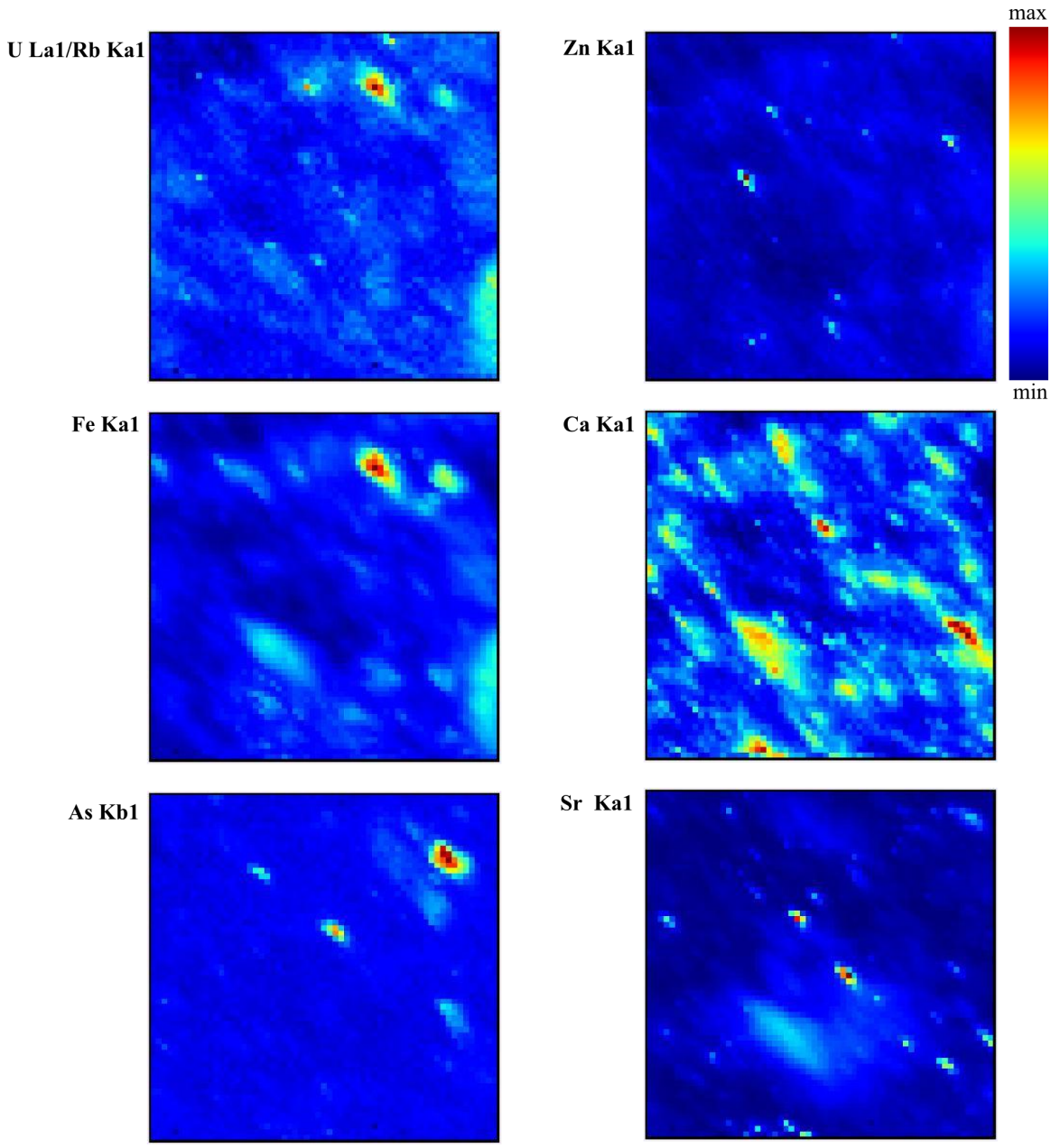


Figure 7.21 XRF elemental distribution maps of KAM091516

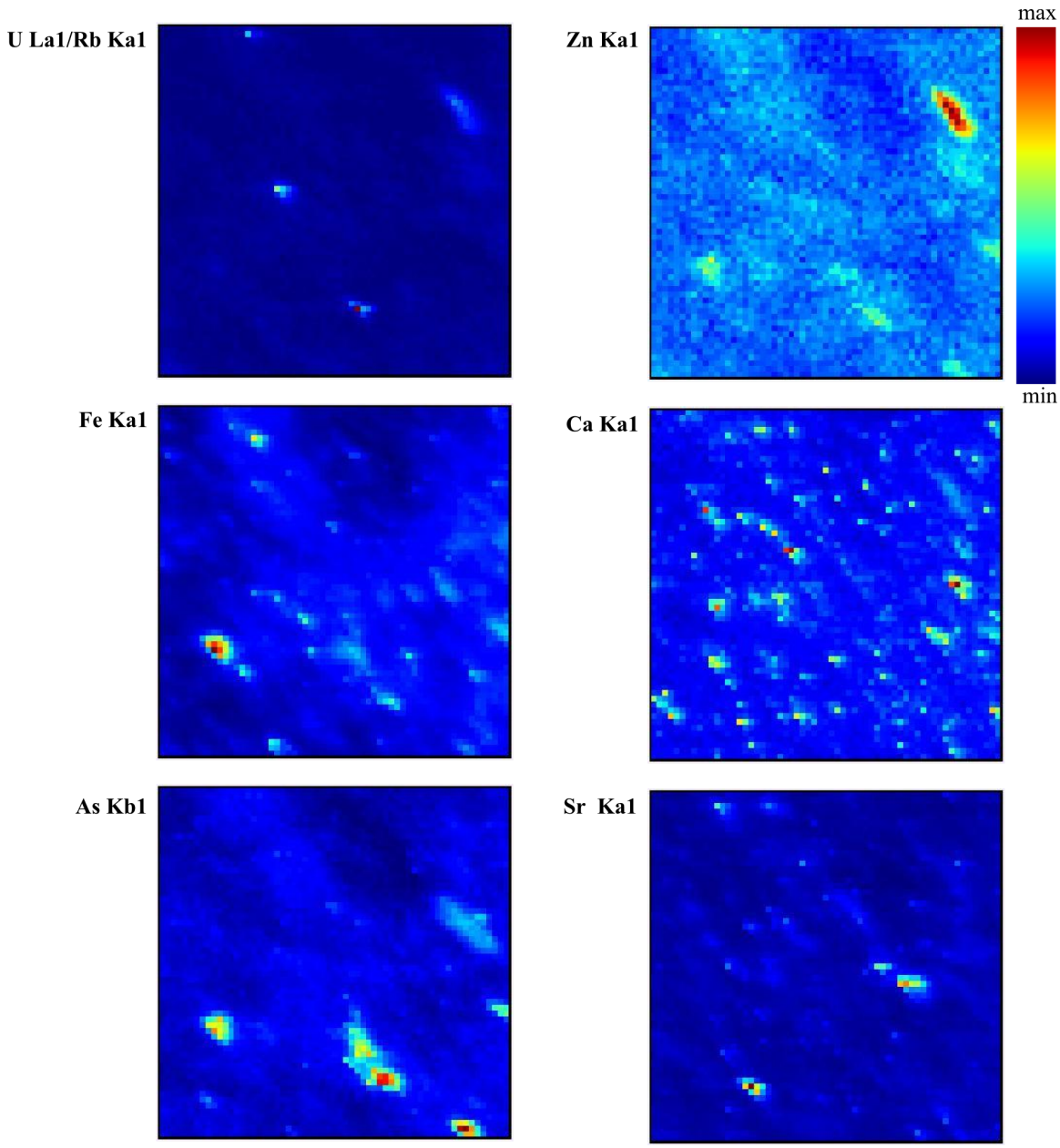


Figure 7.22 XRF elemental distribution maps of KAM144308

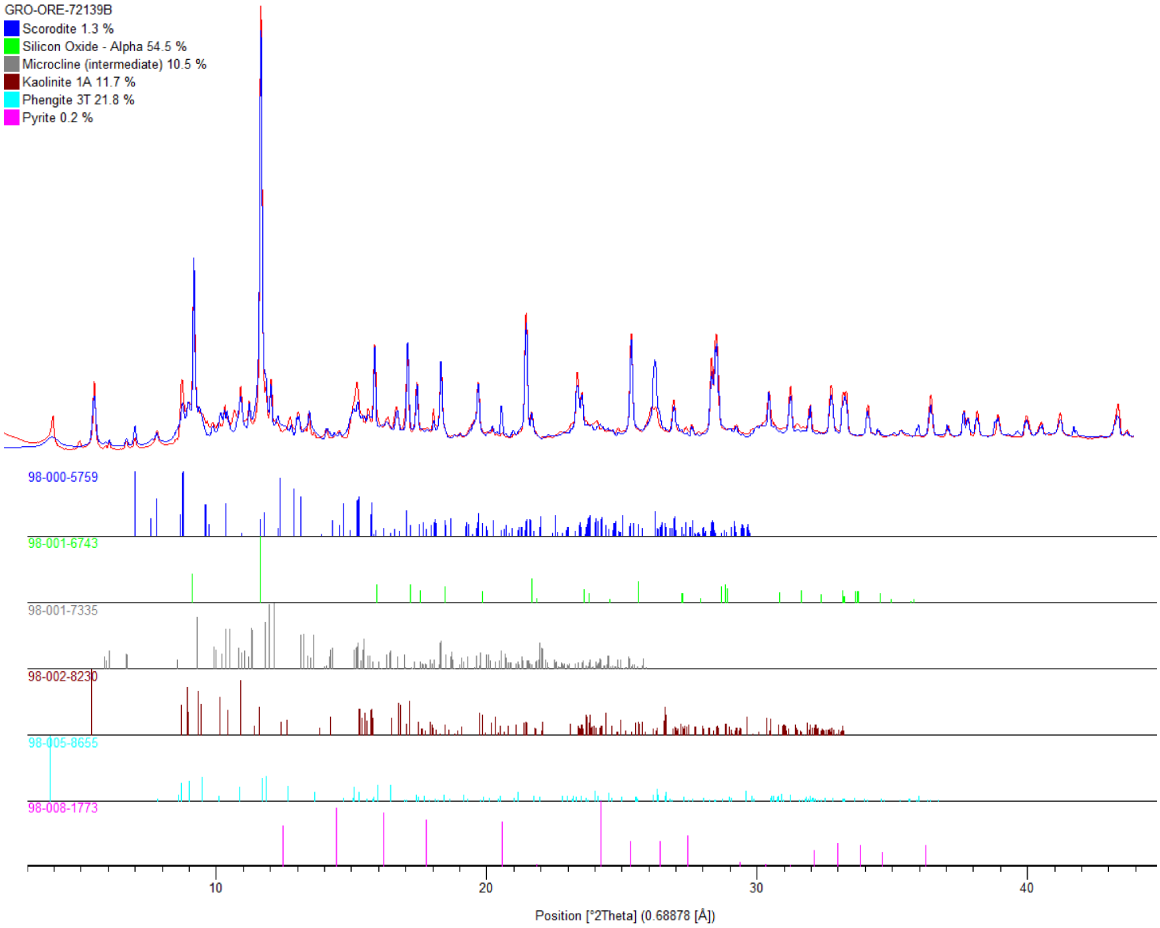


Figure 7.23 Diffraction pattern of GRO ore

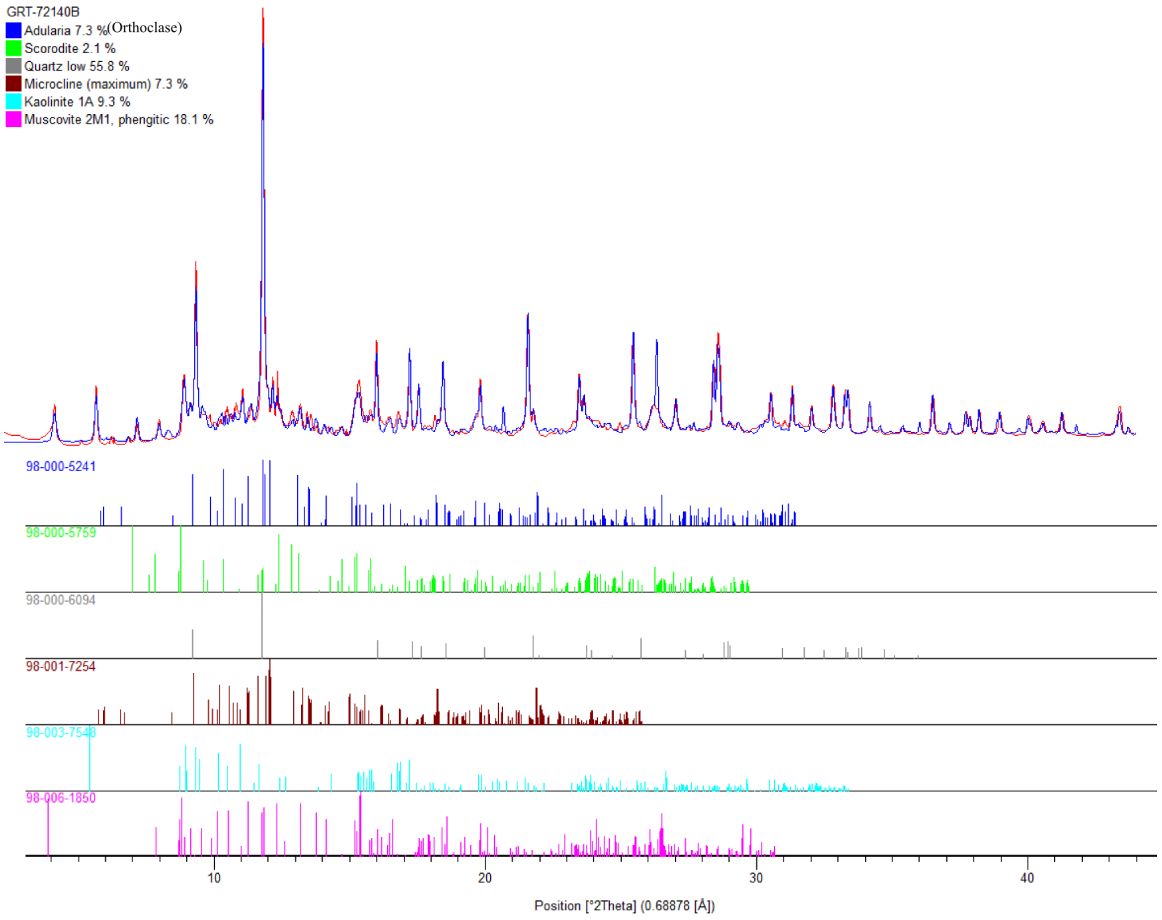


Figure 7.24 Diffraction pattern of GRT ore

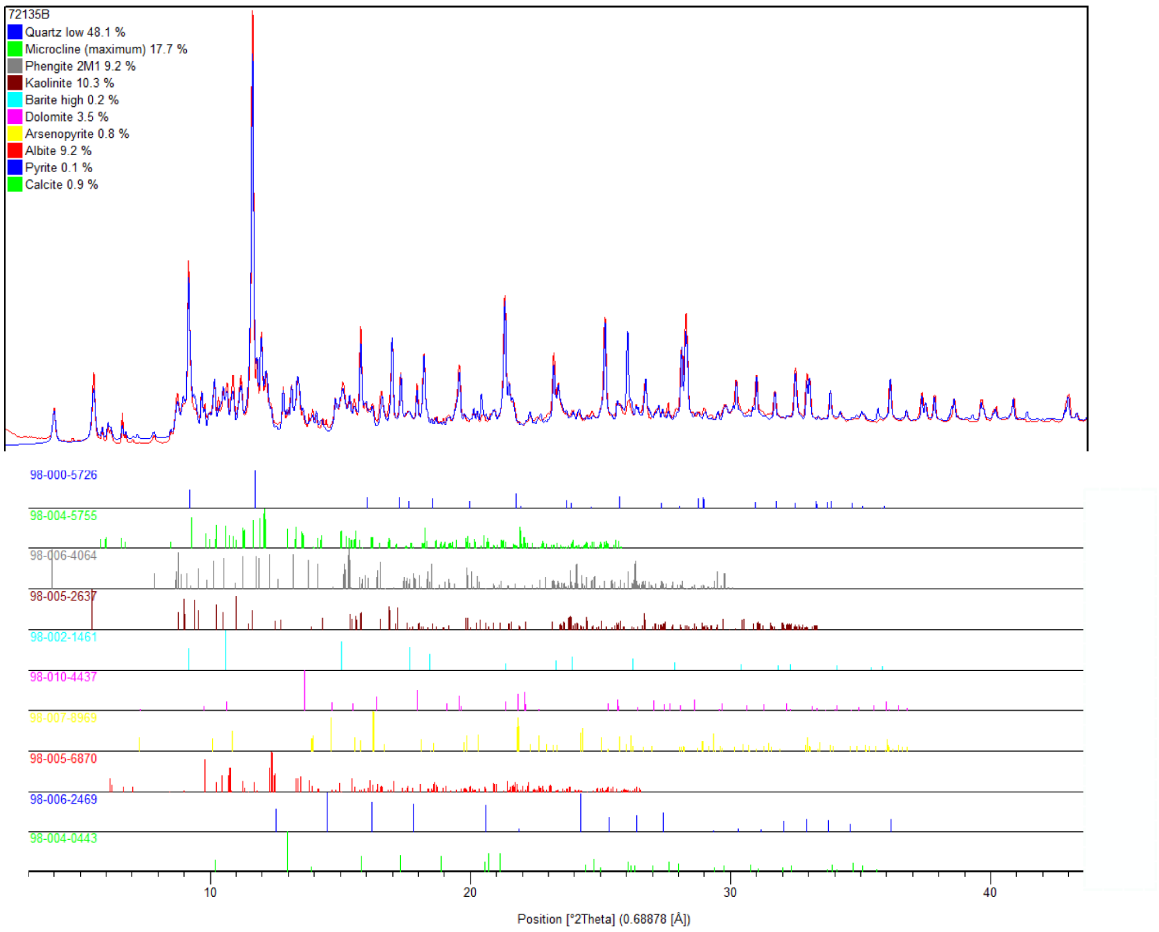


Figure 7.25 Diffraction pattern of 72135B

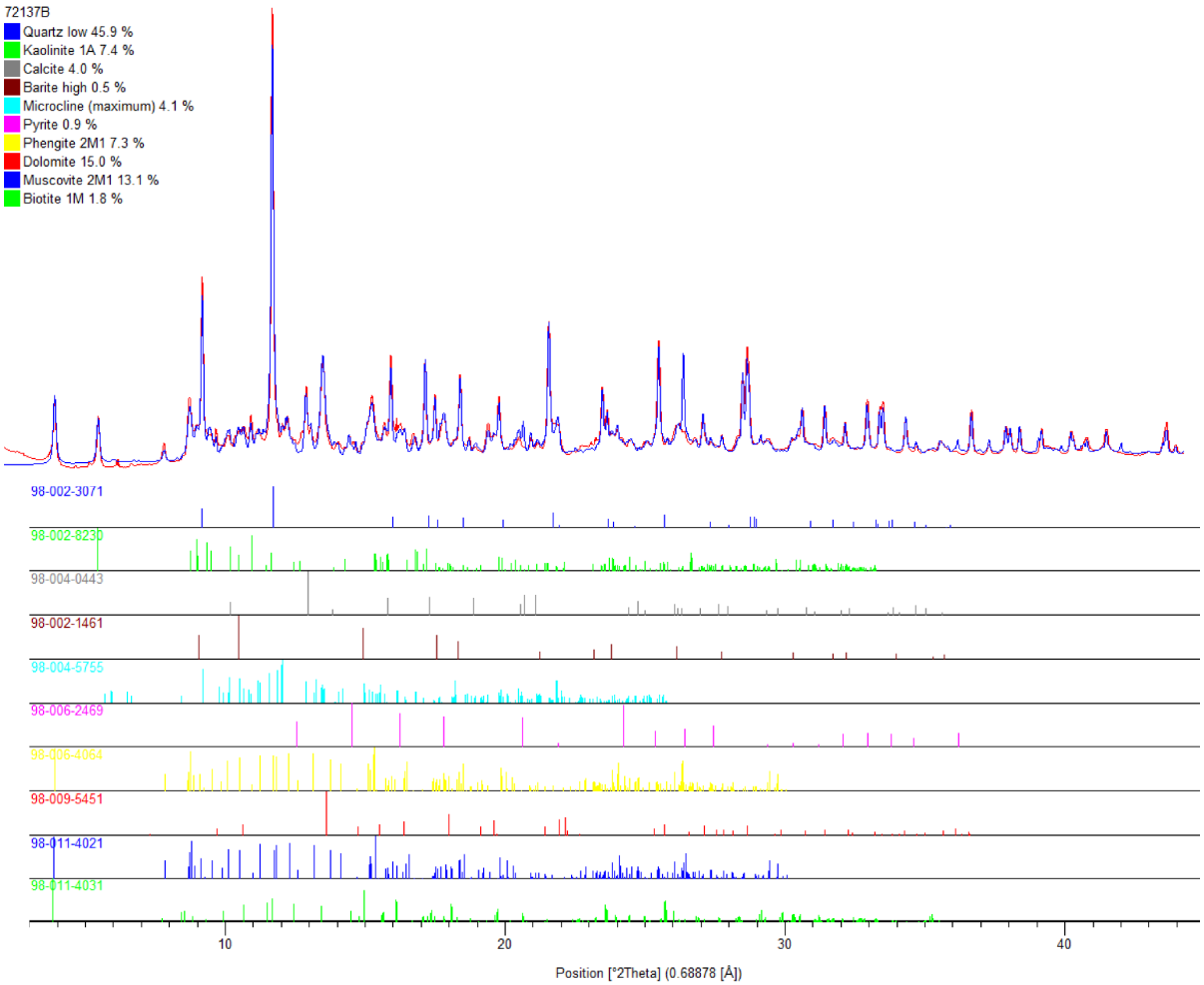


Figure 7.26 Diffraction pattern of 72137B

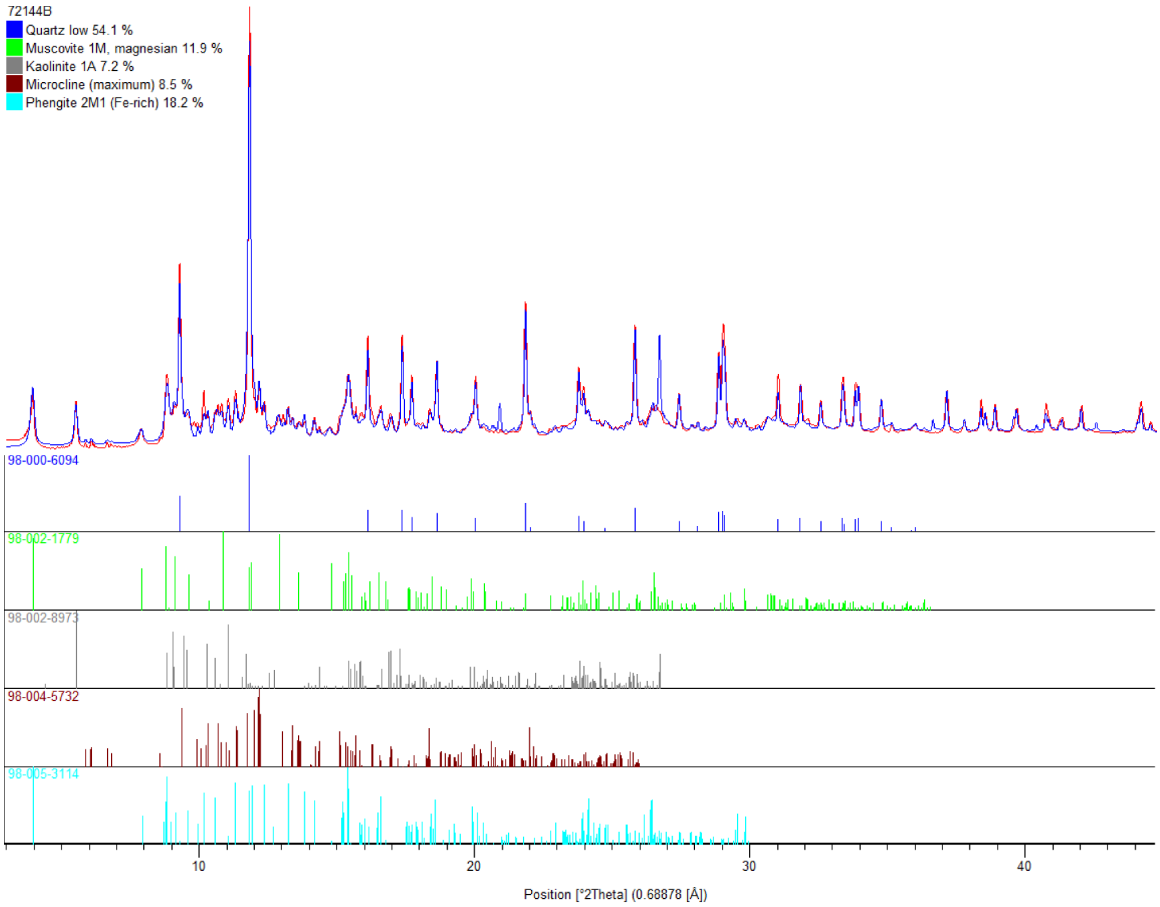


Figure 7.27 Diffraction pattern of 72144B

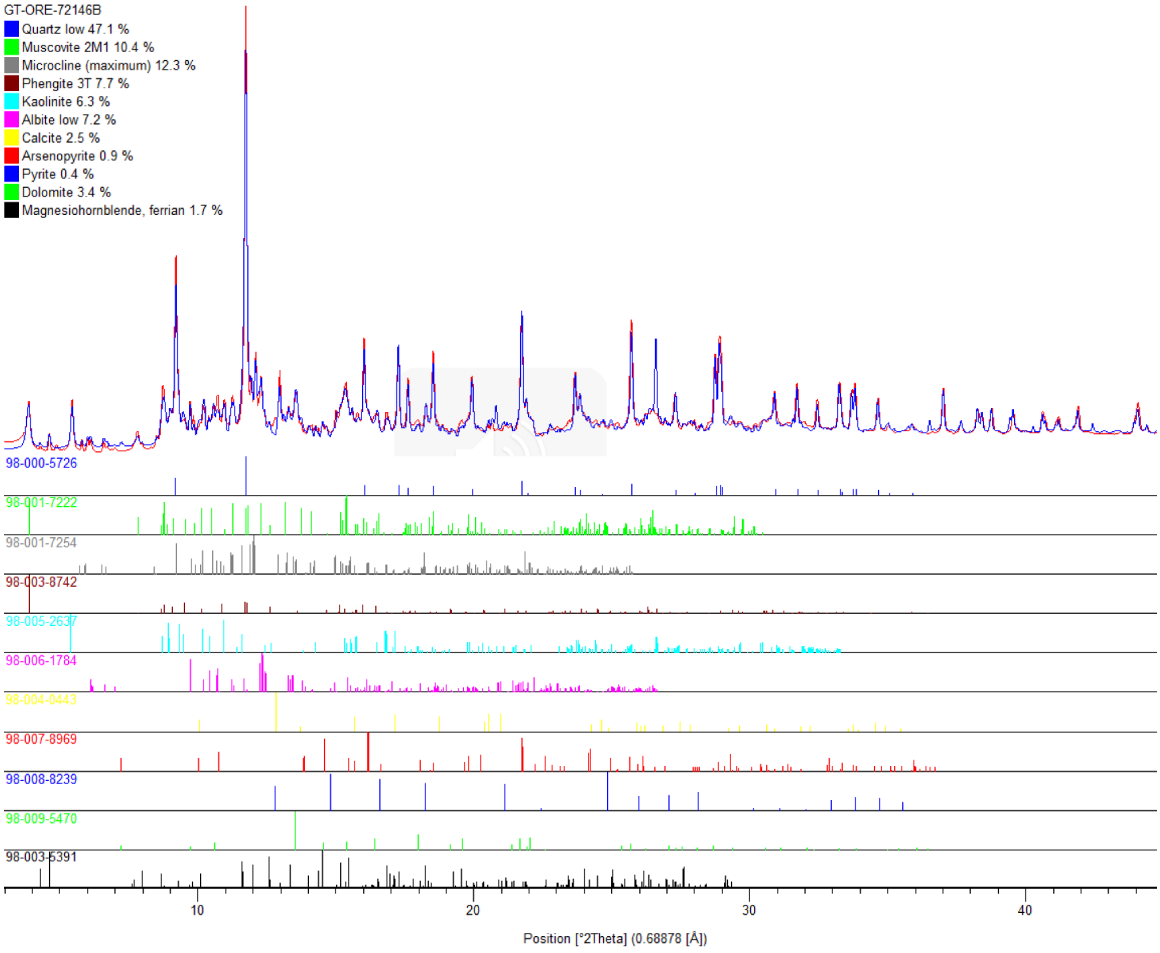


Figure 7.28 Diffraction pattern of GT ore

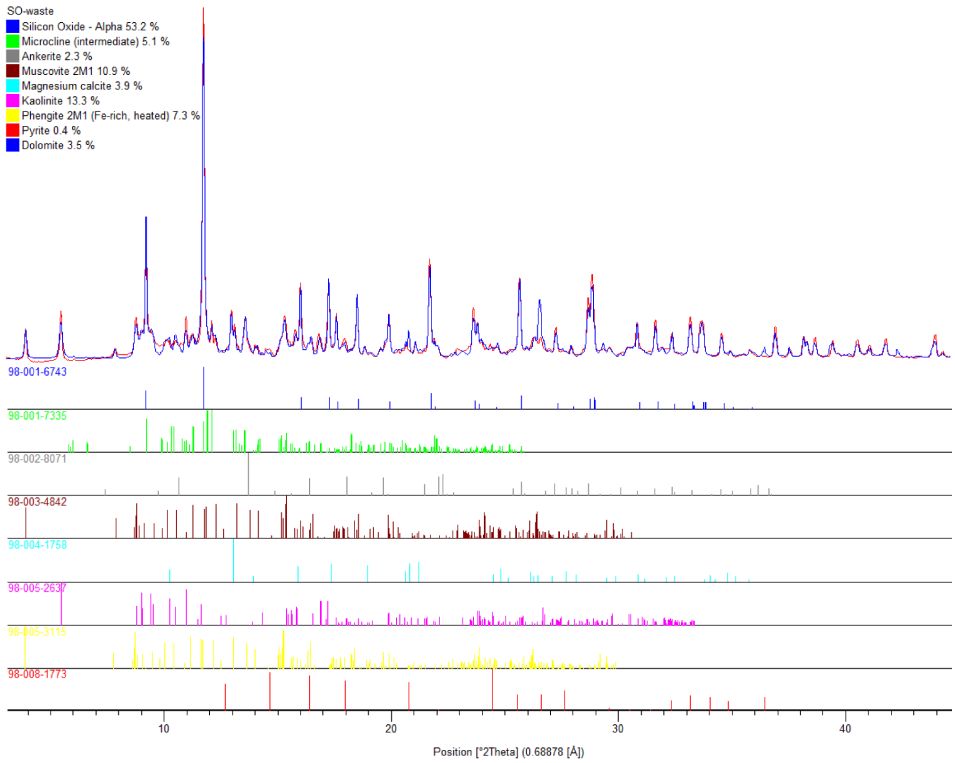


Figure 7.29 Diffraction pattern of SO waste

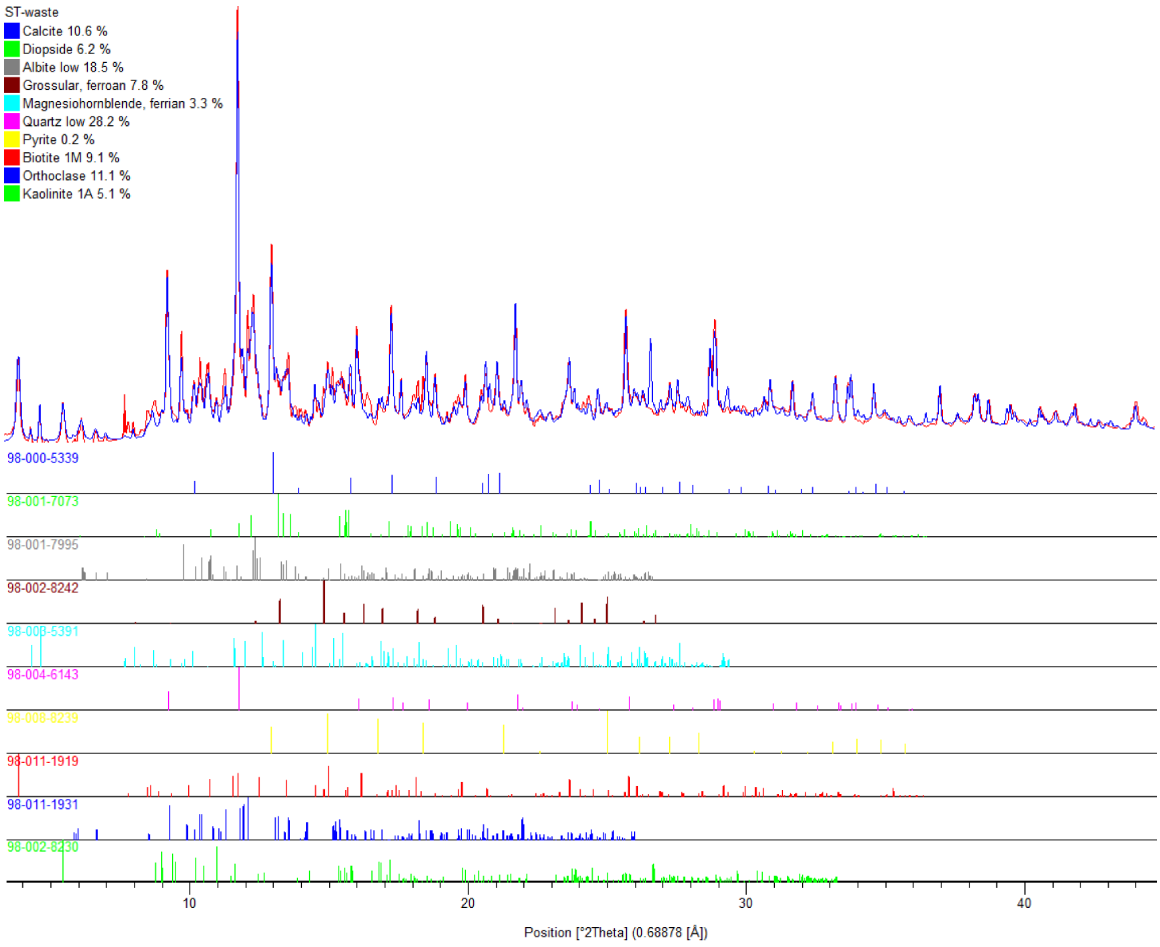


Figure 7.30 Diffraction pattern of ST waste

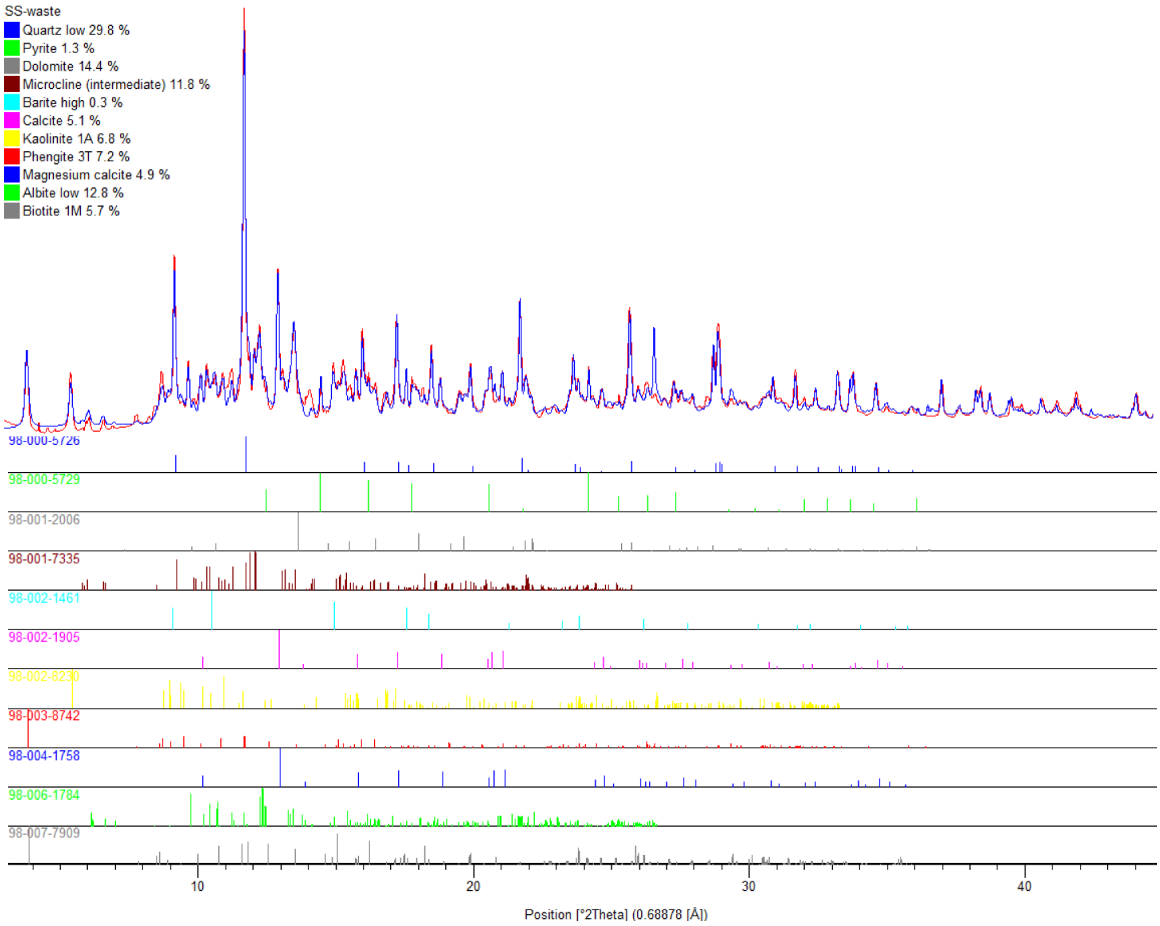


Figure 7.31 Diffraction pattern of SS waste

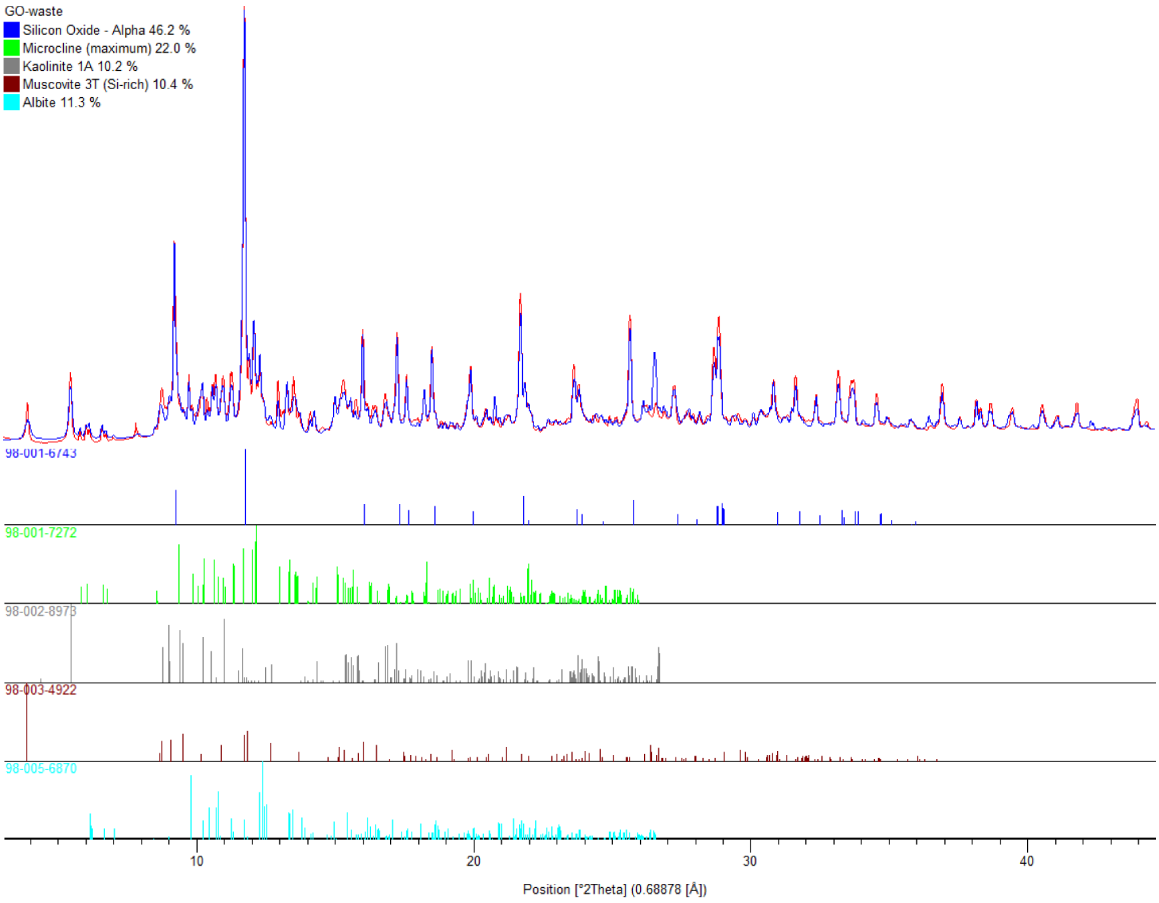


Figure 7.32 Diffraction pattern of GO waste

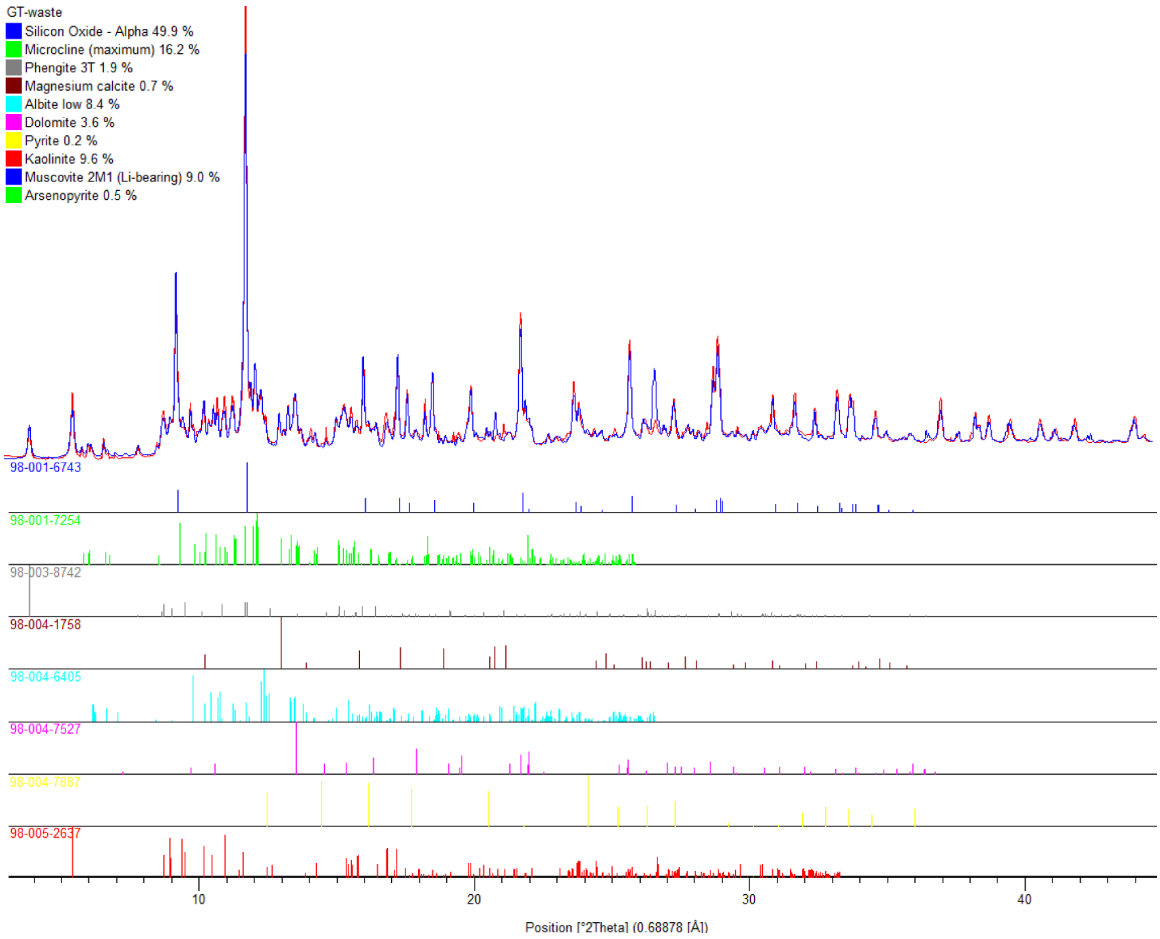


Figure 7.33 Diffraction pattern of GT waste

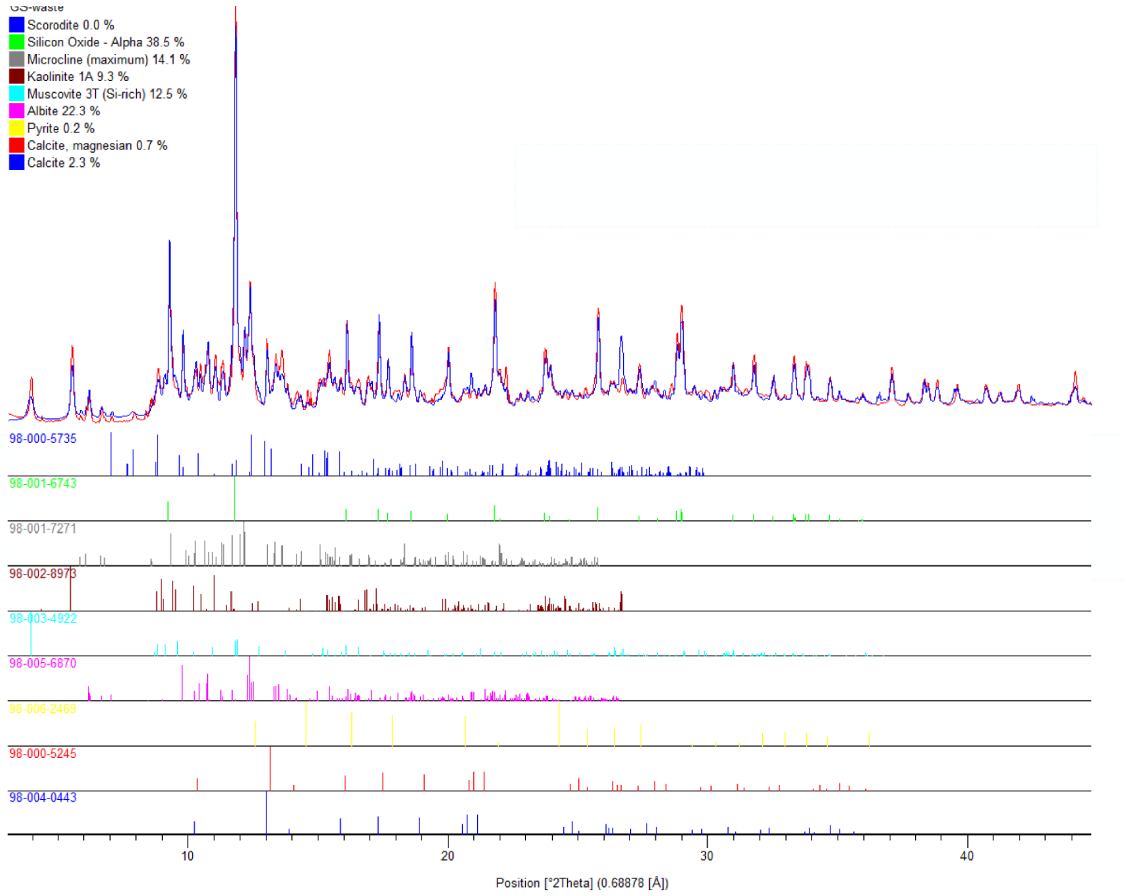


Figure 7.34 Diffraction pattern of GS waste

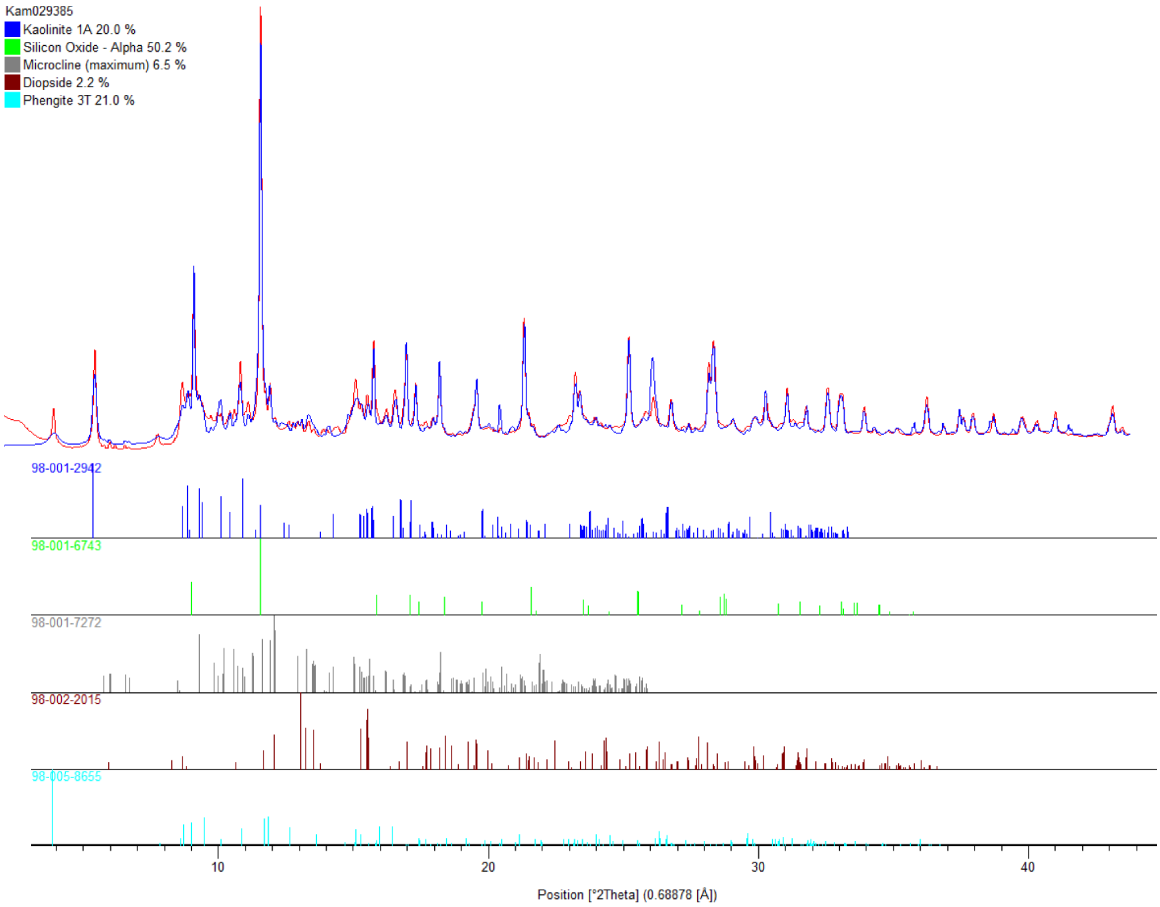


Figure 7.35 Diffraction pattern of KAM029385

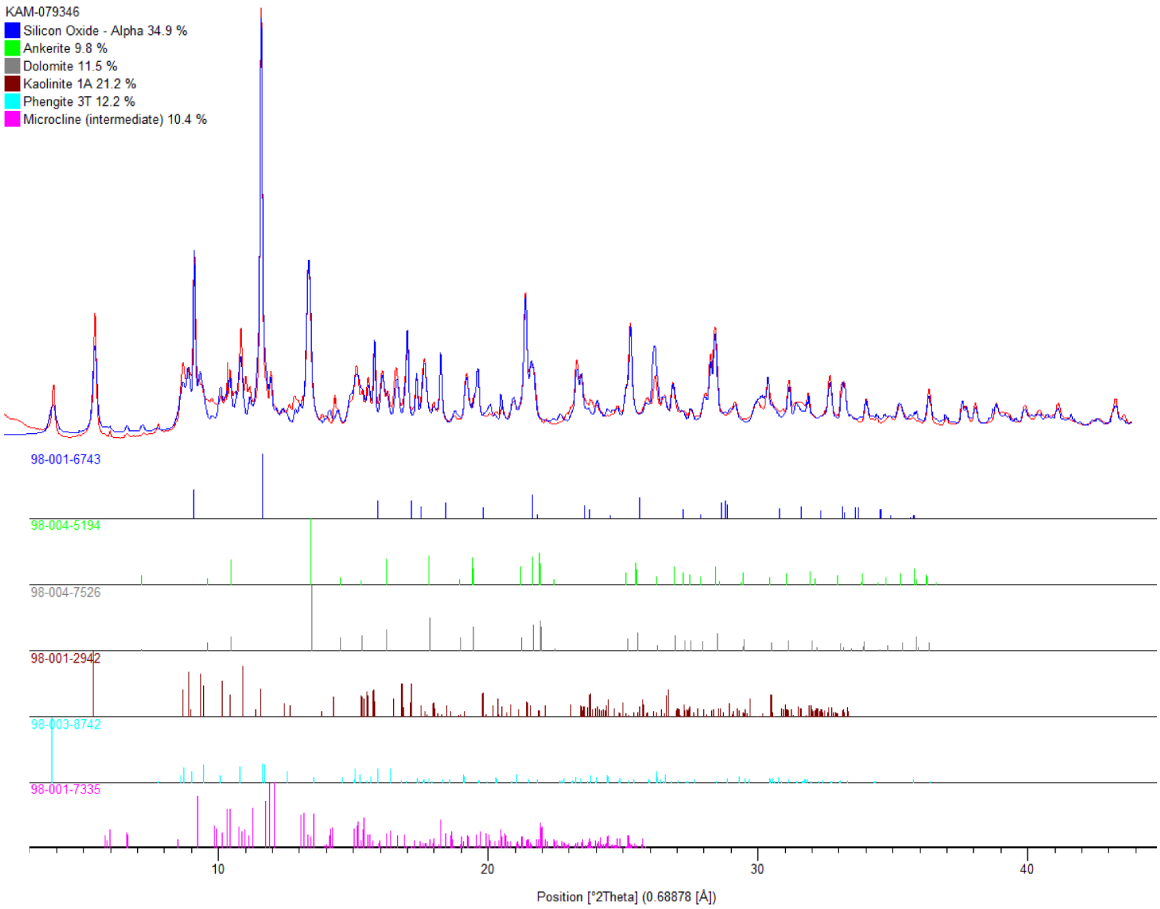


Figure 7.36 Diffraction pattern of KAM079346

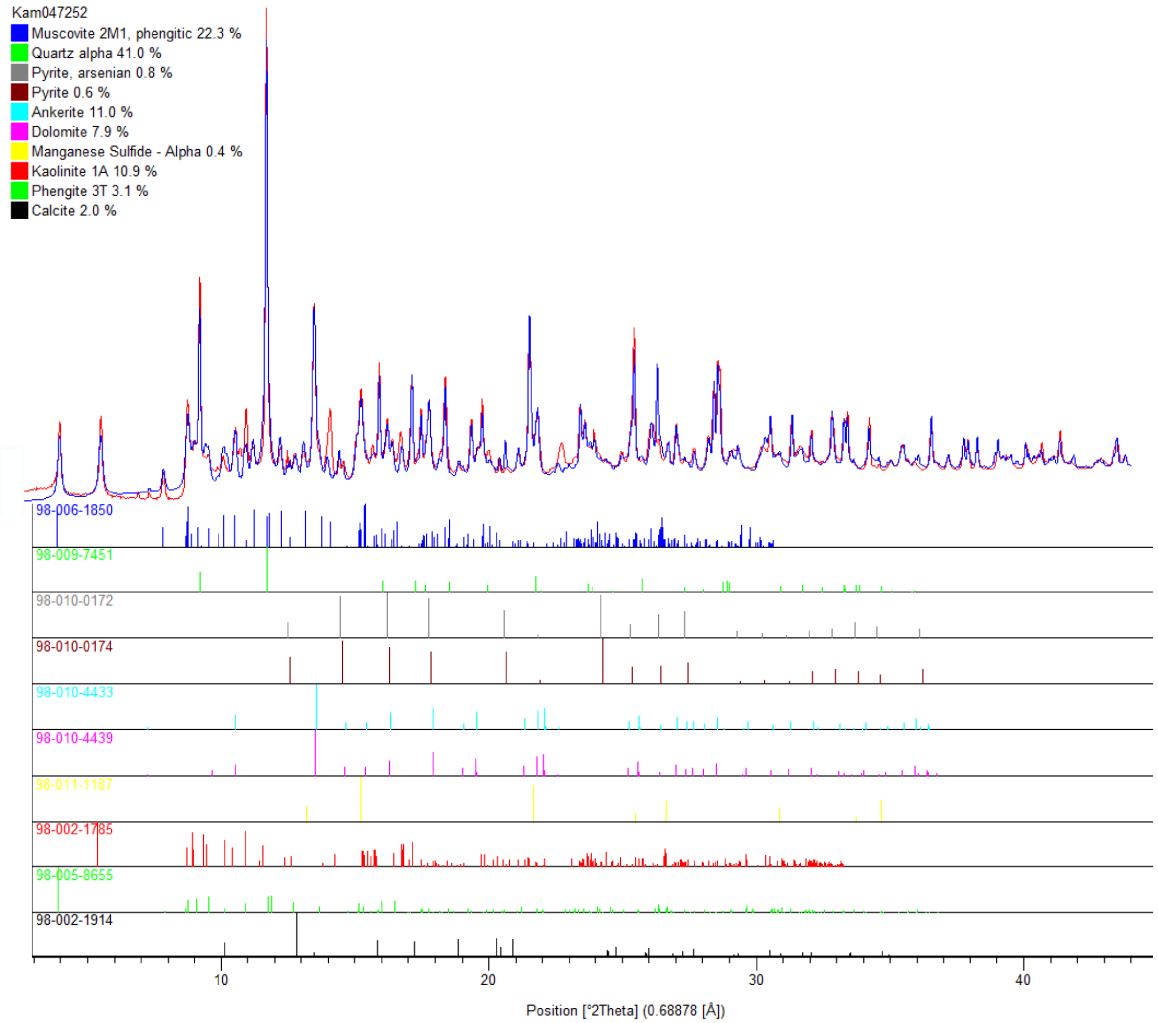


Figure 7.37 Diffraction pattern of KAM047252

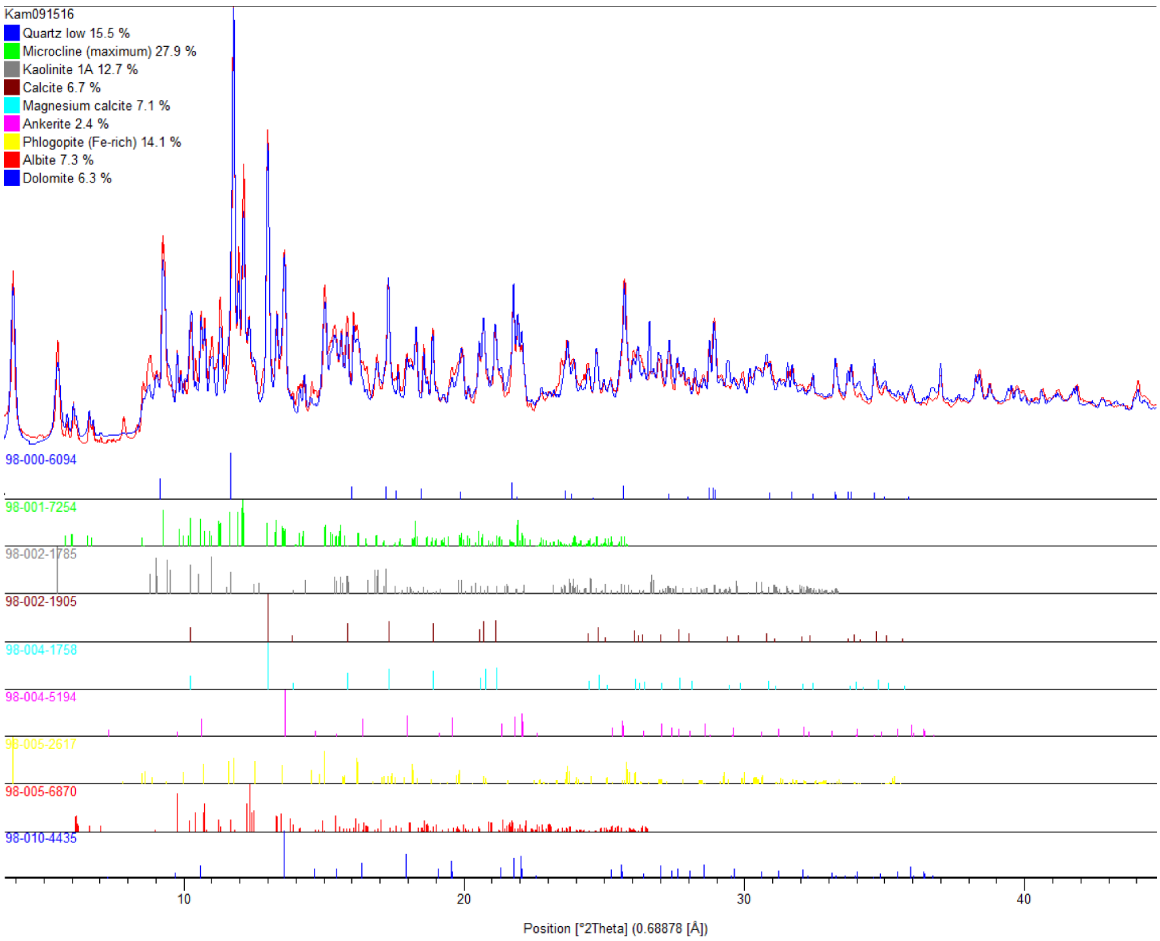


Figure 7.38 Diffraction pattern of KAM091516

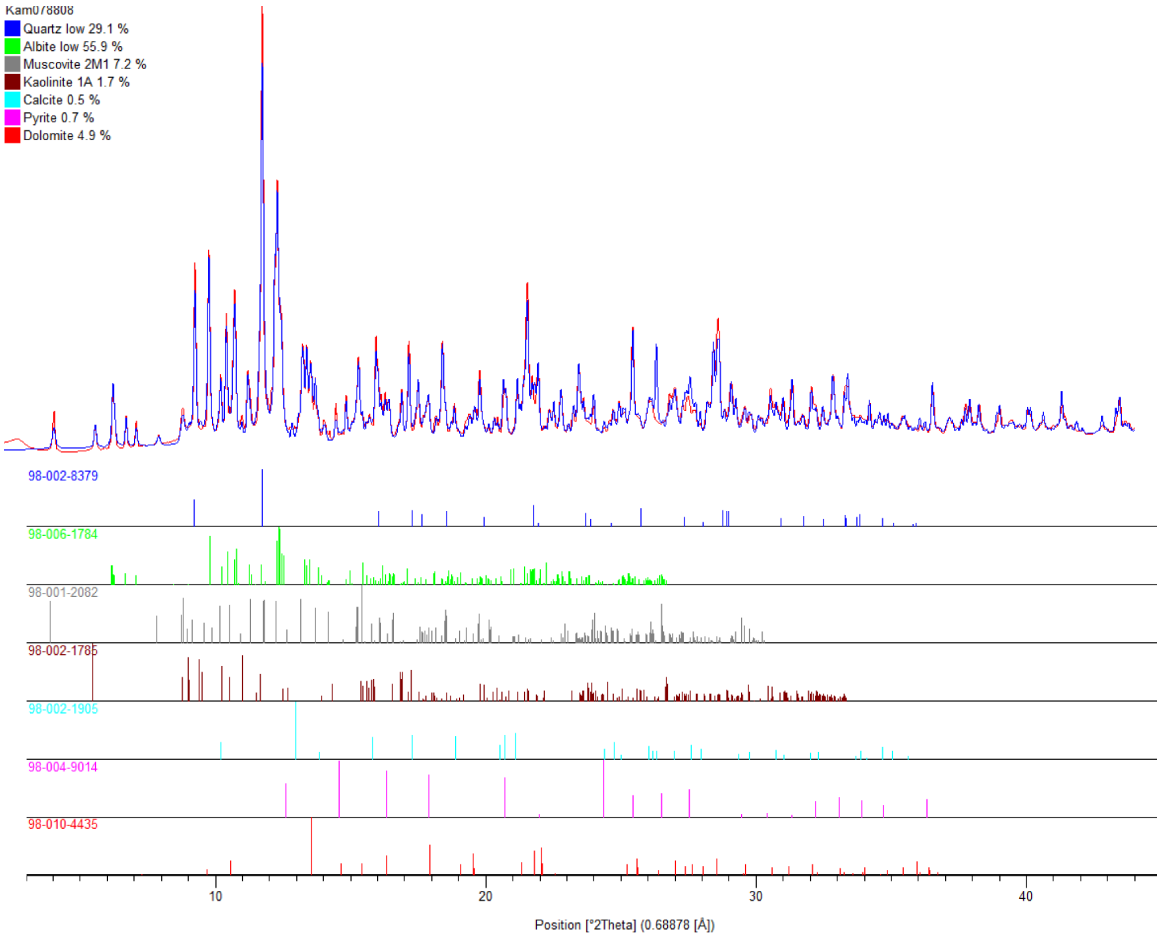


Figure 7.39 Diffraction pattern of KAM078808

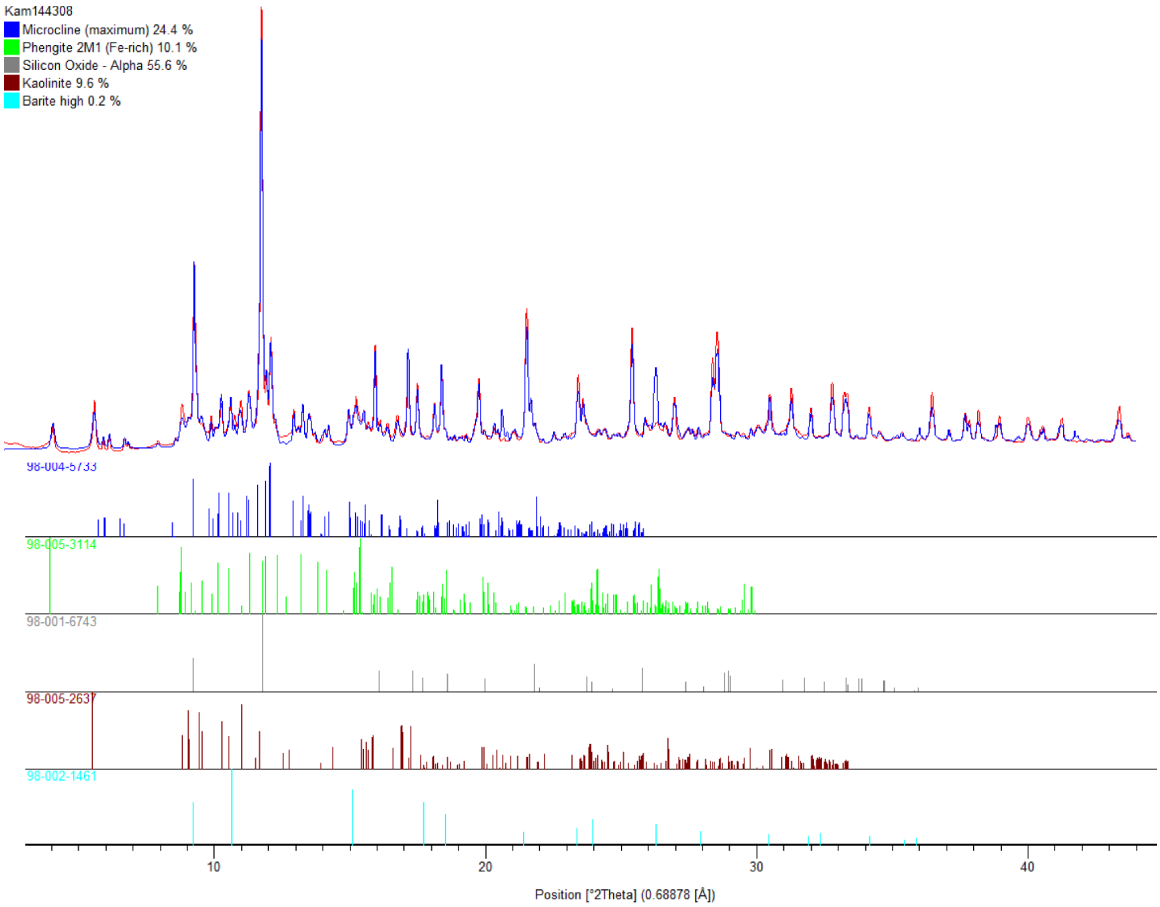


Figure 7.40 Diffraction pattern of KAM155308

Appendix C: Static Test Results

Appendix C.1: Static Test Results for Waste Rock

Appendix C.2: Static Test Results for Ore

Appendix C.3: Static Test Results for Leach Tailings

Appendix C.4: Static Test Results for Overburden

GOLDCORP

Appendix C.1: Static Test Results for Waste Rock

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	kg$CaCO_3$/t	%	%	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Oxide Facies for Gneiss Waste Rock																											
ABA001	KAM000219	CFD0002	21	22	Waste	Oxide	Gneiss	FG	7.1	7.3	*<0.01*	0.01	0.02	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	3.0	4.0	2.8	3.0	3.7	10	15	10	13
ABA043	KAM050495	CFD0152	149	150	Waste	Oxide	Gneiss	MxF	7.1	8.2	*<0.01*	*<0.01*	0.01	*<0.3*	0.28	0.90	22	21	23	25	21	23	25	72	68	77	83
ABA052	KAM079466	CFD0254	72	73	Waste	Oxide	Gneiss	MxF	7.4	9.1	*<0.01*	0.01	0.01	*<0.3*	0.27	1.0	21	23	25	25	21	25	25	70	76	83	83
ABA063	KAM125214	CFD0307	10	11	Waste	Oxide	Gneiss	MxF	8.3	8.4	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	8.0	8.0	1.3	8.0	7.7	5.2	15	27	27
ABA064	KAM125257	CFD0307	49	50	Waste	Oxide	Gneiss	MxF	7.4	7.5	0.01	*<0.01*	*<0.01*	0.30	0.020	*<0.2*	1.6	*<4.5*	4.0	5.0	1.2	4.0	4.7	5.0	14	13	16
ABA080	KAM115505	CFR0360	25.91	27.43	Waste	Oxide	Gneiss	MxF	7.5	7.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.10	0.20	7.8	4.5	4.0	5.0	7.5	4.0	4.7	26	15	13	17
ABA081	KAM117096	CFR0384	22.86	24.38	Waste	Oxide	Gneiss	MxF	7.3	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	5.0	5.0	4.4	5.0	4.7	16	15	17	17
ABA083	KAM119516	CFR0418	19.81	21.34	Waste	Oxide	Gneiss	MxF	8.6	8.5	0.01	*<0.01*	*<0.01*	0.30	0.050	0.20	3.9	4.5	6.0	7.0	3.6	6.0	6.7	12	15	19	22
ABA085	KAM120107	CFR0425	15.24	16.76	Waste	Oxide	Gneiss	MxM	7.2	7.9	*<0.01*	0.01	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	5.0	6.0	4.4	5.0	5.7	16	15	17	20
ABA096	KAM137284	CFR0468	32	33.53	Waste	Oxide	Gneiss	MxF	8.5	8.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	8.0	9.0	3.6	8.0	8.7	13	15	27	30
ABA104	KAM139298	CFR0482	10.67	12.19	Waste	Oxide	Gneiss	MxF	7.2	7.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.070	*<0.2*	5.4	*<4.5*	3.0	4.0	5.1	3.0	3.7	18	15	10	13
ABA136	KAM151967	CFR0584	109.73	111.25	Waste	Oxide	Gneiss	MxF	7.2	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.070	0.20	5.4	4.5	3.0	4.0	5.1	3.0	3.7	18	15	10	13
ABA137	KAM151932	CFR0584	60.96	62.48	Waste	Oxide	Gneiss	MxF	7.5	8.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	7.0	8.0	4.4	7.0	7.7	16	15	23	27
ABA138	KAM152219	CFR0586	155.45	156.97	Waste	Oxide	Gneiss	MxF	7.2	8.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	6.0	7.0	4.4	6.0	6.7	16	15	20	23
ABA144	KAM152716	CFR0591	30.48	32	Waste	Oxide	Gneiss	MxF	7.2	7.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.30	1.0	23	23	24	25	23	24	25	78	76	80	83
ABA145	KAM153015	CFR0594	60.96	62.48	Waste	Oxide	Gneiss	MxF	7.4	8.5	0.08	0.01	0.10	2.5	0.25	0.80	19	18	20	21	17	18	19	7.8	7.3	8.0	8.4
ABA146	KAM153091	CFR0594	164.59	166.12	Waste	Oxide	Gneiss	MxF	7.0	7.2	0.01	0.02	*<0.01*	0.30	0.10	0.30	7.8	6.8	9.0	10	7.5	9.0	9.7	25	22	29	32
ABA149	KAM153152	CFR0595	60.96	62.48	Waste	Oxide	Gneiss	MxF	8.7	9.0	0.02	*<0.01*	0.03	0.60	0.28	1.0	22	23	21	23	21	20	22	35	36	34	37
ABA224	R277421	CFD0423	53	54	Waste	Oxide	Gneiss	MxM	-	6.8	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA225	R272412	CFD0436	9	10	Waste	Oxide	Gneiss	FG	-	7.7	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA226	R272445	CFD0436	38	39	Waste	Oxide	Gneiss	FG	-	7.8	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA227	R272537	CFD0436	120	121	Waste	Oxide	Gneiss	MxF	-	8.4	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA228	R271769	CFD0425	80	81	Waste	Oxide	Gneiss	MxF	-	9.3	*<0.01*	-	-	*<0.3*	0.15	-	12	-	-	-	11	-	-	39	-	-	-
ABA229	R272589	CFD0436	166	167	Waste	Oxide	Gneiss	MxF	-	7.5	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA230	R280455	CFD0497	90	91	Waste	Oxide	Gneiss	MxM	-	8.6	0.10	-	-	3.1	0.26	-	20	-	-	-	17	-	-	6.5	-	-	-
ABA231	R277177	CFD0421	47	48	Waste	Oxide	Gneiss	MxM	-	7.5	0.01	-	-	0.30	0.030	-	2.3	-	-	-	2.0	-	-	7.5	-	-	-
ABA232	R277505	CFD0426	58	59	Waste	Oxide	Gneiss	MxM	-	7.2	*<0.01*	-	-	*<0.3*	*<0.01*	-	*<0.8*	-	-	-	0.48	-	-	2.6	-	-	-
ABA233	R277739	CFD0431	118	119	Waste	Oxide	Gneiss	MxF	-	7.6	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA234	R277403	CFD0423	37	38	Waste	Oxide	Gneiss	MxM	-	8.4	*<0.01*	-	-	*<0.3*	0.020	-	1.6	-	-	-	1.3	-	-	5.2	-	-	-
ABA235	R277137	CFD0421	11	12	Waste	Oxide	Gneiss	MxM	-	7.7	0.01	-	-	0.30	0.030	-	2.3	-	-	-	2.0	-	-	7.5	-	-	-
ABA380	KAM075906	CFD0216	90	91	Waste	Oxide	Gneiss	MxF	7.8	7.1	0.01	0.01	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	-	-	1.2	-	-	5.0	14	-	-
ABA382	KAM067845	CFD0221	211	212	Waste	Oxide	Gneiss	FG	-	8.6	0.06	*<0.01*	0.06	1.9	0.52	1.6	40	36	-	-	38	-	-	22	19	-	-
ABA384	KAM068794	CFD0238	227	228	Waste	Oxide	Gneiss	FG	7.0	6.4	0.01	0.02	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	-	-	1.2	-	-	5.0	14	-	-
ABA393	KAM030104	CFR0109	50.9	52.43	Waste	Oxide	Gneiss	FG	6.6	6.6	0.02	0.01	0.01	0.60	0.020	*<0.2*	1.6	*<4.5*	-	-	0.93	-	-	2.5	7.2	-	-
Statistical Summary						**Oxide**	**Gneiss**	**n**	21	34	34	22	22	34	34	22	34	22	18	18	34	18	18	34	22	18	18
								Max	8.7	9.3	0.10	0.02	0.10	3.1	0.50	1.6	40	36	25	25	39	25	25	78	76	83	83
								90th PCTL	8.5	8.6	0.02	0.01	0.03	0.60	0.30	1.0	22	23	23	25	21	23	25	38	65	78	83
								75th PCTL	7.5	8.4	0.01	0.01	0.01	0.30	0.10	0.70	7.8	15	17	18	7.5	15	16	18	18	28	32
								Median	7.3	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.10	0.20	3.9	4.5	6.5	7.5	3.6	6.2	7.2	9.1	15	20	23
								25th PCTL	7.2	7.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	4.3	5.0	1.2	4.0	4.7	5.0	15	13	16
								10th PCTL	7.0	7.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	3.0	4.0	0.50	2.7	3.7	2.5	14	10	13
								Min	6.6	6.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	*<0.2*	*<0.8*	*<4.5*	3.0	4.0	0.50	2.7	3.7	2.5	7.2	8.0	8.4
Upper Transition Facies for Gneiss Waste Rock																											
ABA016	KAM029087	CFD0175	145	146	Waste	Upper transition	Gneiss	MxF	7.1	7.5	0.01	0.01	*<0.01*	0.30	0.64	2.1	50	48	52	53	49	52	53	159	153	166	170
ABA042	KAM050492	CFD0152	146	147	Waste	Upper transition	Gneiss	MxF	7.3	8.1	*<0.01*	0.01	0.01	*<0.3*	0.35	1.2	27	27	30	30	27	30	30	91	91	100	100
ABA057	KAM096548	CFD0269	33	34	Waste	Upper transition	Gneiss	FG	7.5	8.5	0.94	*<0.01*	0.90	29	0.030	*<0.2*	2.3	*<4.5*	40	5.0	-27	11	-24	0.080	0.15	1.4	0.17
ABA059	KAM097012	CFD0272	17	18	Waste	Upper transition	Gneiss	FG	7.4	7.6	*<0.01*	0.01	0.01	*<0.3*	0.030	0.10	2.3	2.3	6.0	6.0	2.0	6.0	5.7	7.8	7.6	20	20
ABA060	KAM097065	CFD0272	65	66	Waste	Upper transition	Gneiss	FG	7.1	8	0.04	*<0.01*	0.04	1.3	0.42	1.4	33	32	34	36	31	33	35	26	25	27	29
ABA069	KAM145287	CFD0338	123	124	Waste	Upper transition	Gneiss	FG	7.4	7.4	0.01	*<0.01*	*<0.01*	0.30	0.020	*<0.2*	1.6	*<4.5*	3.0	5.0	1.2	3.0	4.7	5.0	14	9.6	16
ABA101	KAM137634	CFR0470	109.73	111.25	Waste	Upper transition	Gneiss	MxF	7.6	7.8	0.06	*<0.01*	0.04	1.9	0.35	1.1	27	25	26	27	25	24	25	14	13	14	14
ABA105	KAM139327	CFR0482	50.29	51.82	Waste	Upper transition	Gneiss	MxF	7.2	7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.11	*<0.2*	8.5	*<4.5*	2.0	3.0	8.2	2.0	2.7	28	15	6.7	10
ABA141	KAM152499	CFR0589	77.72	79.25	Waste	Upper transition	Gneiss	MxF	7.6	8.8	0.03	0.02	0.03	0.90	0.44	1.2	34	27	30	31	33	29	30	36	29	32	33
ABA147	KAM152978	CFR0594	10.67	12.19	Waste	Upper transition	Gneiss	MxF	9.2	9.4	*<0.01*	0.01	*<0.01*	*<0.3*	0.27	0.90	21	21	22	23	21	22	23	70	68	73	77
ABA237	R270907	CFD0412	10	11	Waste	Upper transition	Gneiss	MxF	-	8.2	0.01	-	-	0.30	0.63	-	49	-	-	-	49	-	-	156	-	-	-
ABA238	R280433	CFD0497	28	29	Waste	Upper transition	Gneiss	MxM	-	7.7	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA239	Q034712	CFD0473	7	8	Waste	Upper transition	Gneiss	FG	-	7.9	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA240	Q034807	CFD0473	117	118	Waste	Upper transition	Gneiss	FG	-	7.6	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA241	R272496	CFD0436	83	84	Waste	Upper transition	Gneiss	MxF	-	7.5	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA242	R270718	CFD0404	69	70	Waste	Upper transition	Gneiss	MxF	-	7.5	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA243	R271483	CFD0420	51	52	Waste	Upper transition	Gneiss	MxF	-	7.5	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA244	R272865	CFD0441	40	41	Waste	Upper transition	Gneiss	MxF	-	7.1	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA245	R278947	CFD0461	10	11	Waste	Upper transition	Gneiss	MxM	-	7	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA353	R304081	CFD0525	10	11	Waste	Upper Transition	Gneiss	MxF	8.4	7.5	*<0.01*	0.01	0.01	0.30	0.010	*<0.2*	0.80	*<4.5*	-	-	0.46	-	-	2.5	14	-	-
ABA367	R545582	CFD0524	56	57	Waste	Upper Transition	Gneiss	MxF	7.9	7.2	0.01	*<0.01*	0.02	0.30	0.020	*<0.2*	1.6	*<4.5*	-	-	1.2	-	-	5.0	14	-	-
ABA373	R271332	CFD0417	58	59	Waste	Upper Transition	Gneiss	MxF	7.5	6.8	0.08	0.01	0.05	2.5	0.010	*<0.2*	0.80	*<4.5*	-	-	-1.7	-	-	0.31	1.8	-	-
ABA385	KAM068709	CFD0238	151	152	Waste	Upper Transition	Gneiss	MxF	-	-	*<0.01*	0.01	0.01	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	-	-	3.6	-	-	13	15	-	-
ABA386	KAM069164	CFD0242	220.45	221	Waste	Upper Transition	Gneiss	FG	7.1	6.6	*<0.01*	0.01	0.02	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA407	R272624	CFD0438	17	18	Waste	Upper Transition	Gneiss	MxF	7.9	7.8	*<0.01*	0.02	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
ABA411	R544193	CFD0502	40	41	Waste	Upper Transition	Gneiss	MxF	7.4	6.9	*<0.01*	0.01	0.02	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	16	25	26	17	17	26	26	17	26	17	10	10	26	10	10	26	17	10	10
								Max	9.2	9.4	0.94	0.02	0.90	29	0.64	2.1	50	48	52	53	49	52	53	159	153	166	170
								90th PCTL	8.2	8.4	0.05	0.01	0.04	1.6	0.43	1.3	33	29	41	38	32	35	37	80	77	107	107
								75th PCTL	7.7	7.9	0.01	0.01	0.03	0.31	0.23	1.1	18	25	33	31	18	30	30	23	26	63	66
								Median	7.5	7.5	0.01	0.01	0.01	0.31	0.030	*<0.2*	1.9	*<4.5*	28	25	1.2	23	24	5.1	15	24	24
								25th PCTL	7.3	7.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	1.0	*<4.5*	10	5.3	0.50	6.9	4.9	2.6	14	11	15
								10th PCTL	7.1	6.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	2.9	4.8	0.50	2.6	0	2.5	5.3	6.1	9.0
								Min	7.1	6.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	0.10	0.80	2.3	2.0	3.0	-27	1.7	-24	0.10	0.20	1.4	0.20

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Lower Transition Facies for Gneiss Waste Rock																											
ABA019	KAM029649	CFD0177	73	74	Waste	Lower transition	Gneiss	MxM	9.5	9.3	0.02	0.02	0.01	0.60	0.14	0.50	11	11	20	20	10	19	19	17	18	32	32
ABA020	KAM029658	CFD0177	81	82	Waste	Lower transition	Gneiss	MxM	7.9	9.5	0.05	*<0.01*	0.07	1.6	1.1	4.0	86	91	127	121	85	125	119	55	58	81	77
ABA047	KAM051446	CFD0166	13	14	Waste	Lower transition	Gneiss	MxM	9.5	9.3	*<0.01*	*<0.01*	0.01	*<0.3*	0.12	0.50	9.3	11	28	23	9.0	28	23	31	38	93	77
ABA051	KAM079117	CFD0251	51	52	Waste	Lower transition	Gneiss	MxF	7.2	7.9	0.27	0.02	0.25	8.4	0.67	2.3	52	52	48	50	44	40	42	6.2	6.2	5.7	5.9
ABA058	KAM096948	CFD0270	230	231	Waste	Lower transition	Gneiss	MxF	7.2	8.2	0.10	*<0.01*	0.06	3.1	0.82	2.8	64	64	61	56	61	58	53	20	20	20	18
ABA067	KAM129499	CFD0332	50	51	Waste	Lower Transition	Gneiss	MxM	9.5	9.5	0.04	*<0.01*	0.04	1.3	0.12	0.40	9.3	9.1	15	17	8.1	14	16	7.5	7.3	12	14
ABA070	KAM099512	CFD0338	10	11	Waste	Lower transition	Gneiss	MxF	7.9	8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	4.0	5.0	1.3	4.0	4.7	5.2	15	13	17
ABA073	KAM145537	CFD0339	111	112	Waste	Lower transition	Gneiss	MxF	9	9.1	0.01	*<0.01*	*<0.01*	0.30	0.12	0.50	9.3	11	13	15	9.0	13	15	30	36	42	48
ABA098	KAM137429	CFR0469	28.96	30.48	Waste	Lower transition	Gneiss	MxF	8.7	8.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	8.0	9.0	2.8	8.0	8.7	10	15	27	30
ABA106	KAM139356	CFR0482	89.92	91.44	Waste	Lower transition	Gneiss	MxF	7.2	8.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.28	0.80	22	18	30	34	21	30	34	72	61	100	113
ABA117	KAM122524	CFR0529	21.34	22.86	Waste	Lower transition	Gneiss	FG	9.5	9.6	*<0.01*	0.01	*<0.01*	*<0.3*	0.11	0.30	8.5	6.8	13	14	8.2	13	14	28	23	43	47
ABA142	KAM152462	CFR0589	25.91	27.43	Waste	Lower transition	Gneiss	MxF	8.3	9	0.01	0.02	0.01	0.30	0.17	0.60	13	14	19	20	13	19	20	42	44	61	64
ABA150	KAM153129	CFR0595	30.48	32	Waste	Lower transition	Gneiss	MxM	7.5	8.8	0.11	0.01	0.10	3.4	0.99	3.5	77	80	104	116	73	101	113	22	23	30	34
ABA246	R273797	CFD0458	9	10	Waste	Lower transition	Gneiss	FG	-	8.3	0.01	-	-	0.30	0.18	-	14	-	-	-	14	-	-	45	-	-	-
ABA247	R283019	CFD0484	33	34	Waste	Lower transition	Gneiss	FG	-	7.9	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA249	R273398	CFD0447	188	189	Waste	Lower transition	Gneiss	MxF	-	8.5	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA250	R279032	CFD0461	85	86	Waste	Lower transition	Gneiss	MxM	-	9	0.28	-	-	8.8	0.38	-	30	-	-	-	21	-	-	3.4	-	-	-
ABA251	R274019	CFD0464	10	11	Waste	Lower transition	Gneiss	FG	-	8.1	*<0.01*	-	-	*<0.3*	0.030	-	2.3	-	-	-	2.0	-	-	7.8	-	-	-
ABA252	R274341	CFD0467	80	81	Waste	Lower transition	Gneiss	MxF	-	8.9	*<0.01*	-	-	*<0.3*	0.020	-	1.6	-	-	-	1.3	-	-	5.2	-	-	-
ABA253	R282397	CFD0474	95	96	Waste	Lower transition	Gneiss	MxF	-	7.3	*<0.01*	-	-	*<0.3*	*<0.01*	-	*<0.8*	-	-	-	0.48	-	-	2.6	-	-	-
ABA254	R270666	CFD0404	10	11	Waste	Lower transition	Gneiss	MxF	-	8.9	*<0.01*	-	-	*<0.3*	0.050	-	3.9	-	-	-	3.6	-	-	13	-	-	-
ABA255	R271756	CFD0424	62	63	Waste	Lower transition	Gneiss	MxM	-	8.2	0.01	-	-	0.30	0.040	-	3.1	-	-	-	2.8	-	-	9.9	-	-	-
ABA256	R271112	CFD0415	8	9	Waste	Lower transition	Gneiss	MxM	-	8.9	0.08	-	-	2.5	0.26	-	20	-	-	-	18	-	-	8.1	-	-	-
ABA257	R273315	CFD0447	115	116	Waste	Lower transition	Gneiss	FG	-	8.5	0.01	-	-	0.30	0.090	-	7.0	-	-	-	6.7	-	-	22	-	-	-
ABA258	R276507	CFD0409	12	13	Waste	Lower transition	Gneiss	MxM	-	8	*<0.01*	-	-	*<0.3*	0.030	-	2.3	-	-	-	2.0	-	-	7.8	-	-	-
ABA259	R280545	CFD0499	10	11	Waste	Lower transition	Gneiss	MxM	-	8.4	0.02	-	-	0.60	0.010	-	0.80	-	-	-	0.15	-	-	1.2	-	-	-
ABA260	R280565	CFD0499	28	29	Waste	Lower transition	Gneiss	MxM	-	8.7	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA261	R274115	CFD0464	95	96	Waste	Lower transition	Gneiss	MxF	-	8.6	0.12	-	-	3.8	1.1	-	85	-	-	-	81	-	-	23	-	-	-
ABA262	R274262	CFD0467	10	11	Waste	Lower transition	Gneiss	MxF	-	9.1	*<0.01*	-	-	*<0.3*	0.10	-	7.8	-	-	-	7.5	-	-	26	-	-	-
ABA263	R282302	CFD0474	10	11	Waste	Lower transition	Gneiss	FG	-	7.2	*<0.01*	-	-	*<0.3*	0.030	-	2.3	-	-	-	2.0	-	-	7.8	-	-	-
ABA264	R271435	CFD0420	9	10	Waste	Lower transition	Gneiss	MxF	-	8.6	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA265	R271165	CFD0415	55	56	Waste	Lower transition	Gneiss	MxF	-	9.3	0.03	-	-	0.90	0.12	-	9.3	-	-	-	8.4	-	-	9.9	-	-	-
ABA267	R273694	CFD0456	97	98	Waste	Lower transition	Gneiss	MxM	-	8.2	0.30	-	-	9.4	0.58	-	45	-	-	-	36	-	-	4.8	-	-	-
ABA269	R279507	CFD0468	60	61	Waste	Lower transition	Gneiss	MxF	-	8.5	0.02	-	-	0.60	0.010	-	0.80	-	-	-	0.15	-	-	1.2	-	-	-
ABA270	R272186	CFD0433	10	11	Waste	Lower transition	Gneiss	MxF	-	7.6	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA271	R283079	CFD0484	87	88	Waste	Lower transition	Gneiss	FG	-	8.6	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA272	Q034772	CFD0473	86	87	Waste	Lower transition	Gneiss	MxF	-	8.5	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA273	R282171	CFD0439	30	31	Waste	Lower transition	Gneiss	MxF	-	7.6	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA274	R277372	CFD0423	10	11	Waste	Lower transition	Gneiss	MxM	-	9.3	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA275	R283492	CFD0496	10	11	Waste	Lower transition	Gneiss	MxF	-	8.6	0.03	-	-	0.90	0.010	-	0.80	-	-	-	-0.16	-	-	0.83	-	-	-
ABA276	R273866	CFD0460	63	64	Waste	Lower transition	Gneiss	FG	-	9	0.04	-	-	1.3	0.23	-	18	-	-	-	17	-	-	14	-	-	-
ABA277	R273898	CFD0460	91	92	Waste	Lower transition	Gneiss	MxF	-	9.3	0.08	-	-	2.5	0.73	-	57	-	-	-	54	-	-	23	-	-	-
ABA278	Q035773	CFD0491	9	10	Waste	Lower transition	Gneiss	MxF	-	8.2	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA279	Q035789	CFD0491	60	61	Waste	Lower transition	Gneiss	MxF	-	6.8	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA280	R271699	CFD0424	12	13	Waste	Lower transition	Gneiss	MxF	-	9.2	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA282	R282102	CFD0437	70	71	Waste	Lower transition	Gneiss	MxF	-	7.3	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA283	R273302	CFD0447	59	60	Waste	Lower transition	Gneiss	FG	-	8.8	0.08	-	-	2.5	0.74	-	57	-	-	-	55	-	-	23	-	-	-
ABA284	R273593	CFD0456	7	8	Waste	Lower transition	Gneiss	MxF	-	8	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA338	R270835	CFD0406	32	33	Waste	Lower Transition	Gneiss	MxF	9.2	9.3	0.01	0.02	0.01	0.30	0.64	2.1	50	48	-	-	49	-	-	159	153	-	-
ABA339	R270848	CFD0406	58	58.309	Waste	Lower Transition	Gneiss	MxF	9.4	9.4	*<0.01*	0.01	*<0.01*	*<0.3*	0.21	0.70	16	16	-	-	16	-	-	54	53	-	-
ABA340	R270686	CFD0404	27	28	Waste	Lower Transition	Gneiss	MxM	9	8.9	0.07	*<0.01*	0.05	2.2	0.34	1.1	26	25	-	-	24	-	-	12	11	-	-
ABA341	R270737	CFD0404	85	86	Waste	Lower Transition	Gneiss	FG	9.2	9.2	0.01	*<0.01*	*<0.01*	0.30	0.45	1.5	35	34	-	-	35	-	-	112	109	-	-
ABA342	R551085	CFD0563	10	11	Waste	Lower Transition	Gneiss	MxM	9.4	9.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.21	0.70	16	16	-	-	16	-	-	54	53	-	-
ABA343	R551107	CFD0563	30	31	Waste	Lower Transition	Gneiss	MxM	8.8	8.8	0.06	0.01	0.05	1.9	1.0	3.3	78	75	-	-	76	-	-	41	40	-	-
ABA344	R551131	CFD0563	50	51	Waste	Lower Transition	Gneiss	MxM	9.2	9.2	0.01	*<0.01*	*<0.01*	0.30	0.54	1.8	42	41	-	-	42	-	-	134	131	-	-
ABA348	R304313	CFD0541	56	57	Waste	Lower Transition	Gneiss	MxM	8.3	8.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA360	R623829	CFD0555	10	11	Waste	Lower Transition	Gneiss	MxF	9.2	9.2	0.01	*<0.01*	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	-	-	1.2	-	-	5.0	14	-	-
ABA361	R623933	CFD0555	102	103	Waste	Lower Transition	Gneiss	MxF	8.4	8.6	0.03	0.01	0.01	0.90	0.47	1.6	37	36	-	-	36	-	-	39	39	-	-
ABA362	R507027	CFD0555	185	186	Waste	Lower Transition	Gneiss	FG	9	8.9	0.03	0.01	0.04	0.90	0.57	1.9	44	43	-	-	43	-	-	47	46	-	-
ABA363	R545397	CFD0520	20	21	Waste	Lower Transition	Gneiss	FG	7.7	7	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA364	R545422	CFD0520	41	42	Waste	Lower Transition	Gneiss	FG	7.7	7.2	*<0.01*	0.01	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA366	R545552	CFD0524	30	31	Waste	Lower Transition	Gneiss	MxF	8.4	8.4	0.02	0.03	0.01	0.60	0.15	0.50	12	11	-	-	11	-	-	19	18	-	-
ABA369	R545644	CFD0526	81	82	Waste	Lower Transition	Gneiss	MxF	8.6	8.6	*<0.01*	*<0.01*	0.01	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	-	-	3.6	-	-	13	15	-	-
ABA370	R545697	CFD0528	42	43	Waste	Lower Transition	Gneiss	MxF	8.2	7.8	*<0.01*	0.01	0.01	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA371	R271272	CFD0417	5	6	Waste	Lower Transition	Gneiss	MxF	9.8	9.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	-	-	3.6	-	-	13	15	-	-
ABA372	R271299	CFD0417	30	30.7	Waste	Lower Transition	Gneiss	MxF	7.9	7.4	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA376	R279575	CFD0468	120	121	Waste	Lower Transition	Gneiss	MxF	9.2	9.1	0.01	0.01	*<0.01*	0.30	0.070	0.20	5.4	4.5	-	-	5.1	-	-	17	15	-	-
ABA390	R278608	CFD0450	10	11	Waste	Lower Transition	Gneiss	MxF	6.8	7.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA391	R278677	CFD0450	71	72	Waste	Lower Transition	Gneiss	MxF	7.4	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA392	R278725	CFD0450	114	114.287	Waste	Lower Transition	Gneiss	MxF	7.3	7.6	0.01	0.01	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.5	14	-	-
ABA395	R545811	CFD0529	58	59	Waste	Lower Transition	Gneiss	FG	9.5	9.5	*<0.01*	0.01	0.01	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
ABA399	R543714	CFD0549	30	31	Waste	Lower Transition	Gneiss	MxF	9.4	9.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.090	0.20	7.0	4.5	-	-	6.7	-	-	23	15	-	-
ABA400	R543741	CFD0549	53	54	Waste	Lower Transition	Gneiss	MxF	8.1	8.1	*<0.01*	0.02	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
ABA402	R544003	CFD0553	80	81	Waste	Lower Transition	Gneiss	MxF	8.8	8.9	0.01	0.02	0.01	0.30	0.10	0.30	7.8	6.8	-	-	7.5	-	-	25	22	-	-
ABA405	R554003	CFD0501	10	11	Waste	Lower Transition	Gneiss	MxF	8.1	7.6	*<0.01*	0.02	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA406	R554039	CFD0501	42	43	Waste	Lower Transition	Gneiss	MxF	9.2	9	*<0.01*	0.02	0.01	*<0.3*	0.11	0.30	8.5	6.8	-	-	8.2	-	-	28	23	-	-
ABA409	R272762	CFD0438	184	185	Waste	Lower Transition	Gneiss	FG	9	9.2	0.14	0.02	0.15	4.4	0.68	2.3	53	52	-	-	48	-	-	12	12	-	-
ABA410	R544159	CFD0502	10	11	Waste	Lower Transition	Gneiss	MxF	8.2	8	*<0.01*	0.01	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA412	R544228	CFD0502	70	71	Waste	Lower Transition	Gneiss	MxF	9.1	9.1	*<0.01*	*<0.01*	0.01	*<0.3*	0.67	2.1	52	48	-	-	52	-	-	173	159	-	-
Statistical Summary							**Lower Transition**	**Gneiss**	**n**	44	79	79	44	44	79	79	44	79	44	13	13	79	13	13	79	44	13	13
									Max	9.8	9.7	0.30	0.03	0.25	9.4	1.1	4.0	86	91	127	121	85	125	119	173	159	100	113
									90th PCTL	9.5	9.3	0.08	0.02	0.06	2.5	0.70	2.3	52	52	95	104	50	92	101	49	60	91	77
									75th PCTL	9.2	9.1	0.02	0.01	0.01	0.60	0.20	1.5	19	35	48	50	17	40	42	23	39	61	64
									Median	8.8	8.6	0.01	0.01	0.01	0.30	0.10	0.40	3.9	8.0	20	20	3.6	19	20	7.8	15	32	34
									25th PCTL	7.9	8.1	*<0.01*	*<0.01*	0.01	*<0.3*	0.00	*<0.2*	1.6	*<4.5*	13	15	1.2	13	15	5.0	15	20	18
									10th PCTL	7.3	7.6	*<0.01*	*<0.01*	0.01	*<0.3*	0.00	*<0.2*	0.80	*<4.5*	9.0	10	0.50	8.7	9.7	2.6	14	12	14
									Min	6.8	6.8	*<0.01*	*<0.01*	0.01	*<0.3*	*<0.01*	*<0.2*	*<0.8*	*<4.5*	4.0	5.0	-0.20	3.7	4.7	0.80	6.2	5.7	5.9

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	kgCaCO$_3$/t	%	%	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Fresh Facies for Gneiss Waste Rock																											
ABA065	KAM128393	CFD0326	25	26	Waste	Fresh	Gneiss	MxM	7.6	7.6	0.01	0.01	0.01	0.30	0.040	0.20	3.1	4.5	7.0	9.0	2.8	7.0	8.7	9.9	15	22	29
ABA066	KAM128504	CFD0326	75	76	Waste	Fresh	Gneiss	MxM	8.6	8.5	0.01	0.01	0.01	0.30	0.080	0.30	6.2	6.8	13	15	5.9	13	15	20	22	42	48
ABA071	KAM145241	CFD0338	81	82	Waste	Fresh	Gneiss	MxM	9.0	9.0	0.04	*<0.01*	0.02	1.3	1.2	4.3	93	98	128	140	92	127	139	75	78	102	112
ABA097	KAM137325	CFR0468	88.39	89.92	Waste	Fresh	Gneiss	MxM	8.7	8.8	0.03	*<0.01*	0.02	0.90	0.090	0.30	7.0	6.8	23	25	6.1	22	24	7.5	7.3	25	27
ABA099	KAM137468	CFR0469	82.3	83.82	Waste	Fresh	Gneiss	MxM	7.7	8.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.96	3.1	75	71	117	120	74	117	120	248	235	390	400
ABA108	KAM139795	CFR0486	25.91	27.43	Waste	Fresh	Gneiss	MxM	8.4	8.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	8.0	8.0	3.6	8.0	7.7	13	15	27	27
ABA139	KAM152151	CFR0586	60.96	62.48	Waste	Fresh	Gneiss	MxF	7.9	8.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	6.0	6.0	2.8	6.0	5.7	10	15	20	20
ABA140	KAM152186	CFR0586	109.73	111.25	Waste	Fresh	Gneiss	MxF	8.9	9.2	*<0.01*	0.01	*<0.01*	*<0.3*	0.14	0.50	11	11	12	13	11	12	13	36	38	40	43
ABA143	KAM152536	CFR0589	128.02	129.54	Waste	Fresh	Gneiss	FG	7.3	8.8	0.15	0.01	0.11	4.7	0.57	1.9	44	43	42	43	40	37	38	9.4	9.2	9.0	9.2
ABA148	KAM153051	CFR0594	109.73	111.25	Waste	Fresh	Gneiss	MxF	7.2	8.5	0.14	0.01	0.11	4.4	0.31	1.1	24	25	24	25	20	20	21	5.5	5.7	5.5	5.7
ABA285	R277457	CFD0426	16	17	Waste	Fresh	Gneiss	MxM	-	8.8	*<0.01*	-	-	*<0.3*	0.23	-	18	-	-	-	18	-	-	59	-	-	-
ABA286	R279452	CFD0468	11	12	Waste	Fresh	Gneiss	MxF	-	9.0	*<0.01*	-	-	*<0.3*	0.020	-	1.6	-	-	-	1.3	-	-	5.2	-	-	-
ABA287	R274861	CFD0472	100	101	Waste	Fresh	Gneiss	MxM	-	9.1	0.43	-	-	13	0.32	-	25	-	-	-	11	-	-	1.9	-	-	-
ABA288	R283657	CFD0498	82	83	Waste	Fresh	Gneiss	MxM	-	8.8	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA289	Q035925	CFD0495	94	95	Waste	Fresh	Gneiss	MxM	-	8.5	0.01	-	-	0.30	0.21	-	16	-	-	-	16	-	-	52	-	-	-
ABA290	R272262	CFD0433	123	124	Waste	Fresh	Gneiss	MxF	-	8.6	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA293	R276133	CFD0393	45	46	Waste	Fresh	Gneiss	MxM	-	9.0	0.06	-	-	1.9	0.78	-	61	-	-	-	59	-	-	32	-	-	-
ABA294	R276236	CFD0401	18	19	Waste	Fresh	Gneiss	MxM	-	8.6	0.01	-	-	0.30	0.45	-	35	-	-	-	35	-	-	112	-	-	-
ABA295	R271028	CFD0412	117	118	Waste	Fresh	Gneiss	MxF	-	8.8	*<0.01*	-	-	*<0.3*	0.19	-	15	-	-	-	14	-	-	49	-	-	-
ABA297	R279539	CFD0468	89	90	Waste	Fresh	Gneiss	MxF	-	9.4	0.03	-	-	0.90	0.41	-	32	-	-	-	31	-	-	34	-	-	-
ABA298	R275689	CFD0495	57	58	Waste	Fresh	Gneiss	MxM	-	9.1	0.05	-	-	1.6	0.44	-	34	-	-	-	33	-	-	22	-	-	-
ABA299	R272239	CFD0433	57	58	Waste	Fresh	Gneiss	MxF	-	8.9	0.07	-	-	2.2	0.35	-	27	-	-	-	25	-	-	12	-	-	-
ABA300	R278428	CFD0445	118	119	Waste	Fresh	Gneiss	MxF	-	9.3	*<0.01*	-	-	*<0.3*	0.10	-	7.8	-	-	-	7.5	-	-	26	-	-	-
ABA301	R273296	CFD0447	10	11	Waste	Fresh	Gneiss	FG	-	9.3	*<0.01*	-	-	*<0.3*	0.10	-	7.8	-	-	-	7.5	-	-	26	-	-	-
ABA302	R270935	CFD0412	35	36	Waste	Fresh	Gneiss	MxF	-	9.2	0.02	-	-	0.60	0.31	-	24	-	-	-	23	-	-	38	-	-	-
ABA346	R277538	CFD0426	87	88	Waste	Fresh	Gneiss	MxM	9.3	9.3	0.13	0.01	0.09	4.1	0.060	0.20	4.7	4.5	-	-	0.59	-	-	1.2	1.1	-	-
ABA347	R304284	CFD0541	30	31	Waste	Fresh	Gneiss	FG	9.0	9.0	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA350	R304041	CFD0539	10	11	Waste	Fresh	Gneiss	FG	9.5	9.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA351	R304231	CFD0539	45	46	Waste	Fresh	Gneiss	MxM	8.6	8.4	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA354	R304119	CFD0525	45	46	Waste	Fresh	Gneiss	MxM	8.8	9.2	0.02	*<0.01*	0.03	0.60	0.17	0.60	13	14	-	-	13	-	-	21	22	-	-
ABA355	R304173	CFD0525	91	92	Waste	Fresh	Gneiss	FG	9.7	9.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.070	0.20	5.4	4.5	-	-	5.1	-	-	18	15	-	-
ABA356	R623617	CFD0548	10	11	Waste	Fresh	Gneiss	MxF	9.2	9.2	*<0.01*	0.01	0.02	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA357	R623685	CFD0548	70	71	Waste	Fresh	Gneiss	MxF	9.2	9.2	*<0.01*	0.01	*<0.01*	*<0.3*	0.27	0.90	21	21	-	-	21	-	-	70	68	-	-
ABA358	R623742	CFD0548	120	121	Waste	Fresh	Gneiss	MxF	9.2	9.3	0.02	0.01	*<0.01*	0.60	0.27	0.90	21	21	-	-	20	-	-	34	33	-	-
ABA365	R545443	CFD0520	60	61	Waste	Fresh	Gneiss	FG	9.5	9.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA374	R271368	CFD0417	91	92	Waste	Fresh	Gneiss	FG	9.7	9.6	0.01	0.01	0.02	0.30	0.12	0.30	9.3	6.8	-	-	9.0	-	-	30	22	-	-
ABA378	R279593	CFD0468	135	136	Waste	Fresh	Gneiss	MxF	9.8	9.8	0.08	*<0.01*	0.05	2.5	0.52	1.7	40	39	-	-	38	-	-	16	15	-	-
ABA379	R279615	CFD0468	155	155.692	Waste	Fresh	Gneiss	MxF	9.9	9.8	0.09	0.03	0.09	2.8	0.22	0.70	17	16	-	-	14	-	-	6.1	5.7	-	-
ABA381	R511981	CFR0700	48.77	49.42	Waste	Fresh	Gneiss	MxM	8.5	8.6	0.17	0.01	0.16	5.3	1.1	3.6	88	82	-	-	82	-	-	17	15	-	-
ABA387	Q034442	CFD0469	19	20	Waste	Fresh	Gneiss	MxF	9.2	8.6	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA388	Q034516	CFD0469	102	103	Waste	Fresh	Gneiss	MxF	9.7	9.3	0.04	0.01	0.04	1.3	0.19	0.60	15	14	-	-	13	-	-	12	11	-	-
ABA389	Q034537	CFD0469	121	121.9	Waste	Fresh	Gneiss	MxF	8.9	8.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA396	R545818	CFD0529	65	66	Waste	Fresh	Gneiss	MxF	9.7	9.7	*<0.01*	*<0.01*	0.01	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA398	R543692	CFD0549	10	11	Waste	Fresh	Gneiss	FG	9.1	9.2	*<0.01*	0.02	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA401	R543957	CFD0553	40	41	Waste	Fresh	Gneiss	MxF	8.7	8.9	0.15	0.02	0.14	4.7	1.3	4.0	98	91	-	-	93	-	-	21	19	-	-
ABA404	R550544	CFD0553	160	161	Waste	Fresh	Gneiss	MxF	8.9	8.9	0.02	0.01	*<0.01*	0.60	0.74	2.3	57	52	-	-	57	-	-	92	84	-	-
ABA408	R272713	CFD0438	96	97	Waste	Fresh	Gneiss	MxF	9.5	9.5	0.01	0.02	0.01	0.30	0.14	0.40	11	9.1	-	-	11	-	-	35	29	-	-
ABA413	R276141	CFD0393	127	128	Waste	Fresh	Gneiss	MxM	8.9	8.9	*<0.01*	0.02	0.01	*<0.3*	1.2	4.1	95	93	-	-	94	-	-	316	311	-	-
ABA414	R276153	CFD0393	170	171	Waste	Fresh	Gneiss	MxM	8.8	9.0	0.04	*<0.01*	0.06	1.3	1.2	3.9	90	89	-	-	89	-	-	72	71	-	-
Statistical Summary						**Fresh**	**Gneiss**	**n**	34	49	49	34	34	49	49	34	49	34	10	10	49	10	10	49	34	10	10
								Max	9.9	9.8	0.43	0.03	0.16	13	1.3	4.3	98	98	128	140	94	127	139	316	311	390	400
								90th PCTL	9.7	9.5	0.13	0.02	0.10	4.1	1.0	3.8	77	87	118	122	76	118	122	73	76	131	141
								75th PCTL	9.5	9.3	0.04	0.01	0.04	1.3	0.40	1.6	32	35	38	39	31	34	35	35	27	41	47
								Median	9.0	9.0	0.01	0.01	0.01	0.31	0.20	0.40	13	8.0	18	20	11	16	18	17	15	26	28
								25th PCTL	8.6	8.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.00	*<0.2*	3.1	*<4.5*	9.0	10	1.3	8.7	9.7	5.2	15	21	22
								10th PCTL	7.8	8.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.00	*<0.2*	0.80	*<4.5*	6.9	7.8	0.50	6.6	7.5	2.6	7.9	8.6	8.8
								Min	7.2	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.00	*<0.2*	0.80	*<4.5*	6.0	6.0	0.50	5.7	5.7	1.1	1.1	5.5	5.7
Statistical Summary for Gneiss Waste Rock								**n**	115	187	188.00	117.00	117.00	188	188	117	188	117	51	51	188	51	51	188	117	51	51
								n < DL	-	-	88.00	44.00	48.00	88	2	46	2	46	0	0	0	0	0	0	0	0	0
								Max	9.9	9.8	0.94	0.03	0.90	29	1.3	4.3	98	98	128	140	94	127	139	303	298	390	400
								90th PCTL	9.5	9.3	0.08	0.02	0.06	2.5	0.64	2.3	50	52	52	53	48	52	53	62	73	93	83
								75th PCTL	9.2	9.1	0.02	0.01	0.02	0.60	0.27	1.0	21	23	29	26	20	26	25	26	29	43	48
								Median	8.4	8.5	0.01	0.01	0.01	0.30	0.060	0.20	4.7	4.5	15	15	4.4	13	15	9.9	15	27	27
								25th PCTL	7.4	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	6.0	6.5	1.2	5.7	6.2	5.0	14	13	16
								10th PCTL	7.2	7.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	4.0	5.0	0.50	3.7	4.7	2.5	10	9.0	10
								Min	6.6	6.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	0.10	*<0.8*	2.3	2.0	3.0	-27	1.7	-24	0.10	0.20	1.4	0.20

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Oxide Facies for Schist Waste Rock																											
ABA005	KAM022322	CFD0110	95	96	Waste	Oxide	Schist	RQM	6.8	7.6	0.42	0.06	0.29	13	2.0	6.9	155	157	135	154	142	122	141	12	12	10	12
ABA026	KAM037656	CFD0096	59	60	Waste	Oxide	Schist	BtS	6.8	7.4	0.26	0.01	0.18	8.1	2.0	6.9	154	157	134	144	146	126	136	19	19	16	18
ABA074	KAM146948	CFD0345	60	61	Waste	Oxide	Schist	BtS_carb	7.8	8	0.02	0.01	0.01	0.60	1.8	6.5	138	148	154	163	138	153	162	221	236	246	261
ABA077	J957606	CFD0350	60	61	Waste	Oxide	Schist	BtS_carb	7.3	7.8	0.01	*<0.01*	0.01	0.30	3.2	12	250	268	268	271	250	268	271	800	858	858	867
ABA090	KAM133632	CFR0431	71.63	73.15	Waste	Oxide	Schist	BtS	7	7.2	0.44	*<0.01*	0.34	14	0.81	2.4	63	55	47	44	49	33	30	4.6	4.0	3.4	3.2
ABA094	KAM135457	CFR0454	24.38	25.91	Waste	Oxide	Schist	BtS	7.6	7.3	0.01	*<0.01*	0.01	0.30	0.080	*<0.2*	6.2	*<4.5*	5.0	6.0	5.9	5.0	5.7	20	14	16	19
ABA125	KAM149844	CFR0566	10.67	12.19	Waste	Oxide	Schist	BtS	7.2	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	4.0	4.0	4.4	4.0	3.7	16	15	13	13
ABA128	KAM149954	CFR0567	47.24	48.77	Waste	Oxide	Schist	BtS	7.3	8.1	0.02	*<0.01*	*<0.01*	0.60	2.4	9.0	183	205	183	180	183	182	179	293	327	293	288
ABA129	KAM150033	CFR0567	155.45	156.97	Waste	Oxide	Schist	BtS	7	7.2	0.01	*<0.01*	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	5.0	7.0	2.0	5.0	6.7	7.5	14	16	22
ABA130	KAM150823	CFR0574	10.67	12.19	Waste	Oxide	Schist	BtS	7.2	8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	1.4	5.1	112	116	120	129	111	120	129	372	386	400	430
ABA131	KAM150859	CFR0574	60.96	62.48	Waste	Oxide	Schist	BtS	7.2	8.5	0.01	0.01	0.01	0.30	0.29	1.0	23	23	22	25	22	22	25	72	73	70	80
ABA133	KAM150951	CFR0575	60.96	62.48	Waste	Oxide	Schist	BtS	7.5	8	0.08	0.03	0.05	2.5	2.9	10	222	230	227	231	219	225	229	89	92	91	92
ABA201	R276929	CFD0416	13	14	Waste	Oxide	Schist	BtS	-	8.2	0.01	-	-	0.30	0.29	-	23	-	-	-	22	-	-	72	-	-	-
ABA202	R270012	CFD0384	13	14	Waste	Oxide	Schist	BtS_carb	-	7.5	0.05	-	-	1.6	0.12	-	9.3	-	-	-	7.8	-	-	6.0	-	-	-
ABA383	KAM068572	CFD0234	225.1	226	Waste	Oxide	Schist	MsS	7.1	6.6	*<0.01*	*<0.01*	0.02	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
Statistical Summary						**Oxide**	**Schist**	**n**	13	15	15	13	13	15	15	13	15	13	12	12	15	12	12	15	13	12	12
								Max	7.8	8.5	0.44	0.06	0.34	14	3.2	12	250	268	268	271	250	268	271	800	858	858	867
								90th PCTL	7.6	8.2	0.36	0.03	0.27	11	2.7	9.9	206	225	223	226	205	220	224	341	375	389	416
								75th PCTL	7.3	8	0.07	0.01	0.05	2.0	2.0	6.9	155	157	161	167	144	161	167	155	236	258	268
								Median	7.2	7.6	0.01	*<0.01*	0.01	0.31	0.81	5.1	63	116	127	137	49	121	132	20	19	43	51
								25th PCTL	7	7.4	0.01	*<0.01*	0.01	0.31	0.10	0.20	7.8	4.5	18	21	6.8	17	20	9.6	14	15	17
								10th PCTL	6.8	7.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.042	*<0.2*	3.3	*<4.5*	5.0	6.1	3.0	4.7	5.8	5.5	12	11	12
								Min	6.8	6.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	4.0	4.0	1.3	3.7	3.7	4.6	4.0	3.4	3.2
Upper Transition Facies for Schist Waste Rock																											
ABA004	KAM022156	CFD0107	149	150	Waste	Upper transition	Schist	RQM	7.4	8.1	0.24	0.01	0.23	7.5	1.6	5.8	121	132	100	104	114	93	97	16	18	13	14
ABA027	KAM037928	CFD0099	30	31	Waste	Upper transition	Schist	BtS_carb	7.2	7.9	0.01	*<0.01*	0.02	0.30	1.5	5.4	120	123	135	134	119	135	134	382	393	432	429
ABA062	KAM081561	CFD0202	58	58.5	Waste	Upper transition	Schist	BtS	8.3	8.6	1.02	*<0.01*	0.97	32	2.2	8.0	172	182	209	202	140	177	170	5.4	5.7	6.6	6.3
ABA076	KAM147059	CFD0345	160	161	Waste	Upper transition	Schist	BtS	7.9	8.1	0.51	*<0.01*	0.51	16	2.7	9.8	209	223	205	198	193	189	182	13	14	13	12
ABA092	KAM135149	CFR0452	10.67	12.19	Waste	Upper Transition	Schist	BtS	8.3	8.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	6.0	7.0	2.0	6.0	6.7	7.8	15	20	23
ABA124	KAM149042	CFR0559	35.05	36.58	Waste	Upper transition	Schist	BtS	7.4	8.1	0.02	*<0.01*	*<0.01*	0.60	1.2	4.0	89	91	92	95	89	91	94	143	145	147	152
ABA204	R270174	CFD0388	8	9	Waste	Upper transition	Schist	MsS	-	7.7	0.03	-	-	0.90	0.46	-	36	-	-	-	35	-	-	38	-	-	-
ABA205	R276797	CFD0413	115	116	Waste	Upper transition	Schist	BtS	-	8.1	0.01	-	-	0.30	2.2	-	168	-	-	-	168	-	-	539	-	-	-
ABA206	Q033613	CFD0407	52	53	Waste	Upper transition	Schist	BtS	-	8.4	0.06	-	-	1.9	2.2	-	168	-	-	-	167	-	-	90	-	-	-
ABA316	R270207	CFD0390	5	6	Waste	Upper Transition	Schist	MsS	8.3	8.2	0.08	0.01	0.05	2.5	1.2	4.1	95	93	-	-	93	-	-	38	37	-	-
ABA317	R270258	CFD0390	50	51	Waste	Upper Transition	Schist	BtS_carb	8.5	8.3	0.07	0.03	0.01	2.2	0.70	2.3	54	52	-	-	52	-	-	25	24	-	-
ABA320	R270432	CFD0392	44	45	Waste	Upper Transition	Schist	BtS_carb	8.2	8.4	0.02	0.01	*<0.01*	0.60	0.96	3.0	75	68	-	-	74	-	-	119	109	-	-
ABA323	Q033713	CFD0411	24	25	Waste	Upper Transition	Schist	BtS_Carb	8.2	8.1	0.03	*<0.01*	0.02	0.90	2.4	7.8	185	177	-	-	184	-	-	197	189	-	-
ABA332	Q033589	CFD0407	32	33	Waste	Upper Transition	schist	BtS	8.5	8.4	0.04	0.01	0.01	1.3	1.0	3.3	79	75	-	-	78	-	-	63	60	-	-
Statistical Summary						**Upper Transition**	**Schist**	**n**	11	14	14	11	11	14	14	11	14	11	6	6	14	6	6	14	11	6	6
								Max	8.5	8.6	1.02	0.03	0.97	32	2.7	9.8	209	223	209	202	193	189	182	539	393	432	429
								90th PCTL	8.5	8.4	0.43	0.01	0.51	13	2.3	8.0	181	182	207	200	179	183	176	327	189	290	290
								75th PCTL	8.3	8.4	0.08	0.01	0.14	2.4	2.2	6.8	168	155	188	182	160	167	161	137	127	115	120
								Median	8.2	8.2	0.04	*<0.01*	0.02	1.1	1.4	4.1	108	93	118	119	103	114	115	51	37	17	19
								25th PCTL	7.7	8.1	0.02	*<0.01*	*<0.01*	0.63	0.98	3.2	76	72	94	97	75	92	95	18	16	13	13
								10th PCTL	7.4	8	0.01	*<0.01*	*<0.01*	0.31	0.53	2.3	41	52	49	51	40	49	51	9.4	14	9.7	9.4
								Min	7.2	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	6.0	7.0	2.0	5.7	6.7	5.4	5.7	6.6	6.3
Lower Transition Facies for Schist Waste Rock																											
ABA021	KAM033153	CFD0164	148	149	Waste	Lower transition	Schist	BtS	9.4	9.3	0.14	0.02	0.11	4.4	0.44	1.6	34	36	57	96	30	53	92	7.8	8.3	13	22
ABA024	KAM036666	CFD0087	17	18	Waste	Lower transition	Schist	BtS_carb	7.2	8.5	0.06	*<0.01*	0.05	1.9	0.43	1.4	33	32	48	85	31	46	83	18	17	26	45
ABA025	KAM037046	CFD0091	12	13	Waste	Lower transition	Schist	BtS	7.2	7.9	0.01	0.01	*<0.01*	0.30	0.84	2.8	65	64	100	104	65	100	104	209	204	320	333
ABA031	KAM039252	CFD0116	75	76	Waste	Lower transition	Schist	RQM	7.2	8.3	0.06	0.01	0.03	1.9	1.2	4.3	95	98	110	116	94	108	114	51	52	59	62
ABA038	KAM047995	CFD0135	153	154	Waste	Lower transition	Schist	BtS	7.3	8.5	0.09	0.02	0.07	2.8	1.2	4.1	90	93	115	123	87	112	120	32	33	41	44
ABA054	KAM081312	CFD0198	85	86	Waste	Lower transition	Schist	BtS	8.9	8.7	*<0.01*	*<0.01*	0.01	*<0.3*	0.070	0.20	5.4	4.5	7.0	7.0	5.1	7.0	6.7	18	15	23	23
ABA086	KAM133474	CFR0429	59.44	60.96	Waste	Lower transition	Schist	BtS	8.4	8.4	0.15	*<0.01*	0.13	4.7	0.78	2.5	61	57	60	63	56	55	58	13	12	13	13
ABA208	R276736	CFD0413	61	62	Waste	Lower transition	Schist	BtS	-	8.2	0.32	-	-	10	1.0	-	78	-	-	-	68	-	-	7.8	-	-	-
ABA209	R270032	CFD0384	31	32	Waste	Lower transition	Schist	BtS_carb	-	8.2	0.25	-	-	7.8	0.90	-	70	-	-	-	62	-	-	8.9	-	-	-
ABA210	R276281	CFD0401	58	59	Waste	Lower transition	Schist	BtS	-	8	0.01	-	-	0.30	1.4	-	109	-	-	-	109	-	-	350	-	-	-
ABA211	R276567	CFD0409	65	66	Waste	Lower transition	Schist	BtS	-	8	0.01	-	-	0.30	0.77	-	60	-	-	-	59	-	-	191	-	-	-
ABA318	R270302	CFD0390	88	89	Waste	Lower Transition	Schist	BtS_carb	7.2	8.6	0.03	0.01	0.01	0.90	3.0	9.5	230	216	-	-	229	-	-	245	230	-	-
ABA319	R270394	CFD0392	10	11	Waste	Lower Transition	Schist	BtS_carb	8	8.2	0.01	0.01	*<0.01*	0.30	0.79	2.5	61	57	-	-	61	-	-	196	182	-	-
ABA325	R512767	CFR0724	39.62	41.15	Waste	Lower Transition	schist	BtS	8.7	8.9	0.06	0.01	0.05	1.9	0.42	1.2	33	27	-	-	31	-	-	17	15	-	-
ABA333	R277487	CFD0426	43	44	Waste	Lower Transition	schist	BtS	8.2	7.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA335	R550437	CFD0518	25	26	Waste	Lower Transition	schist	BtS	8.1	8.3	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA336	R550471	CFD0518	55	56	Waste	Lower Transition	Schist	BtS_carb	7.9	8	0.12	0.01	0.07	3.8	1.9	6.4	147	146	-	-	143	-	-	39	39	-	-
ABA337	R550494	CFD0518	75	75.032	Waste	Lower Transition	schist	BtS	8.6	8.5	0.01	0.01	*<0.01*	0.30	0.81	2.7	63	61	-	-	63	-	-	201	196	-	-
ABA345	R551151	CFD0563	68	69	Waste	Lower Transition	schist	BtS	8.8	8.5	0.02	*<0.01*	0.01	0.60	0.69	2.2	54	50	-	-	53	-	-	86	80	-	-
Statistical Summary						**Lower Transition**	**Schist**	**n**	15	19	19	15	15	19	19	15	19	15	7	7	19	7	7	19	15	7	7
								Max	9.4	9.3	0.32	0.02	0.13	10	3.0	9.5	230	216	115	123	229	112	120	350	230	320	333
								90th PCTL	8.9	8.7	0.17	0.02	0.09	5.3	1.5	5.6	117	126	112	119	116	110	117	216	201	163	170
								75th PCTL	8.7	8.5	0.11	0.01	0.06	3.3	1.1	3.5	84	78	105	110	77	104	109	194	131	50	54
								Median	8.1	8.3	0.03	0.01	0.01	0.94	0.79	2.5	61	57	60	96	61	55	92	32	33	26	44
								25th PCTL	7.3	8.1	0.01	*<0.01*	*<0.01*	0.31	0.44	1.3	34	30	53	74	31	49	71	11	15	18	23
								10th PCTL	7.2	8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.060	*<0.2*	4.7	*<4.5*	32	41	4.4	30	38	7.2	13	13	19
								Min	7.2	7.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	7.0	7.0	0.48	6.7	6.7	2.6	8.3	13	13

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Fresh Facies for Schist Waste Rock																											
ABA082	KAM131674	CFR0401	15.24	16.76	Waste	Fresh	Schist	BtS	8.2	8.1	0.01	*<0.01*	*<0.01*	0.30	0.42	1.4	33	32	47	51	32	47	51	104	102	150	163
ABA084	KAM132888	CFR0420	32	33.53	Waste	Fresh	Schist	BtS	8.1	8.6	0.01	*<0.01*	0.01	0.30	1.4	4.9	108	111	147	149	108	147	149	345	356	470	477
ABA091	KAM133659	CFR0431	109.73	111.25	Waste	Fresh	Schist	BtS	8.8	8.8	0.97	0.03	0.80	30	0.90	2.9	70	66	99	99	40	69	69	2.3	2.2	3.3	3.3
ABA093	KAM135298	CFR0453	10.67	12.19	Waste	Fresh	Schist	BtS	8.4	8.3	0.08	*<0.01*	0.04	2.5	0.77	2.6	60	59	122	125	57	120	123	24	24	49	50
ABA095	KAM135693	CFR0456	10.67	12.19	Waste	Fresh	Schist	BtS	8.7	8.6	0.01	*<0.01*	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	11	12	2.0	11	12	7.5	14	35	38
ABA127	KAM149916	CFR0566	109.73	111.25	Waste	Fresh	Schist	BtS_carb	7.3	8.1	0.63	*<0.01*	0.53	20	1.1	3.3	82	75	108	107	62	88	87	4.1	3.8	5.5	5.4
ABA132	KAM150898	CFR0574	114.3	115.82	Waste	Fresh	Schist	BtS	7.3	8.2	0.61	*<0.01*	0.56	19	0.98	3.4	76	77	108	114	57	89	95	4.0	4.1	5.7	6.0
ABA134	KAM150984	CFR0575	106.68	108.2	Waste	Fresh	Schist	BtS	7.3	8.3	0.07	0.01	0.03	2.2	1.3	4.6	101	105	109	106	99	107	104	46	48	50	48
ABA212	Q033565	CFD0407	10	11	Waste	Fresh	Schist	BtS	-	8.8	0.09	-	-	2.8	0.54	-	42	-	-	-	39	-	-	15	-	-	-
ABA213	R280479	CFD0497	111	112	Waste	Fresh	Schist	BtS	-	8.9	0.02	-	-	0.60	0.17	-	13	-	-	-	13	-	-	21	-	-	-
ABA214	R274802	CFD0472	47	48	Waste	Fresh	Schist	BtS	-	8.5	*<0.01*	-	-	*<0.3*	*<0.01*	-	*<0.8*	-	-	-	0.48	-	-	2.6	-	-	-
ABA215	R275143	CFD0482	40	41	Waste	Fresh	Schist	BtS	-	8.1	0.01	-	-	0.30	1.2	-	93	-	-	-	93	-	-	298	-	-	-
ABA216	R276122	CFD0393	87	88	Waste	Fresh	Schist	BtS	-	8.7	*<0.01*	-	-	*<0.3*	0.22	-	17	-	-	-	17	-	-	57	-	-	-
ABA217	R270181	CFD0388	92	93	Waste	Fresh	Schist	BtS_carb	-	8.5	0.29	-	-	9.1	0.91	-	71	-	-	-	62	-	-	7.8	-	-	-
ABA218	R283622	CFD0498	28	29	Waste	Fresh	Schist	BtS	-	9	0.01	-	-	0.30	0.33	-	26	-	-	-	25	-	-	82	-	-	-
ABA219	R276979	CFD0416	57	58	Waste	Fresh	Schist	BtS	-	8.4	0.04	-	-	1.3	4.9	-	376	-	-	-	375	-	-	301	-	-	-
ABA220	R276002	CFD0387	148	149	Waste	Fresh	Schist	BtS	-	9.2	0.14	-	-	4.4	0.57	-	44	-	-	-	40	-	-	10	-	-	-
ABA221	R276317	CFD0401	129	130	Waste	Fresh	Schist	BtS	-	8.4	0.11	-	-	3.4	0.66	-	51	-	-	-	48	-	-	15	-	-	-
ABA222	R270104	CFD0386	59	60	Waste	Fresh	Schist	BtS_carb	-	8.5	0.21	-	-	6.6	0.74	-	57	-	-	-	51	-	-	8.8	-	-	-
ABA223	R270127	CFD0386	80	81	Waste	Fresh	Schist	MsS	-	8.6	0.14	-	-	4.4	1.3	-	100	-	-	-	96	-	-	23	-	-	-
ABA321	R270466	CFD0392	74	75	Waste	Fresh	Schist	BtS_carb	8.4	8.6	0.16	*<0.01*	0.12	5.0	0.74	2.3	57	52	-	-	52	-	-	11	10	-	-
ABA322	R270482	CFD0392	88	89	Waste	Fresh	Schist	BtS_carb	8.3	8.2	0.02	0.01	*<0.01*	0.60	1.9	6.2	149	141	-	-	148	-	-	238	225	-	-
ABA326	R512983	CFR0731	32	32.395	Waste	Fresh	schist	BtS	8.6	8.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.13	0.30	10	6.8	-	-	9.8	-	-	34	23	-	-
ABA329	R270202	CFD0388	110	110.2	Waste	Fresh	Schist	BtS_carb	9.2	9.3	0.19	0.01	0.17	5.9	1.7	5.8	135	132	-	-	129	-	-	23	22	-	-
ABA330	R276299	CFD0401	74	75	Waste	Fresh	schist	BtS	8.7	8.6	0.06	*<0.01*	0.04	1.9	0.68	2.1	53	48	-	-	51	-	-	28	25	-	-
ABA331	R276331	CFD0401	141	142	Waste	Fresh	schist	BtS	8.5	8.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.99	3.2	77	73	-	-	77	-	-	256	242	-	-
ABA377	R279587	CFD0468	131	132	Waste	Fresh	Schist	AmBtS	9	9	0.23	0.01	0.19	7.2	1.4	4.6	111	105	-	-	104	-	-	15	15	-	-
ABA415	R277001	CFD0398	49	50	Waste	Fresh	schist	BtS	8.8	8.9	*<0.01*	*<0.01*	0.01	*<0.3*	0.16	0.40	12	9.1	-	-	12	-	-	41	30	-	-
ABA416	R277017	CFD0398	64	65	Waste	Fresh	schist	BtS	9	9	*<0.01*	0.01	*<0.01*	*<0.3*	0.44	1.3	34	30	-	-	34	-	-	114	98	-	-
ABA417	R277021	CFD0398	124	125	Waste	Fresh	schist	BtS	9	9.2	*<0.01*	0.02	0.01	*<0.3*	0.62	1.9	48	43	-	-	48	-	-	160	144	-	-
ABA418	R277041	CFD0398	160	161	Waste	Fresh	schist	BtS	9.3	9.3	0.16	0.02	0.16	5.0	0.53	1.7	41	39	-	-	36	-	-	8.2	7.7	-	-
Statistical Summary						**Fresh**	**Schist**	**n**	19	31	31	19	19	31	31	19	31	19	8	8	31	8	8	31	19	8	8
								Max	9.3	9.3	1.00	0.00	0.80	30	4.9	6.2	376	141	147	149	375	147	149	345	356	470	477
								90th PCTL	9	9.2	0.30	0.00	0.50	9.1	1.4	5.1	111	116	130	132	108	128	130	256	229	246	257
								75th PCTL	8.9	8.9	0.20	0.00	0.20	5.0	1.1	4.0	87	91	112	117	85	110	109	93	100	75	78
								Median	8.6	8.6	0.10	*<0.01*	0.00	1.9	0.70	2.6	57	59	108	107	51	89	91	23	24	42	43
								25th PCTL	8.3	8.4	0.00	*<0.01*	*<0.01*	0.30	0.40	1.6	33	35	86	87	33	63	64	9.4	12	5.6	5.8
								10th PCTL	7.3	8.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.20	0.40	12	8.6	36	39	12	36	39	4.1	4.0	4.8	4.8
								Min	7.3	8.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	*<0.2*	*<0.8*	*<4.5*	11	12	0.50	11	12	2.3	2.2	3.3	3.3
Statistical Summary for Schist Waste Rock								**n**	58	79	79	58	58	79	79	58	79	58	33	33	79	33	33	79	58	33	33
								n < DL	-	-	14	30	18	14	1	7	1	7	0	0	0	0	0	0	0	0	0
								Max	9.4	9.3	1.00	0.10	1.00	32	4.9	12	376	268	268	271	375	268	271	800	858	858	867
								90th PCTL	8.9	8.9	0.30	0.00	0.30	9.3	2.2	7.9	169	179	201	194	167	181	178	294	234	384	410
								75th PCTL	8.6	8.6	0.10	0.00	0.10	4.4	1.4	5.3	110	121	135	144	108	126	136	131	131	147	152
								Median	8.2	8.3	0.00	*<0.01*	0.00	0.90	0.80	2.9	63	65	108	106	59	93	97	28	25	26	38
								25th PCTL	7.3	8.1	0.00	*<0.01*	*<0.01*	0.30	0.40	1.4	33	32	47	51	31	46	51	11	14	13	13
								10th PCTL	7.2	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.10	*<0.2*	5.3	*<4.5*	6.2	7.0	5.0	5.9	6.7	5.3	8.1	5.8	6.1
								Min	6.8	6.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	*<0.2*	*<0.8*	*<4.5*	4.0	4.0	0.50	3.7	3.7	2.3	2.2	3.3	3.2
Oxide Facies for Granite Waste Rock																											
ABA157	R305807	CFD0382	76	77	Waste	Oxide	Granite	GG	6.2	6	0.01	0.01	0.01	0.30	0.010	*<0.2*	0.80	*<4.5*	2.0	4.0	0.46	2.0	3.7	2.5	14	6.4	13
ABA158	R305808	CFD0382	79	80	Waste	Oxide	Granite	GG	6	5.9	0.01	0.01	0.01	0.30	0.010	*<0.2*	0.80	*<4.5*	1.0	3.0	0.46	1.0	2.7	2.5	14	3.2	9.6
ABA174	R305826	CFD0403	7	8	Waste	Oxide	Granite	GG	6.4	6.1	0.01	*<0.01*	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	2.0	4.0	1.2	2.0	3.7	5.0	14	6.4	13
ABA421	I354544	CFD0053	50.29	51	Waste	Oxide	Granite	GG	6.3	6.7	0.01	0.02	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	2.0	-	2.0	2.0	-	7.5	14	6.4	-
ABA423	Q033319	CFD0403	7	7.8	Waste	Oxide	Granite	GG	6.6	6.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	2.0	-	2.8	2.0	-	10	15	6.7	-
ABA429	Q032778	CFD0394	39.7	40	Waste	Oxide	Granite	GG	7.5	7.8	*<0.01*	0.02	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	4.0	-	2.8	4.0	-	10	15	13	-
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	3	6	6	3	6	6	6	3
								Max	7.5	7.8	0.01	0.02	0.01	0.31	0.040	*<0.2*	3.1	*<4.5*	4.0	4.0	2.8	3.7	3.7	10	15	13	13
								90th PCTL	7.1	7.3	0.01	0.02	0.01	0.31	0.040	*<0.2*	3.1	*<4.5*	3.0	4.0	2.8	2.7	3.7	10	15	10	13
								75th PCTL	6.6	6.8	0.01	0.02	0.01	0.31	0.038	*<0.2*	2.9	*<4.5*	2.0	4.0	2.6	1.7	3.7	9.6	15	6.6	13
								Median	6.4	6.4	0.01	0.01	*<0.01*	0.31	0.025	*<0.2*	1.9	*<4.5*	2.0	4.0	1.6	1.7	3.7	6.2	14	6.4	13
								25th PCTL	6.2	6	*<0.01*	0.01	*<0.01*	*<0.3*	0.013	*<0.2*	0.97	*<4.5*	2.0	3.5	0.66	1.7	3.2	3.1	14	6.4	11
								10th PCTL	6.1	6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.78	*<4.5*	1.5	3.2	0.46	1.2	2.9	2.5	14	4.8	10
								Min	6	5.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.78	*<4.5*	1.0	3.0	0.46	0.69	2.7	2.5	14	3.2	9.6

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	kg$CaCO_3$/t	%	%	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Upper Transition Facies for Granite Waste Rock																											
ABA013	KAM025898	CFD0150	81	82	Waste	Upper transition	Granite	GG	6.9	6.5	0.01	*<0.01*	*<0.01*	0.30	0.030	0.10	2.3	2.3	3.0	4.0	2.0	3.0	3.7	7.5	7.3	9.6	13
ABA151	R305801	CFD0381	13	14	Waste	Upper transition	Granite	GG	8.9	8.8	0.01	0.02	0.01	0.30	0.070	0.30	5.4	6.8	4.0	6.0	5.1	4.0	5.7	17	22	13	19
ABA152	R305802	CFD0381	35	36	Waste	Upper transition	Granite	GG	7	6.9	0.01	0.01	*<0.01*	0.30	0.030	*<0.2*	2.3	4.5	3.0	5.0	2.0	3.0	4.7	7.5	15	9.6	16
ABA167	R305818	CFD0394	30	31	Waste	Upper transition	Granite	GG	6.4	6.2	0.06	0.05	0.01	1.9	0.010	*<0.2*	0.80	*<4.5*	1.0	2.0	-1.1	-1.0	0.13	0.41	2.4	0.53	1.1
ABA169	R305821	CFD0399	20	21	Waste	Upper transition	Granite	GG	7.4	7.2	0.13	0.04	0.08	4.1	0.030	*<0.2*	2.3	*<4.5*	3.0	4.0	-1.7	-1.0	-0.060	0.57	1.1	0.74	0.98
ABA172	R305824	CFD0396	29	30	Waste	Upper transition	Granite	GG	5.7	5.8	0.01	*<0.01*	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	1.0	2.0	1.2	1.0	1.7	5.0	14	3.2	6.4
ABA178	R305831	CFD0400	11	12	Waste	Upper transition	Granite	GG	7.1	7	0.01	*<0.01*	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	2.0	4.0	2.0	2.0	3.7	7.5	14	6.4	13
ABA189	CFD0399_10_20	CFD0399	10	20	Waste	Upper transition	Granite	GG	-	6	0.12	0.01	0.11	3.8	-	-	-	-	1.0	-	-3.8	-3.0	-	-	-	0.27	-
ABA190	CFD0396_50_60	CFD0396	50	60	Waste	Upper transition	Granite	GG	-	7	*<0.01*	0.01	*<0.01*	*<0.3*	-	-	-	-	2.0	-	-0.30	2.0	-	-	-	6.7	-
ABA191	CFD0394_31_41	CFD0394	31	41	Waste	Upper transition	Granite	GG	-	6.9	0.01	*<0.01*	0.01	0.30	-	-	-	-	2.0	-	-0.31	2.0	-	-	-	6.4	-
ABA192	CFD0394_55_66	CFD0394	55	66	Waste	Upper transition	Granite	GG	-	7.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	-	-	-	-	3.0	-	-0.30	3.0	-	-	-	10	-
ABA195	CFD0381_4_13	CFD0381	4	13	Waste	Upper transition	Granite	GG	-	8.8	*<0.01*	0.02	*<0.01*	*<0.3*	-	-	-	-	6.0	-	-0.30	6.0	-	-	-	20	-
ABA196	CFD0380_36_50	CFD0380	36	50	Waste	Upper transition	Granite	GG	-	6.8	*<0.01*	0.01	*<0.01*	*<0.3*	-	-	-	-	2.0	-	-0.30	2.0	-	-	-	6.7	-
ABA431	Q041083	CFD0380	30	30.18	Waste	Upper Transition	Granite	GG	7.6	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	2.0	-	1.3	2.0	-	5.2	15	6.7	-
ABA434	Q032756	CFD0394	19.5	19.6	Waste	Upper Transition	Granite	GG	7.2	7.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	3.0	-	1.3	3.0	-	5.2	15	10	-
ABA435	Q032826	CFD0394	81.1	81.7	Waste	Upper Transition	Granite	GG	6.9	6.8	0.01	0.01	*<0.01*	0.30	0.010	*<0.2*	0.80	*<4.5*	1.0	-	0.46	1.0	-	2.5	14	3.2	-
ABA436	Q032927	CFD0396	65	65.528	Waste	Upper Transition	Granite	GG	6.8	6	0.01	0.01	*<0.01*	0.30	0.010	*<0.2*	0.80	*<4.5*	1.0	-	0.46	1.0	-	2.5	14	3.2	-
Statistical Summary						**Upper Tranistion**	**Granite**	**n**	11	17	17	17	17	17	11	11	11	11	17	7	17	17	7	11	11	17	7
								Max	8.9	8.8	0.13	0.05	0.11	4.1	0.070	0.30	5.4	6.8	6.0	6.0	5.1	5.7	5.7	17	22	20	19
								90th PCTL	7.6	8	0.08	0.03	0.04	2.6	0.030	0.20	2.3	4.5	3.4	5.4	2.0	3.1	5.1	7.4	15	11	17
								75th PCTL	7.3	7.2	0.01	0.01	0.01	0.31	0.030	0.20	2.3	4.5	3.0	4.5	1.3	2.7	4.2	7.4	15	9.6	14
								Median	7	6.9	0.01	0.01	*<0.01*	0.31	0.020	*<0.2*	1.6	*<4.5*	2.0	4.0	0.46	1.7	3.7	5.2	14	6.7	13
								25th PCTL	6.9	6.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.015	*<0.2*	1.2	*<4.5*	1.0	3.0	-0.30	0.69	0.91	2.5	11	3.2	3.7
								10th PCTL	6.4	6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	1.0	2.0	-1.4	-0.95	0.050	0.57	2.4	0.66	1.0
								Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	1.0	2.0	-3.8	-2.8	-0.063	0.41	1.1	0.27	0.98
Lower Transition Facies for Granite Waste Rock																											
ABA010	KAM024598	CFD0137	49	50	Waste	Lower transition	Granite	GG	9	8.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.11	0.40	8.5	9.1	7.0	7.0	8.2	7.0	6.7	28	30	23	23
ABA154	R305804	CFD0382	10	11	Waste	Lower transition	Granite	GG	8.5	8.4	0.01	0.02	0.01	0.30	0.080	0.30	6.2	6.8	5.0	6.0	5.9	5.0	5.7	20	22	16	19
ABA155	R305805	CFD0382	50	51	Waste	Lower transition	Granite	GG	7.2	7	0.01	0.01	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	3.0	5.0	2.0	3.0	4.7	7.5	14	9.6	16
ABA159	R305809	CFD0383	10	11	Waste	Lower transition	Granite	GG	8.7	8.5	0.01	0.01	*<0.01*	0.30	0.040	0.20	3.1	4.5	4.0	6.0	2.8	4.0	5.7	9.9	15	13	19
ABA160	R305811	CFD0383	48	49	Waste	Lower transition	Granite	GG	8.8	8.6	0.01	0.01	0.01	0.30	0.10	0.40	7.8	9.1	6.0	7.0	7.5	6.0	6.7	25	29	19	22
ABA164	R305815	CFD0389	10	11	Waste	Lower transition	Granite	GG	8.9	8.6	0.01	*<0.01*	*<0.01*	0.30	0.010	*<0.2*	0.80	*<4.5*	4.0	5.0	0.46	4.0	4.7	2.5	14	13	16
ABA166	R305817	CFD0389	45	46	Waste	Lower transition	Granite	GG	6.4	6.2	0.03	0.01	0.01	0.90	0.050	*<0.2*	3.9	*<4.5*	2.0	4.0	2.9	1.0	3.1	4.1	4.8	2.1	4.3
ABA193	CFD383_115_125	CFD0383	115	125	Waste	Lower transition	Granite	GG	-	8.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	-	-	-	-	7.0	-	-0.30	7.0	-	-	-	23	-
ABA194	CFD0382_84_94	CFD0382	84	94	Waste	Lower transition	Granite	GG	-	6.6	*<0.01*	0.02	*<0.01*	*<0.3*	-	-	-	-	3.0	-	-0.30	3.0	-	-	-	10	-
ABA424	Q041284	CFD0382	4	5	Waste	Lower Transition	Granite	GG	8.6	9	*<0.01*	0.01	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	5.0	-	3.6	5.0	-	13	15	17	-
ABA425	Q041377	CFD0382	87	88	Waste	Lower Transition	Granite	GG	7.4	7.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	2.0	-	2.0	2.0	-	7.8	15	6.7	-
ABA426	Q041396	CFD0382	103	104	Waste	Lower Transition	Granite	GG	6.7	6.6	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	1.0	-	1.3	1.0	-	5.2	15	3.3	-
ABA427	Q041404	CFD0382	110	111	Waste	Lower Transition	Granite	GG	6.8	6.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	3.0	-	2.0	3.0	-	7.8	15	10	-
ABA430	Q041069	CFD0380	18	18.1	Waste	Lower Transition	Granite	GG	6.3	5.9	0.05	0.02	0.01	1.6	0.030	*<0.2*	2.3	*<4.5*	2.0	-	0.77	0.00	-	1.5	2.9	1.3	-
Statistical Summary						**Lower Tranistion**	**Granite**	**n**	12	14	14	14	14	14	12	12	12	12	14	7	14	14	7	12	12	14	7
								Max	9	9	0.05	0.02	0.01	1.6	0.11	0.40	8.5	9.1	7.0	7.0	8.2	6.7	6.7	28	30	23	23
								90th PCTL	8.9	8.7	0.02	0.02	0.01	0.75	0.098	0.39	7.6	8.9	6.7	7.0	7.0	6.4	6.7	24	28	22	23
								75th PCTL	8.7	8.6	0.01	0.01	0.01	0.31	0.058	0.23	4.5	5.1	5.0	6.5	3.4	4.7	6.2	15	17	17	21
								Median	8	7.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.035	*<0.2*	2.7	*<4.5*	3.5	6.0	2.0	3.2	5.7	7.8	15	11	19
								25th PCTL	6.8	6.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	2.3	5.0	0.89	1.9	4.7	4.9	14	7.4	16
								10th PCTL	6.4	6.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.021	*<0.2*	1.6	*<4.5*	2.0	4.6	-0.071	0.81	4.0	2.6	5.8	2.5	11
								Min	6.3	5.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	1.0	4.0	-0.30	0.44	3.1	1.5	2.9	1.3	4.3
Fresh Facies for Granite Waste Rock																											
ABA012	KAM025798	CFD0147	260	261	Waste	Fresh	Granite	GG	8.8	8.7	0.01	*<0.01*	0.01	0.30	0.26	0.80	20	18	18	19	20	18	19	65	58	58	61
ABA162	R305813	CFD0385	10	11	Waste	Fresh	Granite	GG	9	8.7	0.01	0.01	0.01	0.30	0.040	0.20	3.1	4.5	4.0	5.0	2.8	4.0	4.7	9.9	15	13	16
ABA163	R305814	CFD0385	59	60	Waste	Fresh	Granite	GG	7.4	7.1	0.01	0.01	0.01	0.30	*<0.01*	*<0.2*	*<0.8*	*<4.5*	2.0	4.0	0.46	2.0	3.7	2.5	14	6.4	13
ABA165	R305816	CFD0389	30	31	Waste	Fresh	Granite	GG	8.5	8.4	0.05	*<0.01*	0.01	1.6	0.010	*<0.2*	0.80	*<4.5*	4.0	5.0	-0.79	2.0	3.4	0.50	2.9	2.6	3.2
ABA168	R305819	CFD0394	88	89	Waste	Fresh	Granite	GG	8.5	8.3	0.01	0.01	0.01	0.30	0.050	0.20	3.9	4.5	4.0	6.0	3.6	4.0	5.7	12	15	13	19
ABA179	R305832	CFD0400	60	61	Waste	Fresh	Granite	GG	6.8	6.7	0.01	0.01	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	2.0	3.0	1.2	2.0	2.7	5.0	14	6.4	9.6
ABA180	CFD0396_72_81	CFD0396	72	81	Waste	Fresh	Granite	GG	-	6.7	0.06	0.02	0.04	1.9	-	-	-	-	5.0	-	-1.9	3.0	-	-	-	2.7	-
ABA182	CFD0394_94_104	CFD0394	94	104	Waste	Fresh	Granite	GG	-	7.3	0.14	*<0.01*	0.14	4.4	-	-	-	-	6.0	-	-4.4	2.0	-	-	-	1.4	-
ABA186	CFD0380_2_17	CFD0380	2	17	Waste	Fresh	Granite	GG	-	8.8	*<0.01*	0.01	*<0.01*	*<0.3*	-	-	-	-	5.0	-	-0.30	5.0	-	-	-	17	-
ABA187	CFD0380_22_30	CFD0380	22	30	Waste	Fresh	Granite	GG	-	8.3	*<0.01*	0.01	*<0.01*	*<0.3*	-	-	-	-	3.0	-	-0.30	3.0	-	-	-	10	-
ABA198	CFD0385_28_38	CFD0385	28	38	Waste	Fresh	Granite	GG	-	9	0.03	*<0.01*	0.03	0.90	-	-	-	-	4.0	-	-0.94	3.0	-	-	-	4.3	-
ABA199	CFD0385_38_48	CFD0385	38	48	Waste	Fresh	Granite	GG	-	8.6	0.02	*<0.01*	0.02	0.60	-	-	-	-	3.0	-	-0.63	2.0	-	-	-	4.8	-
ABA200	CFD0385_48_58	CFD0385	48	58	Waste	Fresh	Granite	GG	-	8.3	0.03	*<0.01*	0.03	0.90	-	-	-	-	3.0	-	-0.94	2.0	-	-	-	3.2	-
ABA437	Q041055	CFD0380	5	6	Waste	Fresh	Granite	GG	9.2	9.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.090	0.20	7.0	4.5	6.0	-	6.7	6.0	-	23	15	20	-
ABA438	Q041063	CFD0380	12	13	Waste	Fresh	Granite	GG	9.1	9.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.070	0.20	5.4	4.5	6.0	-	5.1	6.0	-	18	15	20	-
ABA439	Q041678	CFD0385	8	9	Waste	Fresh	Granite	GG	9.2	9.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	6.0	-	2.8	6.0	-	10	15	20	-
ABA440	Q041699	CFD0385	27	28	Waste	Fresh	Granite	GG	9	8.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	0.20	3.1	4.5	5.0	-	2.8	5.0	-	10	15	17	-
ABA441	Q032423	CFD0385	92	92.58	Waste	Fresh	Granite	GG	7.9	7.7	0.03	0.02	0.01	0.90	0.010	*<0.2*	0.80	*<4.5*	3.0	-	-0.16	2.0	-	0.83	4.8	3.2	-
ABA442	Q032601	CFD0391	3.35	3.879	Waste	Fresh	Granite	GG	8.3	8.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.090	*<0.2*	7.0	*<4.5*	5.0	-	6.7	5.0	-	23	15	17	-
ABA443	Q033167	CFD0400	60	60.963	Waste	Fresh	Granite	GG	8	7.3	0.01	*<0.01*	*<0.01*	0.30	0.010	*<0.2*	0.80	*<4.5*	2.0	-	0.46	2.0	-	2.5	14	6.4	-
Statistical Summary						**Fresh**	**Granite**	**n**	13	20	20	20	20	20	13	13	13	13	20	6	20	20	6	13	13	20	6
								Max	9.2	9.3	0.14	0.02	0.14	4.4	0.26	0.80	20	18	18	19	20	18	19	65	58	58	61
								90th PCTL	9.2	9.2	0.05	0.01	0.03	1.6	0.090	0.20	7.0	4.5	6.0	13	6.7	5.7	12	23	15	20	40
								75th PCTL	9	8.8	0.03	0.01	0.01	0.94	0.070	0.20	5.4	4.5	5.3	5.8	3.0	4.7	5.4	18	15	17	18
								Median	8.5	8.5	0.01	*<0.01*	0.01	0.31	0.040	*<0.2*	3.1	*<4.5*	4.0	5.0	0.46	3.1	4.2	10	15	8.2	14
								25th PCTL	8	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	3.0	4.3	-0.67	2.1	3.5	2.5	14	4.0	10
								10th PCTL	7.5	7.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	2.0	3.5	-1.0	1.7	3.1	1.2	6.7	2.7	6.4
								Min	6.8	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	2.0	3.0	-4.4	1.6	2.7	0.50	2.9	1.4	3.2

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Statistical Summary for Granite Waste Rock								**n**	42	57	57	57	38	57	42	42	42	42	57	23	42	57	23	42	42	57	3
								n < DL	-	-	22	21	13	22	1	30	1	30	0	0	0	0	0	0	0	0	0
								Max	9.2	9.3	0.14	0.05	0.14	4.4	0.26	0.80	20	18	18	19	20	18	19	65	58	58	61
								90th PCTL	9	8.8	0.05	0.02	0.03	1.6	0.089	0.29	6.9	6.6	6.0	6.8	6.6	5.7	6.5	22	21	19	53
								75th PCTL	8.7	8.6	0.01	0.01	0.01	0.31	0.048	0.20	3.7	4.5	5.0	6.0	2.9	3.7	5.7	9.9	15	13	42
								Median	7.4	7.3	0.01	0.01	0.01	0.31	0.030	*<0.2*	2.3	*<4.5*	3.0	5.0	2.0	2.7	3.7	7.4	14	6.7	23
								25th PCTL	6.8	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	2.0	4.0	0.54	1.7	3.3	2.5	14	3.2	18
								10th PCTL	6.3	6.06	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.78	*<4.5*	1.0	3.0	0.46	0.69	1.9	1.6	4.8	2.4	15
								Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	0.10	0.78	2.3	1.0	2.0	-1.7	-2.8	-0.063	0.41	1.1	0.27	13
Oxide Facies for Other Lithologies Waste Rock																											
ABA017	KAM029389	CFD0176	96	97	Waste	Oxide	Dykes	FC	7.1	7.4	0.02	0.01	0.02	0.60	0.090	0.30	7.0	6.8	9.0	9.0	6.4	8.0	8.4	11	11	14	14
ABA018	KAM029393	CFD0176	99	100	Waste	Oxide	Dykes	FC	7	6.7	0.02	*<0.01*	0.01	0.60	0.040	0.10	3.1	2.3	6.0	6.0	2.5	5.0	5.4	5.0	3.6	9.6	9.6
ABA056	KAM084551	CFD0237	181	181.5	Waste	Oxide	HU	HU	7.1	7.6	0.03	*<0.01*	0.03	0.90	0.28	0.70	22	16	16	19	21	15	18	23	17	17	20
ABA306	R277468	CFD0426	26	27	Waste	Oxide	SZ	SZ	-	8	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	-	-	-	2.6	0.00	-	-
Statistical Summary						**Oxide**	**Other Lithologies**	**n**	3	4	4	3	3	4	4	3	4	3	3	3	3	3	3	4	4	3	3
								Max	7.1	8	0.03	0.01	0.03	0.94	0.28	0.70	22	16	16	19	21	15	18	23	17	17	20
								90th PCTL	7.1	7.9	0.03	0.01	0.03	0.84	0.22	0.62	17	14	15	17	18	14	16	20	15	17	19
								75th PCTL	7.1	7.7	0.02	0.01	0.03	0.70	0.14	0.50	11	11	13	14	14	12	13	14	12	16	17
								Median	7.1	7.5	0.02	*<0.01*	0.02	0.63	0.065	0.30	5.0	6.8	9.0	9.0	6.4	8.4	8.4	8.1	7.3	14	14
								25th PCTL	7.1	7.2	0.02	*<0.01*	0.02	0.54	0.033	0.20	2.5	4.5	7.5	7.5	4.4	6.9	6.9	4.4	2.7	12	12
								10th PCTL	7	6.9	*<0.01*	*<0.01*	0.01	*<0.3*	0.019	0.14	1.5	3.2	6.6	6.6	3.3	6.0	6.0	3.3	1.1	11	11
								Min	7	6.7	*<0.01*	*<0.01*	0.01	*<0.3*	0.010	0.10	0.80	2.3	6.0	6.0	2.5	5.4	5.4	2.6	0.00	9.6	9.6
Upper Transition Facies for Other Lithologies Waste Rock																											
ABA061	KAM019714	CFD0083	8	9	Waste	Upper transition	Metabasalt/	Amph	8.6	8.7	0.01	*<0.01*	*<0.01*	0.30	0.36	1.3	28	30	37	38	28	37	38	89	95	118	122
ABA303	Q033703	CFD0411	15	16	Waste	Upper transition	dykes	DIOR	-	7.5	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA072	KAM145425	CFD0339	10	11	Waste	Upper transition	Dykes	FC	7.1	7	0.01	*<0.01*	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	5.0	7.0	2.0	5.0	6.7	7.5	14	16	22
ABA311	Q034859	CFD0473	164	165	Waste	Upper transition	dykes	FC	-	7.4	0.02	-	-	0.60	0.040	-	3.1	-	-	-	2.5	-	-	5.0	-	-	-
ABA305	R273647	CFD0456	55	56	Waste	Upper transition	Fault	FLT	-	7.3	*<0.01*	-	-	*<0.3*	0.030	-	2.3	-	-	-	2.0	-	-	7.8	-	-	-
ABA022	KAM035755	CFD0080	122	123	Waste	Upper transition	YO	YO	7.7	8.1	0.53	0.01	0.42	17	3.0	11	234	241	204	202	217	187	185	14	15	12	12
ABA368	R545623	CFD0524	92	92.6	Waste	Upper Transition	Yx	Yx	8.3	8.3	0.02	*<0.01*	*<0.01*	0.60	0.020	*<0.2*	1.6	*<4.5*	-	-	-	-	-	2.5	7.2	-	-
Statistical Summary						**Upper Transition**	**Other Lithologies**	**n**	4	7	7	4	4	7	7	4	7	4	3	3	6	3	3	7	4	3	3
								Max	8.6	8.7	0.53	0.01	0.42	17	3.0	11	234	241	204	202	217	187	185	89	95	118	122
								90th PCTL	8.5	8.5	0.22	0.01	0.30	7.0	1.4	7.8	110	178	171	169	122	157	156	44	71	98	102
								75th PCTL	8.4	8.2	0.02	*<0.01*	0.11	0.63	0.20	3.6	16	82	121	120	21	112	112	11	35	67	72
								Median	8	7.5	0.01	*<0.01*	*<0.01*	0.31	0.030	0.75	2.3	17	37	38	2.3	37	38	7.4	14	16	22
								25th PCTL	7.6	7.4	0.01	*<0.01*	*<0.01*	0.31	0.025	*<0.2*	1.9	*<4.5*	21	23	2.0	21	22	5.0	13	14	17
								10th PCTL	7.3	7.2	0.01	*<0.01*	*<0.01*	0.31	0.020	*<0.2*	1.6	*<4.5*	11	13	1.6	11	13	4.0	9.4	13	14
								Min	7.1	7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	5.0	7.0	1.2	4.7	6.7	2.5	7.2	12	12
Lower Transition Facies for Other Lithologies Waste Rock																											
ABA449	R283583	CFD0496	90	91	Waste	Lower Transition	Metabasalt	MBSLT	8.6	8.7	0.34	0.01	-	11	2.4	8.2	187	186	192	-	176	181	-	18	18	18	-
ABA304	R283583	CFD0496	90	91	Waste	Lower transition	Metabasalt/	MBSLT	-	8.4	0.35	-	-	11	2.4	-	182	-	-	-	171	-	-	17	-	-	-
ABA312	R282332	CFD0474	37	38	Waste	Lower transition	dykes	IV	-	8.7	*<0.01*	-	-	*<0.3*	0.31	-	24	-	-	-	24	-	-	80	-	-	-
ABA313	Q035862	CFD0491	124	125	Waste	Lower transition	dykes	IV	-	6.9	0.02	-	-	0.60	0.020	-	1.6	-	-	-	0.93	-	-	2.5	-	-	-
ABA308	Q033764	CFD0411	70	71	Waste	Lower transition	YC	YC	-	8	0.12	-	-	3.8	2.5	-	192	-	-	-	188	-	-	51	-	-	-
ABA310	R276691	CFD0413	21	22	Waste	Lower transition	Ylim	Ylim	-	8.1	*<0.01*	-	-	*<0.3*	0.31	-	24	-	-	-	24	-	-	80	-	-	-
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	1	6	6	1	0	6	6	1	6	1	1	0	6	1	0	6	1	1	0
								Max	-	8.7	0.35	-	-	11	2.5	8.2	192	-	-	-	188	-	-	80	-	-	-
								90th PCTL	-	8.7	0.35	-	-	11	2.4	8.2	189	-	-	-	182	-	-	80	-	-	-
								75th PCTL	-	8.6	0.29	-	-	8.9	2.4	8.2	186	-	-	-	175	-	-	73	-	-	-
								Median	-	8.3	0.07	-	-	2.2	1.3	8.2	103	-	-	-	98	-	-	34	-	-	-
								25th PCTL	-	8	0.01	-	-	0.38	0.31	8.2	24	-	-	-	24	-	-	17	-	-	-
								10th PCTL	-	7.5	*<0.01*	-	-	*<0.3*	0.17	8.2	13	-	-	-	12	-	-	9.6	-	-	-
								Min	-	6.9	*<0.01*	-	-	*<0.3*	0.020	8.2	1.6	-	-	-	0.93	-	-	2.5	-	-	-
Fresh Facies for Other Lithologies Waste Rock																											
ABA447	R274909	CFD0472	143.2	144	Waste	Fresh	Metabasalt	MBSLT	8	8.1	*<0.01*	0.02	-	*<0.3*	0.36	1.2	28	27	44	-	28	44	-	93	91	147	-
ABA448	R274918	CFD0472	150	151	Waste	Fresh	Metabasalt	MBSLT	8.6	8.9	0.07	*<0.01*	-	2.2	0.23	0.80	18	18	29	-	16	27	-	8.2	8.3	13	-
ABA450	R293475	CFR0730	91.44	92.96	Waste	Fresh	Metabasalt	MBSLT	8.6	8.7	0.21	0.03	-	6.6	0.88	2.9	68	66	80	-	62	73	-	10	10	12	-
ABA087	KAM133438	CFR0429	10.67	12.19	Waste	Fresh	Mafic/	RU	9	8.7	0.04	0.01	0.02	1.3	3.1	9.6	241	218	260	269	240	259	268	193	175	208	215
ABA307	R277453	CFD0423	81	82	Waste	Fresh	Mafic/	RU	-	8.2	0.01	-	-	0.30	0.90	-	70	-	-	-	70	-	-	223	-	-	-
ABA349	R304353	CFD0541	90	91	Waste	Fresh	IV	IV	8.7	8.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.22	0.70	17	16	-	-	17	-	-	57	53	-	-
ABA352	R304282	CFD0539	90	91	Waste	Fresh	IV	IV	8.7	8.6	*<0.01*	*<0.01*	0.02	*<0.3*	0.86	2.9	67	66	-	-	66	-	-	222	220	-	-
Statistical Summary						**Fresh**	**Other Lithologies**	**n**	6	7	7	6	3	7	7	6	7	6	4	1	7	4	1	7	6	4	1
								Max	9	8.9	0.21	0.03	0.02	6.6	3.1	9.6	241	218	260	-	240	259	-	223	220	208	-
								90th PCTL	8.9	8.8	0.13	0.03	0.02	3.9	1.8	6.3	138	142	206	-	138	203	-	223	197	190	-
								75th PCTL	8.7	8.8	0.06	0.02	0.02	1.7	0.89	2.9	69	66	125	-	68	120	-	208	154	162	-
								Median	8.7	8.7	0.01	0.01	0.02	0.31	0.86	2.1	67	47	62	-	62	59	-	93	72	80	-
								25th PCTL	8.6	8.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.30	0.90	23	21	40	-	22	39	-	34	21	13	-
								10th PCTL	8.3	8.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.23	0.75	18	17	34	-	16	32	-	9.5	9.2	13	-
								Min	8	8.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.22	0.70	17	16	29	-	16	27	-	8.2	8.3	12	-
Statistical Summary for Other Lithologies Waste Rock								**n**	14	24	24	14	10	24	24	14	24	14	11	7	24	11	7	24	15	11	7
								n < DL	-	-	7	7	3	7	0	2	0	2	0	0	0	0	0	0	0	0	0
								Max	9	8.9	0.53	0.03	0.42	17	3.1	11	241	241	260	269	240	259	268	223	211	208	215
								90th PCTL	8.7	8.7	0.30	0.02	0.07	9.4	2.5	9.2	190	209	204	229	184	187	218	162	143	141	159
								75th PCTL	8.6	8.7	0.05	0.01	0.02	1.5	0.89	2.9	69	66	136	120	67	127	112	80	69	68	72
								Median	8.5	8.1	0.02	*<0.01*	0.02	0.63	0.30	1.0	23	23	37	19	22	37	18	15	15	16	20
								25th PCTL	7.3	7.475	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.038	0.40	2.9	9.1	13	8.0	2.4	12	7.5	6.8	9.2	13	13
								10th PCTL	7.1	7.09	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	6.0	6.6	1.0	5.4	6.2	3.3	5.1	12	11
								Min	7	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	0.10	0.80	2.3	5.0	6.0	0.48	4.7	5.4	2.5	0.00	9.6	9.6

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit
Sulphate Sulphur determined by 25% HCL with Gravimetric Finish.
Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP-MS Finish.
T-AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material, derived from Total S * 31.25.
NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material.
Carbonate NP (CaNP) is calculated from total inorganic carbon (TIC); T-C NP* calculated from Total-C * 77.6.
Net NP (NNP) = NP - AP; Neutralization potential ratio (NPR).

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Gneiss Waste Rock																											
ABA043	KAM050495	CFD0152	149.0	150.0	Waste	Oxide	Gneiss	MxF	8.4	-	-	-	-	-	-	1.3	0.47	0.020	0.035	0.0073	0.00025	0.00025	0.13	0.000025	18	0.00025	0.000050
ABA064	KAM125257	CFD0307	49.0	50.0	Waste	Oxide	Gneiss	MxF	8.0	-	-	-	-	-	-	*<0.5*	3.6	0.041	0.19	0.069	*<0.0005*	*<0.0005*	0.014	*<0.00005*	0.84	0.0040	0.00073
ABA080	KAM115505	CFR0360	25.9	27.4	Waste	Oxide	Gneiss	MxF	7.2	-	-	-	-	-	-	*<0.5*	0.019	0.0028	0.0095	0.017	*<0.0005*	*<0.0005*	0.034	*<0.00005*	2.4	*<0.0005*	0.00020
ABA096	KAM137284	CFR0468	32.0	33.5	Waste	Oxide	Gneiss	MxF	8.3	-	-	-	-	-	-	0.52	3.8	0.0053	0.12	0.055	*<0.0005*	0.00063	*0.010*	*<0.00005*	0.57	0.0039	0.0010
ABA104	KAM139298	CFR0482	10.7	12.2	Waste	Oxide	Gneiss	MxF	7.4	-	-	-	-	-	-	0.80	3.0	0.021	0.18	0.085	*<0.0005*	*<0.0005*	0.022	*<0.00005*	0.67	0.0028	0.00071
ABA138	KAM152219	CFR0586	155.5	157.0	Waste	Oxide	Gneiss	MxF	8.8	-	-	-	-	-	-	3.5	0.26	0.0014	0.015	0.021	*<0.0005*	*<0.0005*	0.013	*<0.00005*	8.8	*<0.0005*	*<0.0001*
ABA144	KAM152716	CFR0591	30.5	32.0	Waste	Oxide	Gneiss	MxF	8.9	-	-	-	-	-	-	1.9	0.13	0.0069	0.17	0.025	*<0.0005*	*<0.0005*	0.017	*<0.00005*	12	*<0.0005*	*<0.0001*
ABA146	KAM153091	CFR0594	164.6	166.1	Waste	Oxide	Gneiss	MxF	8.3	-	-	-	-	-	-	16	0.036	0.047	1.2	0.0019	*<0.0005*	*<0.0005*	0.036	*<0.00005*	20	0.0029	*<0.0001*
ABA149	KAM153152	CFR0595	61.0	62.5	Waste	Oxide	Gneiss	MxF	9.4	-	-	-	-	-	-	1.4	0.43	0.0049	0.076	0.0052	*<0.0005*	*<0.0005*	0.016	*<0.00005*	6.6	*<0.0005*	*<0.0001*
Statistical Summary						**Oxide**	**Gneiss**	**n**	9	-	-	-	-	-	-	9	9	9	9	9	9	9	9	9	9	9	9
								Max	9.4	-	-	-	-	-	-	16	3.8	0.047	1.2	0.085	0.00050	0.00063	0.13	0.000050	20	0.0040	0.0010
								90th PCTL	9.0	-	-	-	-	-	-	6.0	3.7	0.042	0.39	0.072	0.00050	0.00053	0.054	0.000050	18	0.0039	0.00079
								75th PCTL	8.8	-	-	-	-	-	-	1.9	3.0	0.021	0.18	0.055	*<0.0005*	*<0.0005*	0.034	*<0.00005*	12	0.0029	0.00071
								Median	8.3	-	-	-	-	-	-	1.3	0.43	0.0069	0.12	0.021	*<0.0005*	*<0.0005*	0.017	*<0.00005*	6.6	0.00050	0.00010
								25th PCTL	8.0	-	-	-	-	-	-	0.52	0.13	0.0049	0.035	0.0073	*<0.0005*	*<0.0005*	0.014	*<0.00005*	0.84	*<0.0005*	*<0.0001*
								10th PCTL	7.4	-	-	-	-	-	-	*<0.5*	0.032	0.0025	0.014	0.0045	*<0.0005*	*<0.0005*	0.012	*<0.00005*	0.65	*<0.0005*	*<0.0001*
								Min	7.2	-	-	-	-	-	-	*<0.5*	0.019	0.0014	0.0095	0.0019	*<0.0005*	*<0.0005*	0.010	*<0.00005*	0.57	*<0.0005*	*<0.0001*
Upper Transition Facies for Gneiss Waste Rock																											
ABA016	KAM029087	CFD0175	145.0	146.0	Waste	Upper transition	Gneiss	MxF	8.1	-	-	-	-	-	-	1.7	0.11	0.0071	0.014	0.011	0.00025	0.00025	0.042	0.000025	28	0.0016	0.000050
ABA059	KAM097012	CFD0272	17.0	18.0	Waste	Upper transition	Gneiss	FG	8.6	-	-	-	-	-	-	0.55	7.6	0.028	0.20	0.11	0.00050	0.00050	0.043	0.000050	0.52	0.0029	0.0016
ABA060	KAM097065	CFD0272	65.0	66.0	Waste	Upper transition	Gneiss	FG	8.3	-	-	-	-	-	-	12	0.28	0.012	0.094	0.13	0.00025	0.00025	0.14	0.000025	23	0.00025	0.000050
ABA147	KAM152978	CFR0594	10.7	12.2	Waste	Upper transition	Gneiss	MxF	9.5	-	-	-	-	-	-	0.89	4.1	0.00045	0.015	0.048	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	0.00069	0.00066
ABA353	R304081	CFD0525	10.0	11.0	Waste	Upper Transition	Gneiss	MxF	7.7	4.2	*<0.05*	*<0.5*	0.17	0.0098	0.0027	0.90	0.51	0.0019	0.046	0.031	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.99	0.0013	0.00033
ABA367	R545582	CFD0524	56.0	57.0	Waste	Upper Transition	Gneiss	MxF	7.9	3.9	*<0.05*	*<0.5*	0.096	0.013	0.011	0.70	0.044	0.0049	0.079	0.0021	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.37	*<0.0005*	*<0.0001*
ABA411	R544193	CFD0502	40.0	41.0	Waste	Upper Transition	Gneiss	MxF	7.3	3.3	*<0.05*	*<0.5*	0.069	0.021	0.011	*<0.5*	0.028	0.0013	0.0079	0.0027	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.55	*<0.0005*	0.0017
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	7	-	-	-	-	-	-	7	7	7	7	7	7	7	7	7	7	7	7
								Max	9.5	-	-	-	-	-	-	12	7.6	0.028	0.20	0.13	*<0.0005*	*<0.0005*	0.14	*<0.00005*	28	0.0029	0.0017
								90th PCTL	8.9	-	-	-	-	-	-	6.0	5.5	0.019	0.14	0.12	*<0.0005*	*<0.0005*	0.081	*<0.00005*	25	0.0021	0.0016
								75th PCTL	8.4	-	-	-	-	-	-	1.3	2.3	0.0097	0.087	0.078	*<0.0005*	*<0.0005*	0.043	*<0.00005*	14	0.0015	0.0011
								Median	8.1	-	-	-	-	-	-	0.89	0.28	0.0049	0.046	0.031	*<0.0005*	*<0.0005*	0.010	*<0.00005*	0.99	0.00069	0.00033
								25th PCTL	7.8	-	-	-	-	-	-	0.63	0.079	0.0016	0.014	0.0067	0.00038	0.00038	*<0.01*	0.000038	0.54	*<0.0005*	0.000075
								10th PCTL	7.5	-	-	-	-	-	-	0.53	0.038	0.00094	0.012	0.0025	0.00025	0.00025	*<0.01*	0.000025	0.46	0.00040	0.000050
								Min	7.3	-	-	-	-	-	-	*<0.5*	0.028	0.00045	0.0079	0.0021	0.00025	0.00025	*<0.01*	0.000025	0.37	0.00025	0.000050
Lower Transition Facies for Gneiss Waste Rock																											
ABA019	KAM029649	CFD0177	73.0	74.0	Waste	Lower transition	Gneiss	MxM	9.8	-	-	-	-	-	-	0.55	2.6	0.0026	0.015	0.011	0.00050	0.00050	0.026	0.000050	2.2	0.00050	0.00010
ABA058	KAM096948	CFD0270	230.0	231.0	Waste	Lower transition	Gneiss	MxF	8.6	-	-	-	-	-	-	15	0.64	0.0039	0.016	0.020	0.00025	0.00025	0.047	0.000025	25	0.00025	0.000050
ABA067	KAM129499	CFD0332	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	9.7	-	-	-	-	-	-	1.1	4.1	0.0018	0.012	0.031	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	3.8	*<0.0005*	0.00035
ABA070	KAM099512	CFD0338	10.0	11.0	Waste	Lower transition	Gneiss	MxF	9.2	33	*<0.05*	*<0.5*	0.16	0.0093	0.010	4.1	0.19	0.00020	0.0066	0.27	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.1	*<0.0005*	*<0.0001*
ABA073	KAM145537	CFD0339	111.0	112.0	Waste	Lower transition	Gneiss	MxF	9.2	28	*<0.05*	*<0.5*	0.12	0.0073	0.0089	7.3	0.20	0.0037	0.029	0.30	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.7	*<0.0005*	*<0.0001*
ABA098	KAM137429	CFR0469	29.0	30.5	Waste	Lower transition	Gneiss	MxF	9.4	26	*<0.05*	*<0.5*	0.13	*<0.005*	0.0041	*<0.5*	0.65	0.00017	0.019	0.0075	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	*<0.0005*	*<0.0001*
ABA106	KAM139356	CFR0482	89.9	91.4	Waste	Lower transition	Gneiss	MxF	9.3	32	*<0.05*	*<0.5*	0.21	*<0.005*	0.0062	2.7	0.26	0.00011	0.0045	0.0048	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	*<0.0001*
ABA117	KAM122524	CFR0529	21.3	22.9	Waste	Lower transition	Gneiss	FG	8.1	7.5	*<0.05*	*<0.5*	0.35	0.0081	0.0060	*<0.5*	2.0	0.0021	0.028	0.054	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.85	0.011	0.00086
ABA142	KAM152462	CFR0589	25.9	27.4	Waste	Lower transition	Gneiss	MxF	9.3	27	*<0.05*	*<0.5*	0.098	*<0.005*	0.0045	8.8	0.17	0.00049	0.014	0.23	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.6	*<0.0005*	*<0.0001*
ABA150	KAM153129	CFR0595	30.5	32.0	Waste	Lower transition	Gneiss	MxM	9.4	38	*<0.05*	*<0.5*	0.21	*<0.005*	0.0084	1.6	0.42	0.00082	0.056	0.0080	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.6	*<0.0005*	*<0.0001*
ABA246	R273797	CFD0458	9.0	10.0	Waste	Lower transition	Gneiss	FG	7.7	4.5	*<0.05*	*<0.5*	0.098	*<0.005*	0.024	*<0.5*	0.027	0.0017	0.017	0.0036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.28	*<0.0005*	*<0.0001*
ABA247	R283019	CFD0484	33.0	34.0	Waste	Lower transition	Gneiss	FG	9.2	26	*<0.05*	*<0.5*	0.15	*<0.005*	0.011	0.72	0.24	0.00056	0.033	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
ABA249	R273398	CFD0447	188.0	189.0	Waste	Lower transition	Gneiss	MxF	9.3	20	*<0.05*	*<0.5*	0.095	*<0.005*	*<0.001*	*<0.5*	0.42	0.00084	0.043	0.0067	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	3.2	*<0.0005*	*<0.0001*
ABA250	R279032	CFD0461	85.0	86.0	Waste	Lower transition	Gneiss	MxM	9.3	22	*<0.05*	*<0.5*	0.065	*<0.005*	0.0032	1.7	0.39	0.00027	0.021	0.0040	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
ABA251	R274019	CFD0464	10.0	11.0	Waste	Lower transition	Gneiss	FG	7.6	4.0	*<0.05*	*<0.5*	0.091	*<0.005*	*<0.001*	0.66	0.25	0.0033	0.092	0.0016	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.15	*<0.0005*	*<0.0001*
ABA252	R274341	CFD0467	80.0	81.0	Waste	Lower transition	Gneiss	MxF	9.2	24	*<0.05*	*<0.5*	0.11	*<0.005*	0.0027	0.97	0.24	0.00078	0.013	0.0026	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.6	*<0.0005*	*<0.0001*
ABA253	R282397	CFD0474	95.0	96.0	Waste	Lower transition	Gneiss	MxF	7.4	3.8	*<0.05*	*<0.5*	0.054	0.0074	0.0067	*<0.5*	0.016	0.00063	0.0080	0.0033	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.45	*<0.0005*	*<0.0001*
ABA254	R270666	CFD0404	10.0	11.0	Waste	Lower transition	Gneiss	MxF	7.5	3.3	*<0.05*	*<0.5*	0.11	*<0.005*	0.0037	1.1	1.2	0.0064	0.033	0.019	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.77	0.00055	0.00039
ABA255	R271756	CFD0424	62.0	63.0	Waste	Lower transition	Gneiss	MxM	9.4	28	*<0.05*	*<0.5*	0.17	0.0054	0.011	1.2	0.34	0.00013	0.0071	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.8	*<0.0005*	*<0.0001*
ABA256	R271112	CFD0415	8.0	9.0	Waste	Lower transition	Gneiss	MxM	19	16	16	16	16	16	16	19	19	19	19	19	19	19	19	19	19	19	19
ABA257	R273315	CFD0447	115.0	116.0	Waste	Lower transition	Gneiss	FG	9.8	38	*<0.05*	*<0.5*	0.30	0.0090	0.024	15	4.1	0.0064	0.092	0.30	0.00050	0.00050	0.047	0.000050	25	0.011	0.00086
ABA258	R276507	CFD0409	12.0	13.0	Waste	Lower transition	Gneiss	MxM	9.4	33	*<0.05*	*<0.5*	0.20	0.0080	0.011	7.6	2.1	0.0038	0.046	0.24	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.2	0.00051	0.00036
ABA259	R280545	CFD0499	10.0	11.0	Waste	Lower transition	Gneiss	MxM	9.3	28	*<0.05*	*<0.5*	0.20	0.0060	0.0090	2.2	0.65	0.0023	0.031	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	0.00010
ABA260	R280565	CFD0499	28.0	29.0	Waste	Lower transition	Gneiss	MxM	9.2	25	*<0.05*	*<0.5*	0.10	*<0.005*	0.0060	1.1	0.34	0.00082	0.017	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
ABA261	R274115	CFD0464	95.0	96.0	Waste	Lower transition	Gneiss	MxF	8.4	6.8	*<0.05*	*<0.5*	0.10	*<0.005*	0.0040	*<0.5*	0.22	0.00038	0.013	0.0038	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.5	*<0.0005*	*<0.0001*
ABA262	R274262	CFD0467	10.0	11.0	Waste	Lower transition	Gneiss	MxF	7.6	3.9	*<0.05*	*<0.5*	0.10	*<0.005*	0.0020	*<0.5*	0.14	0.00016	0.0070	0.0024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.42	*<0.0005*	*<0.0001*
ABA263	R282302	CFD0474	10.0	11.0	Waste	Lower transition	Gneiss	FG	7.4	3.3	*<0.05*	*<0.5*	0.10	*<0.005*	*<0.001*	*<0.5*	0.016	0.00011	0.0045	*<0.001*	0.00025	0.00025	0.010	0.000025	0.15	0.00025	0.000050
ABA264	R271435	CFD0420	9.0	10.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA265	R271165	CFD0415	55.0	56.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA267	R273694	CFD0456	97.0	98.0	Waste	Lower transition	Gneiss	MxM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA269	R279507	CFD0468	60.0	61.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA270	R272186	CFD0433	10.0	11.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA271	R283079	CFD0484	87.0	88.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA272	Q034772	CFD0473	86.0	87.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA273	R282171	CFD0439	30.0	31.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA274	R277372	CFD0423	10.0	11.0	Waste	Lower transition	Gneiss	MxM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ABA275	R283492	CFD0496	10.0	11.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA276	R273866	CFD0460	63.0	64.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA277	R273898	CFD0460	91.0	92.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA278	Q035773	CFD0491	9.0	10.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA279	Q035789	CFD0491	60.0	61.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA280	R271699	CFD0424	12.0	13.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA282	R282102	CFD0437	70.0	71.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA283	R273302	CFD0447	59.0	60.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA284	R273593	CFD0456	7.0	8.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA338	R270835	CFD0406	32.0	33.0	Waste	Lower Transition	Gneiss	MxF	9.2	33	*<0.05*	*<0.5*	0.16	0.0093	0.010	4.1	0.19	0.00020	0.0066	0.27	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.1	*<0.0005*	*<0.0001*
ABA340	R270686	CFD0404	27.0	28.0	Waste	Lower Transition	Gneiss	MxM	9.2	28	*<0.05*	*<0.5*	0.12	0.0073	0.0089	7.3	0.20	0.0037	0.029	0.30	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.7	*<0.0005*	*<0.0001*
ABA342	R551085	CFD0563	10.0	11.0	Waste	Lower Transition	Gneiss	MxM	9.4	26	*<0.05*	*<0.5*	0.13	*<0.005*	0.0041	*<0.5*	0.65	0.00017	0.019	0.0075	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	*<0.0005*	*<0.0001*
ABA344	R551131	CFD0563	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	9.3	32	*<0.05*	*<0.5*	0.21	*<0.005*	0.0062	2.7	0.26	0.00011	0.0045	0.0048	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	*<0.0001*
ABA348	R304313	CFD0541	56.0	57.0	Waste	Lower Transition	Gneiss	MxM	8.1	7.5	*<0.05*	*<0.5*	0.35	0.0081	0.0060	*<0.5*	2.0	0.0021	0.028	0.054	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.85	0.011	0.00086
ABA361	R623933	CFD0555	102.0	103.0	Waste	Lower Transition	Gneiss	MxF	9.3	27	*<0.05*	*<0.5*	0.098	*<0.005*	0.0045	8.8	0.17	0.00049	0.014	0.23	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.6	*<0.0005*	*<0.0001*
ABA362	R507027	CFD0555	185.0	186.0	Waste	Lower Transition	Gneiss	FG	9.4	38	*<0.05*	*<0.5*	0.21	*<0.005*	0.0084	1.6	0.42	0.00082	0.056	0.0080	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.6	*<0.0005*	*<0.0001*
ABA363	R545397	CFD0520	20.0	21.0	Waste	Lower Transition	Gneiss	FG	7.7	4.5	*<0.05*	*<0.5*	0.098	*<0.005*	0.024	*<0.5*	0.027	0.0017	0.017	0.0036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.28	*<0.0005*	*<0.0001*
ABA369	R545644	CFD0526	81.0	82.0	Waste	Lower Transition	Gneiss	MxF	9.2	26	*<0.05*	*<0.5*	0.15	*<0.005*	0.011	0.72	0.24	0.00056	0.033	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
ABA395	R545811	CFD0529	58.0	59.0	Waste	Lower Transition	Gneiss	FG	9.3	20	*<0.05*	*<0.5*	0.095	*<0.005*	*<0.001*	*<0.5*	0.42	0.00084	0.043	0.0067	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	3.2	*<0.0005*	*<0.0001*
ABA399	R543714	CFD0549	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	9.3	22	*<0.05*	*<0.5*	0.065	*<0.005*	0.0032	1.7	0.39	0.00027	0.021	0.0040	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
ABA400	R543741	CFD0549	53.0	54.0	Waste	Lower Transition	Gneiss	MxF	7.6	4.0	*<0.05*	*<0.5*	0.091	*<0.005*	*<0.001*	0.66	0.25	0.0033	0.092	0.0016	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.15	*<0.0005*	*<0.0001*
ABA402	R544003	CFD0553	80.0	81.0	Waste	Lower Transition	Gneiss	MxF	9.2	24	*<0.05*	*<0.5*	0.11	*<0.005*	0.0027	0.97	0.24	0.00078	0.013	0.0026	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.6	*<0.0005*	*<0.0001*
ABA405	R554003	CFD0501	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	7.4	3.8	*<0.05*	*<0.5*	0.054	0.0074	0.0067	*<0.5*	0.016	0.00063	0.0080	0.0033	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.45	*<0.0005*	*<0.0001*
ABA410	R544159	CFD0502	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	7.5	3.3	*<0.05*	*<0.5*	0.11	*<0.005*	0.0037	1.1	1.2	0.0064	0.033	0.019	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.77	0.00055	0.00039
ABA412	R544228	CFD0502	70.0	71.0	Waste	Lower Transition	Gneiss	MxF	9.4	28	*<0.05*	*<0.5*	0.17	0.0054	0.011	1.2	0.34	0.00013	0.0071	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.8	*<0.0005*	*<0.0001*
Statistical Summary						**Lower Transition**	**Gneiss**	**n**	19	16	16	16	16	16	16	19	19	19	19	19	19	19	19	19	19	19	19
								Max	9.8	38	*<0.05*	*<0.5*	0.30	0.0090	0.024	15	4.1	0.0064	0.092	0.30	0.00050	0.00050	0.047	0.000050	25	0.011	0.00086
								90th PCTL	9.4	33	*<0.05*	*<0.5*	0.20	0.0080	0.011	7.6	2.1	0.0038	0.046	0.24	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.2	0.00051	0.00036
								75th PCTL	9.3	28	*<0.05*	*<0.5*	0.20	0.0060	0.0090	2.2	0.65	0.0023	0.031	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	0.00010
								Median	9.2	25	*<0.05*	*<0.5*	0.10	*<0.005*	0.0060	1.1	0.34	0.00082	0.017	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
								25th PCTL	8.4	6.8	*<0.05*	*<0.5*	0.10	*<0.005*	0.0040	*<0.5*	0.22	0.00038	0.013	0.0038	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.5	*<0.0005*	*<0.0001*
								10th PCTL	7.6	3.9	*<0.05*	*<0.5*	0.10	*<0.005*	0.0020	*<0.5*	0.14	0.00016	0.0070	0.0024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.42	*<0.0005*	*<0.0001*
								Min	7.4	3.3	*<0.05*	*<0.5*	0.10	*<0.005*	*<0.001*	*<0.5*	0.016	0.00011	0.0045	*<0.001*	0.00025	0.00025	0.010	0.000025	0.15	0.00025	0.000050
Fresh Facies for Gneiss Waste Rock																											
ABA065	KAM128393	CFD0326	25.0	26.0	Waste	Fresh	Gneiss	MxM	8.1	-	-	-	-	-	-	0.92	5.5	0.028	0.14	0.13	*<0.0005*	*<0.0005*	0.011	*<0.00005*	1.9	0.0046	0.0015
ABA097	KAM137325	CFR0468	88.4	89.9	Waste	Fresh	Gneiss	MxM	9.1	-	-	-	-	-	-	8.8	0.43	0.00093	0.024	0.029	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.0	*<0.0005*	*<0.0001*
ABA139	KAM152151	CFR0586	61.0	62.5	Waste	Fresh	Gneiss	MxF	9.1	-	-	-	-	-	-	*<0.5*	3.2	0.0021	0.060	0.042	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.2	0.0014	0.00073
ABA143	KAM152536	CFR0589	128.0	129.5	Waste	Fresh	Gneiss	FG	9.0	-	-	-	-	-	-	10	0.24	0.0087	0.064	0.095	*<0.0005*	*<0.0005*	0.023	*<0.00005*	9.5	*<0.0005*	*<0.0001*
ABA148	KAM153051	CFR0594	109.7	111.3	Waste	Fresh	Gneiss	MxF	8.9	-	-	-	-	-	-	7.3	0.15	0.015	0.16	0.021	*<0.0005*	*<0.0005*	0.017	*<0.00005*	11	*<0.0005*	*<0.0001*
ABA347	R304284	CFD0541	30.0	31.0	Waste	Fresh	Gneiss	FG	8.7	11	*<0.05*	*<0.5*	0.12	*<0.005*	0.0064	0.95	0.99	0.0012	0.016	0.0084	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.1	*<0.0005*	0.0016
ABA350	R304041	CFD0539	10.0	11.0	Waste	Fresh	Gneiss	FG	8.8	9.8	*<0.05*	1.1	0.16	*<0.005*	*<0.001*	0.56	1.0	0.00053	0.012	0.013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.30	*<0.0005*	*<0.0001*
ABA354	R304119	CFD0525	45.0	46.0	Waste	Fresh	Gneiss	MxM	9.3	33	*<0.05*	*<0.5*	0.33	*<0.005*	0.0074	1.8	0.43	0.00021	0.0063	0.0014	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
ABA356	R623617	CFD0548	10.0	11.0	Waste	Fresh	Gneiss	MxF	8.5	8.5	*<0.05*	*<0.5*	0.17	*<0.005*	0.0040	*<0.5*	0.57	0.00066	0.014	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.70	*<0.0005*	0.00029
ABA358	R623742	CFD0548	120.0	121.0	Waste	Fresh	Gneiss	MxF	9.4	27	*<0.05*	*<0.5*	0.081	*<0.005*	0.0097	6.8	0.22	0.00037	0.0063	0.33	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.0	*<0.0005*	*<0.0001*
ABA365	R545443	CFD0520	60.0	61.0	Waste	Fresh	Gneiss	FG	8.9	12	*<0.05*	0.51	0.20	*<0.005*	0.0025	1.1	0.46	0.00016	0.0041	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.2	*<0.0005*	0.00011
ABA396	R545818	CFD0529	65.0	66.0	Waste	Fresh	Gneiss	MxF	9.3	16	*<0.05*	0.57	0.17	*<0.005*	0.0043	0.55	0.54	0.00036	0.013	0.011	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.7	*<0.0005*	*<0.0001*
ABA398	R543692	CFD0549	10.0	11.0	Waste	Fresh	Gneiss	FG	8.9	11	*<0.05*	*<0.5*	0.12	*<0.005*	*<0.001*	0.62	0.50	0.00029	0.019	0.0051	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.76	*<0.0005*	*<0.0001*
ABA401	R543957	CFD0553	40.0	41.0	Waste	Fresh	Gneiss	MxF	9.1	41	*<0.05*	*<0.5*	0.16	*<0.005*	0.0010	3.5	0.16	*<0.0001*	0.0053	0.0062	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.3	*<0.0005*	*<0.0001*
ABA413	R276141	CFD0393	127.0	128.0	Waste	Fresh	Gneiss	MxM	9.1	36	*<0.05*	*<0.5*	0.28	0.0059	0.018	1.3	0.062	0.00012	0.0022	0.0013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.3	*<0.0005*	*<0.0001*
ABA414	R276153	CFD0393	170.0	171.0	Waste	Fresh	Gneiss	MxM	9.2	31	*<0.05*	1.6	0.17	0.0060	0.011	2.9	0.071	0.00052	0.0024	0.018	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.8	*<0.0005*	*<0.0001*
Statistical Summary						**Fresh**	**Gneiss**	**n**	16	11	11	11	11	11	11	16	16	16	16	16	16	16	16	16	16	16	16
								Max	9.4	41	*<0.05*	1.6	0.33	0.0060	0.018	10	5.5	0.028	0.16	0.33	*<0.0005*	*<0.0005*	0.023	*<0.00005*	11	0.0046	0.0016
								90th PCTL	9.3	36	*<0.05*	1.1	0.28	0.0059	0.011	8.0	2.1	0.012	0.10	0.11	*<0.0005*	*<0.0005*	0.014	*<0.00005*	8.2	0.00093	0.0011
								75th PCTL	9.1	32	*<0.05*	0.54	0.19	*<0.005*	0.0086	4.3	0.68	0.0014	0.033	0.032	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	0.00016
								Median	9.1	16	*<0.05*	*<0.5*	0.17	*<0.005*	0.0043	1.2	0.45	0.00053	0.014	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	3.7	*<0.0005*	*<0.0001*
								25th PCTL	8.9	11	*<0.05*	*<0.5*	0.14	*<0.005*	0.0018	0.61	0.21	0.00027	0.0061	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.2	*<0.0005*	*<0.0001*
								10th PCTL	8.6	9.8	*<0.05*	*<0.5*	0.12	*<0.005*	0.0010	0.53	0.11	0.00014	0.0033	0.0033	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.73	*<0.0005*	*<0.0001*
								Min	8.1	8.5	*<0.05*	*<0.5*	0.081	*<0.005*	*<0.001*	*<0.5*	0.062	*<0.0001*	0.0022	0.0013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.30	*<0.0005*	*<0.0001*
Statistical Summary for Gneiss Waste Rock								**n**	51	30	30	30	30	30	30	51	51	51	51	51	51	51	51	51	51	51	51
								n < DL	0	0	30	26	0	20	4	10	0	1	0	1	45	44	35	45	0	35	30
								Max	9.8	41	*<0.05*	1.6	0.35	0.021	0.024	16	7.6	0.047	1.2	0.33	0.00050	0.00063	0.14	0.000050	28	0.011	0.0017
								90th PCTL	9.4	33	*<0.05*	0.50	0.22	0.0094	0.011	8.8	3.6	0.020	0.16	0.13	0.00050	0.00050	0.036	0.000050	12	0.0029	0.00086
								75th PCTL	9.3	28	*<0.05*	*<0.5*	0.17	0.0060	0.010	2.8	0.82	0.0051	0.062	0.045	*<0.0005*	*<0.0005*	0.015	*<0.00005*	6.7	0.00050	0.00031
								Median	8.9	21	*<0.05*	*<0.5*	0.14	0.0050	0.0061	1.1	0.42	0.0014	0.019	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
								25th PCTL	8.2	7.8	*<0.05*	*<0.5*	0.098	*<0.005*	0.0028	0.55	0.18	0.00047	0.012	0.0052	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.85	*<0.0005*	*<0.0001*
								10th PCTL	7.6	3.9	*<0.05*	*<0.5*	0.080	*<0.005*	0.0010	*<0.5*	0.044	0.00017	0.0063	0.0021	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.52	*<0.0005*	*<0.0001*
								Min	7.2	3.3	*<0.05*	*<0.5*	0.054	*<0.005*	*<0.001*	*<0.5*	0.016	*<0.0001*	0.0022	*<0.001*	0.00025	0.00025	*<0.01*	0.000025	0.15	0.00025	0.000050

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Schist Waste Rock																											
ABA005	KAM022322	CFD0110	95.0	96.0	Waste	Oxide	Schist	RQM	8.0	-	-	-	-	-	-	925	0.17	0.0092	0.048	0.040	0.00050	0.00050	0.16	0.000050	222	0.00050	0.00010
ABA026	KAM037656	CFD0096	59.0	60.0	Waste	Oxide	Schist	BtS	8.3	-	-	-	-	-	-	546	0.22	0.0023	0.0010	0.036	0.00050	0.00050	0.058	0.000050	120	0.00050	0.00010
ABA074	KAM146948	CFD0345	60.0	61.0	Waste	Oxide	Schist	BtS_carb	8.5	-	-	-	-	-	-	4.5	0.088	0.0012	*<0.001*	0.030	*<0.0005*	*<0.0005*	0.012	*<0.00005*	16	0.0044	*<0.0001*
ABA077	J957606	CFD0350	60.0	61.0	Waste	Oxide	Schist	BtS_carb	8.4	-	-	-	-	-	-	1.8	0.048	0.0041	0.0060	0.021	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	20	0.0022	*<0.0001*
ABA125	KAM149844	CFR0566	10.7	12.2	Waste	Oxide	Schist	BtS	8.6	-	-	-	-	-	-	4.3	0.069	0.012	0.056	0.070	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	15	0.00077	*<0.0001*
ABA130	KAM150823	CFR0574	10.7	12.2	Waste	Oxide	Schist	BtS	8.5	-	-	-	-	-	-	2.2	0.061	0.0027	0.0070	0.036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	20	0.0044	*<0.0001*
ABA131	KAM150859	CFR0574	61.0	62.5	Waste	Oxide	Schist	BtS	8.8	-	-	-	-	-	-	20	0.090	0.010	0.16	0.059	*<0.0005*	*<0.0005*	0.036	*<0.00005*	12	*<0.0005*	*<0.0001*
Statistical Summary						**Oxide**	**Schist**	**n**	7	-	-	-	-	-	-	7	7	7	7	7	7	7	7	7	7	7	7
								Max	8.8	-	-	-	-	-	-	925	0.22	0.012	0.16	0.070	0.00050	0.00050	0.16	0.000050	222	0.0044	0.00010
								90th PCTL	8.7	-	-	-	-	-	-	698	0.19	0.011	0.098	0.063	0.00050	0.00050	0.10	0.000050	161	0.0044	0.00010
								75th PCTL	8.6	-	-	-	-	-	-	283	0.13	0.0098	0.052	0.049	0.00050	0.00050	0.047	0.000050	70	0.0033	0.00010
								Median	8.5	-	-	-	-	-	-	4.5	0.088	0.0041	0.0070	0.036	*<0.0005*	*<0.0005*	0.012	*<0.00005*	20	0.00077	*<0.0001*
								25th PCTL	8.3	-	-	-	-	-	-	3.2	0.065	0.0025	0.0035	0.033	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	16	0.00050	*<0.0001*
								10th PCTL	8.2	-	-	-	-	-	-	2.0	0.056	0.0018	*<0.001*	0.027	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	14	0.00050	*<0.0001*
								Min	8.0	-	-	-	-	-	-	1.8	0.048	0.0012	*<0.001*	0.021	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	12	*<0.0005*	*<0.0001*
Upper Transition Facies for Schist Waste Rock																											
ABA027	KAM037928	CFD0099	30	31	Waste	Upper transition	Schist	BtS_carb	8.3	-	-	-	-	-	-	8.4	0.15	0.0028	0.00050	0.20	0.00025	0.00025	0.047	0.000025	22	0.00025	0.000050
ABA332	Q033589	CFD0407	32	33	Waste	Upper Transition	schist	BtS	8.8	46	*<0.05*	*<0.5*	0.51	0.0062	0.029	29	0.092	0.00011	*<0.001*	0.022	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	10	0.00061	*<0.0001*
Lower Transition Facies for Schist Waste Rock																											
ABA031	KAM039252	CFD0116	75	76	Waste	Lower transition	Schist	RQM	8.6	-	-	-	-	-	-	12	0.40	0.00053	0.00050	0.25	0.00025	0.00025	0.055	0.000025	19	0.00061	0.000050
ABA038	KAM047995	CFD0135	153	154	Waste	Lower transition	Schist	BtS	8.7	-	-	-	-	-	-	8.6	0.23	0.016	0.011	0.059	0.00025	0.00025	0.048	0.000025	11	0.00025	0.000050
ABA054	KAM081312	CFD0198	85	86	Waste	Lower transition	Schist	BtS	9.3	-	-	-	-	-	-	*<0.5*	7.3	0.022	0.36	0.070	0.00050	0.00050	0.025	0.000050	2.5	0.0046	0.00099
ABA333	R277487	CFD0426	43	44	Waste	Lower Transition	schist	BtS	7.8	4.8	*<0.05*	*<0.5*	0.29	0.011	0.0018	1.1	1.1	0.0022	0.029	0.019	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.65	0.0022	0.00049
ABA335	R550437	CFD0518	25	26	Waste	Lower Transition	schist	BtS	8.3	20	*<0.05*	*<0.5*	0.17	*<0.005*	0.0043	5.0	0.29	0.0012	0.0084	0.032	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.0	0.0012	0.00022
ABA336	R550471	CFD0518	55	56	Waste	Lower Transition	Schist	BtS_carb	8.5	32	*<0.05*	*<0.5*	0.26	*<0.005*	0.012	130	0.055	0.0022	0.0031	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	44	*<0.0005*	*<0.0001*
ABA337	R550494	CFD0518	75	75	Waste	Lower Transition	schist	BtS	9.0	33	*<0.05*	*<0.5*	0.21	0.0084	0.013	12	0.17	0.00076	0.0054	0.20	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	*<0.0005*	*<0.0001*
ABA345	R551151	CFD0563	68	69	Waste	Lower Transition	schist	BtS	9.0	35	*<0.05*	*<0.5*	0.41	0.0051	0.0086	11	0.13	0.0014	0.015	0.27	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.00079	*<0.0001*
Statistical Summary						**Lower Transition**	**Schist**	**n**	8	5	5	5	5	5	5	8	8	8	8	8	8	8	8	8	8	8
								Max	9.3	35	*<0.05*	*<0.5*	0.41	0.011	0.013	130	7.3	0.022	0.36	0.27	*<0.0005*	*<0.0005*	0.055	*<0.00005*	44	0.0046	0.00099
								90th PCTL	9.1	34	*<0.05*	*<0.5*	0.36	0.0098	0.012	48	3.0	0.018	0.13	0.26	*<0.0005*	*<0.0005*	0.050	*<0.00005*	27	0.0029	0.00064
								75th PCTL	9.0	33	*<0.05*	*<0.5*	0.29	0.0084	0.012	12	0.57	0.0057	0.019	0.22	*<0.0005*	*<0.0005*	0.031	*<0.00005*	13	0.0014	0.00029
								Median	8.7	32	*<0.05*	*<0.5*	0.26	0.0051	0.0086	9.9	0.26	0.0018	0.0098	0.065	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.00070	*<0.0001*
								25th PCTL	8.4	20	*<0.05*	*<0.5*	0.21	*<0.005*	0.0043	4.0	0.16	0.0011	0.0048	0.041	0.00044	0.00044	*<0.01*	0.000044	5.9	*<0.0005*	*<0.0001*
								10th PCTL	8.2	11	*<0.05*	*<0.5*	0.19	*<0.005*	0.0028	0.92	0.11	0.00069	0.0023	0.028	0.00025	0.00025	*<0.01*	0.000025	1.9	0.00043	0.000050
								Min	7.8	4.8	*<0.05*	*<0.5*	0.17	*<0.005*	0.0018	*<0.5*	0.055	0.00053	0.00050	0.019	0.00025	0.00025	*<0.01*	0.000025	0.65	0.00025	0.000050
Fresh Facies for Schist Waste Rock																											
ABA132	KAM150898	CFR0574	114.3	115.8	Waste	Fresh	Schist	BtS	8.6	-	-	-	-	-	-	97	0.072	0.011	0.0060	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	27	*<0.0005*	*<0.0001*
ABA330	R276299	CFD0401	74.0	75.0	Waste	Fresh	schist	BtS	8.9	25	*<0.05*	*<0.5*	0.090	0.0065	0.013	21	0.14	0.00017	0.0049	0.0020	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	12	*<0.0005*	0.00013
ABA331	R276331	CFD0401	141.0	142.0	Waste	Fresh	schist	BtS	9.0	43	*<0.05*	*<0.5*	0.35	0.0056	0.016	0.93	0.090	0.00034	0.0078	0.0027	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.5	*<0.0005*	*<0.0001*
ABA415	R277001	CFD0398	49.0	50.0	Waste	Fresh	schist	BtS	9.3	24	*<0.05*	*<0.5*	0.11	0.0087	0.0082	0.52	0.22	0.00038	0.0045	0.0018	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	0.00087	0.00014
ABA416	R277017	CFD0398	64.0	65.0	Waste	Fresh	schist	BtS	9.3	27	*<0.05*	*<0.5*	0.14	0.0075	0.0069	0.54	0.16	0.00026	0.0066	0.0016	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.8	*<0.0005*	*<0.0001*
ABA417	R277021	CFD0398	124.0	125.0	Waste	Fresh	schist	BtS	9.3	31	*<0.05*	*<0.5*	0.16	*<0.005*	0.0087	0.53	0.12	0.00026	0.0028	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.1	*<0.0005*	*<0.0001*
ABA418	R277041	CFD0398	160.0	161.0	Waste	Fresh	schist	BtS	9.4	29	*<0.05*	*<0.5*	0.21	0.0077	0.0077	2.3	0.17	0.00020	*<0.001*	0.0036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
Statistical Summary						**Fresh**	**Schist**	**n**	7	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	7
								Max	9.4	43	*<0.05*	*<0.5*	0.35	0.0087	0.016	97	0.20	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	27	0.00087	0.00014
								90th PCTL	9.3	37	*<0.05*	*<0.5*	0.28	0.0082	0.014	51	0.20	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	18	0.00065	0.00013
								75th PCTL	9.3	31	*<0.05*	*<0.5*	0.20	0.0077	0.012	11	0.20	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	9.7	*<0.0005*	0.00012
								Median	9.3	28	*<0.05*	*<0.5*	0.15	0.0070	0.0085	0.90	0.10	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	*<0.0001*
								25th PCTL	8.9	25	*<0.05*	*<0.5*	0.11	0.0058	0.0078	0.50	0.10	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.0	*<0.0005*	*<0.0001*
								10th PCTL	8.8	25	*<0.05*	*<0.5*	0.098	0.0053	0.0073	0.50	0.10	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	*<0.0005*	*<0.0001*
								Min	8.6	24	*<0.05*	*<0.5*	0.090	*<0.005*	0.0069	0.50	0.10	0.00	*<0.001*	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
Statistical Summary for Schist Waste Rock								**n**	24	12	12	12	12	12	12	24	24	24	24	24	24	24	24	24	24	24
								n < DL	0	0	12	12	0	3	0	1	0	0	3	1	18	18	16	18	0	9	14
								Max	9.4	46	*<0.05*	*<0.5*	0.51	0.011	0.029	925	7.3	0.022	0.36	0.27	0.00050	0.00050	0.16	0.000050	222	0.0046	0.00099
								90th PCTL	9.3	42	*<0.05*	*<0.5*	0.41	0.0087	0.015	120	0.36	0.012	0.054	0.20	0.00050	0.00050	0.053	0.000050	39	0.0037	0.00020
								75th PCTL	9.0	34	*<0.05*	*<0.5*	0.30	0.0079	0.013	20	0.22	0.0053	0.012	0.062	*<0.0005*	*<0.0005*	0.028	*<0.00005*	20	0.00094	0.00010
								Median	8.7	30	*<0.05*	*<0.5*	0.21	0.0064	0.0087	6.7	0.14	0.0018	0.0060	0.036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.00050	*<0.0001*
								25th PCTL	8.4	25	*<0.05*	*<0.5*	0.16	0.0051	0.0075	1.6	0.089	0.00037	0.0024	0.015	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.9	*<0.0005*	*<0.0001*
								10th PCTL	8.3	20	*<0.05*	*<0.5*	0.11	*<0.005*	0.0046	0.53	0.063	0.00022	*<0.001*	0.0019	0.00033	0.00033	0.010	0.000033	5.4	*<0.0005*	0.000065
								Min	7.8	4.8	*<0.05*	*<0.5*	0.090	*<0.005*	0.0018	*<0.5*	0.048	0.00011	0.00050	*<0.001*	0.00025	0.00025	0.010	0.000025	0.65	0.00025	0.000050

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Granite Waste Rock																											
ABA157	R305807	CFD0382	76	77	Waste	Oxide	Granite	GG	6.8	-	-	-	-	-	-	*<0.5*	0.11	0.029	0.25	*<0.001*	*<0.0005*	*<0.0005*	0.052	*<0.00005*	0.17	*<0.0005*	*<0.0001*
ABA158	R305808	CFD0382	79	80	Waste	Oxide	Granite	GG	6.6	-	-	-	-	-	-	*<0.5*	*<0.005*	0.017	0.096	*<0.001*	*<0.0005*	*<0.0005*	0.026	*<0.00005*	0.24	*<0.0005*	*<0.0001*
ABA174	R305826	CFD0403	7.0	8.0	Waste	Oxide	Granite	GG	6.7	-	-	-	-	-	-	1.7	5.2	0.018	3.5	0.013	*<0.0005*	*<0.0005*	0.10	*<0.00005*	0.94	*<0.0005*	0.0024
Upper Transition Facies for Granite Waste Rock																											
ABA013	KAM025898	CFD0150	81	82	Waste	Upper transition	Granite	GG	7.5	-	-	-	-	-	-	4.0	9.7	0.011	0.023	0.047	0.00050	0.00050	0.048	0.000050	0.43	0.00050	0.00027
ABA151	R305801	CFD0381	13	14	Waste	Upper transition	Granite	GG	8.8	-	-	-	-	-	-	*<0.5*	4.9	0.00034	0.020	0.054	*<0.0005*	*<0.0005*	0.041	*<0.00005*	1.5	0.00066	0.00082
ABA152	R305802	CFD0381	35	36	Waste	Upper transition	Granite	GG	8.4	-	-	-	-	-	-	4.6	15	0.0052	1.5	0.069	0.00070	*<0.0005*	0.038	*<0.00005*	2.9	0.00065	0.0012
ABA167	R305818	CFD0394	30	31	Waste	Upper transition	Granite	GG	6.8	-	-	-	-	-	-	5.2	3.3	0.035	0.46	0.029	*<0.0005*	*<0.0005*	0.052	*<0.00005*	0.52	*<0.0005*	*<0.0001*
ABA169	R305821	CFD0399	20	21	Waste	Upper transition	Granite	GG	7.4	-	-	-	-	-	-	16	4.2	0.0026	0.059	0.034	*<0.0005*	*<0.0005*	0.036	*<0.00005*	1.6	*<0.0005*	0.00092
ABA172	R305824	CFD0396	29	30	Waste	Upper transition	Granite	GG	6.5	-	-	-	-	-	-	*<0.5*	*<0.005*	0.010	0.018	*<0.001*	*<0.0005*	*<0.0005*	0.013	*<0.00005*	0.31	*<0.0005*	*<0.0001*
ABA178	R305831	CFD0400	11	12	Waste	Upper transition	Granite	GG	7.6	-	-	-	-	-	-	1.3	5.0	0.0055	0.76	0.048	0.0012	*<0.0005*	0.018	0.000050	1.2	*<0.0005*	0.0017
Statistical Summary						**Upper Transition**	**Granite**	**n**	7	-	-	-	-	-	-	7	7	7	7	7	7	7	7	7	7	7	7
								Max	8.8	-	-	-	-	-	-	16	15	0.035	1.5	0.069	0.0012	0.00050	0.052	0.000050	2.9	0.00066	0.0017
								90th PCTL	8.5	-	-	-	-	-	-	9.4	12	0.021	1.1	0.060	0.00090	0.00050	0.050	0.000050	2.1	0.00065	0.0014
								75th PCTL	8.0	-	-	-	-	-	-	4.9	7.3	0.011	0.61	0.051	0.00060	*<0.0005*	0.045	*<0.00005*	1.6	0.00058	0.0010
								Median	7.5	-	-	-	-	-	-	4.0	4.9	0.0055	0.059	0.047	*<0.0005*	*<0.0005*	0.038	*<0.00005*	1.2	*<0.0005*	0.00082
								25th PCTL	7.1	-	-	-	-	-	-	0.92	3.7	0.0039	0.021	0.031	*<0.0005*	*<0.0005*	0.027	*<0.00005*	0.48	*<0.0005*	0.00019
								10th PCTL	6.7	-	-	-	-	-	-	*<0.5*	2.0	0.0017	0.019	0.018	*<0.0005*	*<0.0005*	0.016	*<0.00005*	0.38	*<0.0005*	*<0.0001*
								Min	6.5	-	-	-	-	-	-	*<0.5*	*<0.005*	0.00034	0.018	*<0.001*	*<0.0005*	*<0.0005*	0.013	*<0.00005*	0.31	*<0.0005*	*<0.0001*
Lower Transition Facies for Granite Waste Rock																											
ABA154	R305804	CFD0382	10	11	Waste	Lower transition	Granite	GG	8.5	-	-	-	-	-	-	*<0.5*	4.5	0.0014	0.038	0.047	*<0.0005*	*<0.0005*	0.075	*<0.00005*	1.4	0.00056	0.0013
ABA155	R305805	CFD0382	50	51	Waste	Lower transition	Granite	GG	7.6	-	-	-	-	-	-	1.2	5.1	0.042	0.36	0.053	*<0.0005*	*<0.0005*	0.016	*<0.00005*	1.6	*<0.0005*	0.0045
ABA159	R305809	CFD0383	10	11	Waste	Lower transition	Granite	GG	8.8	-	-	-	-	-	-	0.55	5.2	0.00058	0.035	0.059	*<0.0005*	*<0.0005*	0.026	*<0.00005*	1.2	0.00071	0.00099
ABA160	R305811	CFD0383	48	49	Waste	Lower transition	Granite	GG	8.8	-	-	-	-	-	-	0.70	4.3	0.0017	0.018	0.050	*<0.0005*	*<0.0005*	0.031	*<0.00005*	1.6	0.00062	0.0012
ABA164	R305815	CFD0389	10	11	Waste	Lower transition	Granite	GG	8.9	-	-	-	-	-	-	*<0.5*	5.6	0.00093	0.13	0.065	*<0.0005*	*<0.0005*	0.030	*<0.00005*	1.1	0.0011	0.0022
ABA166	R305817	CFD0389	45	46	Waste	Lower transition	Granite	GG	6.4	-	-	-	-	-	-	0.97	6.5	0.16	2.5	0.0087	0.00066	*<0.0005*	0.012	*<0.00005*	0.98	*<0.0005*	0.0014
Statistical Summary						**Lower Transition**	**Granite**	**n**	6	-	-	-	-	-	-	6	6	6	6	6	6	6	6	6	6	6	6
								Max	8.9	-	-	-	-	-	-	1.2	6.5	0.16	2.5	0.065	0.00066	*<0.0005*	0.075	*<0.00005*	1.6	0.0011	0.0045
								90th PCTL	8.9	-	-	-	-	-	-	1.1	6.0	0.10	1.4	0.062	0.00058	*<0.0005*	0.053	*<0.00005*	1.6	0.00088	0.0034
								75th PCTL	8.8	-	-	-	-	-	-	0.90	5.5	0.032	0.30	0.058	*<0.0005*	*<0.0005*	0.031	*<0.00005*	1.6	0.00069	0.0020
								Median	8.6	-	-	-	-	-	-	0.63	5.1	0.0015	0.082	0.052	*<0.0005*	*<0.0005*	0.028	*<0.00005*	1.3	0.00059	0.0013
								25th PCTL	7.8	-	-	-	-	-	-	0.51	4.6	0.0010	0.036	0.048	*<0.0005*	*<0.0005*	0.019	*<0.00005*	1.1	0.00052	0.0012
								10th PCTL	7.0	-	-	-	-	-	-	*<0.5*	4.4	0.00076	0.026	0.028	*<0.0005*	*<0.0005*	0.014	*<0.00005*	1.0	*<0.0005*	0.0011
								Min	6.4	-	-	-	-	-	-	*<0.5*	4.3	0.00058	0.018	0.0087	*<0.0005*	*<0.0005*	0.012	*<0.00005*	0.98	*<0.0005*	0.00099
Fresh Facies for Granite Waste Rock																											
ABA012	KAM025798	CFD0147	260	261	Waste	Fresh	Granite	GG	9.2	-	-	-	-	-	-	4.4	0.42	0.00062	0.030	0.022	0.00025	0.00025	0.060	0.000025	3.5	0.00025	0.000050
ABA162	R305813	CFD0385	10	11	Waste	Fresh	Granite	GG	8.9	-	-	-	-	-	-	*<0.5*	5.2	0.00093	0.083	0.056	*<0.0005*	*<0.0005*	0.19	*<0.00005*	1.1	0.00073	0.0010
ABA163	R305814	CFD0385	59	60	Waste	Fresh	Granite	GG	7.6	-	-	-	-	-	-	*<0.5*	3.9	0.043	0.28	0.018	*<0.0005*	*<0.0005*	0.027	*<0.00005*	0.61	*<0.0005*	0.0050
ABA165	R305816	CFD0389	30	31	Waste	Fresh	Granite	GG	8.8	-	-	-	-	-	-	*<0.5*	5.0	0.0039	0.42	0.045	*<0.0005*	*<0.0005*	0.038	*<0.00005*	1.0	0.00088	0.00098
ABA168	R305819	CFD0394	88	89	Waste	Fresh	Granite	GG	8.5	-	-	-	-	-	-	3.7	7.5	0.0069	0.039	0.058	*<0.0005*	*<0.0005*	0.031	*<0.00005*	1.1	0.00075	0.0011
ABA179	R305832	CFD0400	60	61	Waste	Fresh	Granite	GG	7.0	-	-	-	-	-	-	1.9	2.9	0.064	1.3	0.013	*<0.0005*	*<0.0005*	0.019	*<0.00005*	0.32	*<0.0005*	0.00019
ABA439	Q041678	CFD0385	8.0	9.0	Waste	Fresh	Granite	GG	8.0	6.1	*<0.05*	*<0.5*	0.21	0.0088	0.0025	*<0.5*	0.35	0.00039	0.0031	0.0028	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.41	*<0.0005*	*<0.0001*
ABA441	Q032423	CFD0385	92	93	Waste	Fresh	Granite	GG	6.6	2.5	*<0.05*	*<0.5*	0.20	0.0078	0.0043	27	0.0074	0.00053	0.0051	0.016	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	0.0071
Statistical Summary						**Fresh**	**Granite**	**n**	8	-	-	-	-	-	-	8	8	8	8	8	8	8	8	8	8	8	8
								Max	9.2	-	-	-	-	-	-	27	7.5	0.064	1.3	0.058	*<0.0005*	*<0.0005*	0.19	*<0.00005*	4.7	0.00088	0.0071
								90th PCTL	9.0	-	-	-	-	-	-	11	5.8	0.049	0.68	0.057	*<0.0005*	*<0.0005*	0.099	*<0.00005*	3.8	0.00079	0.0056
								75th PCTL	8.8	-	-	-	-	-	-	3.9	5.0	0.016	0.31	0.048	*<0.0005*	*<0.0005*	0.044	*<0.00005*	1.7	0.00074	0.0021
								Median	8.2	-	-	-	-	-	-	1.2	3.4	0.0024	0.061	0.020	*<0.0005*	*<0.0005*	0.029	*<0.00005*	1.1	*<0.0005*	0.00099
								25th PCTL	7.4	-	-	-	-	-	-	*<0.5*	0.40	0.00060	0.024	0.016	*<0.0005*	*<0.0005*	0.017	*<0.00005*	0.56	*<0.0005*	0.00017
								10th PCTL	6.9	-	-	-	-	-	-	*<0.5*	0.24	0.00049	0.0045	0.010	0.00043	0.00043	*<0.01*	0.000043	0.38	0.00043	0.000085
								Min	6.6	-	-	-	-	-	-	*<0.5*	0.0074	0.00039	0.0031	0.0028	0.00025	0.00025	*<0.01*	0.000025	0.32	0.00025	0.000050
Statistical Summary for Granite Waste Rock								**n**	24	2	2	2	2	2	2	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	0	0	2	2	0	0	0	10	2	0	0	3	19	22	2	21	0	13	5
								Max	9.2	6.1	*<0.05*	*<0.5*	0.21	0.0090	0.0040	27	15	0.16	3.5	0.069	0.0012	0.00050	0.19	0.000050	4.7	0.0011	0.0071
								90th PCTL	8.9	5.7	*<0.05*	*<0.5*	0.21	0.0090	0.0040	5.0	7.2	0.042	1.5	0.059	0.00061	*<0.0005*	0.071	0.000050	2.5	0.00074	0.0039
								75th PCTL	8.8	5.2	*<0.05*	*<0.5*	0.21	0.0090	0.0040	3.8	5.2	0.021	0.43	0.053	*<0.0005*	*<0.0005*	0.049	*<0.00005*	1.6	0.00065	0.0015
								Median	7.6	4.3	*<0.05*	*<0.5*	0.21	0.0080	0.0030	0.84	4.7	0.0054	0.089	0.039	*<0.0005*	*<0.0005*	0.031	*<0.00005*	1.1	*<0.0005*	0.00100
								25th PCTL	6.8	3.4	*<0.05*	*<0.5*	0.20	0.0080	0.0030	*<0.5*	2.3	0.00093	0.028	0.013	*<0.0005*	*<0.0005*	0.019	*<0.00005*	0.50	*<0.0005*	0.00017
								10th PCTL	6.6	2.9	*<0.05*	*<0.5*	0.20	0.0080	0.0030	*<0.5*	*<0.005*	0.00055	0.018	0.0020	*<0.0005*	*<0.0005*	0.012	*<0.00005*	0.31	*<0.0005*	*<0.0001*
								Min	6.4	2.5	*<0.05*	*<0.5*	0.20	0.0080	0.0030	*<0.5*	*<0.005*	0.00034	0.0031	*<0.001*	0.00025	0.00025	0.010	0.000025	0.17	0.00025	0.000050
Oxide and Fresh Facies for Other Lithologies Waste Rock																											
ABA018	KAM029393	CFD0176	99	100	Waste	Oxide	Dykes	FC	7.5	-	-	-	-	-	-	1.5	0.032	0.0079	0.0065	0.026	0.00025	0.00025	0.091	0.000025	3.5	0.00025	0.000050
ABA056	KAM084551	CFD0237	181	182	Waste	Oxide	HU	HU	8.2	-	-	-	-	-	-	-	0.12	0.0096	0.55	0.0097	0.00025	0.00025	0.21	0.000025	13	0.00059	0.000050
ABA352	R304282	CFD0539	90	91	Waste	Fresh	IV	IV	9.2	32	*<0.05*	*<0.5*	0.14	*<0.005*	0.011	0.62	0.31	0.00063	0.0034	0.0048	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.0	*<0.0005*	*<0.0001*

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Gneiss Waste Rock																														
ABA043	KAM050495	CFD0152	149.0	150.0	Waste	Oxide	Gneiss	MxF	0.00050	0.015	0.000050	0.0072	3.4	0.0046	0.000025	0.0091	0.00025	0.15	54	0.00025	3.0	0.000025	1.5	0.066	0.00012	0.00025	0.0050	0.000070	0.00050	0.0050
ABA064	KAM125257	CFD0307	49.0	50.0	Waste	Oxide	Gneiss	MxF	0.0018	5.7	0.0068	*<0.005*	0.47	0.13	0.00014	0.0028	0.0013	*<0.3*	3.0	*<0.0005*	17	0.00010	2.6	0.0055	0.00013	*<0.0005*	0.085	0.0018	0.0090	*<0.01*
ABA080	KAM115505	CFR0360	25.9	27.4	Waste	Oxide	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.38	0.096	*<0.00005*	0.0014	*<0.0005*	*<0.3*	7.1	*<0.0005*	7.7	*<0.00005*	0.69	0.011	0.00021	*<0.0005*	*<0.01*	0.00018	*<0.001*	*<0.01*
ABA096	KAM137284	CFR0468	32.0	33.5	Waste	Oxide	Gneiss	MxF	0.0030	3.2	0.0097	*<0.005*	0.50	0.080	*<0.00005*	0.012	0.0016	*<0.3*	2.0	*<0.0005*	13	0.000092	5.4	0.0057	*<0.0001*	*<0.0005*	0.12	0.0036	0.0047	*<0.01*
ABA104	KAM139298	CFR0482	10.7	12.2	Waste	Oxide	Gneiss	MxF	0.0044	3.8	0.010	*<0.005*	0.27	0.15	0.00014	0.0074	0.0013	*<0.3*	12	*<0.0005*	12	*<0.00005*	0.87	0.0069	0.00063	*<0.0005*	0.033	0.0043	0.0032	*<0.01*
ABA138	KAM152219	CFR0586	155.5	157.0	Waste	Oxide	Gneiss	MxF	*<0.001*	0.33	0.00046	*<0.005*	1.8	0.011	*<0.00005*	0.0091	*<0.0005*	*<0.3*	7.4	*<0.0005*	6.5	*<0.00005*	4.6	0.046	*<0.0001*	*<0.0005*	*<0.01*	0.00051	*<0.001*	*<0.01*
ABA144	KAM152716	CFR0591	30.5	32.0	Waste	Oxide	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.56	0.00062	*<0.00005*	0.0097	*<0.0005*	*<0.3*	9.3	*<0.0005*	4.3	*<0.00005*	0.56	0.042	*<0.0001*	*<0.0005*	*<0.01*	0.00011	*<0.001*	*<0.01*
ABA146	KAM153091	CFR0594	164.6	166.1	Waste	Oxide	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	0.011	4.7	0.00082	0.000065	0.064	*<0.0005*	*<0.3*	6.4	*<0.0005*	5.2	*<0.00005*	0.50	0.11	0.00013	*<0.0005*	*<0.01*	0.0034	*<0.001*	*<0.01*
ABA149	KAM153152	CFR0595	61.0	62.5	Waste	Oxide	Gneiss	MxF	*<0.001*	0.062	0.00013	*<0.005*	1.8	0.0023	*<0.00005*	0.0077	*<0.0005*	*<0.3*	5.3	*<0.0005*	5.3	*<0.00005*	12	0.049	*<0.0001*	*<0.0005*	*<0.01*	0.019	0.0023	*<0.01*
Statistical Summary						**Oxide**	**Gneiss**	**n**	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
								Max	0.0044	5.7	0.010	0.011	4.7	0.15	0.00014	0.064	0.0016	*<0.3*	54	*<0.0005*	17	0.00010	12	0.11	0.00063	0.00050	0.12	0.019	0.0090	*<0.01*
								90th PCTL	0.0033	4.2	0.0098	0.0079	3.6	0.13	0.00014	0.022	0.0014	*<0.3*	21	*<0.0005*	13	0.000094	6.7	0.074	0.00029	*<0.0005*	0.092	0.0072	0.0056	*<0.01*
								75th PCTL	0.0018	3.2	0.0068	*<0.005*	1.8	0.096	0.000065	0.0097	0.0013	*<0.3*	9.3	*<0.0005*	12	*<0.00005*	4.6	0.049	0.00013	*<0.0005*	0.033	0.0036	0.0032	*<0.01*
								Median	*<0.001*	0.062	0.00013	*<0.005*	0.56	0.011	*<0.00005*	0.0091	*<0.0005*	*<0.3*	7.1	*<0.0005*	6.5	*<0.00005*	1.5	0.042	0.00012	*<0.0005*	*<0.01*	0.0018	0.0010	*<0.01*
								25th PCTL	*<0.001*	0.030	0.00010	*<0.005*	0.47	0.0023	*<0.00005*	0.0074	*<0.0005*	*<0.3*	5.3	*<0.0005*	5.2	*<0.00005*	0.69	0.0069	*<0.0001*	*<0.0005*	*<0.01*	0.00018	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.36	0.00078	*<0.00005*	0.0025	*<0.0005*	*<0.3*	2.8	*<0.0005*	4.1	*<0.00005*	0.55	0.0057	*<0.0001*	*<0.0005*	*<0.01*	0.00010	*<0.001*	*<0.01*
								Min	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.27	0.00062	*<0.00005*	0.0014	*<0.0005*	0.15	2.0	0.00025	3.0	0.000025	0.50	0.0055	*<0.0001*	0.00025	0.0050	0.000070	0.00050	0.0050
Upper Transition Facies for Gneiss Waste Rock																														
ABA016	KAM029087	CFD0175	145.0	146.0	Waste	Upper transition	Gneiss	MxF	0.00050	0.015	0.000050	0.0025	4.0	0.0054	0.000025	0.0058	0.00025	0.15	19	0.00025	5.2	0.000025	2.3	0.11	0.000050	0.00025	0.0050	0.000069	0.0046	0.0050
ABA059	KAM097012	CFD0272	17.0	18.0	Waste	Upper transition	Gneiss	FG	0.0053	4.7	0.023	0.0050	0.49	0.28	0.000025	0.015	0.0025	0.15	16	0.00050	18	0.000050	14	0.010	0.00027	0.0011	0.11	0.0032	0.015	0.010
ABA060	KAM097065	CFD0272	65.0	66.0	Waste	Upper transition	Gneiss	FG	0.00050	0.015	0.000050	0.0096	3.6	0.0087	0.000025	0.018	0.00025	0.15	51	0.00025	2.8	0.000025	2.6	0.14	0.00014	0.00025	0.0050	0.0030	0.00050	0.0050
ABA147	KAM152978	CFR0594	10.7	12.2	Waste	Upper transition	Gneiss	MxF	0.0052	1.6	0.0053	*<0.005*	0.38	0.039	*<0.00005*	0.0029	*<0.0005*	*<0.3*	10	*<0.0005*	14	*<0.00005*	8.6	0.018	*<0.0001*	0.00060	0.058	0.0074	0.0041	*<0.01*
ABA353	R304081	CFD0525	10.0	11.0	Waste	Upper Transition	Gneiss	MxF	0.0016	1.2	0.00028	*<0.005*	0.20	0.031	*<0.00005*	0.0011	0.0023	*<0.3*	1.5	*<0.0005*	5.2	*<0.00005*	0.62	0.0033	*<0.0001*	*<0.0005*	*<0.01*	0.00013	0.0017	*<0.01*
ABA367	R545582	CFD0524	56.0	57.0	Waste	Upper Transition	Gneiss	MxF	*<0.001*	0.047	*<0.0001*	*<0.005*	0.055	0.0020	0.0056	0.00093	*<0.0005*	*<0.3*	3.0	*<0.0005*	2.4	*<0.00005*	0.43	0.0031	0.00021	*<0.0005*	*<0.01*	0.00039	*<0.001*	*<0.01*
ABA411	R544193	CFD0502	40.0	41.0	Waste	Upper Transition	Gneiss	MxF	*<0.001*	0.24	*<0.0001*	*<0.005*	0.23	0.0086	0.0012	0.00015	*<0.0005*	*<0.3*	0.99	*<0.0005*	2.9	*<0.00005*	0.48	0.0043	*<0.0001*	*<0.0005*	*<0.01*	0.00018	*<0.001*	*<0.01*
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.0053	4.7	0.023	0.0096	4.0	0.28	0.0056	0.018	0.0025	*<0.3*	51	*<0.0005*	18	*<0.00005*	14	0.14	0.00027	0.0011	0.11	0.0074	0.015	*<0.01*
								90th PCTL	0.0052	2.8	0.012	0.0068	3.8	0.13	0.0029	0.017	0.0024	*<0.3*	32	*<0.0005*	16	*<0.00005*	11	0.12	0.00023	0.00080	0.079	0.0049	0.0089	*<0.01*
								75th PCTL	0.0034	1.4	0.0028	0.0050	2.0	0.035	0.00061	0.011	0.0014	*<0.3*	18	*<0.0005*	9.5	*<0.00005*	5.6	0.066	0.00018	0.00055	0.034	0.0031	0.0044	*<0.01*
								Median	*<0.001*	0.24	*<0.0001*	*<0.005*	0.38	0.0087	*<0.00005*	0.0029	*<0.0005*	0.30	10	*<0.0005*	5.2	*<0.00005*	2.3	0.010	*<0.0001*	*<0.0005*	*<0.01*	0.00039	0.0017	*<0.01*
								25th PCTL	0.00075	0.031	0.000075	*<0.005*	0.21	0.0070	0.000025	0.0010	*<0.0005*	0.15	2.2	0.00038	2.8	0.000038	0.55	0.0038	*<0.0001*	*<0.0005*	*<0.01*	0.00016	*<0.001*	0.0075
								10th PCTL	0.00050	0.015	0.000050	0.0040	0.14	0.0040	0.000025	0.00062	0.00025	0.15	1.3	0.00025	2.6	0.000025	0.46	0.0032	0.000080	0.00025	0.0050	0.00010	0.00080	0.0050
								Min	0.00050	0.015	0.000050	0.0025	0.055	0.0020	0.000025	0.00015	0.00025	0.15	0.99	0.00025	2.4	0.000025	0.43	0.0031	0.000050	0.00025	0.0050	0.000069	0.00050	0.0050
Lower Transition Facies for Gneiss Waste Rock																														
ABA019	KAM029649	CFD0177	73.0	74.0	Waste	Lower transition	Gneiss	MxM	0.0010	0.43	0.00049	0.0050	0.78	0.0061	0.000025	0.011	0.00050	0.15	42	0.00050	5.9	0.000050	47	0.0086	0.00010	0.00050	0.027	0.026	0.041	0.010
ABA058	KAM096948	CFD0270	230.0	231.0	Waste	Lower transition	Gneiss	MxF	0.00050	0.015	0.000050	0.0050	12	0.018	0.000025	0.012	0.00025	0.15	54	0.00025	1.7	0.000025	3.6	0.100	0.00014	0.00025	0.0050	0.0032	0.00050	0.0050
ABA067	KAM129499	CFD0332	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	2.1	0.0035	*<0.005*	0.96	0.035	*<0.00005*	0.026	*<0.0005*	*<0.3*	13	0.0012	14	*<0.00005*	7.7	0.014	*<0.0001*	0.00099	0.092	0.0094	0.0071	*<0.01*
ABA070	KAM099512	CFD0338	10.0	11.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.4	0.00054	*<0.00005*	0.0049	*<0.0005*	*<0.3*	4.4	*<0.0005*	2.9	*<0.00005*	2.0	0.072	*<0.0001*	*<0.0005*	*<0.01*	0.0017	*<0.001*	*<0.01*
ABA073	KAM145537	CFD0339	111.0	112.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.95	0.00051	*<0.00005*	0.011	*<0.0005*	*<0.3*	6.2	0.0021	3.5	*<0.00005*	1.6	0.051	*<0.0001*	*<0.0005*	*<0.01*	0.011	0.0066	*<0.01*
ABA098	KAM137429	CFR0469	29.0	30.5	Waste	Lower transition	Gneiss	MxF	*<0.001*	0.16	0.00010	*<0.005*	0.31	0.0037	*<0.00005*	0.0012	*<0.0005*	*<0.3*	3.0	*<0.0005*	3.8	*<0.00005*	2.4	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.00037	0.0019	*<0.01*
ABA106	KAM139356	CFR0482	89.9	91.4	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.1	*<0.0005*	*<0.00005*	0.0050	*<0.0005*	*<0.3*	6.1	*<0.0005*	3.6	*<0.00005*	2.5	0.020	*<0.0001*	*<0.0005*	*<0.01*	0.000038	0.0054	*<0.01*
ABA117	KAM122524	CFR0529	21.3	22.9	Waste	Lower transition	Gneiss	FG	*<0.001*	2.4	0.00020	*<0.005*	0.65	0.031	*<0.00005*	0.00090	0.0025	*<0.3*	1.1	*<0.0005*	12	*<0.00005*	1.9	0.0060	*<0.0001*	0.00067	0.043	0.00027	0.0063	*<0.01*
ABA142	KAM152462	CFR0589	25.9	27.4	Waste	Lower transition	Gneiss	MxF	*<0.001*	0.046	*<0.0001*	*<0.005*	1.7	0.0013	*<0.00005*	0.016	*<0.0005*	*<0.3*	7.2	*<0.0005*	3.6	*<0.00005*	1.1	0.11	*<0.0001*	*<0.0005*	*<0.01*	0.00082	0.0087	*<0.01*
ABA150	KAM153129	CFR0595	30.5	32.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.3	0.0014	*<0.00005*	0.0055	*<0.0005*	*<0.3*	6.4	*<0.0005*	3.3	*<0.00005*	2.1	0.038	*<0.0001*	*<0.0005*	*<0.01*	0.00012	0.0014	*<0.01*
ABA246	R273797	CFD0458	9.0	10.0	Waste	Lower transition	Gneiss	FG	*<0.001*	0.084	0.00011	*<0.005*	0.065	0.0072	0.0014	0.00061	*<0.0005*	*<0.3*	2.8	*<0.0005*	2.7	*<0.00005*	0.32	0.0034	0.00025	*<0.0005*	*<0.01*	0.00021	*<0.001*	*<0.01*
ABA247	R283019	CFD0484	33.0	34.0	Waste	Lower transition	Gneiss	FG	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.88	*<0.0005*	0.000065	0.0019	*<0.0005*	*<0.3*	3.7	*<0.0005*	4.6	*<0.00005*	2.4	0.019	*<0.0001*	*<0.0005*	*<0.01*	0.000046	*<0.001*	*<0.01*
ABA249	R273398	CFD0447	188.0	189.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	0.13	0.00011	*<0.005*	0.16	0.0036	*<0.00005*	0.0033	*<0.0005*	*<0.3*	0.73	*<0.0005*	4.0	*<0.00005*	4.8	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.0013	*<0.001*	*<0.01*
ABA250	R279032	CFD0461	85.0	86.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	0.071	0.00016	*<0.005*	0.25	0.0017	*<0.00005*	0.0044	*<0.0005*	*<0.3*	1.5	*<0.0005*	3.5	*<0.00005*	4.0	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00052	*<0.001*	*<0.01*
ABA251	R274019	CFD0464	10.0	11.0	Waste	Lower transition	Gneiss	FG	*<0.001*	0.051	0.00045	*<0.005*	0.061	0.00055	*<0.00005*	0.0031	*<0.0005*	*<0.3*	2.9	*<0.0005*	2.0	*<0.00005*	0.39	0.0012	*<0.0001*	*<0.0005*	*<0.01*	0.00058	*<0.001*	*<0.01*
ABA252	R274341	CFD0467	80.0	81.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	0.058	0.00032	*<0.005*	1.7	0.0019	*<0.00005*	0.026	*<0.0005*	*<0.3*	2.1	*<0.0005*	2.6	*<0.00005*	1.6	0.027	*<0.0001*	*<0.0005*	*<0.01*	0.00078	*<0.001*	*<0.01*
ABA253	R282397	CFD0474	95.0	96.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.10	0.0069	*<0.00005*	0.00021	*<0.0005*	*<0.3*	1.7	*<0.0005*	1.4	*<0.00005*	0.44	0.0028	*<0.0001*	*<0.0005*	*<0.01*	0.00025	*<0.001*	*<0.01*
ABA254	R270666	CFD0404	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.0031	1.1	0.00087	*<0.005*	0.31	0.083	*<0.00005*	0.0030	*<0.0005*	*<0.3*	0.99	*<0.0005*	3.6	*<0.00005*	0.86	0.0060	*<0.0001*	*<0.0005*	0.015	0.0012	0.0020	*<0.01*
ABA255	R271756	CFD0424	62.0	63.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	*<0.0005*	*<0.00005*	0.0089	*<0.0005*	*<0.3*	4.7	*<0.0005*	2.9	*<0.00005*	1.6	0.024	*<0.0001*	*<0.0005*	*<0.01*	0.00021	0.0027	*<0.01*
ABA256	R271112	CFD0415	8.0	9.0	Waste	Lower transition	Gneiss	MxM	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
ABA257	R273315	CFD0447	115.0	116.0	Waste	Lower transition	Gneiss	FG	0.0031	2.4	0.0035	0.0050	12	0.083	0.0014	0.026	0.0025	*<0.3*	54	0.0021	14	0.000050	47	0.11	0.00025	0.00099	0.092	0.026	0.041	0.010
ABA258	R276507	CFD0409	12.0	13.0	Waste	Lower transition	Gneiss	MxM	0.0010	1.3	0.00057	0.0050	2.3	0.032	0.000053	0.018	0.00050	*<0.3*	18	0.00063	7.2	*<0.00005*	5.4	0.078	0.00011	0.00053	0.030	0.0097	0.0074	*<0.01*
ABA259	R280545	CFD0499	10.0	11.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	0.14	0.00026	*<0.005*	1.4	0.0070	*<0.00005*	0.011	*<0.0005*	*<0.3*	6.3	*<0.0005*	3.9	*<0.00005*	3.0	0.032	*<0.0001*	*<0.0005*	0.010	0.0015	0.0059	*<0.01*
ABA260	R280565	CFD0499	28.0	29.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	0.051	0.00010	*<0.005*	0.88	0.0019	*<0.00005*	0.0049	*<0.0005*	*<0.3*	3.7	*<0.0005*	3.5	*<0.00005*	2.0	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00058	0.0014	*<0.01*
ABA261	R274115	CFD0464	95.0	96.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.28	0.00055	*<0.00005*	0.0025	*<0.0005*	*<0.3*	1.9	*<0.0005*	2.8	*<0.00005*	1.3	0.0073	*<0.0001*	*<0.0005*	*<0.01*	0.00023	*<0.001*	*<0.01*
ABA262	R274262	CFD0467	10.0	11.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.095	*<0.0005*	0.000045	0.00084	*<0.0005*	0.27	1.1	*<0.0005*	2.0	*<0.00005*	0.43	0.0032	*<0.0001*	*<0.0005*	*<0.01*	0.00011	*<0.001*	*<0.01*
ABA263	R282302	CFD0474	10.0	11.0	Waste	Lower transition	Gneiss	FG	0.00050	0.015	0.000050	*<0.005*	0.061	*<0.0005*	0.000025	0.00021	0.00025	0.15	0.73	0.00025	1.4	0.000025	0.32	0.0012	0.00010	0.00025	0.0050	0.000038	0.00050	0.0050
ABA264	R271435	CFD0420	9.0	10.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA265	R271165	CFD0415	55.0	56.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA267	R273694	CFD0456	97.0	98.0	Waste	Lower transition	Gneiss	MxM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA269	R279507	CFD0468	60.0	61.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA270	R272186	CFD0433	10.0	11.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA271	R283079	CFD0484	87.0	88.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA272	Q034772	CFD0473	86.0	87.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA273	R282171	CFD0439	30.0	31.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA274	R277372	CFD0423	10.0	11.0	Waste	Lower transition	Gneiss	MxM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ABA275	R283492	CFD0496	10.0	11.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA276	R273866	CFD0460	63.0	64.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA277	R273898	CFD0460	91.0	92.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA278	Q035773	CFD0491	9.0	10.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA279	Q035789	CFD0491	60.0	61.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA280	R271699	CFD0424	12.0	13.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA282	R282102	CFD0437	70.0	71.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA283	R273302	CFD0447	59.0	60.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA284	R273593	CFD0456	7.0	8.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA338	R270835	CFD0406	32.0	33.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.4	0.00054	*<0.00005*	0.0049	*<0.0005*	*<0.3*	4.4	*<0.0005*	2.9	*<0.00005*	2.0	0.072	*<0.0001*	*<0.0005*	*<0.01*	0.0017	*<0.001*	*<0.01*
ABA340	R270686	CFD0404	27.0	28.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.95	0.00051	*<0.00005*	0.011	*<0.0005*	*<0.3*	6.2	0.0021	3.5	*<0.00005*	1.6	0.051	*<0.0001*	*<0.0005*	*<0.01*	0.011	0.0066	*<0.01*
ABA342	R551085	CFD0563	10.0	11.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	0.16	0.00010	*<0.005*	0.31	0.0037	*<0.00005*	0.0012	*<0.0005*	*<0.3*	3.0	*<0.0005*	3.8	*<0.00005*	2.4	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.00037	0.0019	*<0.01*
ABA344	R551131	CFD0563	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.1	*<0.0005*	*<0.00005*	0.0050	*<0.0005*	*<0.3*	6.1	*<0.0005*	3.6	*<0.00005*	2.5	0.020	*<0.0001*	*<0.0005*	*<0.01*	0.000038	0.0054	*<0.01*
ABA348	R304313	CFD0541	56.0	57.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	2.4	0.00020	*<0.005*	0.65	0.031	*<0.00005*	0.00090	0.0025	*<0.3*	1.1	*<0.0005*	12	*<0.00005*	1.9	0.0060	*<0.0001*	0.00067	0.043	0.00027	0.0063	*<0.01*
ABA361	R623933	CFD0555	102.0	103.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	0.046	*<0.0001*	*<0.005*	1.7	0.0013	*<0.00005*	0.016	*<0.0005*	*<0.3*	7.2	*<0.0005*	3.6	*<0.00005*	1.1	0.11	*<0.0001*	*<0.0005*	*<0.01*	0.00082	0.0087	*<0.01*
ABA362	R507027	CFD0555	185.0	186.0	Waste	Lower Transition	Gneiss	FG	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.3	0.0014	*<0.00005*	0.0055	*<0.0005*	*<0.3*	6.4	*<0.0005*	3.3	*<0.00005*	2.1	0.038	*<0.0001*	*<0.0005*	*<0.01*	0.00012	0.0014	*<0.01*
ABA363	R545397	CFD0520	20.0	21.0	Waste	Lower Transition	Gneiss	FG	*<0.001*	0.084	0.00011	*<0.005*	0.065	0.0072	0.0014	0.00061	*<0.0005*	*<0.3*	2.8	*<0.0005*	2.7	*<0.00005*	0.32	0.0034	0.00025	*<0.0005*	*<0.01*	0.00021	*<0.001*	*<0.01*
ABA369	R545644	CFD0526	81.0	82.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.88	*<0.0005*	0.000065	0.0019	*<0.0005*	*<0.3*	3.7	*<0.0005*	4.6	*<0.00005*	2.4	0.019	*<0.0001*	*<0.0005*	*<0.01*	0.000046	*<0.001*	*<0.01*
ABA395	R545811	CFD0529	58.0	59.0	Waste	Lower Transition	Gneiss	FG	*<0.001*	0.13	0.00011	*<0.005*	0.16	0.0036	*<0.00005*	0.0033	*<0.0005*	*<0.3*	0.73	*<0.0005*	4.0	*<0.00005*	4.8	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.0013	*<0.001*	*<0.01*
ABA399	R543714	CFD0549	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	0.071	0.00016	*<0.005*	0.25	0.0017	*<0.00005*	0.0044	*<0.0005*	*<0.3*	1.5	*<0.0005*	3.5	*<0.00005*	4.0	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00052	*<0.001*	*<0.01*
ABA400	R543741	CFD0549	53.0	54.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	0.051	0.00045	*<0.005*	0.061	0.00055	*<0.00005*	0.0031	*<0.0005*	*<0.3*	2.9	*<0.0005*	2.0	*<0.00005*	0.39	0.0012	*<0.0001*	*<0.0005*	*<0.01*	0.00058	*<0.001*	*<0.01*
ABA402	R544003	CFD0553	80.0	81.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	0.058	0.00032	*<0.005*	1.7	0.0019	*<0.00005*	0.026	*<0.0005*	*<0.3*	2.1	*<0.0005*	2.6	*<0.00005*	1.6	0.027	*<0.0001*	*<0.0005*	*<0.01*	0.00078	*<0.001*	*<0.01*
ABA405	R554003	CFD0501	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.10	0.0069	*<0.00005*	0.00021	*<0.0005*	*<0.3*	1.7	*<0.0005*	1.4	*<0.00005*	0.44	0.0028	*<0.0001*	*<0.0005*	*<0.01*	0.00025	*<0.001*	*<0.01*
ABA410	R544159	CFD0502	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.0031	1.1	0.00087	*<0.005*	0.31	0.083	*<0.00005*	0.0030	*<0.0005*	*<0.3*	0.99	*<0.0005*	3.6	*<0.00005*	0.86	0.0060	*<0.0001*	*<0.0005*	0.015	0.0012	0.0020	*<0.01*
ABA412	R544228	CFD0502	70.0	71.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	*<0.0005*	*<0.00005*	0.0089	*<0.0005*	*<0.3*	4.7	*<0.0005*	2.9	*<0.00005*	1.6	0.024	*<0.0001*	*<0.0005*	*<0.01*	0.00021	0.0027	*<0.01*
Statistical Summary						**Lower Transition**	**Gneiss**	**n**	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
								Max	0.0031	2.4	0.0035	0.0050	12	0.083	0.0014	0.026	0.0025	*<0.3*	54	0.0021	14	0.000050	47	0.11	0.00025	0.00099	0.092	0.026	0.041	0.010
								90th PCTL	0.0010	1.3	0.00057	0.0050	2.3	0.032	0.000053	0.018	0.00050	*<0.3*	18	0.00063	7.2	*<0.00005*	5.4	0.078	0.00011	0.00053	0.030	0.0097	0.0074	*<0.01*
								75th PCTL	*<0.001*	0.14	0.00026	*<0.005*	1.4	0.0070	*<0.00005*	0.011	*<0.0005*	*<0.3*	6.3	*<0.0005*	3.9	*<0.00005*	3.0	0.032	*<0.0001*	*<0.0005*	0.010	0.0015	0.0059	*<0.01*
								Median	*<0.001*	0.051	0.00010	*<0.005*	0.88	0.0019	*<0.00005*	0.0049	*<0.0005*	*<0.3*	3.7	*<0.0005*	3.5	*<0.00005*	2.0	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00058	0.0014	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.28	0.00055	*<0.00005*	0.0025	*<0.0005*	*<0.3*	1.9	*<0.0005*	2.8	*<0.00005*	1.3	0.0073	*<0.0001*	*<0.0005*	*<0.01*	0.00023	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.095	*<0.0005*	0.000045	0.00084	*<0.0005*	0.27	1.1	*<0.0005*	2.0	*<0.00005*	0.43	0.0032	*<0.0001*	*<0.0005*	*<0.01*	0.00011	*<0.001*	*<0.01*
								Min	0.00050	0.015	0.000050	*<0.005*	0.061	*<0.0005*	0.000025	0.00021	0.00025	0.15	0.73	0.00025	1.4	0.000025	0.32	0.0012	0.00010	0.00025	0.0050	0.000038	0.00050	0.0050
Fresh Facies for Gneiss Waste Rock																														
ABA065	KAM128393	CFD0326	25.0	26.0	Waste	Fresh	Gneiss	MxM	0.0066	3.1	0.0044	*<0.005*	1.2	0.15	0.000053	0.0086	0.0017	*<0.3*	3.8	*<0.0005*	14	*<0.00005*	3.2	0.014	*<0.0001*	0.00074	0.069	0.0026	0.0069	*<0.01*
ABA097	KAM137325	CFR0468	88.4	89.9	Waste	Fresh	Gneiss	MxM	*<0.001*	0.24	*<0.0001*	0.0068	1.6	0.0066	*<0.00005*	0.024	*<0.0005*	*<0.3*	6.2	0.00082	6.0	*<0.00005*	7.2	0.030	*<0.0001*	*<0.0005*	0.012	0.0015	0.0055	*<0.01*
ABA139	KAM152151	CFR0586	61.0	62.5	Waste	Fresh	Gneiss	MxF	0.0016	5.0	0.0039	*<0.005*	0.82	0.11	*<0.00005*	0.0047	*<0.0005*	*<0.3*	3.5	*<0.0005*	15	0.000052	8.0	0.014	*<0.0001*	0.0026	0.083	0.0036	0.0079	*<0.01*
ABA143	KAM152536	CFR0589	128.0	129.5	Waste	Fresh	Gneiss	FG	*<0.001*	*<0.03*	*<0.0001*	0.0056	2.1	0.0020	*<0.00005*	0.040	*<0.0005*	*<0.3*	7.0	*<0.0005*	3.0	*<0.00005*	12	0.11	*<0.0001*	*<0.0005*	*<0.01*	0.0053	*<0.001*	*<0.01*
ABA148	KAM153051	CFR0594	109.7	111.3	Waste	Fresh	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	0.0059	3.4	0.0030	*<0.00005*	0.045	*<0.0005*	*<0.3*	8.0	*<0.0005*	3.3	*<0.00005*	8.4	0.065	*<0.0001*	*<0.0005*	*<0.01*	0.059	*<0.001*	*<0.01*
ABA347	R304284	CFD0541	30.0	31.0	Waste	Fresh	Gneiss	FG	0.0027	0.63	0.0012	*<0.005*	0.30	0.015	*<0.00005*	0.0017	*<0.0005*	*<0.3*	2.9	*<0.0005*	6.5	*<0.00005*	2.4	0.0044	*<0.0001*	*<0.0005*	*<0.01*	0.00078	0.0016	*<0.01*
ABA350	R304041	CFD0539	10.0	11.0	Waste	Fresh	Gneiss	FG	0.0015	0.45	0.00051	*<0.005*	0.15	0.014	*<0.00005*	0.0010	*<0.0005*	*<0.3*	0.58	*<0.0005*	4.6	*<0.00005*	4.7	0.0018	*<0.0001*	*<0.0005*	*<0.01*	0.00097	0.0017	*<0.01*
ABA354	R304119	CFD0525	45.0	46.0	Waste	Fresh	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.93	0.00098	*<0.00005*	0.0058	*<0.0005*	*<0.3*	6.6	*<0.0005*	3.2	*<0.00005*	4.0	0.027	*<0.0001*	*<0.0005*	*<0.01*	0.00044	0.0035	*<0.01*
ABA356	R623617	CFD0548	10.0	11.0	Waste	Fresh	Gneiss	MxF	*<0.001*	0.28	0.00020	*<0.005*	0.23	0.021	0.000076	0.0026	*<0.0005*	*<0.3*	1.8	*<0.0005*	3.5	*<0.00005*	2.6	0.0024	*<0.0001*	*<0.0005*	0.012	0.000097	0.0031	*<0.01*
ABA358	R623742	CFD0548	120.0	121.0	Waste	Fresh	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	*<0.0005*	*<0.00005*	0.0031	*<0.0005*	*<0.3*	3.1	*<0.0005*	3.9	*<0.00005*	4.4	0.044	*<0.0001*	*<0.0005*	*<0.01*	0.0014	*<0.001*	*<0.01*
ABA365	R545443	CFD0520	60.0	61.0	Waste	Fresh	Gneiss	FG	*<0.001*	0.18	0.00039	*<0.005*	0.19	0.010	*<0.00005*	0.0060	*<0.0005*	*<0.3*	2.0	*<0.0005*	3.7	*<0.00005*	3.6	0.0055	*<0.0001*	*<0.0005*	*<0.01*	0.0012	*<0.001*	*<0.01*
ABA396	R545818	CFD0529	65.0	66.0	Waste	Fresh	Gneiss	MxF	*<0.001*	0.11	0.00012	*<0.005*	0.18	0.011	*<0.00005*	0.0055	*<0.0005*	*<0.3*	0.69	*<0.0005*	4.1	*<0.00005*	5.6	0.0082	*<0.0001*	*<0.0005*	*<0.01*	0.00041	0.0016	*<0.01*
ABA398	R543692	CFD0549	10.0	11.0	Waste	Fresh	Gneiss	FG	*<0.001*	0.17	0.00044	*<0.005*	0.14	0.0067	*<0.00005*	0.0028	*<0.0005*	*<0.3*	1.9	*<0.0005*	2.7	*<0.00005*	3.2	0.0033	*<0.0001*	*<0.0005*	*<0.01*	0.00077	*<0.001*	*<0.01*
ABA401	R543957	CFD0553	40.0	41.0	Waste	Fresh	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	3.0	0.0015	*<0.00005*	0.012	*<0.0005*	*<0.3*	6.9	*<0.0005*	2.6	*<0.00005*	2.8	0.034	*<0.0001*	*<0.0005*	*<0.01*	0.0016	0.0052	*<0.01*
ABA413	R276141	CFD0393	127.0	128.0	Waste	Fresh	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.7	0.00053	*<0.00005*	0.0059	*<0.0005*	*<0.3*	4.2	*<0.0005*	2.9	*<0.00005*	1.9	0.023	*<0.0001*	*<0.0005*	*<0.01*	0.000036	0.0022	*<0.01*
ABA414	R276153	CFD0393	170.0	171.0	Waste	Fresh	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.7	0.00055	*<0.00005*	0.0015	*<0.0005*	*<0.3*	2.6	*<0.0005*	3.2	*<0.00005*	2.4	0.031	*<0.0001*	*<0.0005*	*<0.01*	0.000036	0.0053	*<0.01*
Statistical Summary						**Fresh**	**Gneiss**	**n**	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
								Max	0.0066	5.0	0.0044	0.0068	3.4	0.15	0.000076	0.045	0.0017	*<0.3*	8.0	0.00082	15	0.000052	12	0.11	*<0.0001*	0.0026	0.083	0.059	0.0079	*<0.01*
								90th PCTL	0.0022	1.9	0.0026	0.0058	2.8	0.066	0.000052	0.032	*<0.0005*	*<0.3*	6.9	*<0.0005*	10	*<0.00005*	8.2	0.054	*<0.0001*	0.00062	0.041	0.0045	0.0062	*<0.01*
								75th PCTL	0.0011	0.32	0.00046	*<0.005*	2.2	0.014	*<0.00005*	0.0095	*<0.0005*	*<0.3*	6.3	*<0.0005*	5.0	*<0.00005*	6.0	0.032	*<0.0001*	*<0.0005*	0.011	0.0018	0.0052	*<0.01*
								Median	*<0.001*	0.14	0.00011	*<0.005*	0.98	0.0066	*<0.00005*	0.0056	*<0.0005*	*<0.3*	3.3	*<0.0005*	3.6	*<0.00005*	3.8	0.018	*<0.0001*	*<0.0005*	*<0.01*	0.0011	0.0020	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.22	0.0013	*<0.00005*	0.0027	*<0.0005*	*<0.3*	1.9	*<0.0005*	3.1	*<0.00005*	2.7	0.0052	*<0.0001*	*<0.0005*	*<0.01*	0.00043	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.16	0.00054	*<0.00005*	0.0016	*<0.0005*	*<0.3*	1.2	*<0.0005*	2.8	*<0.00005*	2.4	0.0029	*<0.0001*	*<0.0005*	*<0.01*	0.000067	*<0.001*	*<0.01*
								Min	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.14	*<0.0005*	*<0.00005*	0.0010	*<0.0005*	*<0.3*	0.58	*<0.0005*	2.6	*<0.00005*	1.9	0.0018	*<0.0001*	*<0.0005*	*<0.01*	0.000036	*<0.001*	*<0.01*
Statistical Summary for Gneiss Waste Rock								**n**	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
								n < DL	35	17	21	41	0	4	36	0	39	45	0	42	0	42	0	0	39	40	34	0	19	45
								Max	0.0066	5.7	0.023	0.011	12	0.28	0.0056	0.064	0.0025	0.30	54	0.0021	18	0.00010	47	0.14	0.00063	0.0026	0.12	0.059	0.041	0.010
								90th PCTL	0.0030	3.1	0.0044	0.0056	3.4	0.096	0.000076	0.024	0.0013	0.30	16	0.00050	14	0.000050	8.4	0.100	0.00014	0.00060	0.069	0.0074	0.0071	0.010
								75th PCTL	0.0010	0.44	0.00046	*<0.005*	1.8	0.020	0.000050	0.011	*<0.0005*	*<0.3*	7.1	*<0.0005*	5.9	*<0.00005*	4.7	0.043	*<0.0001*	*<0.0005*	0.011	0.0031	0.0050	*<0.01*
								Median	*<0.001*	0.062	0.00010	*<0.005*	0.82	0.0061	*<0.00005*	0.0055	*<0.0005*	*<0.3*	4.2	*<0.0005*	3.7	*<0.00005*	2.5	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00078	0.0017	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.26	0.0014	*<0.00005*	0.0027	*<0.0005*	*<0.3*	2.1	*<0.0005*	2.9	*<0.00005*	1.5	0.0059	*<0.0001*	*<0.0005*	*<0.01*	0.00021	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.15	0.00053	0.000025	0.0010	0.00050	0.15	1.1	*<0.0005*	2.6	*<0.00005*	0.50	0.0033	*<0.0001*	*<0.0005*	*<0.01*	0.000070	*<0.001*	*<0.01*
								Min	0.00050	0.015	0.000050	0.0025	0.055	*<0.0005*	0.000025	0.00015	0.00025	0.15	0.58	0.00025	1.4	0.000025	0.32	0.0012	0.000050	0.00025	0.0050	0.000036	0.00050	0.0050

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Schist Waste Rock																														
ABA005	KAM022322	CFD0110	95.0	96.0	Waste	Oxide	Schist	RQM	0.0010	0.015	0.00010	0.047	79	0.065	0.000025	0.0073	0.00050	0.15	106	0.0022	2.8	0.000050	5.4	0.79	0.00092	0.00050	0.025	0.012	0.0010	0.010
ABA026	KAM037656	CFD0096	59.0	60.0	Waste	Oxide	Schist	BtS	0.0010	0.015	0.00010	0.025	56	0.044	0.000025	0.0096	0.00050	0.15	57	0.0011	2.6	0.000050	2.0	0.63	0.00021	0.00050	0.017	0.0092	0.0010	0.010
ABA074	KAM146948	CFD0345	60.0	61.0	Waste	Oxide	Schist	BtS_carb	*<0.001*	*<0.03*	*<0.0001*	0.0050	6.3	0.00075	*<0.00005*	0.0036	*<0.0005*	*<0.3*	17	*<0.0005*	3.6	*<0.00005*	1.2	0.087	*<0.0001*	*<0.0005*	*<0.01*	0.000054	*<0.001*	*<0.01*
ABA077	J957606	CFD0350	60.0	61.0	Waste	Oxide	Schist	BtS_carb	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.5	0.0017	0.0017	0.0063	*<0.0005*	*<0.3*	10	*<0.0005*	4.7	*<0.00005*	0.60	0.22	*<0.0001*	*<0.0005*	*<0.01*	0.000019	*<0.001*	*<0.01*
ABA125	KAM149844	CFR0566	10.7	12.2	Waste	Oxide	Schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.54	0.0021	*<0.00005*	0.0060	*<0.0005*	*<0.3*	6.2	*<0.0005*	5.6	*<0.00005*	0.52	0.047	*<0.0001*	*<0.0005*	*<0.01*	0.000079	*<0.001*	*<0.01*
ABA130	KAM150823	CFR0574	10.7	12.2	Waste	Oxide	Schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.76	0.00087	*<0.00005*	0.0064	*<0.0005*	*<0.3*	9.7	*<0.0005*	4.6	*<0.00005*	0.50	0.040	0.00054	*<0.0005*	*<0.01*	0.000072	*<0.001*	*<0.01*
ABA131	KAM150859	CFR0574	61.0	62.5	Waste	Oxide	Schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	4.3	0.0017	0.000071	0.014	*<0.0005*	*<0.3*	18	*<0.0005*	3.7	*<0.00005*	0.58	0.12	*<0.0001*	*<0.0005*	*<0.01*	0.00030	*<0.001*	*<0.01*
Statistical Summary						**Oxide**	**Schist**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.0010	*<0.03*	0.00010	0.047	79	0.065	0.0017	0.014	0.00050	*<0.3*	106	0.0022	5.6	0.000050	5.4	0.79	0.00092	0.00050	0.025	0.012	0.0010	0.010
								90th PCTL	0.0010	*<0.03*	0.00010	0.034	65	0.052	0.00071	0.011	0.00050	*<0.3*	77	0.0015	5.1	0.000050	3.3	0.69	0.00069	0.00050	0.020	0.010	0.0010	0.010
								75th PCTL	0.0010	*<0.03*	0.00010	0.015	31	0.023	0.000061	0.0084	0.00050	*<0.3*	38	0.00080	4.7	0.000050	1.6	0.42	0.00038	0.00050	0.014	0.0048	0.0010	0.010
								Median	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	4.3	0.0017	*<0.00005*	0.0064	*<0.0005*	*<0.3*	17	*<0.0005*	3.7	*<0.00005*	0.60	0.12	*<0.0001*	*<0.0005*	*<0.01*	0.000079	*<0.001*	*<0.01*
								25th PCTL	*<0.001*	0.023	*<0.0001*	*<0.005*	1.6	0.0013	*<0.00005*	0.0061	*<0.0005*	0.23	9.9	*<0.0005*	3.2	*<0.00005*	0.55	0.067	*<0.0001*	*<0.0005*	*<0.01*	0.000063	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	0.015	*<0.0001*	*<0.005*	0.67	0.00082	0.000025	0.0050	*<0.0005*	0.15	8.3	*<0.0005*	2.7	*<0.00005*	0.51	0.044	*<0.0001*	*<0.0005*	*<0.01*	0.000040	*<0.001*	*<0.01*
								Min	*<0.001*	0.015	*<0.0001*	*<0.005*	0.54	0.00075	0.000025	0.0036	*<0.0005*	0.15	6.2	*<0.0005*	2.6	*<0.00005*	0.50	0.040	*<0.0001*	*<0.0005*	*<0.01*	0.000019	*<0.001*	*<0.01*
Upper Transition Facies for Schist Waste Rock																														
ABA027	KAM037928	CFD0099	30	31	Waste	Upper transition	Schist	BtS_carb	0.00050	0.015	0.000050	0.0066	5.0	0.0042	0.00014	0.014	0.00025	0.15	38	0.00025	3.6	0.000025	2.6	0.14	0.000050	0.00025	0.0050	0.00016	0.0015	0.0050
ABA332	Q033589	CFD0407	32	33	Waste	Upper Transition	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	5.5	0.00080	*<0.00005*	0.0025	*<0.0005*	*<0.3*	3.2	*<0.0005*	2.5	*<0.00005*	9.9	0.079	*<0.0001*	*<0.0005*	*<0.01*	0.00035	*<0.001*	*<0.01*
Lower Transition Facies for Schist Waste Rock																														
ABA031	KAM039252	CFD0116	75	76	Waste	Lower transition	Schist	RQM	0.00050	0.015	0.000050	0.019	15	0.0076	0.000025	0.0096	0.00025	0.15	76	0.00025	2.6	0.000025	6.7	0.20	0.00015	0.00025	0.0050	0.00053	0.0044	0.0050
ABA038	KAM047995	CFD0135	153	154	Waste	Lower transition	Schist	BtS	0.00050	0.015	0.000050	0.021	8.9	0.0039	0.000025	0.017	0.00025	0.15	63	0.0011	3.7	0.000025	23	0.11	0.000050	0.00025	0.0050	0.0012	0.012	0.0050
ABA054	KAM081312	CFD0198	85	86	Waste	Lower transition	Schist	BtS	0.0037	4.6	0.0036	0.0050	0.60	0.072	0.000025	0.0094	0.0019	0.15	16	0.00050	25	0.000050	36	0.016	0.00010	0.00050	0.13	0.0041	0.021	0.010
ABA333	R277487	CFD0426	43	44	Waste	Lower Transition	schist	BtS	*<0.001*	1.5	0.00081	*<0.005*	0.41	0.038	0.00062	0.0075	0.00092	*<0.3*	1.6	*<0.0005*	6.6	*<0.00005*	1.3	0.0039	*<0.0001*	*<0.0005*	0.010	0.00059	0.0038	*<0.01*
ABA335	R550437	CFD0518	25	26	Waste	Lower Transition	schist	BtS	*<0.001*	0.33	0.00021	*<0.005*	0.74	0.013	0.000099	0.0064	0.00055	*<0.3*	2.1	*<0.0005*	4.6	*<0.00005*	2.0	0.029	*<0.0001*	*<0.0005*	0.013	0.000046	0.0011	*<0.01*
ABA336	R550471	CFD0518	55	56	Waste	Lower Transition	Schist	BtS_carb	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	8.8	0.0047	*<0.00005*	0.0043	*<0.0005*	*<0.3*	8.9	*<0.0005*	3.7	*<0.00005*	2.2	0.37	*<0.0001*	*<0.0005*	*<0.01*	0.00069	*<0.001*	*<0.01*
ABA337	R550494	CFD0518	75	75	Waste	Lower Transition	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.8	0.0011	*<0.00005*	0.0021	*<0.0005*	*<0.3*	4.4	*<0.0005*	3.7	*<0.00005*	2.4	0.81	*<0.0001*	*<0.0005*	*<0.01*	0.00020	0.0025	*<0.01*
ABA345	R551151	CFD0563	68	69	Waste	Lower Transition	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.1	0.00081	*<0.00005*	0.021	*<0.0005*	*<0.3*	4.3	*<0.0005*	4.4	*<0.00005*	2.5	0.061	*<0.0001*	*<0.0005*	*<0.01*	0.00033	0.0045	*<0.01*
Statistical Summary						**Lower Transition**	**Schist**	**n**	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
								Max	0.0037	4.6	0.0036	0.021	15	0.072	0.00062	0.021	0.0019	*<0.3*	76	0.0011	25	0.000050	36	0.81	0.00015	0.00050	0.13	0.0041	0.021	0.010
								90th PCTL	0.0018	2.4	0.0017	0.019	11	0.048	0.00025	0.018	0.0012	*<0.3*	67	0.00068	12	*<0.00005*	27	0.50	0.00012	*<0.0005*	0.048	0.0020	0.014	*<0.01*
								75th PCTL	0.0010	0.61	0.00036	0.0085	8.8	0.019	0.000062	0.011	0.00064	*<0.3*	27	0.00050	5.1	*<0.00005*	11	0.24	0.00010	*<0.0005*	0.011	0.00081	0.0063	*<0.01*
								Median	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.9	0.0061	*<0.00005*	0.0085	*<0.0005*	*<0.3*	6.6	*<0.0005*	4.1	*<0.00005*	2.4	0.085	*<0.0001*	*<0.0005*	*<0.01*	0.00056	0.0041	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.70	0.0032	0.000025	0.0058	0.00044	0.15	3.7	*<0.0005*	3.7	0.000044	2.1	0.025	*<0.0001*	0.00044	0.0088	0.00030	0.0022	0.0088
								10th PCTL	0.00050	0.015	0.000050	*<0.005*	0.54	0.0010	0.000025	0.0036	0.00025	0.15	1.9	0.00043	3.3	0.000025	1.8	0.012	0.000085	0.00025	0.0050	0.00015	0.0011	0.0050
								Min	0.00050	0.015	0.000050	*<0.005*	0.41	0.00081	0.000025	0.0021	0.00025	0.15	1.6	0.00025	2.6	0.000025	1.3	0.0039	0.000050	0.00025	0.0050	0.000046	*<0.001*	0.0050
Fresh Facies for Schist Waste Rock																														
ABA132	KAM150898	CFR0574	114.3	115.8	Waste	Fresh	Schist	BtS	*<0.001*	*<0.03*	*<0.0001*	0.0098	12	0.0074	*<0.00005*	0.065	*<0.0005*	*<0.3*	28	0.00073	2.7	*<0.00005*	4.6	0.22	*<0.0001*	*<0.0005*	*<0.01*	0.0080	*<0.001*	*<0.01*
ABA330	R276299	CFD0401	74.0	75.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.4	0.0016	*<0.00005*	0.024	*<0.0005*	*<0.3*	3.7	*<0.0005*	3.1	*<0.00005*	1.7	0.025	*<0.0001*	*<0.0005*	*<0.01*	0.00027	*<0.001*	*<0.01*
ABA331	R276331	CFD0401	141.0	142.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	3.3	0.00073	*<0.00005*	0.0056	*<0.0005*	*<0.3*	5.5	*<0.0005*	3.8	*<0.00005*	1.6	0.031	*<0.0001*	*<0.0005*	*<0.01*	0.000097	0.0046	*<0.01*
ABA415	R277001	CFD0398	49.0	50.0	Waste	Fresh	schist	BtS	*<0.001*	0.090	*<0.0001*	*<0.005*	0.75	0.0020	*<0.00005*	0.0030	*<0.0005*	*<0.3*	3.1	*<0.0005*	3.0	*<0.00005*	1.8	0.015	*<0.0001*	*<0.0005*	*<0.01*	0.000052	0.0033	*<0.01*
ABA416	R277017	CFD0398	64.0	65.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.1	0.00073	*<0.00005*	0.0028	*<0.0005*	*<0.3*	3.1	*<0.0005*	2.2	*<0.00005*	2.0	0.017	*<0.0001*	*<0.0005*	*<0.01*	0.000078	0.0025	*<0.01*
ABA417	R277021	CFD0398	124.0	125.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.5	*<0.0005*	*<0.00005*	0.0013	*<0.0005*	*<0.3*	3.7	*<0.0005*	2.9	*<0.00005*	2.2	0.020	*<0.0001*	*<0.0005*	*<0.01*	0.000032	0.0029	*<0.01*
ABA418	R277041	CFD0398	160.0	161.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.6	*<0.0005*	*<0.00005*	0.0040	*<0.0005*	*<0.3*	5.7	*<0.0005*	2.4	*<0.00005*	1.9	0.018	*<0.0001*	*<0.0005*	*<0.01*	0.000022	0.0038	*<0.01*
Statistical Summary						**Fresh**	**Schist**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	*<0.001*	0.090	*<0.0001*	0.0098	12	0.0074	*<0.00005*	0.065	*<0.0005*	*<0.3*	28	0.00073	3.8	*<0.00005*	4.6	0.22	*<0.0001*	*<0.0005*	*<0.01*	0.0080	0.0046	*<0.01*
								90th PCTL	*<0.001*	0.054	*<0.0001*	0.0069	6.6	0.0042	*<0.00005*	0.041	*<0.0005*	*<0.3*	15	0.00059	3.4	*<0.00005*	3.1	0.11	*<0.0001*	*<0.0005*	*<0.01*	0.0034	0.0041	*<0.01*
								75th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.4	0.0018	*<0.00005*	0.015	*<0.0005*	*<0.3*	5.6	*<0.0005*	3.0	*<0.00005*	2.1	0.028	*<0.0001*	*<0.0005*	*<0.01*	0.00018	0.0036	*<0.01*
								Median	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.5	0.00073	*<0.00005*	0.0040	*<0.0005*	*<0.3*	3.7	*<0.0005*	2.9	*<0.00005*	1.9	0.020	*<0.0001*	*<0.0005*	*<0.01*	0.000078	0.0029	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.3	0.00062	*<0.00005*	0.0029	*<0.0005*	*<0.3*	3.4	*<0.0005*	2.5	*<0.00005*	1.7	0.017	*<0.0001*	*<0.0005*	*<0.01*	0.000042	0.0018	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.97	*<0.0005*	*<0.00005*	0.0022	*<0.0005*	*<0.3*	3.1	*<0.0005*	2.3	*<0.00005*	1.6	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.000028	*<0.001*	*<0.01*
								Min	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.75	*<0.0005*	*<0.00005*	0.0013	*<0.0005*	*<0.3*	3.1	*<0.0005*	2.2	*<0.00005*	1.6	0.015	*<0.0001*	*<0.0005*	*<0.01*	0.000022	*<0.001*	*<0.01*
Statistical Summary for Schist Waste Rock								**n**	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	18	15	16	16	0	2	14	0	16	18	0	17	0	18	0	0	17	18	16	0	9	18
								Max	0.0037	4.6	0.0036	0.047	79	0.072	0.0017	0.065	0.0019	0.30	106	0.0022	25	0.000050	36	0.81	0.00092	0.00050	0.13	0.012	0.021	0.010
								90th PCTL	0.0010	0.26	0.00018	0.020	14	0.042	0.00013	0.020	0.00054	0.30	61	0.00099	5.3	0.000050	8.9	0.55	0.00019	0.00050	0.016	0.0068	0.0046	0.010
								75th PCTL	*<0.001*	0.030	0.00010	0.0054	6.9	0.0074	0.000050	0.011	0.00050	*<0.3*	21	0.00050	4.4	*<0.00005*	3.1	0.20	0.00010	*<0.0005*	0.010	0.00061	0.0038	*<0.01*
								Median	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.3	0.0019	*<0.00005*	0.0064	*<0.0005*	*<0.3*	7.5	*<0.0005*	3.6	*<0.00005*	2.0	0.070	*<0.0001*	*<0.0005*	*<0.01*	0.00024	0.0013	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	0.00081	*<0.00005*	0.0039	*<0.0005*	*<0.3*	3.7	*<0.0005*	2.8	*<0.00005*	1.5	0.024	*<0.0001*	*<0.0005*	*<0.01*	0.000068	*<0.001*	*<0.01*
								10th PCTL	0.00065	0.015	0.000065	*<0.005*	0.64	0.00073	0.000025	0.0026	0.00033	0.15	3.1	*<0.0005*	2.5	0.000033	0.59	0.016	*<0.0001*	0.00033	0.0065	0.000036	*<0.001*	0.0065
								Min	0.00050	0.015	0.000050	*<0.005*	0.41	*<0.0005*	0.000025	0.0013	0.00025	0.15	1.6	0.00025	2.2	0.000025	0.50	0.0039	0.000050	0.00025	0.0050	0.000019	*<0.001*	0.0050

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Granite Waste Rock																														
ABA157	R305807	CFD0382	76	77	Waste	Oxide	Granite	GG	*<0.001*	0.29	0.00022	*<0.005*	*<0.05*	0.016	0.00024	0.00013	*<0.0005*	*<0.3*	2.9	*<0.0005*	12	*<0.00005*	0.93	0.0014	*<0.0001*	*<0.0005*	*<0.01*	0.00015	*<0.001*	*<0.01*
ABA158	R305808	CFD0382	79	80	Waste	Oxide	Granite	GG	*<0.001*	0.034	*<0.0001*	*<0.005*	0.056	0.0022	0.00017	*<0.0001*	*<0.0005*	*<0.3*	1.4	*<0.0005*	9.4	*<0.00005*	1.1	0.0023	*<0.0001*	*<0.0005*	*<0.01*	0.000046	*<0.001*	*<0.01*
ABA174	R305826	CFD0403	7.0	8.0	Waste	Oxide	Granite	GG	0.0032	8.5	0.017	*<0.005*	0.23	0.015	*0.00029*	0.00033	0.00060	*<0.3*	4.4	*<0.0005*	22	0.000080	2.1	0.015	0.0013	*<0.0005*	*<0.01*	0.0083	*<0.001*	*<0.01*
Upper Transition Facies for Granite Waste Rock																														
ABA013	KAM025898	CFD0150	81	82	Waste	Upper transition	Granite	GG	0.0010	2.3	0.0075	0.0050	0.28	0.044	0.000025	0.011	0.00050	0.15	7.7	0.00050	37	0.000050	9.1	0.0072	0.00023	0.00050	0.11	0.0073	0.0076	0.010
ABA151	R305801	CFD0381	13	14	Waste	Upper transition	Granite	GG	*<0.001*	6.1	0.013	0.027	0.71	0.48	*<0.00005*	0.0083	*<0.0005*	*<0.3*	9.6	*<0.0005*	24	0.000058	10	0.012	0.00021	*<0.0005*	0.24	0.012	0.010	0.024
ABA152	R305802	CFD0381	35	36	Waste	Upper transition	Granite	GG	0.0091	13	0.026	*<0.005*	1.2	0.36	0.000096	0.0048	0.00053	0.50	1.8	*<0.0005*	40	0.000065	12	0.030	0.00015	*<0.0005*	0.13	0.022	0.0061	0.066
ABA167	R305818	CFD0394	30	31	Waste	Upper transition	Granite	GG	*<0.001*	1.3	0.0022	*<0.005*	0.24	0.0086	0.00055	0.0038	*<0.0005*	*<0.3*	6.8	*<0.0005*	26	0.000082	1.4	0.0049	0.00018	*<0.0005*	*<0.01*	0.0044	*<0.001*	*<0.01*
ABA169	R305821	CFD0399	20	21	Waste	Upper transition	Granite	GG	*<0.001*	5.4	0.0065	*<0.005*	0.54	0.46	*<0.00005*	0.0030	0.00057	*<0.3*	10	*<0.0005*	24	0.000053	9.7	0.012	0.00011	*<0.0005*	0.024	0.0031	0.0030	0.011
ABA172	R305824	CFD0396	29	30	Waste	Upper transition	Granite	GG	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.064	0.0073	*<0.00005*	*<0.0001*	*<0.0005*	*<0.3*	0.89	*<0.0005*	8.7	*<0.00005*	1.2	0.0023	*<0.0001*	*<0.0005*	*<0.01*	0.000035	*<0.001*	*<0.01*
ABA178	R305831	CFD0400	11	12	Waste	Upper transition	Granite	GG	0.0029	4.1	0.027	*<0.005*	0.44	0.47	0.00015	0.0034	0.0015	*<0.3*	2.6	*<0.0005*	18	0.000067	6.5	0.0096	0.00012	*<0.0005*	0.097	0.013	0.0061	0.044
Statistical Summary						**Upper Transition**	**Granite**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.0091	13	0.027	0.027	1.2	0.48	0.00055	0.011	0.0015	0.50	10	0.00050	40	0.000082	12	0.030	0.00023	0.00050	0.24	0.022	0.010	0.066
								90th PCTL	0.0054	8.9	0.026	0.014	0.90	0.47	0.00031	0.0094	0.00094	0.38	9.9	0.00050	38	0.000073	11	0.019	0.00022	0.00050	0.17	0.016	0.0086	0.053
								75th PCTL	0.0020	5.8	0.019	0.0050	0.62	0.46	0.00012	0.0065	0.00055	*<0.3*	8.6	*<0.0005*	31	0.000066	9.8	0.012	0.00020	*<0.0005*	0.12	0.012	0.0069	0.034
								Median	*<0.001*	4.1	0.0075	*<0.005*	0.44	0.36	*<0.00005*	0.0038	0.00050	*<0.3*	6.8	*<0.0005*	24	0.000058	9.1	0.0096	0.00015	*<0.0005*	0.097	0.0073	0.0061	0.011
								25th PCTL	*<0.001*	1.8	0.0043	*<0.005*	0.26	0.026	*<0.00005*	0.0032	*<0.0005*	*<0.3*	2.2	*<0.0005*	21	0.000052	3.9	0.0060	0.00012	*<0.0005*	0.017	0.0038	0.0020	0.010
								10th PCTL	*<0.001*	0.79	0.0013	*<0.005*	0.17	0.0081	0.000040	0.0019	*<0.0005*	0.24	1.4	*<0.0005*	14	*<0.00005*	1.3	0.0038	0.00011	*<0.0005*	*<0.01*	0.0019	*<0.001*	*<0.01*
								Min	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.064	0.0073	0.000025	*<0.0001*	*<0.0005*	0.15	0.89	*<0.0005*	8.7	*<0.00005*	1.2	0.0023	*<0.0001*	*<0.0005*	*<0.01*	0.000035	*<0.001*	*<0.01*
Lower Transition Facies for Granite Waste Rock																														
ABA154	R305804	CFD0382	10	11	Waste	Lower transition	Granite	GG	*<0.001*	7.2	0.0075	0.023	0.70	0.32	*<0.00005*	0.0030	*<0.0005*	*<0.3*	8.8	*<0.0005*	24	0.000051	9.7	0.0098	0.00016	*<0.0005*	0.21	0.0062	0.0086	0.035
ABA155	R305805	CFD0382	50	51	Waste	Lower transition	Granite	GG	0.0029	4.3	0.0043	0.0089	0.75	0.20	0.00010	0.0067	0.00071	*<0.3*	4.3	*<0.0005*	29	0.00016	6.7	0.0080	0.00032	*<0.0005*	0.15	0.0051	0.0034	0.029
ABA159	R305809	CFD0383	10	11	Waste	Lower transition	Granite	GG	*<0.001*	6.6	0.0099	0.029	0.81	0.34	*<0.00005*	0.0023	*<0.0005*	*<0.3*	7.9	*<0.0005*	23	0.000065	8.9	0.011	0.00022	0.00052	0.32	0.016	0.017	0.022
ABA160	R305811	CFD0383	48	49	Waste	Lower transition	Granite	GG	*<0.001*	5.3	0.0078	0.030	0.89	0.35	*<0.00005*	0.00094	*<0.0005*	*<0.3*	10	*<0.0005*	22	0.000052	10	0.0098	0.00020	*<0.0005*	0.22	0.0100	0.0082	0.025
ABA164	R305815	CFD0389	10	11	Waste	Lower transition	Granite	GG	0.0018	6.7	0.015	0.011	0.65	0.34	*<0.00005*	0.012	*<0.0005*	*<0.3*	5.0	*<0.0005*	21	0.00011	7.8	0.012	0.00017	*<0.0005*	0.26	0.015	0.010	0.023
ABA166	R305817	CFD0389	45	46	Waste	Lower transition	Granite	GG	0.0048	18	0.0020	*<0.005*	0.42	0.13	0.000094	0.0012	0.00097	*<0.3*	2.7	*<0.0005*	17	0.000058	3.5	0.0087	*<0.0001*	*<0.0005*	0.022	0.017	0.0047	0.023
Statistical Summary						**Lower Transition**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	0.0048	18	0.015	0.030	0.89	0.35	0.00010	0.012	0.00097	*<0.3*	10	*<0.0005*	29	0.00016	10	0.012	0.00032	0.00052	0.32	0.017	0.017	0.035
								90th PCTL	0.0039	13	0.012	0.029	0.85	0.35	0.000097	0.0093	0.00084	*<0.3*	9.6	*<0.0005*	26	0.00013	10.0	0.011	0.00027	0.00051	0.29	0.016	0.014	0.032
								75th PCTL	0.0026	7.1	0.0094	0.027	0.80	0.34	0.000083	0.0058	0.00066	*<0.3*	8.6	*<0.0005*	24	0.00010	9.5	0.011	0.00022	*<0.0005*	0.25	0.016	0.0098	0.028
								Median	0.0014	6.6	0.0077	0.017	0.72	0.33	*<0.00005*	0.0027	*<0.0005*	*<0.3*	6.5	*<0.0005*	22	0.000062	8.3	0.0098	0.00019	*<0.0005*	0.21	0.012	0.0084	0.024
								25th PCTL	*<0.001*	5.6	0.0051	0.0093	0.66	0.23	*<0.00005*	0.0015	*<0.0005*	*<0.3*	4.5	*<0.0005*	21	0.000054	7.0	0.0090	0.00016	*<0.0005*	0.16	0.0071	0.0056	0.023
								10th PCTL	*<0.001*	4.8	0.0031	0.0070	0.53	0.16	*<0.00005*	0.0011	*<0.0005*	*<0.3*	3.5	*<0.0005*	19	0.000052	5.1	0.0083	0.00013	*<0.0005*	0.084	0.0057	0.0041	0.023
								Min	*<0.001*	4.3	0.0020	*<0.005*	0.42	0.13	*<0.00005*	0.00094	*<0.0005*	*<0.3*	2.7	*<0.0005*	17	0.000051	3.5	0.0080	*<0.0001*	*<0.0005*	0.022	0.0051	0.0034	0.022
Fresh Facies for Granite Waste Rock																														
ABA012	KAM025798	CFD0147	260	261	Waste	Fresh	Granite	GG	0.00050	0.015	0.000050	0.015	0.45	0.0059	0.000025	0.0014	0.00025	0.15	26	0.00025	6.1	0.000025	40	0.018	0.000050	0.00025	0.0050	0.0099	0.019	0.0050
ABA162	R305813	CFD0385	10	11	Waste	Fresh	Granite	GG	0.0059	5.6	0.013	0.022	0.68	0.46	*<0.00005*	0.0093	*<0.0005*	*<0.3*	7.7	*<0.0005*	18	0.000077	9.1	0.0095	0.00021	0.00071	0.25	0.017	0.015	0.030
ABA163	R305814	CFD0385	59	60	Waste	Fresh	Granite	GG	0.0035	2.9	0.0025	*<0.005*	0.35	0.074	*<0.00005*	0.00038	*<0.0005*	*<0.3*	3.0	*<0.0005*	23	*<0.00005*	4.3	0.0056	0.00018	0.00057	0.11	0.0030	0.0029	*<0.01*
ABA165	R305816	CFD0389	30	31	Waste	Fresh	Granite	GG	0.0013	5.8	0.010	0.0081	0.65	0.47	*<0.00005*	0.011	0.00052	*<0.3*	4.2	*<0.0005*	19	0.000056	7.5	0.010	0.00014	*<0.0005*	0.23	0.012	0.0096	0.038
ABA168	R305819	CFD0394	88	89	Waste	Fresh	Granite	GG	0.0011	3.6	0.0072	0.024	0.82	0.35	*<0.00005*	0.00073	*<0.0005*	*<0.3*	9.0	*<0.0005*	16	0.000058	9.0	0.0079	0.00022	0.00059	0.20	0.0036	0.014	0.030
ABA179	R305832	CFD0400	60	61	Waste	Fresh	Granite	GG	0.0034	5.8	0.0017	*<0.005*	0.16	0.031	*<0.00005*	0.0011	*<0.0005*	*<0.3*	3.4	*<0.0005*	19	*<0.00005*	5.5	0.0044	*<0.0001*	*<0.0005*	0.066	0.015	0.0023	*<0.01*
ABA439	Q041678	CFD0385	8.0	9.0	Waste	Fresh	Granite	GG	*<0.001*	0.29	0.00047	*<0.005*	0.13	0.026	*<0.00005*	0.0039	*<0.0005*	*<0.3*	1.5	*<0.0005*	2.8	*<0.00005*	2.0	0.0019	*<0.0001*	*<0.0005*	*<0.01*	0.0011	*<0.001*	*<0.01*
ABA441	Q032423	CFD0385	92	93	Waste	Fresh	Granite	GG	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.8	0.58	*<0.00005*	0.00014	0.0014	*<0.3*	2.6	*<0.0005*	3.6	*<0.00005*	1.8	0.017	*<0.0001*	*<0.0005*	*<0.01*	0.00013	*<0.001*	*<0.01*
Statistical Summary						**Fresh**	**Granite**	**n**	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
								Max	0.0059	5.8	0.013	0.024	1.8	0.58	*<0.00005*	0.011	0.0014	*<0.3*	26	*<0.0005*	23	0.000077	40	0.018	0.00022	0.00071	0.25	0.017	0.019	0.038
								90th PCTL	0.0042	5.8	0.011	0.023	1.1	0.51	*<0.00005*	0.0099	0.00077	*<0.3*	14	*<0.0005*	20	0.000064	18	0.018	0.00021	0.00063	0.24	0.015	0.016	0.032
								75th PCTL	0.0034	5.6	0.0080	0.017	0.71	0.46	*<0.00005*	0.0052	0.00051	*<0.3*	8.0	*<0.0005*	19	0.000057	9.0	0.012	0.00019	0.00058	0.21	0.013	0.014	0.030
								Median	0.0012	3.3	0.0021	0.0066	0.55	0.21	*<0.00005*	0.0013	*<0.0005*	*<0.3*	3.8	*<0.0005*	17	*<0.00005*	6.5	0.0087	0.00012	*<0.0005*	0.087	0.0068	0.0063	*<0.01*
								25th PCTL	*<0.001*	0.23	0.00038	*<0.005*	0.30	0.030	*<0.00005*	0.00064	*<0.0005*	*<0.3*	2.9	*<0.0005*	5.5	*<0.00005*	3.7	0.0053	*<0.0001*	*<0.0005*	*<0.01*	0.0025	0.0020	*<0.01*
								10th PCTL	0.00085	0.026	0.000085	*<0.005*	0.15	0.020	0.000043	0.00031	0.00043	0.26	2.3	0.00043	3.4	0.000043	2.0	0.0037	0.000085	0.00043	0.0085	0.00079	*<0.001*	0.0085
								Min	0.00050	0.015	0.000050	*<0.005*	0.13	0.0059	0.000025	0.00014	0.00025	0.15	1.5	0.00025	2.8	0.000025	1.8	0.0019	0.000050	0.00025	0.0050	0.00013	*<0.001*	0.0050
Statistical Summary for Granite Waste Rock								**n**	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	11	2	3	13	1	0	14	2	14	21	0	22	0	7	0	0	7	18	7	0	7	9
								Max	0.0091	18	0.027	0.030	1.8	0.58	0.00055	0.012	0.0015	0.50	26	0.00050	40	0.00016	40	0.030	0.0013	0.00071	0.32	0.022	0.019	0.066
								90th PCTL	0.0044	8.1	0.016	0.026	0.87	0.47	0.00022	0.010	0.00089	0.30	10	*<0.0005*	28	0.000081	10	0.017	0.00023	0.00056	0.25	0.017	0.015	0.037
								75th PCTL	0.0030	6.2	0.011	0.017	0.72	0.39	0.000097	0.0052	0.00054	*<0.3*	8.1	*<0.0005*	24	0.000066	9.3	0.012	0.00021	*<0.0005*	0.21	0.013	0.0098	0.029
								Median	0.0010	4.8	0.0068	*<0.005*	0.50	0.26	*<0.00005*	0.0027	*<0.0005*	*<0.3*	4.3	*<0.0005*	20	0.000055	7.1	0.0095	0.00016	*<0.0005*	0.10	0.0078	0.0054	0.017
								25th PCTL	*<0.001*	1.0	0.0014	*<0.005*	0.23	0.024	*<0.00005*	0.00064	*<0.0005*	*<0.3*	2.7	*<0.0005*	15	*<0.00005*	2.0	0.0054	*<0.0001*	*<0.0005*	*<0.01*	0.0031	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	0.031	*<0.0001*	*<0.005*	0.084	0.0077	*<0.00005*	0.00013	*<0.0005*	*<0.3*	1.6	*<0.0005*	6.9	*<0.00005*	1.3	0.0023	*<0.0001*	*<0.0005*	*<0.01*	0.00013	*<0.001*	*<0.01*
								Min	0.00050	0.015	0.000050	*<0.005*	0.050	0.0022	0.000025	*<0.0001*	0.00025	0.15	0.89	0.00025	2.8	0.000025	0.93	0.0014	0.000050	0.00025	0.0050	0.000035	*<0.001*	0.0050
Oxide and Fresh Facies for Other Lithologies Waste Rock																														
ABA018	KAM029393	CFD0176	99	100	Waste	Oxide	Dykes	FC	0.00050	0.015	0.000050	0.0025	1.0	0.031	0.000025	0.0031	0.00025	0.15	21	0.00025	8.3	0.000025	1.2	0.035	0.00011	0.00025	0.0050	0.0000050	0.0035	0.0050
ABA056	KAM084551	CFD0237	181	182	Waste	Oxide	HU	HU	0.00050	0.015	0.000050	0.018	5.3	0.0051	0.000025	0.017	0.00079	0.15	60	0.00061	4.6	0.000025	10	0.15	0.00045	0.00025	0.0050	0.0017	0.0011	0.0050
ABA352	R304282	CFD0539	90	91	Waste	Fresh	IV	IV	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	0.0012	*<0.00005*	0.0040	*<0.0005*	*<0.3*	3.3	*<0.0005*	2.8	*<0.00005*	3.0	0.042	*<0.0001*	*<0.0005*	*<0.01*	0.000065	0.0040	*<0.01*

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Oxide Facies for Gneiss Waste Rock																															
ABA001	KAM000219	CFD0002	21.0	22.0	Waste	Oxide	Gneiss	FG	0.060	0.82	578	*<0.2*	*<10*	160	0.87	0.13	0.050	0.060	67	9.5	11	0.77	8.2	1.6	2.1	0.080	0.12	0.27	0.0070	0.23	37
ABA043	KAM050495	CFD0152	149.0	150.0	Waste	Oxide	Gneiss	MxF	0.010	1.0	48	*<0.2*	*<10*	30	0.51	0.070	0.70	*<0.01*	28	0.60	4.0	0.48	1.9	0.48	2.4	0.050	0.31	0.080	*<0.005*	0.27	15
ABA052	KAM079466	CFD0254	72.0	73.0	Waste	Oxide	Gneiss	MxF	0.010	0.56	11	*<0.2*	*<10*	50	0.39	0.26	0.80	0.010	78	2.0	5.0	0.20	0.60	1.0	2.5	0.090	0.23	*<0.01*	0.0080	0.17	40
ABA063	KAM125214	CFD0307	10.0	11.0	Waste	Oxide	Gneiss	MxF	0.030	0.85	175	*<0.2*	*<10*	120	0.40	0.68	0.12	0.010	97	5.8	8.0	1.3	4.5	1.8	4.5	0.11	0.24	0.010	0.014	0.53	54
ABA064	KAM125257	CFD0307	49.0	50.0	Waste	Oxide	Gneiss	MxF	0.17	0.60	114	*<0.2*	*<10*	70	0.53	0.16	0.070	0.010	56	1.4	5.0	0.58	1.9	0.63	1.9	0.060	0.41	0.080	*<0.005*	0.20	31
ABA080	KAM115505	CFR0360	25.9	27.4	Waste	Oxide	Gneiss	MxF	0.010	0.81	100	*<0.2*	*<10*	50	0.49	0.11	0.15	0.010	60	2.0	11	0.32	2.7	0.73	2.3	0.060	0.19	0.080	0.021	0.10	34
ABA081	KAM117096	CFR0384	22.9	24.4	Waste	Oxide	Gneiss	MxF	0.020	0.72	138	*<0.2*	*<10*	180	0.69	0.13	0.080	0.020	89	1.6	5.0	0.91	2.4	1.3	2.6	0.080	0.070	0.090	0.011	0.16	51
ABA083	KAM119516	CFR0418	19.8	21.3	Waste	Oxide	Gneiss	MxF	*<0.01*	0.44	14	*<0.2*	*<10*	40	0.41	0.060	0.13	*<0.01*	43	0.90	7.0	1.1	2.7	0.79	2.3	0.060	0.45	0.010	0.011	0.19	23
ABA085	KAM120107	CFR0425	15.2	16.8	Waste	Oxide	Gneiss	MxM	0.020	0.64	43	*<0.2*	*<10*	110	0.71	0.080	0.11	0.050	44	2.6	5.0	0.60	3.9	0.97	1.9	0.060	0.21	0.020	*<0.005*	0.26	24
ABA096	KAM137284	CFR0468	32.0	33.5	Waste	Oxide	Gneiss	MxF	0.24	1.1	44	*<0.2*	*<10*	150	0.55	2.1	0.25	0.020	106	4.2	14	1.4	9.5	1.8	5.5	0.080	0.21	0.040	0.015	0.62	49
ABA104	KAM139298	CFR0482	10.7	12.2	Waste	Oxide	Gneiss	MxF	0.020	0.77	256	*<0.2*	*<10*	120	1.1	0.15	0.030	0.020	88	1.8	8.0	0.38	12	1.1	2.5	0.070	0.080	0.33	0.0090	0.23	49
ABA136	KAM151967	CFR0584	109.7	111.3	Waste	Oxide	Gneiss	MxF	0.020	0.81	307	*<0.2*	*<10*	100	0.71	0.18	0.080	0.030	82	2.1	12	0.36	2.7	1.4	2.4	0.070	0.14	0.25	0.017	0.14	49
ABA137	KAM151932	CFR0584	61.0	62.5	Waste	Oxide	Gneiss	MxF	0.040	0.70	12	*<0.2*	*<10*	80	0.46	0.080	0.20	0.010	60	3.0	20	2.7	17	1.2	3.1	0.060	0.22	0.030	0.0080	0.32	34
ABA138	KAM152219	CFR0586	155.5	157.0	Waste	Oxide	Gneiss	MxF	0.030	0.55	48	*<0.2*	*<10*	90	0.55	0.10	0.14	0.030	88	1.6	14	0.45	4.9	1.2	1.8	0.070	0.18	0.040	0.0070	0.22	54
ABA144	KAM152716	CFR0591	30.5	32.0	Waste	Oxide	Gneiss	MxF	0.030	0.86	201	*<0.2*	*<10*	60	0.69	0.13	0.92	0.020	49	0.70	5.0	0.50	1.9	0.49	1.9	0.050	0.27	0.090	0.012	0.19	28
ABA145	KAM153015	CFR0594	61.0	62.5	Waste	Oxide	Gneiss	MxF	0.040	0.59	72	*<0.2*	*<10*	90	0.57	0.27	0.69	0.020	38	1.1	10	0.50	3.1	0.95	2.0	*<0.05*	0.30	0.14	0.031	0.17	22
ABA146	KAM153091	CFR0594	164.6	166.1	Waste	Oxide	Gneiss	MxF	0.030	1.1	2100	*<0.2*	*<10*	110	1.5	0.12	0.27	0.050	54	9.2	39	0.69	8.0	1.3	2.8	0.060	0.16	0.18	0.024	0.14	30
ABA149	KAM153152	CFR0595	61.0	62.5	Waste	Oxide	Gneiss	MxF	0.020	0.45	22	*<0.2*	*<10*	20	0.51	0.13	0.61	0.010	55	0.90	10	0.63	2.3	0.53	1.7	0.050	0.24	0.010	0.011	0.17	32
ABA224	R277421	CFD0423	53.0	54.0	Waste	Oxide	Gneiss	MxM	0.020	1.3	823	*<0.2*	*<10*	240	1.7	1.2	0.26	0.020	80	21	52	9.4	9.4	4.0	4.4	0.12	0.060	0.91	0.097	0.36	38
ABA225	R272412	CFD0436	9.0	10.0	Waste	Oxide	Gneiss	FG	0.040	1.1	35	*<0.2*	*<10*	90	1.2	0.070	0.050	*<0.01*	70	2.4	5.0	4.7	2.3	1.2	3.6	0.12	0.21	0.050	0.014	0.30	46
ABA226	R272445	CFD0436	38.0	39.0	Waste	Oxide	Gneiss	FG	0.030	1.9	103	*<0.2*	*<10*	160	1.8	0.10	0.18	0.030	67	13	114	5.6	13	2.5	5.0	0.14	0.24	0.060	0.022	0.84	39
ABA227	R272537	CFD0436	120.0	121.0	Waste	Oxide	Gneiss	MxF	0.040	0.57	53	*<0.2*	*<10*	70	0.69	0.36	0.060	0.030	86	1.4	5.0	1.0	2.0	1.2	2.3	0.11	0.16	0.040	0.018	0.25	44
ABA228	R271769	CFD0425	80.0	81.0	Waste	Oxide	Gneiss	MxF	0.010	0.46	2.7	*<0.2*	*<10*	40	0.34	0.060	0.61	0.010	68	1.7	8.0	1.0	2.4	0.87	2.7	0.080	0.38	*<0.01*	0.015	0.24	43
ABA229	R272589	CFD0436	166.0	167.0	Waste	Oxide	Gneiss	MxF	0.020	0.63	411	*<0.2*	*<10*	150	0.51	0.11	0.040	0.030	67	1.8	4.0	0.66	1.9	1.0	1.7	0.090	0.090	0.51	0.0070	0.21	39
ABA230	R280455	CFD0497	90.0	91.0	Waste	Oxide	Gneiss	MxM	0.020	0.33	23	*<0.2*	*<10*	220	0.57	0.10	0.72	0.010	37	1.0	8.0	0.58	4.2	0.92	1.6	0.10	0.47	0.020	*<0.005*	0.22	21
ABA231	R277177	CFD0421	47.0	48.0	Waste	Oxide	Gneiss	MxM	0.020	0.90	54	*<0.2*	*<10*	90	0.64	0.14	0.10	0.010	84	2.8	7.0	0.23	5.2	1.2	2.2	0.10	0.22	0.13	0.0080	0.22	46
ABA232	R277505	CFD0426	58.0	59.0	Waste	Oxide	Gneiss	MxM	0.010	0.38	40	*<0.2*	*<10*	70	0.37	0.10	0.020	0.010	35	1.6	4.0	0.090	5.3	0.51	1.1	*<0.05*	0.20	0.11	*<0.005*	0.10	20
ABA233	R277739	CFD0431	118.0	119.0	Waste	Oxide	Gneiss	MxF	0.050	0.82	154	*<0.2*	*<10*	130	0.91	0.14	0.020	0.030	95	1.8	6.0	0.29	2.0	1.2	2.2	0.10	0.17	0.21	*<0.005*	0.30	58
ABA234	R277403	CFD0423	37.0	38.0	Waste	Oxide	Gneiss	MxM	0.020	0.34	14	*<0.2*	*<10*	50	0.45	0.13	0.050	0.010	53	1.5	5.0	0.59	10	0.80	1.6	*<0.05*	0.30	0.010	*<0.005*	0.18	24
ABA235	R277137	CFD0421	11.0	12.0	Waste	Oxide	Gneiss	MxM	0.050	1.3	166	*<0.2*	*<10*	120	0.82	1.3	0.25	0.020	131	8.0	4.0	2.7	7.9	1.8	4.0	0.15	0.18	0.25	0.023	0.36	72
ABA380	KAM075906	CFD0216	90.0	91.0	Waste	Oxide	Gneiss	MxF	0.090	0.39	434	0.30	10	30	0.53	0.090	0.050	0.030	40	1.4	3.0	1.7	3.8	0.55	0.99	0.080	0.11	0.15	*<0.005*	0.19	22
ABA382	KAM067845	CFD0221	211.0	212.0	Waste	Oxide	Gneiss	FG	0.010	0.56	96	*<0.2*	*<10*	20	0.57	0.060	1.0	0.010	52	1.1	3.0	0.59	1.7	0.78	1.8	0.080	0.53	0.21	*<0.005*	0.17	30
ABA384	KAM068794	CFD0238	227.0	228.0	Waste	Oxide	Gneiss	FG	0.010	0.65	233	*<0.2*	*<10*	70	0.48	0.050	0.040	0.010	53	3.5	4.0	0.23	12	1.0	2.0	0.080	0.52	0.14	0.014	0.070	31
ABA393	KAM030104	CFR0109	50.9	52.4	Waste	Oxide	Gneiss	FG	0.070	0.48	1240	0.40	10	1280	0.58	0.23	0.060	0.030	68	1.4	5.0	0.74	3.1	1.1	1.7	0.080	0.12	0.61	0.016	0.16	42
Statistical Summary						**Oxide**	**Gneiss**	**n**	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
								Max	0.24	1.9	2100	0.40	10	1280	1.8	2.1	1.0	0.060	131	21	114	9.4	17	4.0	5.5	0.15	0.53	0.91	0.097	0.84	72
								90th PCTL	0.067	1.1	535	*0.20*	*10*	174	1.1	0.58	0.71	0.030	93	8.8	18	2.7	12	1.8	4.3	0.12	0.44	0.31	0.023	0.36	53
								75th PCTL	0.040	0.86	225	*0.20*	*10*	128	0.71	0.18	0.27	0.030	84	3.0	11	1.1	8.0	1.3	2.7	0.098	0.29	0.20	0.016	0.27	46
								Median	0.020	0.68	98	*0.20*	*10*	90	0.57	0.13	0.13	0.020	67	1.8	6.5	0.62	3.5	1.0	2.3	0.080	0.21	0.085	0.011	0.22	37
								25th PCTL	0.020	0.55	41	*0.20*	*10*	53	0.50	0.093	0.053	0.010	52	1.4	5.0	0.46	2.3	0.79	1.8	0.060	0.16	0.033	*0.0050*	0.17	29
								10th PCTL	0.010	0.41	14	*0.20*	*10*	33	0.40	0.063	0.040	0.010	38	0.93	4.0	0.25	1.9	0.54	1.6	0.050	0.096	0.010	*0.0050*	0.14	22
								Min	*0.010*	0.33	2.7	*0.20*	*10*	20	0.34	0.050	0.020	*0.010*	28	0.60	3.0	0.090	0.60	0.48	0.99	*0.050*	0.060	*0.010*	*0.0050*	0.070	15
Upper Transition Facies for Gneiss Waste Rock																															
ABA016	KAM029087	CFD0175	145.0	146.0	Waste	Upper transition	Gneiss	MxF	0.070	1.0	65	*<0.2*	*<10*	70	0.75	0.17	2.0	0.050	73	5.6	37	0.81	14	1.5	3.4	0.080	0.52	0.13	0.030	0.16	42
ABA042	KAM050492	CFD0152	146.0	147.0	Waste	Upper transition	Gneiss	MxF	0.010	0.73	40	*<0.2*	*<10*	50	0.48	0.020	1.1	0.020	40	0.40	3.0	0.38	1.6	0.43	1.5	0.050	0.23	0.050	*<0.005*	0.29	22
ABA057	KAM096548	CFD0269	33.0	34.0	Waste	Upper transition	Gneiss	FG	0.12	0.81	177	*<0.2*	*<10*	220	0.60	0.13	0.030	0.030	62	1.3	9.0	0.43	4.2	0.91	2.5	0.060	0.16	0.060	*<0.005*	0.36	38
ABA059	KAM097012	CFD0272	17.0	18.0	Waste	Upper transition	Gneiss	FG	0.040	0.87	56	*<0.2*	*<10*	140	0.95	0.040	0.060	0.030	76	2.6	6.0	1.1	5.9	1.0	3.1	0.060	0.24	0.040	0.0070	0.35	34
ABA060	KAM097065	CFD0272	65.0	66.0	Waste	Upper transition	Gneiss	FG	0.080	1.1	368	*<0.2*	10	130	0.79	0.33	1.2	0.040	62	1.7	4.0	0.74	4.8	1.0	2.7	0.070	0.22	0.58	0.011	0.29	38
ABA069	KAM145287	CFD0338	123.0	124.0	Waste	Upper transition	Gneiss	FG	0.070	0.53	1150	0.20	10	140	1.1	0.66	0.090	0.020	86	2.0	5.0	1.2	3.6	1.0	1.5	0.070	0.10	0.50	0.013	0.30	52
ABA101	KAM137634	CFR0470	109.7	111.3	Waste	Upper transition	Gneiss	MxF	0.070	0.73	100	*<0.2*	*<10*	110	0.66	0.55	0.83	0.050	105	4.5	13	2.0	4.8	2.0	3.9	0.090	0.30	0.10	0.030	0.19	57
ABA105	KAM139327	CFR0482	50.3	51.8	Waste	Upper transition	Gneiss	MxF	0.030	0.63	230	*<0.2*	*<10*	150	0.84	0.10	0.010	0.020	76	1.6	7.0	0.26	6.6	1.0	2.1	0.060	0.080	0.67	0.011	0.21	40
ABA141	KAM152499	CFR0589	77.7	79.3	Waste	Upper transition	Gneiss	MxF	0.010	0.85	18	*<0.2*	*<10*	80	0.67	0.070	0.87	0.010	67	4.2	13	1.6	3.1	1.3	3.2	0.060	0.40	0.010	0.0060	0.49	40
ABA147	KAM152978	CFR0594	10.7	12.2	Waste	Upper transition	Gneiss	MxF	0.050	0.36	3.7	*<0.2*	*<10*	40	0.35	0.16	0.77	0.020	42	0.60	8.0	0.16	5.4	0.32	1.2	*<0.05*	0.32	0.010	0.0050	0.25	24
ABA237	R270907	CFD0412	10.0	11.0	Waste	Upper transition	Gneiss	MxF	0.090	0.63	202	*<0.2*	*<10*	60	0.78	0.40	2.2	0.030	71	3.8	22	0.73	3.7	1.5	1.7	0.10	0.20	0.060	0.0060	0.25	42
ABA238	R280433	CFD0497	28.0	29.0	Waste	Upper transition	Gneiss	MxM	0.030	0.57	81	*<0.2*	*<10*	70	0.54	2.1	0.040	0.020	48	1.7	5.0	0.30	4.1	0.85	2.0	0.090	0.32	0.020	0.0050	0.21	22
ABA239	Q034712	CFD0473	7.0	8.0	Waste	Upper transition	Gneiss	FG	0.030	0.80	13	*<0.2*	*<10*	50	0.62	0.30	0.040	*<0.01*	46	1.2	7.0	0.17	3.7	0.50	2.2	0.10	0.40	0.020	0.021	0.19	26
ABA240	Q034807	CFD0473	117.0	118.0	Waste	Upper transition	Gneiss	FG	0.020	0.67	383	*<0.2*	*<10*	130	0.55	0.16	0.050	0.020	76	2.7	7.0	0.88	5.1	1.3	2.1	0.10	0.080	0.52	0.0080	0.21	46
ABA241	R272496	CFD0436	83.0	84.0	Waste	Upper transition	Gneiss	MxF	0.020	0.62	118	*<0.2*	*<10*	40	0.53	0.10	0.080	0.010	66	2.1	5.0	0.88	3.7	0.87	1.9	0.090	0.24	0.11	0.0090	0.17	39
ABA242	R270718	CFD0404	69.0	70.0	Waste	Upper transition	Gneiss	MxF	0.030	0.39	518	*<0.2*	*<10*	20	0.70	0.13	0.070	0.050	59	2.1	5.0	0.50	7.5	1.3	1.3	0.060	0.23	0.19	0.0090	0.10	36
ABA243	R271483	CFD0420	51.0	52.0	Waste	Upper transition	Gneiss	MxF	0.010	0.61	345	*<0.2*	*<10*	40	0.65	0.080	0.13	*<0.01*	52	12	3.0	2.9	13	0.87	2.2	0.070	0.14	0.79	0.0080	0.19	54
ABA244	R272865	CFD0441	40.0	41.0	Waste	Upper transition	Gneiss	MxF	0.090	1.1	1235	*<0.2*	*<10*	160	1.8	0.070	0.11	0.090	85	5.1	41	1.6	11	2.1	3.4	0.12	0.070	0.92	0.014	0.34	54
ABA245	R278947	CFD0461	10.0	11.0	Waste	Upper transition	Gneiss	MxM	0.060	0.79	1140	0.20	*<10*	110	0.78	0.46	0.10	0.070	124	4.6	13	0.92	7.8	1.9	2.9	0.12	0.15	2.1	0.030	0.19	63
ABA353	R304081	CFD0525	10.0	11.0	Waste	Upper Transition	Gneiss	MxF	0.15	2.4	252	*<0.2*	10	510	1.9	0.49	0.39	0.030	60	16	59	3.3	9.4	3.9	7.6	0.090	0.040	0.14	0.020	1.0	21
ABA367	R545582	CFD0524	56.0	57.0	Waste	Upper Transition	Gneiss	MxF	0.070	0.67	663	*<0.2*	*<10*	60	0.56	0.17	0.040	0.020	42	1.2	8.0	0.24	4.2	0.99	1.8	*<0.05*	0.13	2.1	0.0090	0.14	22
ABA373	R271332	CFD0417	58.0	59.0	Waste	Upper Transition	Gneiss	MxF	0.050	0.66	2110	*<0.2*	*<10*	170	0.55	0.040	0.040	0.020	72	1.6	5.0	0.79	2.8	1.1	2.1	0.060	0.050	5.2	0.012	0.17	40
ABA385	KAM068709	CFD0238	151.0	152.0	Waste	Upper Transition	Gneiss	MxF	0.090	0.57	217	*<0.2*	*<10*	40	0.56	0.10	0.040	0.030	41	0.80	6.0	0.31	4.5	0.72	1.4	0.070	0.39	1.9	*<0.005*	0.20	23
ABA386	KAM069164	CFD0242	220.5	221.0	Waste	Upper Transition	Gneiss	FG	0.020	0.55	720	0.20	*<10*	60	0.73	0.12	0.050	0.030	37	5.7	3.0	1.9	5.4	1.4	1.6	0.070	0.25	0.20	0.021	0.16	21
ABA407	R272624	CFD0438	17.0	18.0	Waste	Upper Transition	Gneiss	MxF	0.050	3.1	294	*<0.2*	*<10*	340	2.1	0.22	0.46	0.12	75	31	60	5.1	27	4.6	8.2	0.16	0.11	0.10	0.041	1.4	36
ABA411	R544193	CFD0502	40.0	41.0	Waste	Upper Transition	Gneiss	MxF	0.020	1.2	277	*<0.2*	*<10*	80	1.9	0.60	0.020	0.010	33	20	28	0.46	12	3.4	4.0	0.10	0.090	1.3	0.10	0.090	14
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
								Max	0.15	3.1	2110	0.20	10	510	2.1	2.1	2.2	0.12	124	31	60	5.1	27	4.6	8.2	0.16	0.52	5.2	0.10	1.4	63
								90th PCTL	0.090	1.2	1145	0.20	10	195	1.8	0.58	1.1	0.060	85	14	39	2.4	12	2.7	3.9	0.11	0.40	2.0	0.030	0.43	54
								75th PCTL	0.070	0.87	484	*<0.2*	*<10*	140	0.83	0.38	0.69	0.038	75	5.0	13	1.5	7.7	1.5	3.2	0.098	0.29	0.76	0.021	0.30	42
								Median	0.050	0.70	241	*<0.2*	*<10*	80	0.69	0.16	0.085	0.025	64	2.4	7.0	0.80	5.0	1.0	2.1	0.070	0.21	0.17	0.010	0.21	38
								25th PCTL	0.023	0.61	85	*<0.2*	*<10*	53	0.56	0.10	0.040	0.020	47	1.6	5.0	0.39	3.8	0.88	1.7	0.060	0.10	0.060	0.0063	0.18	23
								10th PCTL	0.015	0.54	29	*<0.2*	*<10*	40	0.54	0.055	0.035	0.010	40	1.0	3.5	0.25	3.4	0.61	1.4	0.055	0.075	0.020	*<0.005*	0.15	21
								Min	0.010	0.36	3.7	*<0.2*	*<10*	20	0.35	0.020	0.010	*<0.01*	33	0.40	3.0	0.16	1.6	0.32	1.2	0.050	*<0.05*	0.010	*<0.005*	0.090	14

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Lower Transition Facies for Gneiss Waste Rock																															
ABA019	KAM029649	CFD0177	73.0	74.0	Waste	Lower transition	Gneiss	MxM	0.030	0.72	3.6	*<0.2*	*<10*	50	0.38	0.080	0.53	0.010	80	1.9	6.0	0.57	2.9	1.1	3.8	0.080	0.38	*<0.01*	0.0050	0.38	51
ABA020	KAM029658	CFD0177	81.0	82.0	Waste	Lower transition	Gneiss	MxM	0.040	2.0	2.6	*<0.2*	*<10*	140	0.80	0.090	3.1	0.030	53	14	77	1.8	12	2.8	7.0	0.090	0.26	*<0.01*	0.018	1.1	30
ABA047	KAM051446	CFD0166	13.0	14.0	Waste	Lower transition	Gneiss	MxM	0.010	1.8	2.7	*<0.2*	*<10*	170	0.40	0.050	1.1	0.010	18	12	43	0.63	2.8	2.4	6.6	0.12	0.090	*<0.01*	0.016	0.59	9.9
ABA051	KAM079117	CFD0251	51.0	52.0	Waste	Lower transition	Gneiss	MxF	0.030	1.3	13	*<0.2*	*<10*	60	0.69	0.48	1.2	0.020	95	4.0	6.0	0.73	2.6	2.0	4.3	0.10	0.26	0.020	0.013	0.27	54
ABA058	KAM096948	CFD0270	230.0	231.0	Waste	Lower transition	Gneiss	MxF	0.070	1.1	42	*<0.2*	*<10*	70	0.69	0.41	1.5	0.020	81	1.4	3.0	0.37	1.1	1.1	2.9	0.080	0.20	0.12	*<0.005*	0.31	50
ABA067	KAM129499	CFD0332	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	0.030	0.61	4.7	*<0.2*	*<10*	30	0.33	0.22	0.37	*<0.01*	66	1.7	6.0	0.54	3.0	0.91	3.5	0.060	0.24	0.010	*<0.005*	0.39	40
ABA070	KAM099512	CFD0338	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.010	0.58	14	*<0.2*	*<10*	60	0.70	0.20	0.030	*<0.01*	60	1.8	3.0	0.83	1.7	0.62	2.1	0.050	0.24	0.010	0.015	0.29	22
ABA073	KAM145537	CFD0339	111.0	112.0	Waste	Lower transition	Gneiss	MxF	0.020	0.54	8.8	*<0.2*	*<10*	280	0.42	0.14	0.42	*<0.01*	92	1.1	6.0	1.4	1.4	0.86	2.5	0.080	0.20	0.010	0.0070	0.36	54
ABA098	KAM137429	CFR0469	29.0	30.5	Waste	Lower transition	Gneiss	MxF	0.010	0.98	11	*<0.2*	*<10*	190	0.59	0.35	0.30	0.010	120	4.6	11	1.0	6.3	1.8	6.1	0.15	0.22	0.010	0.012	0.67	88
ABA106	KAM139356	CFR0482	89.9	91.4	Waste	Lower transition	Gneiss	MxF	0.030	1.6	37	*<0.2*	*<10*	360	1.2	0.22	1.1	0.010	62	14	46	3.8	17	2.3	4.4	0.070	0.18	0.050	0.013	0.98	34
ABA117	KAM122524	CFR0529	21.3	22.9	Waste	Lower transition	Gneiss	FG	*<0.01*	0.47	2.6	*<0.2*	*<10*	20	0.24	0.070	0.39	*<0.01*	55	0.90	9.0	0.35	2.0	0.55	2.4	0.070	0.26	*<0.01*	0.022	0.18	34
ABA142	KAM152462	CFR0589	25.9	27.4	Waste	Lower transition	Gneiss	MxF	0.020	0.67	6.5	*<0.2*	*<10*	30	0.59	0.090	0.52	*<0.01*	48	2.5	18	1.4	6.8	1.2	3.3	0.060	0.45	0.010	0.011	0.46	28
ABA150	KAM153129	CFR0595	30.5	32.0	Waste	Lower transition	Gneiss	MxM	0.040	1.8	13	*<0.2*	*<10*	130	0.74	0.40	3.1	0.020	39	11	67	5.7	4.9	2.8	6.1	0.11	0.080	0.010	0.028	1.1	19
ABA246	R273797	CFD0458	9.0	10.0	Waste	Lower transition	Gneiss	FG	0.010	0.81	35	*<0.2*	*<10*	80	0.66	0.060	0.65	0.030	67	2.2	5.0	0.70	1.8	1.3	2.8	0.11	0.53	0.070	0.016	0.26	40
ABA247	R283019	CFD0484	33.0	34.0	Waste	Lower transition	Gneiss	FG	0.040	1.2	69	*<0.2*	*<10*	130	1.2	0.22	0.36	0.030	55	11	56	4.7	19	2.2	3.4	0.060	0.13	0.040	0.028	0.51	24
ABA249	R273398	CFD0447	188.0	189.0	Waste	Lower transition	Gneiss	MxF	0.030	2.1	20	*<0.2*	*<10*	180	0.54	0.16	0.28	0.010	23	13	22	5.9	6.0	3.1	6.9	0.15	0.080	0.010	0.016	1.3	8.4
ABA250	R279032	CFD0461	85.0	86.0	Waste	Lower transition	Gneiss	MxM	0.030	1.3	152	*<0.2*	*<10*	110	0.64	1.0	1.4	0.060	61	11	22	2.0	9.2	2.5	4.4	0.14	0.34	0.010	0.0080	0.87	35
ABA251	R274019	CFD0464	10.0	11.0	Waste	Lower transition	Gneiss	FG	0.020	0.67	29	*<0.2*	*<10*	100	0.74	0.090	0.080	0.030	56	2.4	6.0	0.42	3.5	1.0	2.2	0.10	0.40	0.030	0.015	0.22	29
ABA252	R274341	CFD0467	80.0	81.0	Waste	Lower transition	Gneiss	MxF	0.010	0.35	9.9	*<0.2*	*<10*	80	0.43	0.31	0.030	0.010	51	1.3	7.0	0.48	3.0	0.76	1.5	0.090	0.49	*<0.01*	0.0090	0.18	23
ABA253	R282397	CFD0474	95.0	96.0	Waste	Lower transition	Gneiss	MxF	0.030	0.60	46	*<0.2*	*<10*	40	0.66	0.28	0.060	0.010	76	1.8	2.0	0.60	11	1.0	2.0	*<0.05*	0.29	0.060	0.062	0.13	20
ABA254	R270666	CFD0404	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.010	0.63	68	*<0.2*	*<10*	30	0.64	0.080	0.32	*<0.01*	41	4.4	22	2.1	5.1	1.4	3.5	0.080	0.39	0.020	*<0.005*	0.41	25
ABA255	R271756	CFD0424	62.0	63.0	Waste	Lower transition	Gneiss	MxM	0.010	0.67	20	*<0.2*	*<10*	70	0.51	0.060	0.15	0.030	87	2.1	5.0	0.30	3.0	1.3	2.1	0.11	0.24	0.010	0.010	0.17	51
ABA256	R271112	CFD0415	8.0	9.0	Waste	Lower transition	Gneiss	MxM	0.060	0.99	170	*<0.2*	*<10*	160	0.64	0.26	0.78	0.020	70	3.3	5.0	0.90	5.3	1.4	2.9	0.11	0.30	0.42	0.0090	0.49	43
ABA257	R273315	CFD0447	115.0	116.0	Waste	Lower transition	Gneiss	FG	0.020	0.67	25	*<0.2*	*<10*	180	0.66	0.070	0.28	*<0.01*	42	0.70	5.0	0.15	0.80	0.43	1.7	0.080	0.36	0.040	*<0.005*	0.23	23
ABA258	R276507	CFD0409	12.0	13.0	Waste	Lower transition	Gneiss	MxM	0.030	0.59	145	*<0.2*	*<10*	190	0.97	0.20	0.14	0.010	55	3.3	4.0	0.60	2.5	0.82	1.5	0.060	0.19	0.060	0.0060	0.34	30
ABA259	R280545	CFD0499	10.0	11.0	Waste	Lower transition	Gneiss	MxM	0.020	0.95	16	*<0.2*	*<10*	440	0.35	0.35	0.26	0.020	95	3.7	11	1.0	3.9	2.0	5.2	0.14	0.19	*<0.01*	0.017	0.65	47
ABA260	R280565	CFD0499	28.0	29.0	Waste	Lower transition	Gneiss	MxM	0.010	0.50	22	*<0.2*	*<10*	60	0.43	0.25	0.070	0.020	50	2.0	6.0	0.59	2.3	1.1	2.7	0.10	0.41	0.010	0.0080	0.29	24
ABA261	R274115	CFD0464	95.0	96.0	Waste	Lower transition	Gneiss	MxF	0.020	1.0	70	*<0.2*	*<10*	620	1.1	0.090	2.6	0.030	53	7.4	34	3.1	13	1.8	3.0	0.12	0.31	0.060	0.0090	0.61	31
ABA262	R274262	CFD0467	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.010	0.37	16	*<0.2*	*<10*	60	0.42	0.18	0.28	0.010	43	0.90	7.0	0.49	1.3	0.65	1.6	0.090	0.40	0.010	0.0070	0.25	24
ABA263	R282302	CFD0474	10.0	11.0	Waste	Lower transition	Gneiss	FG	0.050	1.3	90	*<0.2*	*<10*	70	0.81	0.070	0.020	0.020	61	1.1	5.0	0.24	2.0	0.82	3.1	0.050	0.14	0.11	0.0070	0.31	40
ABA264	R271435	CFD0420	9.0	10.0	Waste	Lower transition	Gneiss	MxF	0.020	0.51	166	*<0.2*	*<10*	60	0.83	0.070	0.11	0.010	79	4.4	13	2.9	4.8	1.2	2.3	0.070	0.27	0.060	*<0.005*	0.28	51
ABA265	R271165	CFD0415	55.0	56.0	Waste	Lower transition	Gneiss	MxF	0.020	0.57	4.8	*<0.2*	*<10*	60	0.36	0.21	0.45	0.010	93	1.6	6.0	1.6	1.3	1.7	3.4	0.11	0.21	0.010	0.018	0.32	57
ABA267	R273694	CFD0456	97.0	98.0	Waste	Lower transition	Gneiss	MxM	0.030	4.2	2.7	*<0.2*	*<10*	270	0.52	0.16	2.1	0.010	4.3	20	155	8.8	21	7.3	12	0.23	0.040	*<0.01*	0.030	2.2	2.1
ABA269	R279507	CFD0468	60.0	61.0	Waste	Lower transition	Gneiss	MxF	0.020	0.98	41	*<0.2*	*<10*	300	0.34	0.56	0.20	0.010	111	5.0	8.0	0.77	8.5	1.9	4.5	0.15	0.24	0.010	0.0070	0.62	59
ABA270	R272186	CFD0433	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.040	0.77	6.8	*<0.2*	*<10*	40	0.58	0.10	0.010	0.020	50	1.2	5.0	0.25	1.3	0.59	2.0	0.10	0.17	0.010	*<0.005*	0.28	31
ABA271	R283079	CFD0484	87.0	88.0	Waste	Lower transition	Gneiss	FG	0.010	0.86	13	*<0.2*	*<10*	90	0.64	0.060	0.23	0.020	84	6.1	18	3.0	7.4	1.6	2.7	0.070	0.19	0.010	0.014	0.49	49
ABA272	Q034772	CFD0473	86.0	87.0	Waste	Lower transition	Gneiss	MxF	0.020	1.3	42	*<0.2*	*<10*	160	0.87	0.10	0.53	0.030	76	14	23	4.2	17	2.5	4.4	0.13	0.14	*<0.01*	0.011	0.61	44
ABA273	R282171	CFD0439	30.0	31.0	Waste	Lower transition	Gneiss	MxF	0.020	0.97	56	*<0.2*	*<10*	100	0.95	0.070	0.030	0.020	95	2.1	4.0	2.1	2.6	1.2	2.9	0.12	0.11	0.070	0.0060	0.26	55
ABA274	R277372	CFD0423	10.0	11.0	Waste	Lower transition	Gneiss	MxM	0.010	0.43	4.2	*<0.2*	*<10*	50	0.26	0.25	0.13	0.030	54	4.1	6.0	0.83	5.3	0.79	2.3	0.050	0.18	0.010	0.0070	0.20	25
ABA275	R283492	CFD0496	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.020	0.93	27	*<0.2*	*<10*	200	0.34	0.47	0.21	*<0.01*	105	3.7	7.0	0.92	3.5	1.8	4.4	0.15	0.20	*<0.01*	0.012	0.59	62
ABA276	R273866	CFD0460	63.0	64.0	Waste	Lower transition	Gneiss	FG	0.010	0.81	17	*<0.2*	*<10*	40	0.65	0.19	0.76	0.010	58	4.4	18	1.6	4.2	1.7	3.4	0.11	0.53	*<0.01*	0.018	0.50	35
ABA277	R273898	CFD0460	91.0	92.0	Waste	Lower transition	Gneiss	MxF	0.020	1.2	16	*<0.2*	*<10*	200	0.60	0.15	2.6	0.020	98	8.1	5.0	0.66	14	2.5	4.5	0.15	0.45	*<0.01*	0.011	1.0	55
ABA278	Q035773	CFD0491	9.0	10.0	Waste	Lower transition	Gneiss	MxF	0.010	0.84	67	*<0.2*	*<10*	60	0.72	0.070	0.080	0.010	69	2.7	4.0	2.4	2.8	1.0	2.8	0.10	0.30	0.050	0.0050	0.32	43
ABA279	Q035789	CFD0491	60.0	61.0	Waste	Lower transition	Gneiss	MxF	0.080	1.5	190	*<0.2*	*<10*	70	0.71	0.52	0.060	0.090	74	1.7	3.0	0.78	22	0.97	3.9	0.10	0.21	0.13	0.074	0.14	41
ABA280	R271699	CFD0424	12.0	13.0	Waste	Lower transition	Gneiss	MxF	0.010	0.42	13	*<0.2*	*<10*	70	0.47	0.10	0.060	0.050	86	1.8	7.0	0.67	1.8	1.3	2.0	0.11	0.16	0.020	0.0090	0.26	50
ABA282	R282102	CFD0437	70.0	71.0	Waste	Lower transition	Gneiss	MxF	0.020	0.92	55	*<0.2*	*<10*	60	0.71	0.060	0.020	*<0.01*	44	1.2	4.0	0.19	4.1	0.49	2.0	0.10	0.26	0.070	*<0.005*	0.21	29
ABA283	R273302	CFD0447	59.0	60.0	Waste	Lower transition	Gneiss	FG	0.020	1.7	19	*<0.2*	*<10*	470	0.96	0.060	2.4	0.020	85	12	42	3.7	14	2.5	4.3	0.17	0.15	0.010	0.017	1.3	50
ABA284	R273593	CFD0456	7.0	8.0	Waste	Lower transition	Gneiss	MxF	0.010	1.8	17	*<0.2*	*<10*	300	0.62	0.080	0.21	0.010	46	11	50	2.7	4.0	2.5	5.3	0.13	0.17	0.040	0.017	1.1	20
ABA338	R270835	CFD0406	32.0	33.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.42	17	*<0.2*	*<10*	180	0.84	0.10	1.9	0.050	63	4.2	13	1.7	6.2	1.3	2.7	0.070	0.53	*<0.01*	0.015	0.27	38
ABA339	R270848	CFD0406	58.0	58.3	Waste	Lower Transition	Gneiss	MxF	0.010	0.57	8.3	*<0.2*	*<10*	30	0.42	0.25	0.97	*<0.01*	80	1.8	4.0	1.8	5.6	0.93	3.1	0.10	0.37	*<0.01*	0.052	0.19	49
ABA340	R270686	CFD0404	27.0	28.0	Waste	Lower Transition	Gneiss	MxM	0.020	1.9	16	*<0.2*	*<10*	230	1.2	0.030	1.4	0.020	21	21	97	2.8	26	2.6	4.6	0.10	0.14	0.010	0.0060	1.5	12
ABA341	R270737	CFD0404	85.0	86.0	Waste	Lower Transition	Gneiss	FG	0.050	0.58	8.5	*<0.2*	*<10*	90	0.84	0.16	1.3	0.040	63	6.9	37	1.3	6.8	1.5	2.3	0.070	0.44	*<0.01*	0.0070	0.35	39
ABA342	R551085	CFD0563	10.0	11.0	Waste	Lower Transition	Gneiss	MxM	0.010	0.73	11	*<0.2*	*<10*	70	0.36	0.36	0.78	*<0.01*	52	3.9	11	1.9	3.0	1.3	3.0	0.070	0.27	*<0.01*	0.010	0.48	27
ABA343	R551107	CFD0563	30.0	31.0	Waste	Lower Transition	Gneiss	MxM	0.020	1.9	5.3	*<0.2*	*<10*	250	0.70	0.21	3.6	0.040	15	22	122	1.9	5.3	2.6	6.1	0.14	0.080	*<0.01*	0.010	1.1	7.6
ABA344	R551131	CFD0563	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	0.010	2.2	2.6	*<0.2*	*<10*	430	0.81	0.050	2.3	0.020	12	17	96	2.6	6.7	3.1	6.0	0.12	0.080	*<0.01*	0.010	1.3	5.8
ABA348	R304313	CFD0541	56.0	57.0	Waste	Lower Transition	Gneiss	MxM	0.010	2.5	39	*<0.2*	*<10*	480	1.2	0.56	0.63	0.020	86	18	165	6.4	2.3	4.1	9.7	0.19	0.13	0.030	0.036	1.0	45
ABA360	R623829	CFD0555	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.010	0.40	13	*<0.2*	*<10*	120	0.32	0.15	0.060	0.010	47	1.6	8.0	0.38	1.3	1.1	1.8	0.050	0.42	*<0.01*	*<0.005*	0.25	26
ABA361	R623933	CFD0555	102.0	103.0	Waste	Lower Transition	Gneiss	MxF	0.020	1.6	16	*<0.2*	*<10*	1320	2.2	0.050	1.9	0.050	29	16	62	2.4	13	3.4	7.3	0.14	0.18	*<0.01*	0.018	1.4	15
ABA362	R507027	CFD0555	185.0	186.0	Waste	Lower Transition	Gneiss	FG	0.010	0.63	12	*<0.2*	*<10*	40	0.96	0.070	1.2	0.010	72	1.5	10	1.3	2.5	0.94	2.3	0.070	0.25	0.010	0.0090	0.27	43
ABA363	R545397	CFD0520	20.0	21.0	Waste	Lower Transition	Gneiss	FG	0.010	0.60	141	*<0.2*	*<10*	60	0.50	0.15	0.040	0.010	58	1.4	5.0	0.17	1.7	0.94	1.9	0.050	0.12	1.7	0.031	0.10	33
ABA364	R545422	CFD0520	41.0	42.0	Waste	Lower Transition	Gneiss	FG	0.020	0.60	51	*<0.2*	*<10*	60	0.56	0.30	0.020	0.010	54	1.4	4.0	0.12	3.5	0.67	1.6	0.050	0.11	0.68	0.014	0.15	29
ABA366	R545552	CFD0524	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	0.010	0.50	238	*<0.2*	*<10*	70	0.48	0.37	0.47	0.020	50	1.5	5.0	0.27	6.7	0.84	1.6	0.050	0.32	1.3	0.0060	0.13	29
ABA369	R545644	CFD0526	81.0	82.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.54	50	*<0.2*	*<10*	50	0.70	0.29	0.18	*<0.01*	45	1.2	5.0	0.73	3.6	0.78	1.9	0.050	0.38	0.52	0.011	0.17	24
ABA370	R545697	CFD0528	42.0	43.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.84	70	*<0.2*	*<10*	70	1.2	0.070	0.040	0.030	69	2.2	6.0	0.27	2.8	0.71	2.3	0.060	0.23	0.040	0.0070	0.20	42
ABA371	R271272	CFD0417	5.0	6.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.57	3.8	*<0.2*	*<10*	70	0.43	0.16	0.20	0.010	91	1.5	5.0	0.84	2.6	1.0	3.0	0.080	0.33	*<0.01*	0.010	0.37	53
ABA372	R271299	CFD0417	30.0	30.7	Waste	Lower Transition	Gneiss	MxF	0.060	0.88	332	*<0.2*	*<10*	100	0.81	0.50	0.060	0.020	87	1.6	3.0	1.2	1.3	0.92	2.7	0.070	0.060	0.84	0.0080	0.24	50
ABA376	R279575	CFD0468	120.0	121.0	Waste	Lower Transition	Gneiss	MxF	0.020	1.1	29	*<0.2*	*<10*	40	1.1	0.050	0.42	0.010	47	6.6	47	2.3	9.2	1.7	4.8	0.12	0.48	0.010	0.0060	0.72	28
ABA390	R278608	CFD0450	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.040	1.7	88	*<0.2*	*<10*	160	1.9	0.080	0.23	0.030	78	13	138	4.9	17	2.2	4.8	0.11	0.20	0.11	0.019	0.44	48
ABA391	R278677	CFD0450	71.0	72.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.65	128	*<0.2*	*<10*	70	0.60	0.090	0.020	0.020	50	1.8	4.0	0.21	3.1	0.72	2.0	0.070	0.12	0.090	*<0.005*	0.18	29
ABA392	R278725	CFD0450	114.0	114.3	Waste	Lower Transition	Gneiss	MxF	0.040	0.91	98	*<0.2*	*<10*	80	0.61	0.32	0.040	0.020	65	1.3	7.0	0.25	1.9	0.76	2.5	0.080	0.16	0.21	0.012	0.27	37
ABA395	R545811	CFD0529	58.0	59.0	Waste	Lower Transition	Gneiss	FG	0.020	0.34	21	*<0.2*	*<10*	40	0.48	0.14	0.10	*<0.01*	75	0.60	5.0	0.45	1.6	0.58	1.5	0.080	0.31	0.010	0.013	0.12	43
ABA399	R543714	CFD0549	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	0.010	0.27	11	*<0.2*	*<10*	30	0.45	0.090	0.28	*<0.01*	48	0.80	5.0	0.53	1.5	0.50	1.3	0.070	0.38	*<0.01*	0.0060	0.14	27
ABA400	R543741	CFD0549	53.0	54.0	Waste	Lower Transition	Gneiss	MxF	0.060	0.57	163	*<0.2*	*<10*	30	0.41	0.10	0.030	0.32	41	1.6	5.0	0.34	3.1	0.55	1.6	0.070	0.26	0.36	0.0050	0.21	23
ABA402	R544003	CFD0553	80.0	81.0	Waste	Lower Transition	Gneiss	MxF	0.040	0.37	27	*<0.2*	*<10*	40	0.64	0.10	0.25	0.040	64	1.4	6.0	0.76	3.7	1.0	1.7	0.090	0.46	0.020	*<0.005*	0.19	43
ABA405	R554003	CFD0501	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.70	56	*<0.2*	*<10*	50	0.68	0.060	0.020	0.010	53	1.0	3.0	0.41	2.7	0.61	1.6	0.070	0.13	0.10	0.0050	0.15	28
ABA406	R554039	CFD0501	42.0	43.0	Waste	Lower Transition	Gneiss	MxF	0.030	0.36	7.6	*<0.2*	*<10*	390	0.39	0.14	0.37	0.14	84	2.0	4.0	0.66	2.1	0.57	1.5	0.10	0.27	0.010	*<0.005*	0.25	47
ABA409	R272762	CFD0438	184.0	185.0	Waste	Lower Transition	Gneiss	FG	0.020	0.41	26	*<0.2*	*<10*	140	0.58	0.14	1.5	0.040	84	1.7	6.0	0.46	1.1	1.4	1.9	0.090	0.29	0.010	0.013	0.23	51
ABA410	R544159	CFD0502	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.060	1.5	214	*<0.2*	*<10*	150	1.3	0.14	0.16	0.030	73	10	8.0	2.4	19	2.1	4.3	0.13	0.15	0.050	0.022	0.76	40
ABA412	R544228	CFD0502	70.0	71.0	Waste	Lower Transition	Gneiss	MxF	0.030	1.4	19	*<0.2*	*<10*	70	1.8	0.21	2.2	0.040	76	11	44	2.7	14	2.1	4.6	0.13	0.39	0.010	0.026	1.0	41
Statistical Summary						**Lower Transition**	**Gneiss**	**n**	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
								Max	0.080	4.2	332	*<0.2*	*<10*	1320	2.2	1.0	3.6	0.32	120	22	165	8.8	26	7.3	12	0.23	0.53	1.7	0.074	2.2	88
								90th PCTL	0.042	1.8	146	*<0.2*	*<10*	312	1.2	0.40	2.1	0.040	92	14	63	3.8	15	2.6	6.1	0.14	0.44	0.15	0.026	1.1	53
								75th PCTL	0.030	1.3	56	*<0.2*	*<10*	180	0.81	0.25	1.0	0.030	80	7.8	22	2.2	6.8	2.1	4.4	0.12	0.35	0.060	0.016	0.62	48
								Median	0.020	0.81	20	*<0.2*	*<10*	80	0.64	0.14	0.28	0.020	62	2.4	7.0	0.84	3.5	1.2	2.9	0.090	0.24	0.010	0.010	0.32	35
								25th PCTL	0.010	0.57	11	*<0.2*	*<10*	60	0.46	0.080	0.080	0.010	50	1.6	5.0	0.49	2.3	0.83	2.0	0.070	0.16	*<0.01*	0.0060	0.23	26
								10th PCTL	0.010	0.42	4.6	*<0.2*	*<10*	40	0.36	0.060	0.030	*<0.01*	40	1.2	4.0	0.27	1.4	0.61	1.6	0.050	0.11	*<0.01*	*<0.005*	0.17	19
								Min	*<0.01*	0.27	2.6	*<0.2*	*<10*	20	0.24	0.030	0.010	*<0.01*	4.3	0.60	2.0	0.12	0.80	0.43	1.3

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag ppm	Al %	As ppm	Au ppm	B ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Fe %	Ga ppm	Ge ppm	Hf ppm	Hg ppm	In ppm	K %	La ppm
Fresh Facies for Gneiss Waste Rock																															
ABA065	KAM128393	CFD0326	25.0	26.0	Waste	Fresh	Gneiss	MxM	0.030	1.1	125	<0.2	<10	190	0.73	0.68	0.19	0.030	133	5.8	9.0	1.2	12	1.9	5.0	0.12	0.18	0.070	0.022	0.49	78
ABA066	KAM128504	CFD0326	75.0	76.0	Waste	Fresh	Gneiss	MxM	0.020	0.98	16	<0.2	<10	80	0.45	1.5	0.30	0.010	104	4.2	7.0	2.4	2.3	2.0	5.2	0.090	0.31	0.020	0.012	0.66	58
ABA071	KAM145241	CFD0338	81.0	82.0	Waste	Fresh	Gneiss	MxM	0.010	1.1	5.1	<0.2	<10	190	1.4	0.040	4.0	0.050	68	9.7	183	3.6	3.9	2.0	6.3	0.11	0.24	0.020	0.031	1.0	35
ABA097	KAM137325	CFR0468	88.4	89.9	Waste	Fresh	Gneiss	MxM	0.020	1.6	22	<0.2	<10	220	0.73	0.20	0.61	0.020	63	13	31	1.7	8.9	2.6	5.9	0.090	0.21	0.010	0.0070	1.2	38
ABA099	KAM137468	CFR0469	82.3	83.8	Waste	Fresh	Gneiss	MxM	0.030	1.9	30	<0.2	<10	290	0.50	1.1	3.2	0.030	29	18	366	1.5	9.5	2.5	6.8	0.10	0.13	0.010	0.019	1.2	16
ABA108	KAM139795	CFR0486	25.9	27.4	Waste	Fresh	Gneiss	MxM	0.010	0.97	19	<0.2	<10	160	0.48	1.1	0.12	0.010	96	6.0	10	1.4	4.1	1.5	4.5	0.10	0.26	0.040	0.020	0.57	55
ABA139	KAM152151	CFR0586	61.0	62.5	Waste	Fresh	Gneiss	MxF	0.010	0.59	20	<0.2	<10	40	0.53	0.090	0.19	0.010	72	1.4	13	1.8	2.8	0.88	3.2	0.080	0.35	0.020	0.020	0.26	43
ABA140	KAM152186	CFR0586	109.7	111.3	Waste	Fresh	Gneiss	MxF	0.020	0.40	3.8	<0.2	<10	30	0.40	0.23	0.43	<0.01	48	0.60	13	0.47	2.9	0.58	1.8	0.050	0.37	0.010	0.021	0.25	27
ABA143	KAM152536	CFR0589	128.0	129.5	Waste	Fresh	Gneiss	FG	0.030	0.55	99	<0.2	<10	110	0.61	0.42	1.5	0.010	62	0.80	11	0.68	2.6	0.81	2.2	0.060	0.14	0.020	0.046	0.18	37
ABA148	KAM153051	CFR0594	109.7	111.3	Waste	Fresh	Gneiss	MxF	0.010	0.66	245	<0.2	<10	40	0.79	0.17	0.74	0.020	63	1.7	11	1.2	2.7	0.85	2.5	0.060	0.36	0.050	0.014	0.23	38
ABA285	R277457	CFD0426	16.0	17.0	Waste	Fresh	Gneiss	MxM	0.040	1.3	4.7	<0.2	<10	170	0.32	0.18	1.2	0.030	28	17	93	0.87	20	2.3	4.5	0.090	0.15	<0.01	0.0070	0.68	16
ABA286	R279452	CFD0468	11.0	12.0	Waste	Fresh	Gneiss	MxF	0.020	1.1	16	<0.2	<10	230	0.50	0.98	0.15	0.010	112	5.0	6.0	0.72	9.3	1.8	4.2	0.15	0.23	<0.01	0.015	0.73	54
ABA287	R274861	CFD0472	100.0	101.0	Waste	Fresh	Gneiss	MxM	0.030	1.1	7.4	<0.2	<10	120	0.37	0.24	1.3	0.010	42	11	33	0.86	19	2.0	3.1	0.060	0.17	<0.01	0.012	0.77	26
ABA288	R283657	CFD0498	82.0	83.0	Waste	Fresh	Gneiss	MxM	0.11	0.97	6.1	<0.2	<10	110	0.36	1.5	0.10	0.010	67	4.2	5.0	0.95	4.3	1.7	3.6	0.13	0.29	<0.01	0.011	0.68	34
ABA289	Q035925	CFD0495	94.0	95.0	Waste	Fresh	Gneiss	MxM	0.090	1.4	2.6	<0.2	<10	100	0.65	1.1	0.76	0.060	108	6.4	6.0	0.96	16	1.9	5.9	0.15	0.31	<0.01	0.013	0.79	65
ABA290	R272262	CFD0433	123.0	124.0	Waste	Fresh	Gneiss	MxF	0.020	0.56	23	<0.2	<10	90	0.57	0.13	0.080	0.020	89	1.8	6.0	0.80	2.2	1.3	2.4	0.11	0.24	0.020	0.0070	0.31	51
ABA293	R276133	CFD0393	45.0	46.0	Waste	Fresh	Gneiss	MxM	0.030	2.3	2.0	<0.2	<10	560	0.62	1.6	3.0	0.020	17	20	147	2.4	4.4	3.0	7.2	0.12	0.080	<0.01	0.012	1.2	8.2
ABA294	R276236	CFD0401	18.0	19.0	Waste	Fresh	Gneiss	MxM	0.080	1.9	2.3	<0.2	<10	470	0.48	8.4	2.2	0.050	9.8	19	86	1.8	8.3	2.6	4.7	0.090	0.060	0.010	0.011	0.97	5.1
ABA295	R271028	CFD0412	117.0	118.0	Waste	Fresh	Gneiss	MxF	0.010	0.48	26	<0.2	<10	140	0.51	0.070	0.54	0.030	86	1.4	5.0	0.65	2.2	1.3	2.3	0.12	0.30	<0.01	0.0080	0.30	52
ABA297	R279539	CFD0468	89.0	90.0	Waste	Fresh	Gneiss	MxF	0.010	1.4	8.9	<0.2	<10	120	0.47	0.21	1.5	0.010	58	5.0	35	1.6	3.3	1.9	4.5	0.11	0.37	<0.01	0.010	0.94	34
ABA298	R275689	CFD0495	57.0	58.0	Waste	Fresh	Gneiss	MxM	0.020	2.1	5.5	<0.2	<10	380	0.44	0.36	2.4	0.010	15	18	114	1.4	4.8	2.6	6.0	0.21	0.11	<0.01	0.016	1.1	7.3
ABA299	R272239	CFD0433	57.0	58.0	Waste	Fresh	Gneiss	MxF	0.020	0.41	14	<0.2	<10	60	0.49	0.070	0.80	0.030	56	1.5	5.0	0.53	4.5	0.97	1.9	0.10	0.28	0.010	0.0060	0.29	34
ABA300	R278428	CFD0445	118.0	119.0	Waste	Fresh	Gneiss	MxF	0.010	0.66	2.1	<0.2	<10	70	0.42	0.10	0.40	0.010	94	1.4	7.0	1.3	1.8	1.1	3.1	0.13	0.20	<0.01	0.012	0.40	55
ABA301	R273296	CFD0447	10.0	11.0	Waste	Fresh	Gneiss	FG	0.020	0.54	2.0	<0.2	<10	60	0.36	0.040	0.38	0.010	92	1.5	8.0	0.52	2.9	1.1	2.8	0.12	0.21	<0.01	0.0050	0.32	56
ABA302	R270935	CFD0412	35.0	36.0	Waste	Fresh	Gneiss	MxF	0.010	2.1	18	<0.2	<10	180	0.63	0.020	1.4	0.020	39	15	61	2.4	16	2.9	5.3	0.16	0.23	<0.01	0.0090	1.6	23
ABA346	R277538	CFD0426	87.0	88.0	Waste	Fresh	Gneiss	MxM	0.020	1.5	25	<0.2	<10	310	0.40	0.060	0.64	<0.01	20	16	63	1.9	29	2.5	5.1	0.10	0.080	<0.01	0.0080	0.83	10
ABA347	R304284	CFD0541	30.0	31.0	Waste	Fresh	Gneiss	FG	0.010	0.22	4.7	<0.2	<10	30	0.37	0.060	0.050	<0.01	48	2.2	7.0	0.24	5.6	0.44	0.88	0.050	0.25	<0.01	<0.005	0.13	28
ABA350	R304041	CFD0539	10.0	11.0	Waste	Fresh	Gneiss	FG	0.010	0.35	4.5	<0.2	<10	40	0.42	0.080	0.050	<0.01	51	1.1	6.0	0.18	4.1	0.68	1.7	0.050	0.22	<0.01	0.0060	0.17	26
ABA351	R304231	CFD0539	45.0	46.0	Waste	Fresh	Gneiss	MxM	0.030	2.3	8.5	<0.2	<10	330	0.47	0.12	0.34	0.010	52	15	66	1.9	7.8	3.3	6.8	0.10	0.030	<0.01	0.013	0.99	26
ABA354	R304119	CFD0525	45.0	46.0	Waste	Fresh	Gneiss	MxM	0.010	2.0	5.3	<0.2	<10	170	0.38	0.11	0.69	0.010	56	14	51	1.7	13	3.2	6.4	0.10	0.040	<0.01	0.013	0.87	29
ABA355	R304173	CFD0525	91.0	92.0	Waste	Fresh	Gneiss	FG	0.010	0.34	3.6	<0.2	<10	10	0.30	0.14	0.29	<0.01	43	1.2	9.0	0.30	2.6	0.61	1.8	0.060	0.29	<0.01	0.011	0.090	24
ABA356	R623617	CFD0548	10.0	11.0	Waste	Fresh	Gneiss	MxF	0.010	1.2	6.1	<0.2	<10	250	0.52	0.18	0.26	0.010	35	8.1	12	1.2	5.8	1.7	4.1	0.060	0.060	0.010	0.0070	0.82	18
ABA357	R623685	CFD0548	70.0	71.0	Waste	Fresh	Gneiss	MxF	0.010	1.2	6.1	<0.2	<10	60	0.80	0.030	0.99	0.010	57	8.2	48	1.4	8.5	1.8	4.5	0.090	0.37	<0.01	0.0080	0.80	33
ABA358	R623742	CFD0548	120.0	121.0	Waste	Fresh	Gneiss	MxF	0.030	0.40	6.2	<0.2	<10	670	0.40	0.090	0.87	0.010	40	1.3	7.0	0.20	3.5	0.99	1.6	<0.05	0.48	<0.01	<0.005	0.20	23
ABA365	R545443	CFD0520	60.0	61.0	Waste	Fresh	Gneiss	FG	0.020	0.47	2.4	<0.2	<10	80	0.35	0.69	0.12	<0.01	91	1.5	5.0	1.1	2.5	1.0	3.0	0.090	0.26	<0.01	0.0090	0.28	59
ABA374	R271368	CFD0417	91.0	92.0	Waste	Fresh	Gneiss	FG	0.020	0.52	4.2	<0.2	<10	60	0.45	0.050	0.42	0.010	93	2.4	6.0	2.4	5.6	1.3	4.0	0.12	0.39	<0.01	0.011	0.35	57
ABA378	R279593	CFD0468	135.0	136.0	Waste	Fresh	Gneiss	MxF	0.010	1.9	5.5	<0.2	<10	240	0.47	0.040	1.9	0.010	62	9.3	10	1.9	1.9	2.7	6.1	0.12	0.14	<0.01	0.012	1.3	36
ABA379	R279615	CFD0468	155.0	155.7	Waste	Fresh	Gneiss	MxF	0.040	2.2	7.9	<0.2	<10	390	0.48	0.51	1.1	0.010	49	15	45	2.0	16	3.2	7.1	0.18	0.090	<0.01	0.014	1.2	27
ABA381	R511981	CFR0700	48.8	49.4	Waste	Fresh	Gneiss	MxM	0.020	1.7	10	<0.2	<10	180	0.85	0.48	4.4	0.020	32	13	55	5.1	9.8	2.7	5.4	0.17	0.40	0.040	0.028	0.35	15
ABA387	Q034442	CFD0469	19.0	20.0	Waste	Fresh	Gneiss	MxF	0.050	1.1	6.1	<0.2	<10	90	1.2	0.23	0.20	0.020	88	6.7	56	2.0	6.8	1.7	4.3	0.13	0.43	0.020	0.017	0.67	51
ABA388	Q034516	CFD0469	102.0	103.0	Waste	Fresh	Gneiss	MxF	0.12	0.56	4.2	<0.2	<10	80	0.44	6.5	0.65	0.030	101	1.8	6.0	0.96	6.3	1.1	2.9	0.11	0.29	<0.01	0.0090	0.36	63
ABA389	Q034537	CFD0469	121.0	121.9	Waste	Fresh	Gneiss	MxF	0.010	0.54	44	<0.2	<10	70	0.67	0.11	0.080	<0.01	86	1.7	6.0	3.2	9.4	1.2	2.6	0.10	0.23	0.050	0.011	0.25	49
ABA396	R545818	CFD0529	65.0	66.0	Waste	Fresh	Gneiss	MxF	0.010	0.50	5.1	<0.2	<10	40	0.38	0.16	0.17	<0.01	65	1.3	8.0	0.32	5.2	0.80	3.2	0.090	0.30	0.010	0.028	0.11	36
ABA398	R543692	CFD0549	10.0	11.0	Waste	Fresh	Gneiss	FG	0.020	0.37	13	<0.2	<10	30	0.43	0.30	0.060	0.010	31	0.60	5.0	0.83	2.7	0.73	2.2	0.070	0.36	<0.01	<0.005	0.19	16
ABA401	R543957	CFD0553	40.0	41.0	Waste	Fresh	Gneiss	MxF	0.020	2.2	8.8	<0.2	<10	300	0.79	0.11	3.3	0.010	61	16	17	5.4	3.7	3.7	7.7	0.13	0.13	0.010	0.029	1.4	33
ABA404	R550544	CFD0553	160.0	161.0	Waste	Fresh	Gneiss	MxF	0.030	0.25	37	<0.2	<10	840	0.42	0.16	2.3	0.030	58	1.3	8.0	0.64	2.8	0.90	1.2	0.080	0.42	0.010	0.0070	0.12	39
ABA408	R272713	CFD0438	96.0	97.0	Waste	Fresh	Gneiss	MxF	0.010	0.45	5.1	<0.2	<10	70	0.56	0.060	0.44	0.020	74	1.4	6.0	0.57	0.90	0.80	2.3	0.090	0.33	<0.01	0.012	0.24	44
ABA413	R276141	CFD0393	127.0	128.0	Waste	Fresh	Gneiss	MxM	0.58	2.3	9.5	<0.2	<10	220	0.59	2.1	4.1	0.060	26	18	178	1.7	7.6	3.0	8.7	0.17	0.13	<0.01	0.029	0.64	14
ABA414	R276153	CFD0393	170.0	171.0	Waste	Fresh	Gneiss	MxM	0.030	1.4	6.3	<0.2	<10	80	0.70	0.31	4.2	0.060	25	13	63	0.99	11	2.2	6.1	0.20	0.21	<0.01	0.027	0.18	14
Statistical Summary						**Fresh**	**Gneiss**	**n**	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
								Max	0.58	2.3	245	<0.2	<10	840	1.4	8.4	4.4	0.060	133	20	366	5.4	29	3.7	8.7	0.21	0.48	0.070	0.046	1.6	78
								90th PCTL	0.056	2.2	31	<0.2	<10	382	0.79	1.5	3.2	0.034	97	17	97	2.4	16	3.0	6.8	0.16	0.37	0.024	0.028	1.2	57
								75th PCTL	0.030	1.6	18	<0.2	<10	230	0.62	0.51	1.5	0.020	86	13	55	1.9	9.3	2.5	5.9	0.12	0.31	0.010	0.017	0.87	51
								Median	0.020	1.1	6.3	<0.2	<10	120	0.48	0.18	0.64	0.010	58	5.0	11	1.2	4.8	1.7	4.2	0.10	0.24	<0.01	0.012	0.57	34
								25th PCTL	0.010	0.52	4.7	<0.2	<10	70	0.42	0.090	0.20	0.010	40	1.5	6.0	0.72	2.8	0.99	2.5	0.090	0.14	<0.01	0.0080	0.25	23
								10th PCTL	0.010	0.39	2.6	<0.2	<10	40	0.37	0.048	0.096	<0.01	26	1.3	5.8	0.44	2.3	0.79	1.8	0.060	0.080	<0.01	0.0060	0.18	14
								Min	0.010	0.22	2.0	<0.2	<10	10	0.30	0.020	0.050	<0.01	9.8	0.60	5.0	0.18	0.90	0.44	0.88	<0.05	0.030	<0.01	<0.005	0.090	5.1
Statistical Summary for Gneiss Waste Rock								**n**	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188
								n < DL	1	0	0	117	117	0	0	0	0	19	0	0	0	0	0	0	0	6	0	30	20	0	0
								Max	0.58	4.2	2110	0.40	10	1320	2.2	8.4	4.4	0.32	133	31	366	9.4	29	7.3	12	0.23	0.53	5.2	0.10	2.2	88
								90th PCTL	0.070	1.9	282	<0.2	<10	303	1.1	0.62	2.1	0.050	94	15	62	3.1	14	2.7	6.1	0.14	0.41	0.44	0.028	1.0	54
								75th PCTL	0.040	1.2	101	<0.2	<10	173	0.76	0.30	0.84	0.030	81	8.1	22	1.9	8.2	2.0	4.4	0.11	0.31	0.090	0.017	0.62	48
								Median	0.020	0.77	25	<0.2	<10	90	0.59	0.14	0.28	0.020	62	2.3	7.5	0.88	4.2	1.2	2.8	0.090	0.23	0.020	0.011	0.29	36
								25th PCTL	0.010	0.56	8.8	<0.2	<10	60	0.46	0.080	0.080	0.010	48	1.5	5.0	0.50	2.6	0.87	2.0	0.070	0.14	0.010	0.0070	0.19	24
								10th PCTL	0.010	0.40	4.2	<0.2	<10	40	0.38	0.060	0.040	<0.01	34	1.1	4.0	0.27	1.8	0.61	1.6	0.050	0.080	<0.01	<0.005	0.15	17
								Min	<0.01	0.22	2.0	<0.2	<10	10	0.24	0.020	0.010	<0.01	4.3	0.40	2.0	0.090	0.60	0.32	0.88	<0.05	0.030	<0.01	<0.005	0.070	2.1

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Oxide Facies for Schist Waste Rock																															
ABA005	KAM022322	CFD0110	95.0	96.0	Waste	Oxide	Schist	RQM	0.040	1.3	1025	*<0.2*	10	370	1.1	0.29	3.5	0.030	48	13	32	1.3	18	2.9	3.9	0.080	0.030	0.22	0.029	0.32	24
ABA026	KAM037656	CFD0096	59.0	60.0	Waste	Oxide	Schist	BtS	0.15	1.4	38	*<0.2*	*<10*	100	1.1	1.7	3.6	0.080	68	13	32	2.4	15	3.0	5.8	0.10	0.12	0.12	0.029	0.34	35
ABA074	KAM146948	CFD0345	60.0	61.0	Waste	Oxide	Schist	BtS_carb	0.030	1.4	25	*<0.2*	*<10*	150	0.86	0.32	5.0	0.040	73	13	46	3.1	11	3.0	5.1	0.080	0.050	0.14	0.030	0.53	39
ABA077	J957606	CFD0350	60.0	61.0	Waste	Oxide	Schist	BtS_carb	0.020	0.91	222	*<0.2*	*<10*	80	0.55	0.19	9.8	0.030	81	9.6	18	2.0	12	2.1	3.4	0.11	0.060	0.44	0.029	0.23	45
ABA090	KAM133632	CFR0431	71.6	73.2	Waste	Oxide	Schist	BtS	0.040	0.90	182	*<0.2*	*<10*	310	0.71	0.29	1.3	0.030	69	19	42	0.18	30	4.3	3.2	0.080	0.060	0.75	0.074	0.10	34
ABA094	KAM135457	CFR0454	24.4	25.9	Waste	Oxide	Schist	BtS	0.090	0.80	537	0.20	*<10*	350	0.72	0.80	0.13	0.020	114	5.2	9.0	0.54	4.8	1.7	2.7	0.090	0.14	0.40	0.016	0.33	64
ABA125	KAM149844	CFR0566	10.7	12.2	Waste	Oxide	Schist	BtS	0.020	0.73	153	*<0.2*	*<10*	100	0.47	0.12	0.11	*<0.01*	49	2.9	14	0.27	6.7	1.1	2.2	0.060	0.31	0.47	0.010	0.15	22
ABA128	KAM149954	CFR0567	47.2	48.8	Waste	Oxide	Schist	BtS	0.050	0.88	230	*<0.2*	*<10*	80	0.88	0.39	4.5	0.030	44	8.1	22	0.66	14	2.2	2.5	0.050	0.14	0.38	0.024	0.12	24
ABA129	KAM150033	CFR0567	155.5	157.0	Waste	Oxide	Schist	BtS	0.11	1.1	1405	*<0.2*	*<10*	550	0.85	0.26	0.19	0.10	110	15	30	1.2	15	3.3	3.0	0.11	0.030	0.30	0.022	0.30	54
ABA130	KAM150823	CFR0574	10.7	12.2	Waste	Oxide	Schist	BtS	0.010	0.72	163	*<0.2*	*<10*	220	0.68	0.23	4.5	0.030	54	9.4	40	0.37	4.8	2.7	2.1	0.060	0.080	0.28	0.024	0.18	30
ABA131	KAM150859	CFR0574	61.0	62.5	Waste	Oxide	Schist	BtS	0.38	0.50	543	0.20	10	150	0.44	0.15	0.67	0.040	64	3.4	8.0	0.96	33	1.2	1.3	0.070	0.26	0.70	0.0080	0.31	30
ABA133	KAM150951	CFR0575	61.0	62.5	Waste	Oxide	Schist	BtS	0.060	0.91	238	*<0.2*	*<10*	690	0.96	0.42	7.4	0.080	55	14	41	0.94	57	2.7	2.6	0.080	0.030	0.32	0.031	0.28	27
ABA201	R276929	CFD0416	13.0	14.0	Waste	Oxide	Schist	BtS	0.060	0.81	165	*<0.2*	*<10*	100	1.1	0.20	1.0	0.060	47	19	35	1.2	24	4.3	2.6	0.090	0.020	0.080	0.015	0.18	23
ABA202	R270012	CFD0384	13.0	14.0	Waste	Oxide	Schist	BtS_carb	0.050	1.1	136	*<0.2*	*<10*	1730	0.60	0.15	0.54	0.050	95	7.8	8.0	0.68	5.9	2.5	3.0	0.070	0.25	0.34	0.026	0.16	47
ABA383	KAM068572	CFD0234	225.1	226.0	Waste	Oxide	Schist	MsS	0.020	0.61	191	*<0.2*	*<10*	60	0.43	0.090	0.040	0.010	36	1.1	4.0	0.38	1.0	0.68	1.6	0.070	0.33	0.33	0.012	0.11	21
-						**Oxide**	**Schist**	**n**	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
								Max	0.38	1.4	1405	0.20	10	1730	1.1	1.7	9.8	0.10	114	19	46	3.1	57	4.3	5.8	0.11	0.33	0.75	0.074	0.53	64
								90th PCTL	0.13	1.3	832	0.20	10	634	1.1	0.65	6.4	0.080	104	17	42	2.2	32	3.9	4.6	0.11	0.29	0.61	0.031	0.34	51
								75th PCTL	0.075	1.1	388	*<0.2*	*<10*	360	0.92	0.36	4.5	0.055	77	13	38	1.3	21	3.0	3.3	0.090	0.20	0.42	0.029	0.32	42
								Median	0.050	0.90	191	*<0.2*	*<10*	150	0.72	0.26	1.3	0.030	64	9.6	30	0.94	14	2.7	2.7	0.080	0.080	0.33	0.024	0.23	30
								25th PCTL	0.025	0.77	158	*<0.2*	*<10*	100	0.58	0.17	0.37	0.030	49	6.5	12	0.46	6.3	1.9	2.4	0.070	0.040	0.25	0.016	0.16	24
								10th PCTL	0.020	0.65	77	*<0.2*	*<10*	80	0.45	0.13	0.12	0.014	45	3.1	8.0	0.31	4.8	1.1	1.8	0.060	0.030	0.13	0.011	0.11	23
								Min	0.010	0.50	25	*<0.2*	*<10*	60	0.43	0.090	0.040	*<0.01*	36	1.1	4.0	0.18	1.0	0.68	1.3	0.050	0.020	0.080	0.0080	0.10	21
Upper Transition Facies for Schist Waste Rock																															
ABA004	KAM022156	CFD0107	149.0	150.0	Waste	Upper transition	Schist	RQM	0.030	1.1	144	*<0.2*	*<10*	110	0.66	0.090	2.6	0.040	70	8.2	17	0.33	11	2.6	3.0	0.10	0.090	0.16	0.022	0.28	36
ABA027	KAM037928	CFD0099	30.0	31.0	Waste	Upper transition	Schist	BtS_carb	0.50	1.6	14	*<0.2*	*<10*	450	1.4	0.15	4.4	0.040	75	10	27	3.1	8.9	3.1	6.8	0.10	0.060	0.26	0.033	0.44	39
ABA062	KAM081561	CFD0202	58.0	58.5	Waste	Upper transition	Schist	BtS	0.10	2.4	6.4	*<0.2*	*<10*	280	1.4	3.9	4.0	0.12	55	29	134	4.0	15	4.7	8.0	0.16	0.060	0.010	0.044	1.8	26
ABA076	KAM147059	CFD0345	160.0	161.0	Waste	Upper transition	Schist	BtS	0.070	0.94	160	*<0.2*	*<10*	190	0.75	0.27	4.5	0.070	26	12	37	0.51	17	2.3	2.3	0.050	0.050	0.32	0.022	0.17	12
ABA092	KAM135149	CFR0452	10.7	12.2	Waste	Upper Transition	Schist	BtS	0.040	0.85	50	*<0.2*	*<10*	120	0.43	2.2	0.17	0.020	115	5.0	8.0	0.54	18	1.8	4.7	0.10	0.17	0.020	0.016	0.50	68
ABA124	KAM149042	CFR0559	35.1	36.6	Waste	Upper transition	Schist	BtS	0.11	1.2	9.9	*<0.2*	*<10*	680	0.45	0.23	2.4	0.030	77	9.4	35	1.4	106	2.6	4.4	0.090	0.25	0.030	0.031	0.39	39
ABA204	R270174	CFD0388	8.0	9.0	Waste	Upper transition	Schist	MsS	0.050	1.5	223	*<0.2*	*<10*	610	1.4	0.15	1.7	0.090	72	13	40	3.1	29	4.0	4.6	0.13	0.050	0.19	0.035	0.45	36
ABA205	R276797	CFD0413	115.0	116.0	Waste	Upper transition	Schist	BtS	0.020	0.81	272	*<0.2*	*<10*	60	1.0	0.24	5.1	0.030	29	11	48	1.2	5.2	2.4	2.2	0.090	0.080	0.070	0.023	0.18	16
ABA206	Q033613	CFD0407	52.0	53.0	Waste	Upper transition	Schist	BtS	0.030	2.0	44	*<0.2*	*<10*	290	1.1	0.19	3.9	0.020	62	11	27	0.58	25	2.4	5.2	0.080	0.070	0.23	0.033	0.24	32
ABA316	R270207	CFD0390	5.0	6.0	Waste	Upper Transition	Schist	MsS	0.090	1.3	22	*<0.2*	*<10*	100	0.80	0.85	3.7	0.16	58	17	28	0.75	37	3.9	3.7	0.080	0.040	0.12	0.036	0.32	29
ABA317	R270258	CFD0390	50.0	51.0	Waste	Upper Transition	Schist	BtS_carb	0.020	1.2	24	*<0.2*	*<10*	2410	1.1	0.46	2.4	0.020	109	8.2	25	4.8	8.6	2.4	5.1	0.12	0.33	0.010	0.021	0.48	63
ABA320	R270432	CFD0392	44.0	45.0	Waste	Upper Transition	Schist	BtS_carb	0.030	0.97	312	*<0.2*	10	560	0.88	0.31	3.1	0.030	105	9.0	10	1.6	11	2.5	4.2	0.11	0.25	0.18	0.020	0.32	61
ABA323	Q033713	CFD0411	24.0	25.0	Waste	Upper Transition	Schist	BtS_Carb	0.030	1.0	131	*<0.2*	10	50	1.3	0.48	6.8	0.22	56	12	51	1.7	21	3.3	3.6	0.090	0.12	0.11	0.067	0.17	27
ABA332	Q033589	CFD0407	32.0	33.0	Waste	Upper Transition	schist	BtS	0.060	1.4	25	*<0.2*	*<10*	170	1.2	0.29	2.1	0.030	73	19	35	0.91	48	3.6	4.6	0.10	0.050	0.010	0.026	0.30	36
Statistical Summary						**Upper Transition**	**Schist**	**n**	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								Max	0.50	2.4	312	*<0.2*	10	2410	1.4	3.9	6.8	0.22	115	29	134	4.8	106	4.7	8.0	0.16	0.33	0.32	0.067	1.8	68
								90th PCTL	0.11	1.9	257	*<0.2*	10	659	1.4	1.8	4.9	0.15	107	18	50	3.7	45	4.0	6.3	0.13	0.25	0.25	0.042	0.49	62
								75th PCTL	0.085	1.5	156	*<0.2*	*<10*	533	1.3	0.48	4.3	0.085	77	13	39	2.7	28	3.5	5.0	0.11	0.16	0.19	0.035	0.45	39
								Median	0.045	1.2	47	*<0.2*	*<10*	235	1.0	0.28	3.4	0.035	71	11	32	1.3	17	2.6	4.5	0.10	0.075	0.12	0.029	0.32	36
								25th PCTL	0.030	0.98	23	*<0.2*	*<10*	113	0.76	0.20	2.4	0.030	57	9.1	26	0.62	11	2.4	3.6	0.090	0.053	0.023	0.022	0.25	27
								10th PCTL	0.023	0.88	11	*<0.2*	*<10*	72	0.51	0.15	1.8	0.020	36	8.2	12	0.52	8.7	2.3	2.5	0.080	0.050	0.010	0.020	0.17	19
								Min	0.020	0.81	6.4	*<0.2*	*<10*	50	0.43	0.090	0.17	0.020	26	5.0	8.0	0.33	5.2	1.8	2.2	0.050	0.040	0.010	0.016	0.17	12
Lower Transition Facies for Schist Waste Rock																															
ABA021	KAM033153	CFD0164	148.0	149.0	Waste	Lower transition	Schist	BtS	0.020	2.7	4.1	*<0.2*	*<10*	460	0.29	0.090	1.8	0.010	18	17	103	1.4	7.6	3.4	8.7	0.12	0.050	*<0.01*	0.015	1.8	9.0
ABA024	KAM036666	CFD0087	17.0	18.0	Waste	Lower transition	Schist	BtS_carb	0.060	2.7	11	*<0.2*	*<10*	750	0.80	0.27	1.5	0.070	71	14	32	3.4	28	4.2	13	0.16	0.070	*<0.01*	0.037	1.6	38
ABA025	KAM037046	CFD0091	12.0	13.0	Waste	Lower transition	Schist	BtS	0.10	2.7	20	*<0.2*	*<10*	190	1.2	0.80	2.7	0.10	63	14	60	3.3	15	3.3	9.7	0.14	0.070	0.010	0.024	1.0	34
ABA031	KAM039252	CFD0116	75.0	76.0	Waste	Lower transition	Schist	RQM	0.020	2.3	8.3	*<0.2*	*<10*	1430	1.3	0.30	2.9	0.020	88	12	78	7.3	14	3.2	9.0	0.13	0.15	0.040	0.068	1.1	47
ABA038	KAM047995	CFD0135	153.0	154.0	Waste	Lower transition	Schist	BtS	0.040	2.2	20	*<0.2*	*<10*	270	1.1	1.5	2.9	0.090	67	14	78	4.2	9.2	2.8	8.1	0.14	0.090	0.020	0.026	1.2	36
ABA054	KAM081312	CFD0198	85.0	86.0	Waste	Lower transition	Schist	BtS	0.080	0.39	41	*<0.2*	*<10*	50	0.29	0.19	0.17	0.020	49	2.3	6.0	0.30	4.3	0.91	1.4	0.060	0.37	0.020	*<0.005*	0.21	26
ABA086	KAM133474	CFR0429	59.4	61.0	Waste	Lower transition	Schist	BtS	0.060	1.6	27	*<0.2*	*<10*	230	0.66	0.11	2.0	0.080	90	13	47	2.7	17	2.6	5.8	0.10	0.090	0.030	0.022	1.1	48
ABA208	R276736	CFD0413	61.0	62.0	Waste	Lower transition	Schist	BtS	0.050	2.3	5.3	*<0.2*	*<10*	260	1.1	0.91	2.3	0.070	78	22	41	3.8	43	4.4	7.5	0.15	0.060	0.010	0.035	1.1	40
ABA209	R270032	CFD0384	31.0	32.0	Waste	Lower transition	Schist	BtS_carb	0.060	1.2	8.6	*<0.2*	*<10*	450	0.72	2.4	2.4	0.080	83	7.3	32	3.3	6.1	2.6	4.8	0.080	0.10	0.020	0.030	0.74	44
ABA210	R276281	CFD0401	58.0	59.0	Waste	Lower transition	Schist	BtS	0.050	1.9	35	*<0.2*	*<10*	120	1.0	0.43	4.6	0.090	68	13	122	2.0	3.7	3.2	7.6	0.10	0.090	0.010	0.030	0.58	38
ABA211	R276567	CFD0409	65.0	66.0	Waste	Lower transition	Schist	BtS	0.050	2.3	24	*<0.2*	*<10*	210	0.74	0.44	2.7	0.050	45	20	87	2.6	3.2	3.5	8.9	0.11	0.050	0.010	0.026	0.35	25
ABA318	R270302	CFD0390	88.0	89.0	Waste	Lower Transition	Schist	BtS_carb	0.070	1.5	3.5	*<0.2*	*<10*	10	0.55	0.86	10	0.060	25	9.4	36	1.0	24	1.9	4.5	0.10	0.16	*<0.01*	0.023	0.060	13
ABA319	R270394	CFD0392	10.0	11.0	Waste	Lower Transition	Schist	BtS_carb	0.030	2.1	13	*<0.2*	*<10*	430	0.81	0.33	2.8	0.030	73	18	79	3.9	26	3.6	8.0	0.11	0.040	0.070	0.028	0.60	39
ABA325	R512767	CFR0724	39.6	41.2	Waste	Lower Transition	schist	BtS	0.12	1.6	15	*<0.2*	*<10*	150	0.67	0.55	1.8	0.080	56	13	63	2.5	7.3	2.4	6.2	0.12	0.23	*<0.01*	0.019	0.62	30
ABA333	R277487	CFD0426	43.0	44.0	Waste	Lower Transition	schist	BtS	0.050	1.6	39	*<0.2*	*<10*	180	1.1	0.46	0.16	*<0.01*	82	8.3	41	2.5	3.9	1.7	4.1	0.10	0.12	0.32	0.027	0.62	45
ABA335	R550437	CFD0518	25.0	26.0	Waste	Lower Transition	schist	BtS	0.050	1.7	48	*<0.2*	*<10*	160	0.95	0.27	1.4	0.080	30	15	42	2.9	22	2.5	7.7	0.16	0.31	0.070	0.023	0.090	14
ABA336	R550471	CFD0518	55.0	56.0	Waste	Lower Transition	Schist	BtS_carb	0.090	1.8	38	*<0.2*	*<10*	810	0.61	0.46	6.4	0.16	69	17	35	6.2	34	3.7	6.9	0.12	0.070	*<0.01*	0.050	0.68	36
ABA337	R550494	CFD0518	75.0	75.0	Waste	Lower Transition	schist	BtS	0.070	1.9	15	*<0.2*	*<10*	550	0.66	0.20	2.9	0.050	75	15	65	2.7	38	3.3	7.7	0.12	0.070	*<0.01*	0.019	1.1	38
ABA345	R551151	CFD0563	68.0	69.0	Waste	Lower Transition	schist	BtS	0.070	1.8	22	*<0.2*	*<10*	1050	0.72	0.30	2.8	0.15	14	17	149	4.0	7.2	2.5	5.9	0.14	0.11	*<0.01*	0.029	0.55	6.8
Statistical Summary						**Lower Transition**	**Schist**	**n**	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
								Max	0.12	2.7	48	*<0.2*	*<10*	1430	1.3	2.4	10	0.16	90	22	149	7.3	43	4.4	13	0.16	0.37	0.32	0.068	1.8	48
								90th PCTL	0.092	2.7	40	*<0.2*	*<10*	858	1.1	1.0	5.0	0.11	84	18	107	4.6	35	3.8	9.2	0.15	0.25	0.070	0.040	1.3	45
								75th PCTL	0.070	2.3	31	*<0.2*	*<10*	505	1.1	0.68	2.9	0.085	77	17	79	3.8	25	3.4	8.4	0.14	0.14	0.025	0.030	1.1	39
								Median	0.060	1.9	20	*<0.2*	*<10*	260	0.74	0.43	2.7	0.070	68	14	60	2.9	14	3.2	7.6	0.12	0.090	0.010	0.026	0.68	36
								25th PCTL	0.050	1.6	9.6	*<0.2*	*<10*	170	0.66	0.27	1.8	0.040	47	12	39	2.5	6.7	2.5	5.8	0.10	0.070	*<0.01*	0.023	0.57	25
								10th PCTL	0.028	1.4	5.1	*<0.2*	*<10*	106	0.50	0.17	1.1	0.018	23	8.1	32	1.3	3.9	1.9	4.4	0.096	0.050	*<0.01*	0.018	0.19	12
								Min	0.020	0.39	3.5	*<0.2*	*<10*	10	0.29	0.090	0.16	*<0.01*	14	2.3	6.0	0.30	3.2	0.91	1.4	0.060	0.040	*<0.01*	*<0.005*	0.060	6.8

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Fresh Facies for Schist Waste Rock																															
ABA082	KAM131674	CFR0401	15.2	16.8	Waste	Fresh	Schist	BtS	0.030	2.3	21	<0.2	<10	1060	0.75	0.10	1.8	0.040	35	22	34	3.2	33	4.0	7.9	0.10	0.050	0.010	0.016	1.3	17
ABA084	KAM132888	CFR0420	32.0	33.5	Waste	Fresh	Schist	BtS	0.060	1.7	6.8	<0.2	<10	160	0.62	0.26	4.3	0.050	74	10	22	1.6	13	2.5	6.3	0.080	0.18	0.010	0.015	1.3	40
ABA091	KAM133659	CFR0431	109.7	111.3	Waste	Fresh	Schist	BtS	0.38	1.5	22	<0.2	<10	200	0.54	0.89	2.5	0.19	60	14	27	1.2	23	2.9	6.6	0.060	0.040	0.010	0.015	1.1	31
ABA093	KAM135298	CFR0453	10.7	12.2	Waste	Fresh	Schist	BtS	0.030	2.9	41	<0.2	<10	1900	0.71	0.040	3.1	0.040	28	23	231	6.8	48	3.2	7.0	0.10	0.50	0.030	0.011	1.4	14
ABA095	KAM135693	CFR0456	10.7	12.2	Waste	Fresh	Schist	BtS	0.020	2.3	28	<0.2	<10	530	0.55	0.10	0.19	0.27	51	17	68	3.0	24	3.7	8.3	0.080	0.040	0.010	0.041	1.6	26
ABA127	KAM149916	CFR0566	109.7	111.3	Waste	Fresh	Schist	BtS_carb	0.050	2.0	19	<0.2	<10	260	0.85	0.21	2.5	0.020	65	18	67	3.5	39	3.7	6.7	0.10	0.070	0.020	0.027	1.3	31
ABA132	KAM150898	CFR0574	114.3	115.8	Waste	Fresh	Schist	BtS	0.040	2.0	40	<0.2	<10	310	0.80	0.14	2.6	0.030	52	19	91	4.6	22	3.5	7.5	0.10	0.060	0.030	0.026	1.3	25
ABA134	KAM150984	CFR0575	106.7	108.2	Waste	Fresh	Schist	BtS	0.010	1.5	25	<0.2	<10	1670	0.75	0.26	2.3	0.010	98	10	25	6.5	9.2	3.0	6.2	0.10	0.060	0.010	0.027	0.40	54
ABA212	Q033565	CFD0407	10.0	11.0	Waste	Fresh	Schist	BtS	0.040	2.9	10	<0.2	<10	360	0.70	0.35	2.0	0.090	68	20	61	2.8	21	4.6	11	0.13	0.050	<0.01	0.054	1.6	36
ABA213	R280479	CFD0497	111.0	112.0	Waste	Fresh	Schist	BtS	0.020	2.1	20	<0.2	<10	430	0.72	0.33	1.1	0.010	33	13	28	2.2	5.1	2.8	6.3	0.14	0.080	<0.01	0.0070	1.1	19
ABA214	R274802	CFD0472	47.0	48.0	Waste	Fresh	Schist	BtS	0.050	0.81	72	<0.2	<10	90	0.39	0.96	0.18	0.010	94	4.2	10	0.65	4.5	1.9	3.6	0.080	0.22	<0.01	0.014	0.48	44
ABA215	R275143	CFD0482	40.0	41.0	Waste	Fresh	Schist	BtS	0.050	2.0	133	<0.2	<10	390	1.7	0.41	4.1	0.060	53	19	170	7.2	36	3.2	4.8	0.090	0.22	0.060	0.044	1.3	28
ABA216	R276122	CFD0393	87.0	88.0	Waste	Fresh	Schist	BtS	0.020	2.7	9.8	<0.2	<10	200	1.0	0.14	1.3	0.020	14	21	153	3.1	4.6	3.2	8.7	0.12	0.080	<0.01	0.011	1.0	7.2
ABA217	R270181	CFD0388	92.0	93.0	Waste	Fresh	Schist	BtS_carb	0.020	2.2	12	<0.2	<10	540	0.68	0.15	2.7	0.040	98	14	42	2.8	18	3.7	7.2	0.18	0.050	<0.01	0.028	1.6	51
ABA218	R283622	CFD0498	28.0	29.0	Waste	Fresh	Schist	BtS	0.060	1.6	11	<0.2	<10	240	0.30	18	2.0	0.020	16	14	84	1.1	10	2.1	5.2	0.15	0.12	<0.01	0.0080	0.71	7.4
ABA219	R276979	CFD0416	57.0	58.0	Waste	Fresh	Schist	BtS	0.010	1.2	15	<0.2	<10	130	2.3	0.090	9.1	0.090	19	28	143	12	4.1	3.8	3.2	0.070	0.090	<0.01	0.020	0.40	9.9
ABA220	R276002	CFD0387	148.0	149.0	Waste	Fresh	Schist	BtS	0.040	2.1	1.4	<0.2	<10	250	0.37	0.15	2.4	0.050	14	19	166	3.1	12	2.5	5.9	0.18	0.090	<0.01	0.012	0.71	6.4
ABA221	R276317	CFD0401	129.0	130.0	Waste	Fresh	Schist	BtS	0.020	0.94	1.7	<0.2	<10	40	0.33	0.16	2.6	0.020	11	8.3	63	1.1	8.0	1.4	4.0	0.13	0.12	0.010	0.010	0.49	4.4
ABA222	R270104	CFD0386	59.0	60.0	Waste	Fresh	Schist	BtS_carb	0.030	1.9	22	<0.2	<10	290	0.57	0.24	2.4	0.040	77	13	40	2.3	17	3.4	6.3	0.12	0.060	0.010	0.031	1.4	42
ABA223	R270127	CFD0386	80.0	81.0	Waste	Fresh	Schist	MsS	0.050	1.6	64	<0.2	<10	310	0.90	0.22	3.4	0.070	75	13	42	2.1	20	3.3	5.8	0.11	0.070	0.020	0.031	0.93	40
ABA321	R270466	CFD0392	74.0	75.0	Waste	Fresh	Schist	BtS_carb	0.060	2.2	48	<0.2	<10	250	0.95	0.52	1.9	0.040	90	13	44	4.3	15	3.4	7.9	0.13	0.050	<0.01	0.030	1.4	48
ABA322	R270482	CFD0392	88.0	89.0	Waste	Fresh	Schist	BtS_carb	0.040	2.2	62	<0.2	<10	460	0.80	0.75	6.0	0.050	51	14	72	3.6	27	3.4	7.5	0.11	0.050	<0.01	0.025	1.3	28
ABA326	R512983	CFR0731	32.0	32.4	Waste	Fresh	schist	BtS	0.030	2.4	30	<0.2	<10	90	0.63	0.21	1.3	0.040	20	25	199	4.5	25	3.3	7.1	0.12	0.14	<0.01	0.022	0.44	10
ABA329	R270202	CFD0388	110.0	110.2	Waste	Fresh	Schist	BtS_carb	0.020	1.7	28	<0.2	<10	200	0.59	0.34	5.9	0.030	42	13	66	1.9	10	2.5	6.3	0.13	0.17	<0.01	0.026	1.0	21
ABA330	R276299	CFD0401	74.0	75.0	Waste	Fresh	schist	BtS	0.090	1.2	21	<0.2	<10	140	0.48	0.45	3.1	0.010	21	16	45	0.71	5.8	3.0	4.5	0.26	0.28	<0.01	0.031	0.45	11
ABA331	R276331	CFD0401	141.0	142.0	Waste	Fresh	schist	BtS	0.030	3.0	30	<0.2	<10	460	1.1	0.16	3.5	0.090	33	23	180	5.8	17	4.4	11	0.17	0.080	<0.01	0.030	1.8	18
ABA377	R279587	CFD0468	131.0	132.0	Waste	Fresh	Schist	AmBtS	0.020	0.81	1.9	<0.2	<10	110	0.49	0.16	4.8	0.010	25	9.0	19	1.8	8.4	2.6	3.0	0.18	0.090	<0.01	0.045	0.35	14
ABA415	R277001	CFD0398	49.0	50.0	Waste	Fresh	schist	BtS	0.040	1.6	9.9	<0.2	<10	80	0.39	0.050	1.2	0.010	10	19	157	3.7	14	2.2	4.5	0.13	0.080	0.010	0.0090	0.57	5.3
ABA416	R277017	CFD0398	64.0	65.0	Waste	Fresh	schist	BtS	0.020	2.0	15	<0.2	<10	300	0.56	0.13	1.9	0.020	26	14	96	2.1	8.3	3.1	7.4	0.15	0.080	<0.01	0.013	1.2	14
ABA417	R277021	CFD0398	124.0	125.0	Waste	Fresh	schist	BtS	0.020	1.6	7.4	<0.2	<10	50	0.53	0.080	2.5	0.35	17	15	99	1.4	8.5	2.2	5.8	0.17	0.13	<0.01	0.016	0.59	8.7
ABA418	R277041	CFD0398	160.0	161.0	Waste	Fresh	schist	BtS	0.030	2.2	1.7	<0.2	<10	320	0.47	0.090	2.1	0.040	10	18	120	2.2	9.4	2.7	6.4	0.14	0.080	<0.01	0.0090	1.3	5.6
Statistical Summary						**Fresh**	**Schist**	**n**	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
								Max	0.38	3.0	133	<0.2	<10	1900	2.3	18	9.1	0.35	98	28	231	12	48	4.6	11	0.26	0.50	0.060	0.054	1.8	54
								90th PCTL	0.060	2.7	62	<0.2	<10	540	1.0	0.75	4.8	0.090	90	23	170	6.5	33	3.8	8.3	0.18	0.22	0.020	0.041	1.6	44
								75th PCTL	0.050	2.2	30	<0.2	<10	410	0.80	0.35	3.2	0.055	66	19	132	4.0	22	3.4	7.4	0.15	0.13	0.010	0.030	1.3	33
								Median	0.030	2.0	21	<0.2	<10	260	0.63	0.21	2.5	0.040	35	15	67	2.8	14	3.2	6.3	0.12	0.080	<0.01	0.022	1.1	19
								25th PCTL	0.020	1.6	10.0	<0.2	<10	150	0.51	0.14	1.9	0.020	20	13	41	1.8	8.5	2.6	5.5	0.10	0.060	<0.01	0.013	0.58	10
								10th PCTL	0.020	1.2	1.9	<0.2	<10	90	0.39	0.090	1.2	0.010	14	10	25	1.1	5.1	2.2	4.0	0.080	0.050	<0.01	0.0090	0.44	6.4
								Min	0.010	0.81	1.4	<0.2	<10	40	0.30	0.040	0.18	0.010	10	4.2	10	0.65	4.1	1.4	3.0	0.060	0.040	<0.01	0.0070	0.35	4.4
Statistical Summary for Schist Waste Rock								**n**	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
								Max	0.50	3.0	1405	0.20	10	2410	2.3	18	10	0.35	115	29	231	12	106	4.7	13	0.26	0.50	0.75	0.074	1.8	68
								90th PCTL	0.10	2.4	224	0.20	10	762	1.2	0.89	5.3	0.10	94	20	144	4.6	36	4.0	8.4	0.16	0.25	0.32	0.042	1.4	48
								75th PCTL	0.060	2.1	102	<0.2	<10	455	1.0	0.46	3.8	0.080	75	18	78	3.4	24	3.4	7.4	0.13	0.14	0.13	0.031	1.1	39
								Median	0.040	1.6	25	<0.2	<10	250	0.72	0.27	2.5	0.040	58	13	42	2.2	15	3.0	5.8	0.10	0.080	0.010	0.026	0.55	30
								25th PCTL	0.030	1.1	14	<0.2	<10	125	0.56	0.15	1.7	0.020	33	9.9	28	1.1	8.2	2.5	3.7	0.085	0.060	0.010	0.016	0.32	17
								10th PCTL	0.020	0.81	6.7	<0.2	<10	80	0.43	0.098	0.19	0.010	18	7.7	13	0.54	4.8	1.9	2.6	0.070	0.048	<0.01	0.011	0.17	8.9
								Min	0.010	0.39	1.4	<0.2	<10	10	0.29	0.040	0.040	<0.01	10	1.1	4.0	0.18	1.0	0.68	1.3	0.050	0.020	<0.01	<0.005	0.060	4.4
Oxide Facies for Granite Waste Rock																															
ABA157	R305807	CFD0382	76.0	77.0	Waste	Oxide	Granite	GG	0.020	0.73	1900	<0.2	<10	100	0.54	0.070	0.030	0.020	27	1.5	4.0	0.45	3.0	2.0	1.8	0.090	0.23	0.84	0.012	0.10	15
ABA158	R305808	CFD0382	79.0	80.0	Waste	Oxide	Granite	GG	0.020	0.72	1600	<0.2	<10	50	0.52	0.060	0.030	0.030	21	2.4	3.0	0.24	2.2	2.0	1.7	0.10	0.30	0.71	0.015	0.040	11
ABA174	R305826	CFD0403	7.0	8.0	Waste	Oxide	Granite	GG	0.050	0.47	2960	<0.2	<10	30	0.35	0.070	0.060	0.040	31	1.1	3.0	1.1	1.7	1.6	1.6	0.090	0.28	0.20	0.0080	0.18	17
ABA421	I354544	CFD0053	50.3	51.0	Waste	Oxide	Granite	GG	0.060	0.43	2840	0.20	10	30	0.36	0.77	0.080	0.060	44	0.70	2.0	2.1	1.8	1.0	1.5	0.080	0.11	0.84	0.010	0.21	25
ABA423	Q033319	CFD0403	7.0	7.8	Waste	Oxide	Granite	GG	0.050	0.60	2830	<0.2	10	40	0.43	0.070	0.060	0.030	31	11	2.0	1.3	14	1.6	1.9	0.070	0.23	0.21	0.0080	0.23	18
ABA429	Q032778	CFD0394	39.7	40.0	Waste	Oxide	Granite	GG	0.030	0.54	81	<0.2	<10	100	0.63	0.10	0.050	0.010	82	2.6	5.0	3.2	2.7	1.6	2.8	0.12	0.41	0.010	0.013	0.25	45
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	0.060	0.73	2960	0.20	10	100	0.63	0.77	0.080	0.060	82	11	5.0	3.2	14	2.0	2.8	0.12	0.41	0.84	0.015	0.25	45
								90th PCTL	0.055	0.73	2900	0.20	10	100	0.59	0.44	0.070	0.050	63	6.6	4.5	2.7	8.7	2.0	2.4	0.11	0.36	0.84	0.014	0.24	35
								75th PCTL	0.050	0.69	2838	<0.2	<10	88	0.54	0.093	0.060	0.038	41	2.6	3.8	1.9	2.9	1.9	1.9	0.098	0.30	0.81	0.013	0.23	24
								Median	0.040	0.57	2365	<0.2	<10	45	0.48	0.070	0.055	0.030	31	2.0	3.0	1.2	2.5	1.6	1.7	0.090	0.26	0.46	0.011	0.20	17
								25th PCTL	0.023	0.49	1675	<0.2	<10	33	0.38	0.070	0.035	0.023	28	1.2	2.3	0.61	1.9	1.6	1.6	0.083	0.23	0.20	0.0085	0.12	15
								10th PCTL	0.020	0.45	841	<0.2	<10	30	0.36	0.065	0.030	0.015	24	0.90	2.0	0.35	1.8	1.3	1.5	0.075	0.17	0.11	0.0080	0.070	13
								Min	0.020	0.43	81	<0.2	<10	30	0.35	0.060	0.030	0.010	21	0.70	2.0	0.24	1.7	1.0	1.5	0.070	0.11	0.010	0.0080	0.040	11

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Upper Transition Facies for Granite Waste Rock																															
ABA013	KAM025898	CFD0150	81.0	82.0	Waste	Upper transition	Granite	GG	0.020	0.78	17	*<0.2*	*<10*	30	0.44	0.10	0.040	*<0.01*	73	0.60	5.0	1.2	1.1	0.70	2.7	0.15	0.38	0.020	0.013	0.16	36
ABA151	R305801	CFD0381	13.0	14.0	Waste	Upper transition	Granite	GG	0.030	0.46	2.7	*<0.2*	*<10*	90	0.13	0.090	0.080	0.010	55	1.1	8.0	2.6	3.8	1.2	2.5	0.13	0.66	*<0.01*	0.016	0.32	31
ABA152	R305802	CFD0381	35.0	36.0	Waste	Upper transition	Granite	GG	0.030	1.1	132	*<0.2*	*<10*	100	0.57	0.13	0.090	0.010	49	0.90	3.0	14	5.2	0.96	3.7	0.13	0.35	0.030	0.014	0.19	25
ABA167	R305818	CFD0394	30.0	31.0	Waste	Upper transition	Granite	GG	0.080	0.41	196	*<0.2*	*<10*	50	0.27	0.18	0.020	0.020	29	0.10	4.0	0.47	1.5	0.36	0.96	0.090	0.31	0.29	0.011	0.19	16
ABA169	R305821	CFD0399	20.0	21.0	Waste	Upper transition	Granite	GG	0.060	0.33	90	*<0.2*	*<10*	30	0.71	0.17	0.050	0.020	50	1.6	5.0	0.62	1.6	1.2	1.2	0.12	0.55	0.050	0.011	0.13	28
ABA172	R305824	CFD0396	29.0	30.0	Waste	Upper transition	Granite	GG	0.020	0.82	365	*<0.2*	*<10*	60	0.45	0.13	0.020	0.020	34	0.50	4.0	0.23	1.5	1.3	2.1	0.10	0.36	0.18	0.016	0.020	17
ABA178	R305831	CFD0400	11.0	12.0	Waste	Upper transition	Granite	GG	0.020	0.54	108	*<0.2*	*<10*	50	0.56	0.070	0.050	0.020	37	1.0	5.0	1.5	1.5	0.67	2.2	0.13	0.52	0.030	0.012	0.13	20
ABA189	CFD0399_10_20	CFD0399	10.0	20.0	Waste	Upper transition	Granite	GG	0.080	0.73	1005	*<0.2*	*<10*	50	0.80	0.13	0.050	0.050	48	1.3	2.0	0.68	2.3	1.4	2.1	0.090	0.59	0.28	0.014	0.17	27
ABA190	CFD0396_50_60	CFD0396	50.0	60.0	Waste	Upper transition	Granite	GG	0.030	0.44	156	*<0.2*	*<10*	40	0.50	0.10	0.040	0.010	36	0.80	4.0	2.0	2.3	0.93	1.7	0.090	0.33	0.070	0.0080	0.16	21
ABA191	CFD0394_31_41	CFD0394	31.0	41.0	Waste	Upper transition	Granite	GG	0.050	0.61	408	*<0.2*	*<10*	60	0.55	0.15	0.030	0.020	46	0.90	4.0	1.6	2.5	1.2	1.9	0.080	0.30	0.15	0.011	0.23	25
ABA192	CFD0394_55_66	CFD0394	55.0	66.0	Waste	Upper transition	Granite	GG	0.030	0.48	201	*<0.2*	*<10*	50	0.53	0.090	0.050	0.020	53	0.90	5.0	2.2	1.7	0.88	1.8	0.090	0.35	0.21	0.010	0.16	31
ABA195	CFD0381_4_13	CFD0381	4.0	13.0	Waste	Upper transition	Granite	GG	0.020	0.49	8.6	*<0.2*	*<10*	90	0.17	0.11	0.080	0.010	49	1.3	7.0	3.0	1.4	1.4	2.8	0.10	0.61	0.020	0.016	0.34	27
ABA196	CFD0380_36_50	CFD0380	36.0	50.0	Waste	Upper transition	Granite	GG	0.040	0.70	457	*<0.2*	*<10*	30	0.44	0.13	0.020	0.020	46	0.50	5.0	0.47	4.2	0.83	1.8	0.080	0.30	0.21	0.0070	0.16	25
ABA431	Q041083	CFD0380	30.0	30.2	Waste	Upper Transition	Granite	GG	0.010	0.66	213	*<0.2*	*<10*	30	0.42	0.27	0.050	*<0.01*	34	1.1	4.0	1.3	8.7	0.80	2.4	0.080	0.35	0.020	0.012	0.11	17
ABA434	Q032756	CFD0394	19.5	19.6	Waste	Upper Transition	Granite	GG	0.080	0.76	3020	0.30	10	120	0.61	0.12	0.070	0.030	58	1.4	3.0	1.3	9.2	1.3	2.4	0.090	0.17	0.79	0.0090	0.26	32
ABA435	Q032826	CFD0394	81.1	81.7	Waste	Upper Transition	Granite	GG	0.020	0.54	138	*<0.2*	*<10*	30	0.40	0.080	0.040	*<0.01*	41	0.80	4.0	1.3	7.8	0.67	2.1	0.090	0.30	0.13	0.0090	0.13	22
ABA436	Q032927	CFD0396	65.0	65.5	Waste	Upper Transition	Granite	GG	0.040	0.66	215	*<0.2*	*<10*	40	0.37	0.11	0.010	0.010	44	0.40	4.0	0.55	4.7	0.49	2.0	0.090	0.32	0.20	0.0090	0.13	24
Statistical Summary						**Upper Transition**	**Granite**	**n**	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
								Max	0.080	1.1	3020	0.30	10	120	0.80	0.27	0.090	0.050	73	1.6	8.0	14	9.2	1.4	3.7	0.15	0.66	0.79	0.016	0.34	36
								90th PCTL	0.080	0.80	676	*<0.2*	*<10*	94	0.65	0.17	0.080	0.024	56	1.3	5.8	2.8	8.2	1.4	2.7	0.13	0.60	0.28	0.016	0.28	31
								75th PCTL	0.050	0.73	365	*<0.2*	*<10*	60	0.56	0.13	0.050	0.020	50	1.1	5.0	2.0	4.7	1.2	2.4	0.12	0.52	0.21	0.014	0.19	28
								Median	0.030	0.61	196	*<0.2*	*<10*	50	0.45	0.12	0.050	0.020	46	0.90	4.0	1.3	2.3	0.93	2.1	0.090	0.35	0.13	0.011	0.16	25
								25th PCTL	0.020	0.48	108	*<0.2*	*<10*	30	0.40	0.10	0.030	0.010	37	0.60	4.0	0.62	1.5	0.70	1.8	0.090	0.31	0.030	0.0090	0.13	21
								10th PCTL	0.020	0.43	13	*<0.2*	*<10*	30	0.23	0.086	0.020	*<0.01*	34	0.46	3.0	0.47	1.5	0.60	1.5	0.080	0.30	0.020	0.0086	0.12	17
								Min	0.010	0.33	2.7	*<0.2*	*<10*	30	0.13	0.070	0.010	*<0.01*	29	0.10	2.0	0.23	1.1	0.36	0.96	0.080	0.17	*<0.01*	0.0070	0.020	16
Lower Transition Facies for Granite Waste Rock																															
ABA010	KAM024598	CFD0137	49.0	50.0	Waste	Lower transition	Granite	GG	0.030	0.55	2.1	*<0.2*	*<10*	90	0.16	0.080	0.11	0.010	59	1.5	7.0	3.9	1.6	1.5	3.1	0.13	0.63	*<0.01*	0.017	0.39	33
ABA154	R305804	CFD0382	10.0	11.0	Waste	Lower transition	Granite	GG	0.020	0.45	9.5	*<0.2*	*<10*	90	0.31	0.090	0.080	0.010	54	1.3	8.0	3.7	1.7	1.2	2.5	0.12	0.61	0.010	0.015	0.30	29
ABA155	R305805	CFD0382	50.0	51.0	Waste	Lower transition	Granite	GG	0.14	0.82	41	*<0.2*	*<10*	110	0.35	0.070	0.060	0.010	66	4.6	3.0	4.0	2.5	0.95	3.3	0.14	0.44	0.020	0.013	0.27	32
ABA159	R305809	CFD0383	10.0	11.0	Waste	Lower transition	Granite	GG	0.020	0.53	26	*<0.2*	*<10*	100	0.15	0.070	0.080	0.010	52	1.2	7.0	3.8	1.5	1.2	2.9	0.12	0.70	0.010	0.018	0.35	29
ABA160	R305811	CFD0383	48.0	49.0	Waste	Lower transition	Granite	GG	0.020	0.49	8.2	*<0.2*	*<10*	90	0.25	0.060	0.090	0.010	51	1.5	8.0	3.5	1.2	1.3	2.7	0.14	0.63	0.010	0.015	0.34	28
ABA164	R305815	CFD0389	10.0	11.0	Waste	Lower transition	Granite	GG	0.020	0.43	11	*<0.2*	*<10*	70	0.15	0.060	0.070	0.010	53	1.1	12	1.8	1.3	1.0	2.4	0.13	0.78	0.020	0.013	0.28	29
ABA166	R305817	CFD0389	45.0	46.0	Waste	Lower transition	Granite	GG	0.11	0.95	2320	*<0.2*	*<10*	70	1.4	1.0	0.090	0.46	41	2.4	4.0	4.8	13	2.8	3.3	0.13	0.47	0.050	0.11	0.12	22
ABA193	CFD383_115_125	CFD0383	115.0	125.0	Waste	Lower transition	Granite	GG	0.030	0.49	22	*<0.2*	*<10*	80	0.25	0.080	0.10	0.040	50	2.1	5.0	1.9	2.0	1.6	3.1	0.11	0.36	0.020	0.017	0.24	28
ABA194	CFD0382_84_94	CFD0382	84.0	94.0	Waste	Lower transition	Granite	GG	0.050	0.86	1060	*<0.2*	*<10*	140	1.2	0.060	0.030	0.030	42	3.8	3.0	2.6	1.8	2.5	2.8	0.080	0.27	0.39	0.012	0.15	20
ABA424	Q041284	CFD0382	4.0	5.0	Waste	Lower Transition	Granite	GG	0.030	0.59	22	*<0.2*	*<10*	110	0.20	0.090	0.090	0.020	52	2.3	6.0	3.5	2.5	1.4	3.0	0.10	0.60	*<0.01*	0.014	0.36	27
ABA425	Q041377	CFD0382	87.0	88.0	Waste	Lower Transition	Granite	GG	0.020	0.87	140	*<0.2*	*<10*	30	0.28	0.060	0.020	*<0.01*	35	1.3	3.0	0.35	1.9	0.48	2.5	0.090	0.32	0.11	0.011	0.12	17
ABA426	Q041396	CFD0382	103.0	104.0	Waste	Lower Transition	Granite	GG	0.020	0.94	240	*<0.2*	*<10*	30	0.38	0.080	0.020	0.020	41	1.3	3.0	0.37	1.8	0.52	2.5	0.090	0.30	0.62	0.011	0.080	21
ABA427	Q041404	CFD0382	110.0	111.0	Waste	Lower Transition	Granite	GG	0.050	0.94	461	*<0.2*	*<10*	150	0.63	0.060	0.070	0.010	29	5.0	2.0	4.8	6.2	1.8	3.7	0.070	0.25	0.25	0.012	0.14	11
ABA430	Q041069	CFD0380	18.0	18.1	Waste	Lower Transition	Granite	GG	0.12	0.41	2110	0.20	10	50	0.42	0.38	0.050	0.050	44	0.50	5.0	2.6	2.1	0.84	1.3	0.080	0.15	1.7	0.0070	0.22	24
Statistical Summary						**Lower Transition**	**Granite**	**n**	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								Max	0.14	0.95	2320	0.20	10	150	1.4	1.0	0.11	0.46	66	5.0	12	4.8	13	2.8	3.7	0.14	0.78	1.7	0.11	0.39	33
								90th PCTL	0.12	0.94	1795	*<0.2*	*<10*	131	1.0	0.29	0.097	0.047	57	4.4	8.0	4.5	5.1	2.3	3.3	0.14	0.68	0.55	0.018	0.36	31
								75th PCTL	0.050	0.87	406	*<0.2*	*<10*	108	0.41	0.088	0.090	0.028	53	2.4	7.0	3.8	2.4	1.6	3.1	0.13	0.63	0.22	0.017	0.33	29
								Median	0.030	0.57	33	*<0.2*	*<10*	90	0.30	0.075	0.075	0.010	50	1.5	5.0	3.5	1.9	1.2	2.9	0.12	0.46	0.020	0.014	0.26	27
								25th PCTL	0.020	0.49	13	*<0.2*	*<10*	70	0.21	0.060	0.053	0.010	*<0.01*	1.3	3.0	2.1	1.6	0.97	2.5	0.090	0.31	0.010	0.012	0.14	21
								10th PCTL	0.020	0.44	8.6	*<0.2*	*<10*	36	0.15	0.060	0.023	0.010	36	1.1	3.0	0.79	1.4	0.62	2.4	0.080	0.26	*<0.01*	0.011	0.12	18
								Min	0.020	0.41	2.1	*<0.2*	*<10*	30	0.15	0.060	0.020	*<0.01*	29	0.50	2.0	0.35	1.2	0.48	1.3	0.070	0.15	*<0.01*	0.0070	0.080	11
Fresh Facies for Granite Waste Rock																															
ABA012	KAM025798	CFD0147	260.0	261.0	Waste	Fresh	Granite	GG	0.030	0.58	3.3	*<0.2*	*<10*	120	0.21	0.070	0.57	0.070	63	1.9	6.0	2.6	1.5	1.7	3.7	0.12	0.30	*<0.01*	0.026	0.27	37
ABA162	R305813	CFD0385	10.0	11.0	Waste	Fresh	Granite	GG	0.020	0.42	6.8	*<0.2*	*<10*	90	0.14	0.10	0.070	0.010	42	1.2	6.0	2.9	1.5	1.0	2.5	0.12	0.70	0.020	0.015	0.31	23
ABA163	R305814	CFD0385	59.0	60.0	Waste	Fresh	Granite	GG	0.020	0.77	80	*<0.2*	*<10*	70	0.32	0.10	0.040	*<0.01*	37	2.9	5.0	2.7	3.4	0.88	2.8	0.12	0.45	0.030	0.012	0.24	19
ABA165	R305816	CFD0389	30.0	31.0	Waste	Fresh	Granite	GG	0.030	0.43	27	*<0.2*	*<10*	70	0.22	1.3	0.080	0.35	54	1.2	7.0	1.9	7.2	0.96	2.4	0.13	0.61	0.020	0.097	0.26	30
ABA168	R305819	CFD0394	88.0	89.0	Waste	Fresh	Granite	GG	0.020	0.46	29	*<0.2*	*<10*	90	0.35	0.34	0.080	0.13	81	1.4	7.0	4.1	2.7	1.1	2.9	0.16	0.48	0.010	0.045	0.31	42
ABA179	R305832	CFD0400	60.0	61.0	Waste	Fresh	Granite	GG	0.010	0.98	1355	*<0.2*	*<10*	80	1.6	0.060	0.030	0.030	60	1.4	3.0	2.6	4.6	1.7	3.4	0.13	0.39	0.030	0.014	0.22	32
ABA180	CFD0396_72_81	CFD0396	72.0	81.0	Waste	Fresh	Granite	GG	0.040	0.54	42	*<0.2*	*<10*	20	0.46	0.060	0.080	*<0.01*	57	1.6	4.0	0.45	4.2	1.0	1.8	0.10	0.33	0.22	0.014	0.080	30
ABA182	CFD0394_94_104	CFD0394	94.0	104.0	Waste	Fresh	Granite	GG	0.040	0.53	652	*<0.2*	*<10*	40	0.58	0.060	0.080	0.030	40	1.4	4.0	1.4	2.1	1.4	1.7	0.080	0.28	0.13	0.012	0.19	21
ABA186	CFD0380_2_17	CFD0380	2.0	17.0	Waste	Fresh	Granite	GG	0.020	0.42	7.5	*<0.2*	*<10*	80	0.34	0.37	0.070	0.010	44	1.4	6.0	7.4	1.3	1.2	2.5	0.10	0.56	0.010	0.016	0.29	23
ABA187	CFD0380_22_30	CFD0380	22.0	30.0	Waste	Fresh	Granite	GG	0.020	0.44	14	*<0.2*	*<10*	70	0.35	0.38	0.060	*<0.01*	42	1.1	6.0	4.8	1.2	1.1	2.4	0.11	0.46	0.010	0.015	0.26	21
ABA198	CFD0385_28_38	CFD0385	28.0	38.0	Waste	Fresh	Granite	GG	0.030	0.50	5.4	*<0.2*	*<10*	100	0.14	0.080	0.070	0.010	51	1.5	8.0	2.8	4.0	1.2	2.9	0.12	0.68	*<0.01*	0.015	0.35	27
ABA199	CFD0385_38_48	CFD0385	38.0	48.0	Waste	Fresh	Granite	GG	0.020	0.40	48	*<0.2*	*<10*	80	0.29	0.080	0.070	0.010	49	2.2	7.0	2.8	2.3	1.3	2.4	0.060	0.57	0.010	0.017	0.26	26
ABA200	CFD0385_48_58	CFD0385	48.0	58.0	Waste	Fresh	Granite	GG	0.020	0.49	81	*<0.2*	*<10*	80	0.40	0.080	0.050	0.020	49	3.4	6.0	2.6	3.9	1.2	2.5	0.060	0.50	0.020	0.015	0.25	24
ABA437	Q041055	CFD0380	5.0	6.0	Waste	Fresh	Granite	GG	0.030	0.44	5.0	*<0.2*	*<10*	90	0.35	0.31	0.080	0.020	59	1.4	7.0	8.8	1.0	1.4	3.0	0.12	0.61	*<0.01*	0.016	0.32	34
ABA438	Q041063	CFD0380	12.0	13.0	Waste	Fresh	Granite	GG	0.030	0.47	5.9	*<0.2*	*<10*	90	0.33	0.35	0.080	0.020	49	2.5	6.0	8.8	1.7	1.4	3.1	0.11	0.65	0.010	0.019	0.33	27
ABA439	Q041678	CFD0385	8.0	9.0	Waste	Fresh	Granite	GG	0.020	0.53	3.4	*<0.2*	*<10*	90	0.23	0.11	0.080	0.030	43	1.6	10	2.6	3.2	1.3	2.7	0.090	0.65	*<0.01*	0.013	0.32	23
ABA440	Q041699	CFD0385	27.0	28.0	Waste	Fresh	Granite	GG	0.020	0.44	4.6	*<0.2*	*<10*	80	0.18	0.10	0.070	0.010	56	1.4	6.0	2.5	0.80	1.2	2.8	0.10	0.85	*<0.01*	0.012	0.29	32
ABA441	Q032423	CFD0385	92.0	92.6	Waste	Fresh	Granite	GG	0.010	0.44	82	*<0.2*	*<10*	100	0.35	0.050	0.070	0.010	64	2.6	5.0	2.1	3.5	1.3	2.6	0.12	0.36	0.030	0.011	0.25	33
ABA442	Q032601	CFD0391	3.4	3.9	Waste	Fresh	Granite	GG	0.060	0.46	7.7	*<0.2*	*<10*	120	0.24	0.17	0.070	0.080	48	1.6	9.0	2.2	3.6	1.4	2.6	0.10	0.55	*<0.01*	0.016	0.29	26
ABA443	Q033167	CFD0400	60.0	61.0	Waste	Fresh	Granite	GG	0.010	1.0	1040	*<0.2*	*<10*	90	1.5	0.060	0.030	0.010	71	1.5	4.0	2.4	4.6	1.4	3.8	0.13	0.37	0.020	0.0090	0.25	40
Statistical Summary						**Fresh**	**Granite**	**n**	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
								Max	0.10	1.0	1355	*<0.2*	*<10*	120	1.6	1.3	0.57	0.35	81	3.4	10	8.8	7.2	1.7	3.8	0.16	0.85	0.22	0.097	0.35	42
								90th PCTL	0.040	0.79	691	*<0.2*	*<10*	102	0.68	0.37	0.080	0.085	65	2.6	8.1	7.5	4.6	1.5	3.4	0.13	0.68	0.040	0.028	0.32	37
								75th PCTL	0.030	0.53	80	*<0.2*	*<10*	90	0.36	0.32	0.080	0.030	59	2.0	7.0	3.2	3.9	1.4	3.0	0.12	0.62	0.023	0.016	0.31	32
								Median	0.020	0.47	20	*<0.2*	*<10*	85	0.34	0.10	0.070	0.015	50	1.5	6.0	2.6	3.0	1.2	2.7	0.12	0.53	0.010	0.015	0.27	27
								25th PCTL	0.020	0.44	5.8	*<0.2*	*<10*	78	0.23	0.068	0.068	0.010	44	1.4	5.0	2.3	1.5	1.1	2.4	0.10	0.39	*<0.01*	0.013	0.25	23
								10th PCTL	0.010	0.42	4.5	*<0.2*	*<10*	67	0.18	0.060	0.039	*<0.01*	42	1.2	4.0	1.8	1.2	1.0	2.3	0.078	0.33	*<0.01*	0.012	0.22	21
								Min	0.010	0.40	3.3	*<0.2*	*<10*	20	0.14	0.050	0.030	*<0.01*	37	1.1	3.0	0.45	0.80	0.88	1.7	0.060	0.28	*<0.01*	0.0090	0.080	19

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Statistical Summary for Granite Waste Rock								**n**	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
								n < DL	0	0	0	54	53	0	0	0	0	7	0	0	0	0	0	0	0	0	9	0	0	0
								Max	0.14	1.1	3020	0.30	10	150	1.6	1.3	0.57	0.46	82	11	12	14	14	2.8	3.8	0.16	0.85	1.7	0.11	0.39	45
								90th PCTL	0.068	0.90	1984	*<0.2*	*<10*	110	0.66	0.36	0.090	0.054	64	2.7	8.0	4.8	6.6	1.7	3.3	0.13	0.65	0.48	0.017	0.33	33
								75th PCTL	0.040	0.73	457	*<0.2*	*<10*	90	0.53	0.13	0.080	0.030	54	1.9	6.0	3.2	3.9	1.4	2.9	0.12	0.60	0.20	0.016	0.29	30
								Median	0.030	0.53	82	*<0.2*	*<10*	80	0.36	0.090	0.070	0.020	49	1.4	5.0	2.4	2.3	1.2	2.5	0.10	0.39	0.030	0.013	0.24	26
								25th PCTL	0.020	0.45	11	*<0.2*	*<10*	50	0.25	0.070	0.040	0.010	41	1.1	4.0	1.3	1.6	0.96	2.0	0.090	0.30	0.010	0.011	0.16	21
								10th PCTL	0.020	0.43	5.2	*<0.2*	*<10*	30	0.17	0.060	0.026	*<0.01*	33	0.66	3.0	0.46	1.3	0.69	1.7	0.080	0.26	*<0.01*	0.0090	0.12	17
								Min	0.010	0.33	2.1	*<0.2*	*<10*	20	0.13	0.050	0.010	*<0.01*	21	0.10	2.0	0.23	0.80	0.36	0.96	0.060	0.11	*<0.01*	0.0070	0.020	11
Oxide Facies for Other Lithologies Waste Rock																															
KAM029389	ABA017	CFD0176	96.0	97.0	Waste	Oxide	Dykes	FC	*>100*	1.3	18	*<0.2*	*<10*	230	1.2	0.13	0.22	0.070	9.3	13	2.0	0.88	1065	2.4	2.6	*<0.05*	0.26	0.070	0.036	0.26	3.6
KAM029393	ABA018	CFD0176	99.0	100.0	Waste	Oxide	Dykes	FC	0.050	1.5	110	*<0.2*	*<10*	200	1.3	0.12	0.12	0.070	7.9	9.8	1.0	1.2	2.9	2.1	3.3	*<0.05*	0.16	0.13	0.040	0.25	3.3
KAM084551	ABA056	CFD0237	181.0	181.5	Waste	Oxide	HU	HU	0.090	1.1	1890	*<0.2*	10	50	0.99	0.47	0.40	0.090	15	16	21	2.0	25	3.3	2.9	0.050	0.030	2.0	0.025	0.33	6.7
R277468	ABA306	CFD0426	26.0	27.0	Waste	Oxide	SZ	SZ	0.050	0.79	20	*<0.2*	*<10*	110	0.63	0.37	0.21	0.020	66	6.5	22	1.1	7.9	1.4	2.5	0.070	0.23	0.050	*<0.005*	0.28	38
Statistical Summary						**Oxide**	**Other Lithologies**	**n**	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
								Max	100	1.5	1890	*<0.2*	10	230	1.3	0.47	0.40	0.090	66	16	22	2.0	1065	3.3	3.3	0.070	0.26	2.0	0.040	0.33	38
								90th PCTL	70	1.4	1356	*<0.2*	10	221	1.2	0.44	0.35	0.084	50	15	22	1.7	753	3.0	3.2	0.064	0.25	1.4	0.039	0.32	29
								75th PCTL	25	1.3	555	*<0.2*	*<10*	208	1.2	0.40	0.27	0.075	27	14	21	1.4	285	2.6	3.0	0.055	0.24	0.60	0.037	0.29	15
								Median	0.070	1.2	65	*<0.2*	*<10*	155	1.1	0.25	0.22	0.070	12	11	12	1.1	17	2.3	2.8	*<0.05*	0.20	0.10	0.031	0.27	5.2
								25th PCTL	0.050	0.99	19	*<0.2*	*<10*	95	0.90	0.13	0.19	0.058	9.0	9.0	1.8	1.0	6.7	2.0	2.6	*<0.05*	0.13	0.065	0.020	0.26	3.5
								10th PCTL	0.050	0.87	19	*<0.2*	*<10*	68	0.74	0.12	0.15	0.035	8.3	7.5	1.3	0.94	4.4	1.6	2.5	*<0.05*	0.069	0.056	0.011	0.25	3.4
								Min	0.050	0.79	18	*<0.2*	*<10*	50	0.63	0.12	0.12	0.020	7.9	6.5	1.0	0.88	2.9	1.4	2.5	*<0.05*	0.030	0.050	*<0.005*	0.25	3.3
Upper Transition Facies for Other Lithologies Waste Rock																															
KAM145425	ABA072	CFD0339	10.0	11.0	Waste	Upper transition	Dykes	FC	0.070	1.6	1165	*<0.2*	10	430	2.5	0.30	0.070	0.13	47	15	8.0	6.4	4.5	4.2	5.4	0.070	0.15	0.94	0.035	0.66	22
Q033703	ABA303	CFD0411	15.0	16.0	Waste	Upper transition	dykes	DIOR	0.15	0.80	194	*<0.2*	*<10*	280	0.59	0.44	0.10	0.31	63	0.80	2.0	1.9	6.3	1.6	3.4	0.11	1.2	0.070	0.020	0.22	34
Q034859	ABA311	CFD0473	164.0	165.0	Waste	Upper transition	dykes	FC	0.080	4.0	196	*<0.2*	*<10*	780	1.9	0.050	0.95	0.10	26	35	9.0	15	31	6.3	11	0.20	0.34	0.090	0.046	0.63	12
R273647	ABA305	CFD0456	55.0	56.0	Waste	Upper transition	Fault	FLT	0.060	2.7	450	*<0.2*	*<10*	200	1.5	0.13	0.28	0.020	17	17	66	12	13	3.2	6.0	0.14	0.040	0.12	0.033	0.81	6.5
KAM019714	ABA061	CFD0083	8.0	9.0	Waste	Upper transition	Metabasalt/ Amphibolite	Amph	0.030	1.3	8.1	*<0.2*	*<10*	190	0.54	0.13	1.2	0.060	76	9.2	25	1.1	7.9	2.1	4.3	0.10	0.15	*<0.01*	0.010	0.72	42
KAM035755	ABA022	CFD0080	122.0	123.0	Waste	Upper transition	YO	YO	0.10	1.3	1200	0.40	10	400	1.1	0.34	5.0	0.070	43	16	41	1.2	21	3.0	4.0	0.080	0.040	0.33	0.046	0.29	22
R545623	ABA368	CFD0524	92.0	92.6	Waste	Upper Transition	Yx	Yx	0.020	1.1	87	*<0.2*	*<10*	110	1.2	0.10	0.10	0.020	49	6.6	32	3.1	2.6	1.6	4.3	0.080	0.29	0.20	0.013	0.56	26
Statistical Summary						**Upper Transition**	**Other Lithologies**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.15	4.0	1200	0.40	10	780	2.5	0.44	5.0	0.31	76	35	66	15	31	6.3	11	0.20	1.2	0.94	0.046	0.81	42
								90th PCTL	0.12	3.2	1179	0.28	10	570	2.1	0.38	2.7	0.20	68	24	51	13	25	5.0	8.1	0.16	0.70	0.57	0.046	0.76	37
								75th PCTL	0.090	2.1	808	*<0.2*	10	415	1.7	0.32	1.1	0.12	56	16	37	9.1	17	3.7	5.7	0.13	0.32	0.27	0.041	0.69	30
								Median	0.070	1.3	196	*<0.2*	*<10*	280	1.2	0.13	0.28	0.070	47	15	25	3.1	7.9	3.0	4.3	0.10	0.15	0.12	0.033	0.63	22
								25th PCTL	0.045	1.2	140	*<0.2*	*<10*	195	0.83	0.12	0.10	0.040	35	7.9	8.5	1.5	5.4	1.9	4.1	0.080	0.095	0.080	0.017	0.43	17
								10th PCTL	0.026	0.97	55	*<0.2*	*<10*	158	0.57	0.080	0.088	0.020	23	4.3	5.6	1.1	3.7	1.6	3.8	0.076	0.040	0.046	0.012	0.26	9.7
								Min	0.020	0.80	8.1	*<0.2*	*<10*	110	0.54	0.050	0.070	0.020	17	0.80	2.0	1.1	2.6	1.6	3.4	0.070	0.040	*0.010*	0.010	0.22	6.5
Lower Transition Facies for Other Lithologies Waste Rock																															
R282332	ABA312	CFD0474	37.0	38.0	Waste	Lower transition	dykes	IV	0.050	2.9	5.0	*<0.2*	*<10*	450	0.34	0.050	1.8	0.080	29	14	17	3.8	12	3.6	8.0	0.090	0.63	*<0.01*	0.021	0.47	16
Q035862	ABA313	CFD0491	124.0	125.0	Waste	Lower transition	dykes	IV	0.040	1.9	140	*<0.2*	*<10*	320	1.5	0.060	0.15	0.12	39	15	14	3.2	14	3.4	5.1	0.12	0.36	0.26	0.029	0.46	22
R283583	ABA449	CFD0496	90.0	91.0	Waste	Lower Transition	Metabasalt	MBSLT	0.43	0.76	78	*<0.2*	10	60	1.6	0.39	5.1	0.45	37	18	12	1.6	7.4	4.1	2.5	0.10	0.040	0.050	0.021	0.45	18
R283583	ABA304	CFD0496	90.0	91.0	Waste	Lower transition	Metabasalt/ Amphibolite	MBSLT	0.40	0.79	78	*<0.2*	*<10*	60	1.4	0.37	5.4	0.45	36	18	13	1.5	7.2	4.2	2.4	0.10	0.040	0.070	0.019	0.47	17
Q033764	ABA308	CFD0411	70.0	71.0	Waste	Lower transition	YC	YC	0.030	1.1	128	*<0.2*	*<10*	110	1.5	0.66	5.1	0.10	55	14	32	4.9	9.6	3.9	3.3	0.11	0.030	0.050	0.026	0.27	26
R276691	ABA310	CFD0413	21.0	22.0	Waste	Lower transition	Ylim	Ylim	0.010	0.72	84	*<0.2*	*<10*	160	0.87	0.18	1.1	0.060	82	6.5	6.0	0.59	4.0	1.7	1.7	0.11	0.15	0.12	0.0090	0.25	45
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
								Max	0.43	2.9	140	*<0.2*	10	450	1.6	0.66	5.4	0.45	82	18	32	4.9	14	4.2	8.0	0.12	0.63	0.26	0.029	0.47	45
								90th PCTL	0.42	2.4	134	*<0.2*	10	385	1.6	0.53	5.2	0.45	68	18	25	4.3	13	4.1	6.5	0.12	0.50	0.19	0.028	0.47	35
								75th PCTL	0.31	1.7	117	*<0.2*	*<10*	280	1.5	0.39	5.1	0.37	51	17	16	3.7	12	4.0	4.6	0.11	0.31	0.11	0.025	0.47	25
								Median	0.045	0.93	81	*<0.2*	*<10*	135	1.4	0.28	3.5	0.11	38	14	14	2.4	8.5	3.8	2.9	0.11	0.095	0.060	0.021	0.46	20
								25th PCTL	0.033	0.77	78	*<0.2*	*<10*	73	0.99	0.090	1.2	0.085	36	14	12	1.5	7.3	3.5	2.4	0.10	0.040	0.050	0.020	0.32	17
								10th PCTL	0.020	0.74	42	*<0.2*	*<10*	60	0.61	0.055	0.60	0.070	32	10	9.0	1.0	5.6	2.6	2.0	0.095	0.035	0.030	0.014	0.26	16
								Min	0.010	0.72	5.0	*<0.2*	*<10*	60	0.34	0.050	0.15	0.060	29	6.5	6.0	0.59	4.0	1.7	1.7	0.090	0.030	*<0.01*	0.0090	0.25	16
Fresh Facies for Other Lithologies Waste Rock																															
R304353	ABA349	CFD0541	90.0	91.0	Waste	Fresh	IV	IV	0.020	1.6	28	*<0.2*	*<10*	120	0.41	0.040	0.83	0.040	33	12	2.0	0.71	3.4	2.9	4.8	0.060	0.47	*<0.01*	0.016	0.22	16
R304282	ABA352	CFD0539	90.0	91.0	Waste	Fresh	IV	IV	0.040	2.1	5.0	*<0.2*	*<10*	170	0.23	0.13	2.9	0.10	40	13	16	0.94	13	3.4	6.4	0.070	0.48	*<0.01*	0.028	0.35	21
KAM133438	ABA087	CFR0429	10.7	12.2	Waste	Fresh	Mafic/ Ultramafic	RU	0.030	1.5	9.0	*<0.2*	*<10*	600	0.76	0.26	2.4	0.020	43	33	324	8.4	14	3.2	6.3	0.080	0.030	0.010	0.023	1.1	24
R277453	ABA307	CFD0423	81.0	82.0	Waste	Fresh	Mafic/ Ultramafic	RU	0.030	3.0	29	*<0.2*	*<10*	690	1.2	0.13	3.1	0.030	46	30	413	11	11	3.7	9.2	0.13	0.060	0.010	0.021	1.5	26
R274909	ABA447	CFD0472	143.2	144.0	Waste	Fresh	Metabasalt	MBSLT	0.020	2.6	142	*<0.2*	*<10*	150	1.9	0.070	1.5	*<0.01*	23	20	340	6.2	5.7	3.3	7.6	0.11	0.13	0.070	0.018	1.0	13
R274918	ABA448	CFD0472	150.0	151.0	Waste	Fresh	Metabasalt	MBSLT	0.010	0.91	3.6	*<0.2*	*<10*	30	0.22	0.29	2.0	*<0.01*	14	2.4	15	0.75	6.0	1.2	2.6	0.23	0.22	*<0.01*	0.049	0.070	7.0
R293475	ABA450	CFR0730	91.4	93.0	Waste	Fresh	Metabasalt	MBSLT	0.040	3.1	3.6	*<0.2*	*<10*	300	0.52	0.20	3.3	0.060	30	16	23	5.9	13	4.4	9.4	0.13	0.28	*<0.01*	0.026	0.80	14
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.040	3.1	142	*<0.2*	*<10*	690	1.9	0.29	3.3	0.10	46	33	413	11	14	4.4	9.4	0.23	0.48	0.070	0.049	1.5	26
								90th PCTL	0.040	3.0	74	*<0.2*	*<10*	636	1.5	0.27	3.2	0.076	44	31	369	9.3	13	4.0	9.3	0.17	0.47	0.034	0.036	1.3	24
								75th PCTL	0.035	2.8	29	*<0.2*	*<10*	450	0.98	0.23	3.0	0.050	42	25	332	7.3	13	3.6	8.4	0.13	0.38	0.010	0.027	1.0	22
								Median	0.030	2.1	9.0	*<0.2*	*<10*	170	0.52	0.13	2.4	0.030	33	16	23	5.9	11	3.3	6.4	0.11	0.22	*<0.01*	0.023	0.80	16
								25th PCTL	0.020	1.5	4.3	*<0.2*	*<10*	135	0.32	0.10	1.8	0.015	27	12	16	0.85	5.9	3.0	5.6	0.075	0.095	*<0.01*	0.020	0.29	13
								10th PCTL	0.016	1.3	3.6	*<0.2*	*<10*	84	0.23	0.058	1.2	*<0.01*	19	7.9	9.8	0.73	4.8	2.2	3.9	0.066	0.048	*<0.01*	0.017	0.16	10
								Min	0.010	0.91	3.6	*<0.2*	*<10*	30	0.22	0.040	0.83	*<0.01*	14	2.4	2.0	0.71	3.4	1.2	2.6	0.060	0.030	*<0.01*	0.016	0.070	7.0
Statistical Summary for Other Lithologies Waste Rock								**n**	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	0	0	0	23	20	0	0	0	0	2	0	0	0	0	0	0	0	2	0	6	1	0	0
								Max	100	4.0	1890	0.40	10	780	2.5	0.66	5.4	0.45	82	35	413	15	1065	6.3	11	0.23	1.2	2.0	0.049	1.5	45
								90th PCTL	0.33	2.9	951	*<0.2*	*<10*	555	1.8	0.43	5.1	0.26	65	27	247	9.9	24	4.2	8.8	0.14	0.48	0.31	0.044	0.96	37
								75th PCTL	0.083	2.2	155	*<0.2*	*<10*	340	1.5	0.35	3.0	0.10	47	17	32	6.0	13	3.8	6.4	0.11	0.30	0.12	0.034	0.68	26
								Median	0.045	1.4	81	*<0.2*	*<10*	195	1.1	0.16	1.1	0.070	38	14	17	1.9	8.8	3.2	4.3	0.10	0.16	0.070	0.024	0.46	20
								25th PCTL	0.030	1.0	16	*<0.2*	*<10*	110	0.58	0.12	0.22	0.028	25	9.7	8.8	1.1	5.9	2.1	2.8	0.070	0.040	*<0.01*	0.019	0.27	12
								10th PCTL	0.020	0.79	5.0	*<0.2*	*<10*	60	0.36	0.053	0.11	0.020	14	6.5	2.0	0.79	3.6	1.6	2.5	0.053	0.033	*<0.01*	0.011	0.23	6.6
								Min	0.010	0.72	3.6	*<0.2*	*<10*	30	0.22	0.040	0.070	*<0.01*	7.9	0.80	1.0	0.59	2.6	1.2	1.7	*<0.05*	0.030	*<0.01*	*<0.005*	0.070	3.3

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Oxide Facies for Gneiss Waste Rock																																				
ABA001	KAM000219	CFD0002	21.0	22.0	Waste	Oxide	Gneiss	FG	2.4	0.030	544	1.1	0.010	0.050	7.9	170	13	11	*<0.001*	*<0.01*	16	1.5	0.70	0.70	17	*<0.01*	0.010	30	*<0.005*	0.81	29	10	0.23	12	31	5.0
ABA043	KAM050495	CFD0152	149.0	150.0	Waste	Oxide	Gneiss	MxF	3.0	0.10	133	0.64	0.010	0.13	0.60	30	7.7	17	*<0.001*	*<0.01*	2.9	0.30	0.40	0.30	20	*<0.01*	*<0.01*	38	*<0.005*	0.11	2.4	1.0	0.33	11	5.0	10
ABA052	KAM079466	CFD0254	72.0	73.0	Waste	Oxide	Gneiss	MxF	1.3	0.060	136	0.45	0.11	0.10	1.9	80	3.2	9.5	*<0.001*	*<0.01*	0.63	1.3	0.70	0.30	12	*<0.01*	0.020	26	*<0.005*	0.060	1.8	4.0	0.090	14	8.0	7.2
ABA063	KAM125214	CFD0307	10.0	11.0	Waste	Oxide	Gneiss	MxF	3.9	0.31	380	1.6	0.080	0.34	2.6	390	2.1	47	0.0010	*<0.01*	1.1	2.0	0.80	1.4	8.9	*<0.01*	0.17	32	0.059	0.57	7.3	9.0	0.20	19	19	8.4
ABA064	KAM125257	CFD0307	49.0	50.0	Waste	Oxide	Gneiss	MxF	1.7	0.050	204	0.22	0.020	0.16	1.6	140	8.1	15	*<0.001*	*<0.01*	22	0.40	0.50	0.20	6.0	*<0.01*	0.060	38	*<0.005*	0.16	3.8	6.0	0.60	14	10	15
ABA080	KAM115505	CFR0360	25.9	27.4	Waste	Oxide	Gneiss	MxF	1.1	0.020	183	0.90	*<0.01*	*<0.05*	6.3	210	7.6	6.4	*<0.001*	*<0.01*	3.2	1.3	0.50	1.3	11	*<0.01*	*<0.01*	35	*<0.005*	0.16	11	8.0	0.58	13	8.0	7.1
ABA081	KAM117096	CFR0384	22.9	24.4	Waste	Oxide	Gneiss	MxF	2.2	0.040	489	1.9	0.010	0.060	1.9	220	13	12	*<0.001*	*<0.01*	2.0	1.3	0.40	0.40	9.9	*<0.01*	*<0.01*	33	0.0060	0.12	13	6.0	0.45	15	23	2.4
ABA083	KAM119516	CFR0418	19.8	21.3	Waste	Oxide	Gneiss	MxF	2.3	0.090	138	1.2	0.060	0.33	1.7	60	4.9	21	*<0.001*	*<0.01*	1.4	0.80	0.60	0.90	12	*<0.01*	*<0.01*	41	0.010	0.14	1.4	4.0	1.1	14	12	14
ABA085	KAM120107	CFR0425	15.2	16.8	Waste	Oxide	Gneiss	MxM	1.8	0.070	309	2.9	0.010	0.10	4.7	170	6.4	16	*<0.001*	*<0.01*	2.4	0.70	0.40	0.20	11	*<0.01*	0.010	35	0.0070	0.15	4.5	5.0	0.50	14	18	7.8
ABA096	KAM137284	CFR0468	32.0	33.5	Waste	Oxide	Gneiss	MxF	5.3	0.37	292	1.3	0.050	0.62	6.5	380	33	55	*<0.001*	0.010	3.1	2.1	0.60	1.4	22	*<0.01*	0.23	26	0.095	0.40	6.2	13	0.52	14	18	6.5
ABA104	KAM139298	CFR0482	10.7	12.2	Waste	Oxide	Gneiss	MxF	1.7	0.020	317	1.3	*<0.01*	0.10	3.6	120	22	14	*<0.001*	*<0.01*	14	1.0	0.50	0.40	9.0	*<0.01*	0.010	36	*<0.005*	0.28	12	5.0	0.69	13	21	2.9
ABA136	KAM151967	CFR0584	109.7	111.3	Waste	Oxide	Gneiss	MxF	1.5	0.020	363	1.5	*<0.01*	*<0.05*	6.0	160	11	8.7	*<0.001*	0.010	30	1.3	0.50	0.80	11	*<0.01*	0.010	37	*<0.005*	0.39	8.5	7.0	0.58	15	17	5.7
ABA137	KAM151932	CFR0584	61.0	62.5	Waste	Oxide	Gneiss	MxF	2.6	0.25	228	2.5	0.060	0.15	6.3	180	3.8	31	*<0.001*	0.010	1.3	1.6	0.20	1.5	17	*<0.01*	0.030	32	0.020	0.29	4.6	11	0.94	12	11	8.1
ABA138	KAM152219	CFR0586	155.5	157.0	Waste	Oxide	Gneiss	MxF	1.5	0.040	290	2.1	0.030	0.050	7.4	150	9.5	10	*<0.001*	0.020	1.7	0.60	0.40	0.30	14	*<0.01*	0.010	33	*<0.005*	0.10	2.4	3.0	0.69	7.7	17	5.8
ABA144	KAM152716	CFR0591	30.5	32.0	Waste	Oxide	Gneiss	MxF	1.4	0.020	129	1.4	*<0.01*	0.070	2.1	60	6.5	11	0.0010	0.020	3.3	0.30	0.40	0.90	23	*<0.01*	0.020	36	*<0.005*	0.10	3.6	1.0	0.39	12	5.0	10
ABA145	KAM153015	CFR0594	61.0	62.5	Waste	Oxide	Gneiss	MxF	2.0	0.090	190	2.0	0.060	0.20	2.0	70	3.8	12	*<0.001*	0.13	1.4	0.40	0.40	2.3	41	*<0.01*	0.060	35	0.0050	0.12	7.4	3.0	2.5	14	6.0	11
ABA146	KAM153091	CFR0594	164.6	166.1	Waste	Oxide	Gneiss	MxF	5.9	0.070	1160	2.9	*<0.01*	*<0.05*	19	180	5.8	9.5	*<0.001*	0.020	25	4.2	0.70	0.90	28	*<0.01*	0.010	33	*<0.005*	0.43	20	18	0.43	18	12	6.4
ABA149	KAM153152	CFR0595	61.0	62.5	Waste	Oxide	Gneiss	MxF	1.5	0.13	110	2.0	0.090	0.17	2.6	60	6.0	12	*<0.001*	0.060	0.70	0.40	0.30	0.70	37	*<0.01*	0.020	38	0.0050	0.060	7.7	2.0	2.1	13	5.0	9.1
ABA224	R277421	CFD0423	53.0	54.0	Waste	Oxide	Gneiss	MxM	5.2	0.31	605	1.5	*<0.01*	*<0.05*	34	680	11	39	0.0010	0.010	42	8.8	1.2	3.1	11	*<0.01*	0.10	15	0.029	2.3	19	47	0.39	28	45	2.0
ABA225	R272412	CFD0436	9.0	10.0	Waste	Oxide	Gneiss	FG	2.9	0.15	178	0.15	0.040	0.17	2.6	80	5.8	63	*<0.001*	0.010	4.1	1.2	0.60	1.7	9.5	*<0.01*	0.030	41	0.024	0.39	4.6	6.0	0.24	13	15	7.2
ABA226	R272445	CFD0436	38.0	39.0	Waste	Oxide	Gneiss	FG	6.0	1.2	475	0.47	0.030	*<0.05*	48	300	5.9	87	*<0.001*	0.010	2.4	6.3	0.50	2.2	15	*<0.01*	0.010	26	0.071	0.66	3.6	37	1.0	16	32	8.3
ABA227	R272537	CFD0436	120.0	121.0	Waste	Oxide	Gneiss	MxF	2.3	0.070	226	0.24	0.050	0.080	0.80	170	7.1	20	*<0.001*	0.010	2.6	0.80	0.40	1.2	8.9	*<0.01*	0.020	38	0.0070	0.16	6.7	3.0	0.19	11	16	4.7
ABA228	R271769	CFD0425	80.0	81.0	Waste	Oxide	Gneiss	MxF	3.3	0.21	171	0.24	0.050	0.89	1.7	180	6.4	26	*<0.001*	0.010	0.72	1.1	0.40	3.8	98	*<0.01*	*<0.01*	30	0.033	0.17	2.9	7.0	0.42	9.9	13	12
ABA229	R272589	CFD0436	166.0	167.0	Waste	Oxide	Gneiss	MxF	2.1	0.020	277	0.88	0.010	0.050	1.2	110	10	10	*<0.001*	0.010	5.6	0.70	0.20	0.40	31	*<0.01*	0.030	32	*<0.005*	0.13	9.9	3.0	0.17	8.6	7.0	2.6
ABA230	R280455	CFD0497	90.0	91.0	Waste	Oxide	Gneiss	MxM	1.2	0.10	164	4.2	0.040	0.38	2.1	50	6.8	14	*<0.001*	0.12	0.47	0.50	0.40	0.40	28	*<0.01*	0.030	36	0.0050	0.090	7.9	6.0	0.19	14	9.0	12
ABA231	R277177	CFD0421	47.0	48.0	Waste	Oxide	Gneiss	MxM	2.0	0.040	203	0.25	0.010	0.050	4.7	300	8.4	8.9	*<0.001*	*<0.01*	9.6	1.7	0.40	0.40	7.3	*<0.01*	0.030	32	*<0.005*	0.20	1.3	6.0	0.15	13	12	9.0
ABA232	R277505	CFD0426	58.0	59.0	Waste	Oxide	Gneiss	MxM	1.0	0.010	120	0.45	*<0.01*	0.10	1.4	70	7.1	5.5	*<0.001*	0.010	8.7	0.70	0.50	0.40	11	*<0.01*	0.020	40	*<0.005*	0.11	3.9	5.0	0.15	15	5.0	6.6
ABA233	R277739	CFD0431	118.0	119.0	Waste	Oxide	Gneiss	MxF	1.3	0.030	337	0.61	0.010	0.050	2.5	80	13	17	*<0.001*	0.010	14	0.50	0.30	0.30	6.8	*<0.01*	0.020	36	*<0.005*	0.26	9.1	5.0	0.50	9.6	12	5.1
ABA234	R277403	CFD0423	37.0	38.0	Waste	Oxide	Gneiss	MxM	1.5	0.060	153	0.83	0.030	0.28	1.0	100	7.7	18	*<0.001*	0.010	1.5	0.60	0.40	0.40	5.0	*<0.01*	0.020	41	0.0060	0.11	4.5	3.0	0.080	13	11	11
ABA235	R277137	CFD0421	11.0	12.0	Waste	Oxide	Gneiss	MxM	3.3	0.21	230	0.38	0.020	0.090	5.6	470	5.2	26	*<0.001*	*<0.01*	15	1.9	0.70	2.0	9.8	*<0.01*	0.31	34	0.016	0.36	2.2	8.0	0.22	19	19	5.8
ABA380	KAM075906	CFD0216	90.0	91.0	Waste	Oxide	Gneiss	MxF	0.90	0.020	35	3.9	0.010	0.080	0.50	40	20	11	*<0.001*	*<0.01*	52	0.20	0.30	0.20	11	*<0.01*	0.020	40	*<0.005*	0.29	8.7	*<1*	0.18	7.4	6.0	3.6
ABA382	KAM067845	CFD0221	211.0	212.0	Waste	Oxide	Gneiss	FG	1.6	0.29	196	1.7	0.010	0.090	0.40	80	18	14	*<0.001*	0.040	2.3	0.50	0.60	0.40	34	*<0.01*	0.010	40	*<0.005*	0.090	7.4	1.0	0.16	16	10	17
ABA384	KAM068794	CFD0238	227.0	228.0	Waste	Oxide	Gneiss	FG	1.5	0.010	224	0.43	0.010	*<0.05*	1.4	190	7.8	4.0	*<0.001*	*<0.01*	8.7	1.4	0.50	1.5	20	*<0.01*	*<0.01*	43	*<0.005*	0.29	14	8.0	0.19	14	13	17
ABA393	KAM030104	CFR0109	50.9	52.4	Waste	Oxide	Gneiss	FG	1.4	0.020	156	1.2	*<0.01*	*<0.05*	2.2	120	17	8.4	*<0.001*	0.010	6.6	0.90	0.40	0.80	22	*<0.01*	0.060	34	*<0.005*	0.24	18	4.0	0.71	11	9.0	5.0
Statistical Summary						**Oxide**	**Gneiss**	**n**	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
								Max	6.0	1.2	1160	4.2	0.11	0.89	48	680	33	87	0.0010	0.13	52	8.8	1.2	3.8	98	*0.010*	0.31	43	0.095	2.3	29	47	2.5	28	45	17
								90th PCTL	4.8	0.30	485	2.8	0.060	0.34	7.8	356	17	45	*0.0010*	0.034	24	2.1	0.70	2.1	33	*0.010*	0.088	41	0.032	0.53	17	12	1.00	17	22	13
								75th PCTL	2.8	0.15	315	1.8	0.048	0.17	5.9	188	11	21	*0.0010*	0.010	13	1.5	0.60	1.4	22	*0.010*	0.030	38	0.0093	0.34	9.7	8.0	0.60	15	18	10
								Median	1.9	0.065	214	1.2	0.010	0.090	2.4	145	7.7	14	*0.0010*	0.010	3.1	0.95	0.45	0.75	12	*0.010*	0.020	35	*0.0050*	0.17	7.0	5.5	0.41	13	12	7.2
								25th PCTL	1.5	0.023	158	0.46	0.010	0.050	1.6	80	5.9	10	*0.0010*	*0.010*	1.5	0.53	0.40	0.40	9.8	*0.010*	0.010	32	*0.0050*	0.11	3.7	3.0	0.19	12	8.3	5.3
								10th PCTL	1.2	0.020	130	0.24	*0.010*	*0.050*	0.86	60	4.1	8.5	*0.0010*	*0.010*	0.82	0.40	0.30	0.30	7.8	*0.010*	*0.010*	27	*0.0050*	0.093	2.2	1.3	0.15	9.7	5.3	3.1
								Min	0.90	0.010	35	0.15	*0.010*	*0.050*	0.40	30	2.1	4.0	*0.0010*	*0.010*	0.47	0.20	0.20	0.20	5.0	*0.010*	*0.010*	15	*0.0050*	0.060	1.3	*1.0*	0.080	7.4	5.0	2.0
Upper Transition Facies for Gneiss Waste Rock																																				
ABA016	KAM029087	CFD0175	145.0	146.0	Waste	Upper transition	Gneiss	MxF	2.2	0.080	365	0.45	0.010	*<0.05*	4.2	370	19	10	*<0.001*	*<0.01*	4.1	4.6	0.70	0.90	29	*<0.01*	0.030	31	*<0.005*	0.13	4.3	25	0.15	12	28	23
ABA042	KAM050492	CFD0152	146.0	147.0	Waste	Upper transition	Gneiss	MxF	1.4	0.030	137	0.16	0.010	0.15	0.60	40	5.2	17	*<0.001*	*<0.01*	1.8	0.20	0.30	0.20	27	*<0.01*	*<0.01*	38	*<0.005*	0.090	3.5	1.0	0.21	9.0	3.0	7.3
ABA057	KAM096548	CFD0269	33.0	34.0	Waste	Upper transition	Gneiss	FG	1.1	0.020	579	0.50	0.010	0.050	1.6	150	8.5	18	*<0.001*	*<0.01*	32	0.50	0.20	0.70	19	*<0.01*	0.010	32	*<0.005*	0.18	7.3	8.0	0.72	6.8	9.0	6.4
ABA059	KAM097012	CFD0272	17.0	18.0	Waste	Upper transition	Gneiss	FG	2.7	0.070	445	0.72	0.070	0.18	3.7	190	32	25	*<0.001*	*<0.01*	7.7	1.3	0.50	1.0	11	*<0.01*	*<0.01*	34	0.0080	0.34	6.0	7.0	0.50	14	14	9.9
ABA060	KAM097065	CFD0272	65.0	66.0	Waste	Upper transition	Gneiss	FG	4.6	0.090	257	2.0	0.010	0.060	0.90	170	12	18	*<0.001*	0.040	4.9	0.60	0.30	1.1	27	*<0.01*	0.010	29	*<0.005*	0.15	7.3	2.0	0.62	7.4	11	9.5
ABA069	KAM145287	CFD0338	123.0	124.0	Waste	Upper transition	Gneiss	FG	0.60	0.020	286	1.1	*<0.01*	*<0.05*	0.80	130	19	13	*<0.001*	0.020	5.4	0.50	0.50	0.60	11	*<0.01*	0.040	35	*<0.005*	0.24	22	2.0	0.21	15	22	4.0
ABA101	KAM137634	CFR0470	109.7	111.3	Waste	Upper transition	Gneiss	MxF	2.0	0.16	421	1.8	*<0.01*	0.080	6.4	460	21	11	*<0.001*	0.070	3.9	4.2	0.70	1.6	48	*<0.01*	0.080	22	0.0080	0.25	3.2	30	0.69	21	26	10
ABA105	KAM139327	CFR0482	50.3	51.8	Waste	Upper transition	Gneiss	MxF	1.7	0.020	295	1.5	*<0.01*	0.080	3.5	120	9.8	11	*<0.001*	*<0.01*	4.5	0.80	0.40	0.40	7.6	*<0.01*	0.010	34	*<0.005*	0.29	13	4.0	0.63	13	16	2.9
ABA141	KAM152499	CFR0589	77.7	79.3	Waste	Upper transition	Gneiss	MxF	3.2	0.43	236	2.2	0.050	0.26	7.9	280	4.1	43	*<0.001*	0.060	1.1	1.5	0.30	1.0	34	*<0.01*	0.020	32	0.052	0.24	4.4	14	1.2	13	18	16
ABA147	KAM152978	CFR0594	10.7	12.2	Waste	Upper transition	Gneiss	MxF	0.60	0.030	134	2.5	0.060	0.37	7.1	60	7.1	15	*<0.001*	0.020	0.11	0.20	0.40	0.60	20	*<0.01*	0.14	37	*<0.005*	0.080	2.9	1.0	1.1	10	2.0	12
ABA237	R270907	CFD0412	10.0	11.0	Waste	Upper transition	Gneiss	MxF	1.4	0.12	279	4.4	0.020	0.060	6.6	160	6.0	15	*<0.001*	0.010	1.8	2.2	0.30	0.30	17	*<0.01*	0.17	33	*<0.005*	0.10	2.7	15	0.070	11	14	6.2
ABA238	R280433	CFD0497	28.0	29.0	Waste	Upper transition	Gneiss	MxM	1.2	0.030	146	0.62	0.030	0.19	1.2	80	4.8	10	*<0.001*	0.010	1.4	0.50	0.30	0.50	11	*<0.01*	1.2	40	*<0.005*	0.15	4.8	3.0	0.090	11	7.0	8.8
ABA239	Q034712	CFD0473	7.0	8.0	Waste	Upper transition	Gneiss	FG	1.6	0.020	153	0.52	0.040	0.10	3.1	80	4.0	9.5	*<0.001*	*<0.01*	1.4	0.40	0.40	1.9	4.6	*<0.01*	0.020	41	*<0.005*	0.070	2.5	2.0	0.10	14	3.0	11
ABA240	Q034807	CFD0473	117.0	118.0	Waste	Upper transition	Gneiss	FG	2.1	0.020	331	0.61	0.010	*<0.05*	3.0	200	8.8	10	*<0.001*	0.010	3.6	1.4	0.30	0.60	27	*<0.01*	0.030	33	*<0.005*	0.16	6.4	5.0	0.13	13	10	2.5
ABA241	R272496	CFD0436	83.0	84.0	Waste	Upper transition	Gneiss	MxF	1.4	0.040	140	0.33	0.010	0.090	1.2	240	7.4	11	*<0.001*	0.010	8.3	0.90	0.20	1.3	6.2	*<0.01*	0.020	34	*<0.005*	0.23	5.3	3.0	0.36	11	12	8.4
ABA242	R270718	CFD0404	69.0	70.0	Waste	Upper transition	Gneiss	MxF	0.70	0.030	282	0.42	*<0.01*	*<0.05*	3.0	180	12	6.7	*<0.001*	0.010	83	0.70	0.30	0.70	9.0	*<0.01*	0.010	38	*<0.005*	0.32	2.2	5.0	0.44	12	15	8.2
ABA243	R271483	CFD0420	51.0	52.0	Waste	Upper transition	Gneiss	MxF	2.7	0.070	99	0.95	0.010	0.19	1.5	160	12	23	*<0.001*	*<0.01*	7.4	0.90	0.80	3.9	7.4	*<0.01*	*<0.01*	39	0.011	0.25	11	2.0	0.28	17	13	4.5
ABA244	R272865	CFD0441	40.0	41.0	Waste	Upper transition	Gneiss	MxF	2.4	0.19	72	1.4	0.010	*<0.05*	8.0	170	18	22	*<0.001*	*<0.01*	12	6.4	0.40	0.50	16	*<0.01*	0.020	26	0.0080	0.34	14	37	0.12	16	27	2.3
ABA245	R278947	CFD0461	10.0	11.0	Waste	Upper transition	Gneiss	MxM	2.5	0.050	226	1.1	*<0.01*	*<0.05*	4.4	250	10	9.8	*<0.001*	0.020	39	3.1	0.80	0.80	24	*<0.01*	0.070	27	*<0.005*	0.29	20	13	0.45	24	24	5.3
ABA353	R304081	CFD0525	10.0	11.0	Waste	Upper Transition	Gneiss	MxF	9.1	0.76	823	0.96	0.030	0.11	55	1120	5.2	64	*<0.001*	*<0.01*	16	6.4	0.50	2.7	15	*<0.01*	0.89	12	0.088	0.97	3.3	61	0.22	12	43	1.3
ABA367	R545582	CFD0524	56.0	57.0	Waste	Upper Transition	Gneiss	MxF	2.4	0.010	144	0.39	0.010	0.060	5.1	170	12	11	*<0.001*	*<0.01*	18	0.80	0.50	1.3	74	*<0.01*	0.010	31	*<0.005*	0.67	14	6.0	0.32	11	8.0	4.7
ABA373	R271332	CFD0417	58.0	59.0	Waste	Upper Transition	Gneiss	MxF	2.4	0.010	38	1.0	0.010	*<0.05*	1.0	80	16	10	0.0020	0.080	20	1.0	0.40	1.0	19	*<0.01*	*<0.01*	34	*<0.005*	3.2	12	2.0	0.17	8.0	13	1.4
ABA385	KAM068709	CFD0238	151.0	152.0	Waste	Upper Transition	Gneiss	MxF	1.3	0.020	127	0.18	0.010	0.080	1.2	70	13	11	*<0.001*	*<0.01*	3.9	0.40	0.40	0.30	15	*<0.01*	*<0.01*	41	*<0.005*	0.17	5.7	8.0	0.13	11	5.0	12
ABA386	KAM069164	CFD0242	220.5	221.0	Waste	Upper Transition	Gneiss	FG	1.4	0.020	67	0.90	0.010	*<0.05*	2.3	120	13	10	*<0.001*	*<0.01*	18	3.5	0.40	0.70	48	*<0.01*	0.010	34	*<0.005*	0.20	20	15	0.16	8.5	20	8.9
ABA407	R272624	CFD0438	17.0	18.0	Waste	Upper Transition	Gneiss	MxF	12	1.6	936	0.33	0.030	*<0.05*	25	1290	7.7	107	*<0.001*	*<0.01*	9.7	12	0.90	2.6	28	*<0.01*	0.11	17	0.14	1.9	14	96	0.67	18	70	3.5
ABA411	R544193	CFD0502	40.0	41.0	Waste	Upper Transition	Gneiss	MxF	6.4	0.040	431	0.71	0.010	*<0.05*	26	230	10	7.5	*<0.001*	*<0.01*	10	12	1.0	5.2	14	*<0.01*	0.010	25	*<0.005*	0.56	15	48	0.22	28	23	2.4
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
								Max	12	1.6	936	4.4	0.070	0.37	55	1290	32	107	0.0020	0.080	83	12	1.0	5.2	74	*<0.01*	1.2	41	0.14	3.2	22	96	1.2	28	70	23
								90th PCTL	5.5	0.31	512	2.1	0.045	0.19	16	415	19	34	*<0.001*	0.050	26	6.4	0.80	2.7	41	*<0.01*	0.16	39	0.032	0.82	17	43	0.71	19	28	12
								75th PCTL	2.7	0.088	357	1.3	0.028	0.11	6.6	238	13	18	*<0.001*	0.018	15	3.4	0.50	1.3	27	*<0.01*	0.063	36	0.0073	0.34	13	15	0.59	14	23	9.8
								Median	2.1	0.035	247	0.81	0.010	0.060	3.3	170	10	11	*<0.001*	*<0.01*	6.4	0.95	0.40	0.85	18	*<0.01*	0.020	33	*<0.005*	0.24	6.2	6.5	0.25	12	14	6.9
								25th PCTL	1.4	0.020	138	0.46	0.010	*<0.05*	1.3	120	7.2	10	*<0.001*	*<0.01*	3.7	0.53	0.30	0.60	11	*<0.01*	0.010	29	*<0.005*	0.15	3.7	2.3	0.15	11	9.3	3.6
								10th PCTL	0.90	0.020	86	0.33	*<0.01*	*<0.05*	0.95	75	5.0	9.7	*<0.001*	*<0.01*	1.4	0.40	0.30	0.35	7.5	*<0.01*	*<0.01*	23	*<0.005*	0.095	2.8	2.0	0.11	8.3	4.0	2.4
								Min	0.60	0.010	38	0.16	*<0.01*	*<0.05*	0.60	40	4.0	6.7	*<0.001*	*<0.01*	0.11	0.20	0.20	0.20	4.6	*<0.01*	*<0.01*	12	*<0.005*	0.070	2.2	1.0	0.070	6.8	2.0	1.3

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Lower Transition Facies for Gneiss Waste Rock																																				
ABA019	KAM029649	CFD0177	73.0	74.0	Waste	Lower transition	Gneiss	MxM	4.6	0.26	175	0.74	0.10	0.60	1.0	240	7.0	36	*<0.001*	0.020	0.46	1.1	0.50	2.2	22	*<0.01*	0.010	33	0.047	0.19	3.0	8.0	0.17	12	13	14
ABA020	KAM029658	CFD0177	81.0	82.0	Waste	Lower transition	Gneiss	MxM	15	1.7	577	0.58	0.040	0.070	22	500	6.8	78	*<0.001*	0.060	0.15	7.9	0.70	0.60	69	*<0.01*	0.010	19	0.11	0.42	5.1	55	0.16	13	40	9.8
ABA047	KAM051446	CFD0166	13.0	14.0	Waste	Lower transition	Gneiss	MxM	8.4	1.3	287	0.75	0.18	0.22	16	580	1.3	37	*<0.001*	*<0.01*	0.53	5.7	0.30	2.6	41	*<0.01*	0.010	4.1	0.18	0.20	0.91	54	0.26	6.4	20	2.7
ABA051	KAM079117	CFD0251	51.0	52.0	Waste	Lower transition	Gneiss	MxF	4.5	0.45	228	1.3	0.020	*<0.05*	4.6	290	5.0	14	0.0010	0.29	1.2	2.0	0.80	0.40	41	*<0.01*	0.13	25	*<0.005*	0.090	4.9	10	0.14	16	23	9.3
ABA058	KAM096948	CFD0270	230.0	231.0	Waste	Lower transition	Gneiss	MxF	1.8	0.41	364	1.7	0.020	0.10	1.1	120	8.4	18	*<0.001*	0.10	0.66	0.60	0.40	0.50	31	*<0.01*	0.010	34	*<0.005*	0.26	5.9	2.0	0.26	9.9	14	5.9
ABA067	KAM129499	CFD0332	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	4.9	0.27	163	6.9	0.060	0.73	0.80	150	7.2	40	0.0010	0.050	0.51	0.60	0.50	1.1	12	*<0.01*	0.010	33	0.036	0.24	5.2	5.0	0.12	13	14	8.2
ABA070	KAM099512	CFD0338	10.0	11.0	Waste	Lower transition	Gneiss	MxF	2.3	0.13	190	0.24	0.040	0.28	0.70	100	7.2	30	*<0.001*	*<0.01*	0.40	0.40	0.40	1.3	4.5	*<0.01*	*<0.01*	35	0.014	0.21	3.9	2.0	0.10	11	9.0	8.5
ABA073	KAM145537	CFD0339	111.0	112.0	Waste	Lower transition	Gneiss	MxF	3.2	0.14	311	0.97	0.060	0.44	0.60	130	7.2	34	*<0.001*	0.020	0.45	0.70	0.50	0.60	20	*<0.01*	0.010	36	0.024	0.21	2.6	2.0	0.14	14	20	6.6
ABA098	KAM137429	CFR0469	29.0	30.5	Waste	Lower transition	Gneiss	MxF	6.6	0.40	407	1.7	0.060	0.99	5.6	390	4.9	62	*<0.001*	*<0.01*	0.39	1.9	0.70	1.1	117	*<0.01*	0.13	25	0.12	0.38	4.1	15	0.66	16	19	6.6
ABA106	KAM139356	CFR0482	89.9	91.4	Waste	Lower transition	Gneiss	MxF	8.8	1.2	468	0.88	0.030	0.060	23	730	9.0	74	*<0.001*	0.010	3.1	5.1	0.50	0.30	27	*<0.01*	*<0.01*	17	0.14	0.51	2.7	39	0.38	13	41	6.1
ABA117	KAM122524	CFR0529	21.3	22.9	Waste	Lower transition	Gneiss	FG	2.7	0.20	94	1.6	0.11	1.7	2.9	150	1.3	16	*<0.001*	0.010	0.090	0.80	0.40	3.9	26	*<0.01*	*<0.01*	31	0.047	0.10	3.0	5.0	2.9	9.1	7.0	8.8
ABA142	KAM152462	CFR0589	25.9	27.4	Waste	Lower transition	Gneiss	MxF	4.2	0.32	233	1.9	0.070	0.40	3.3	140	7.0	51	*<0.001*	0.040	0.29	1.5	0.50	1.0	14	*<0.01*	0.010	39	0.038	0.29	6.0	11	2.1	14	16	15
ABA150	KAM153129	CFR0595	30.5	32.0	Waste	Lower transition	Gneiss	MxM	9.1	1.4	721	2.6	0.050	0.20	42	490	5.9	68	0.0010	0.15	0.51	5.0	0.50	2.3	118	*<0.01*	0.060	9.1	0.15	0.35	0.93	39	0.46	10	34	2.3
ABA246	R273797	CFD0458	9.0	10.0	Waste	Lower transition	Gneiss	FG	1.5	0.060	266	0.85	0.010	0.10	1.1	350	6.4	14	*<0.001*	0.020	1.5	1.5	0.30	1.1	28	*<0.01*	0.020	34	0.0080	0.13	2.9	20	0.13	14	16	20
ABA247	R283019	CFD0484	33.0	34.0	Waste	Lower transition	Gneiss	FG	3.4	0.60	343	0.53	0.040	0.070	28	400	5.3	56	*<0.001*	0.010	2.9	5.1	0.40	1.0	17	*<0.01*	*<0.01*	28	0.056	0.48	11	25	0.19	12	27	4.4
ABA249	R273398	CFD0447	188.0	189.0	Waste	Lower transition	Gneiss	MxF	13	1.6	465	0.30	0.060	0.050	14	460	1.9	117	*<0.001*	*<0.01*	1.6	8.1	0.50	3.6	18	*<0.01*	0.020	7.5	0.17	0.50	1.4	49	0.18	19	27	1.8
ABA250	R279032	CFD0461	85.0	86.0	Waste	Lower transition	Gneiss	MxM	5.8	0.94	381	2.6	0.060	0.13	47	430	3.3	57	0.0020	0.34	1.6	2.7	0.90	0.70	64	*<0.01*	0.51	27	0.086	0.42	3.9	26	0.22	12	27	9.9
ABA251	R274019	CFD0464	10.0	11.0	Waste	Lower transition	Gneiss	FG	1.7	0.040	286	0.31	0.080	0.070	3.0	170	9.2	12	*<0.001*	0.010	0.99	0.70	0.40	1.4	13	*<0.01*	0.050	38	*<0.005*	0.13	3.5	5.0	0.090	11	11	13
ABA252	R274341	CFD0467	80.0	81.0	Waste	Lower transition	Gneiss	MxF	1.2	0.050	151	0.61	0.10	0.28	0.90	60	4.3	17	*<0.001*	0.020	0.29	0.40	0.20	1.5	6.2	0.010	0.030	43	0.0050	0.070	2.1	2.0	0.11	11	8.0	14
ABA253	R282397	CFD0474	95.0	96.0	Waste	Lower transition	Gneiss	MxF	1.6	0.030	134	0.71	0.010	0.050	1.4	190	14	9.9	*<0.001*	0.010	3.4	1.3	0.40	2.3	5.6	*<0.01*	*<0.01*	38	*<0.005*	0.25	6.9	5.0	0.22	9.1	11	11
ABA254	R270666	CFD0404	10.0	11.0	Waste	Lower transition	Gneiss	MxF	4.6	0.39	229	0.97	0.020	0.47	5.4	180	6.8	55	*<0.001*	0.010	1.6	2.1	0.50	1.2	13	*<0.01*	*<0.01*	33	0.057	0.34	2.5	15	0.20	14	16	12
ABA255	R271756	CFD0424	62.0	63.0	Waste	Lower transition	Gneiss	MxM	1.6	0.040	239	0.47	0.030	0.050	1.6	150	4.3	8.7	*<0.001*	*<0.01*	1.5	0.80	0.60	1.0	8.7	*<0.01*	0.010	34	*<0.005*	0.18	2.5	4.0	0.23	7.6	9.0	6.7
ABA256	R271112	CFD0415	8.0	9.0	Waste	Lower transition	Gneiss	MxM	3.8	0.15	442	1.3	0.050	0.15	2.1	300	11	37	*<0.001*	0.070	3.6	1.3	0.50	0.70	23	*<0.01*	0.030	23	0.025	0.40	3.4	7.0	0.45	12	35	12
ABA257	R273315	CFD0447	115.0	116.0	Waste	Lower transition	Gneiss	FG	1.4	0.030	117	0.24	0.040	0.14	0.70	60	3.8	13	*<0.001*	0.010	0.93	0.30	0.20	0.40	10	*<0.01*	0.020	41	*<0.005*	0.080	2.6	1.0	0.32	17	3.0	9.4
ABA258	R276507	CFD0409	12.0	13.0	Waste	Lower transition	Gneiss	MxM	1.2	0.050	625	0.16	0.010	0.090	2.5	130	6.0	15	*<0.001*	*<0.01*	9.9	0.80	0.20	1.5	9.4	*<0.01*	0.040	24	*<0.005*	0.16	1.6	3.0	4.7	9.0	5.0	5.5
ABA259	R280545	CFD0499	10.0	11.0	Waste	Lower transition	Gneiss	MxM	5.1	0.35	315	0.99	0.060	0.85	3.2	370	4.2	66	*<0.001*	0.040	0.15	1.7	0.50	1.3	44	0.010	0.18	26	0.12	0.47	3.9	13	0.19	12	26	4.6
ABA260	R280565	CFD0499	28.0	29.0	Waste	Lower transition	Gneiss	MxM	2.7	0.16	206	0.55	0.070	0.61	1.5	110	2.4	25	*<0.001*	0.020	1.4	0.80	0.40	1.1	12	*<0.01*	0.070	39	0.017	0.16	3.7	4.0	0.12	14	9.0	10
ABA261	R274115	CFD0464	95.0	96.0	Waste	Lower transition	Gneiss	MxF	3.8	0.87	397	0.59	0.040	0.050	16	270	5.3	40	*<0.001*	0.15	0.86	4.7	0.20	0.60	124	*<0.01*	0.030	27	0.039	0.31	5.3	24	0.16	11	19	9.5
ABA262	R274262	CFD0467	10.0	11.0	Waste	Lower transition	Gneiss	MxF	1.0	0.040	118	0.53	0.070	0.32	0.70	70	5.4	14	*<0.001*	0.020	0.44	0.50	0.50	0.50	17	*<0.01*	0.030	40	0.0050	0.080	2.2	4.0	0.56	13	6.0	11
ABA263	R282302	CFD0474	10.0	11.0	Waste	Lower transition	Gneiss	FG	1.9	0.030	143	0.30	0.010	0.050	2.1	100	7.4	18	*<0.001*	0.010	3.8	0.80	0.20	1.0	10	*<0.01*	0.010	34	*<0.005*	0.22	9.6	5.0	0.40	9.7	8.0	5.4
ABA264	R271435	CFD0420	9.0	10.0	Waste	Lower transition	Gneiss	MxF	2.7	0.13	307	0.34	0.040	0.17	7.6	150	7.5	33	*<0.001*	0.010	28	1.2	0.60	0.80	9.3	*<0.01*	*<0.01*	35	0.017	0.36	3.3	4.0	0.14	15	23	8.6
ABA265	R271165	CFD0415	55.0	56.0	Waste	Lower transition	Gneiss	MxF	4.3	0.15	356	1.9	0.060	0.70	1.2	140	7.8	39	*<0.001*	0.030	0.090	1.1	0.40	1.5	29	*<0.01*	0.010	33	0.032	0.25	3.8	4.0	0.14	11	24	5.2
ABA267	R273694	CFD0456	97.0	98.0	Waste	Lower transition	Gneiss	MxM	31	3.6	662	1.1	0.080	*<0.05*	43	370	1.2	138	*<0.001*	0.29	0.89	20	0.50	2.0	24	*<0.01*	0.030	0.20	0.24	0.86	0.81	177	0.080	11	72	0.50
ABA269	R279507	CFD0468	60.0	61.0	Waste	Lower transition	Gneiss	MxF	5.3	0.38	263	1.4	0.070	0.46	3.4	430	2.9	52	*<0.001*	0.030	1.6	1.6	0.80	1.9	24	*<0.01*	0.24	30	0.088	0.37	4.4	10	0.65	18	13	6.8
ABA270	R272186	CFD0433	10.0	11.0	Waste	Lower transition	Gneiss	MxF	1.1	0.020	116	0.39	0.020	0.070	1.3	80	3.1	14	*<0.001*	0.010	0.63	0.40	*<0.2*	0.80	6.0	*<0.01*	0.020	35	*<0.005*	0.12	2.4	1.0	0.36	3.6	4.0	5.6
ABA271	R283079	CFD0484	87.0	88.0	Waste	Lower transition	Gneiss	FG	4.4	0.57	310	0.16	0.040	0.080	11	310	7.2	46	*<0.001*	0.010	2.3	2.5	0.40	0.40	15	*<0.01*	*<0.01*	35	0.061	0.31	2.0	17	0.20	12	27	6.0
ABA272	Q034772	CFD0473	86.0	87.0	Waste	Lower transition	Gneiss	MxF	4.8	0.81	438	0.33	0.060	0.11	12	660	7.8	62	*<0.001*	*<0.01*	1.9	4.3	0.40	1.1	47	*<0.01*	0.020	26	0.15	0.40	3.8	38	0.71	15	38	3.5
ABA273	R282171	CFD0439	30.0	31.0	Waste	Lower transition	Gneiss	MxF	3.3	0.10	195	0.44	0.020	0.13	2.9	90	6.2	33	*<0.001*	*<0.01*	3.5	0.80	0.40	0.60	6.4	*<0.01*	0.020	39	0.016	0.24	6.4	3.0	0.18	16	22	3.3
ABA274	R277372	CFD0423	10.0	11.0	Waste	Lower transition	Gneiss	MxM	3.0	0.19	86	0.91	0.070	0.16	1.9	260	2.1	17	0.0010	0.010	0.28	1.4	0.50	1.5	15	*<0.01*	0.020	37	0.015	0.12	2.3	4.0	*<0.05*	12	7.0	5.8
ABA275	R283492	CFD0496	10.0	11.0	Waste	Lower transition	Gneiss	MxF	4.5	0.29	202	3.5	0.080	0.58	3.6	390	3.8	55	*<0.001*	0.040	0.24	1.8	0.60	1.2	20	*<0.01*	0.19	28	0.083	0.40	6.1	10	0.16	15	16	6.2
ABA276	R273866	CFD0460	63.0	64.0	Waste	Lower transition	Gneiss	FG	4.3	0.37	236	1.0	0.090	0.26	5.3	190	3.2	52	*<0.001*	0.060	0.50	1.7	0.40	1.4	25	*<0.01*	0.020	33	0.043	0.31	4.3	12	0.11	13	14	14
ABA277	R273898	CFD0460	91.0	92.0	Waste	Lower transition	Gneiss	MxF	7.4	0.47	461	1.5	0.050	0.38	2.7	1010	9.2	68	*<0.001*	0.10	*<0.05*	2.5	0.90	0.50	92	*<0.01*	0.020	28	0.17	0.43	3.4	45	0.22	19	34	13
ABA278	Q035773	CFD0491	9.0	10.0	Waste	Lower transition	Gneiss	MxF	2.7	0.12	119	0.20	0.040	0.17	2.6	200	5.3	37	*<0.001*	*<0.01*	7.0	0.70	0.50	1.7	6.6	*<0.01*	0.010	38	0.016	0.38	4.5	4.0	0.24	15	11	9.8
ABA279	Q035789	CFD0491	60.0	61.0	Waste	Lower transition	Gneiss	MxF	2.2	0.030	204	0.42	0.010	*<0.05*	1.4	250	88	7.8	*<0.001*	*<0.01*	16	1.5	0.40	3.2	7.8	*<0.01*	0.10	37	*<0.005*	0.29	10	10	0.41	16	22	6.9
ABA280	R271699	CFD0424	12.0	13.0	Waste	Lower transition	Gneiss	MxF	1.2	0.050	292	1.5	0.080	0.16	1.5	170	5.9	18	*<0.001*	*<0.01*	1.3	0.80	*<0.2*	0.60	9.0	*<0.01*	0.020	34	0.010	0.10	3.1	4.0	0.46	12	13	5.0
ABA282	R282102	CFD0437	70.0	71.0	Waste	Lower transition	Gneiss	MxF	2.0	0.020	140	0.34	0.010	0.10	1.2	60	13	11	*<0.001*	*<0.01*	2.9	0.40	0.30	0.60	7.1	*<0.01*	0.020	40	*<0.005*	0.080	6.5	1.0	0.17	18	2.0	7.7
ABA283	R273302	CFD0447	59.0	60.0	Waste	Lower transition	Gneiss	FG	7.1	1.4	491	0.89	0.040	*<0.05*	21	520	7.3	79	0.0010	0.080	0.49	6.9	0.60	0.50	69	*<0.01*	0.010	21	0.084	0.48	7.8	38	0.10	17	35	4.6
ABA284	R273593	CFD0456	7.0	8.0	Waste	Lower transition	Gneiss	MxF	11	1.4	448	0.38	0.050	0.060	23	390	2.2	84	*<0.001*	0.010	1.6	7.5	0.30	2.0	11	*<0.01*	0.020	11	0.13	0.49	0.73	42	0.13	15	21	4.9
ABA338	R270835	CFD0406	32.0	33.0	Waste	Lower Transition	Gneiss	MxF	1.5	0.33	389	1.5	0.040	0.090	10	260	5.1	25	0.0010	0.040	0.37	2.3	0.30	1.5	62	*<0.01*	0.010	32	0.019	0.18	3.0	12	3.7	9.7	18	17
ABA339	R270848	CFD0406	58.0	58.3	Waste	Lower Transition	Gneiss	MxF	3.5	0.19	294	0.59	0.050	0.70	1.2	190	2.8	29	*<0.001*	0.040	3.8	0.90	0.30	15	85	*<0.01*	*<0.01*	35	0.029	0.19	2.9	4.0	0.24	9.6	13	13
ABA340	R270686	CFD0404	27.0	28.0	Waste	Lower Transition	Gneiss	MxM	12	1.9	490	3.4	0.020	*<0.05*	37	510	1.9	142	0.0010	0.13	1.1	3.0	0.30	0.40	22	*<0.01*	*<0.01*	13	0.19	0.95	3.7	53	0.25	8.5	38	4.2
ABA341	R270737	CFD0404	85.0	86.0	Waste	Lower Transition	Gneiss	FG	2.4	0.43	324	1.2	0.030	0.070	16	230	9.7	28	*<0.001*	0.080	1.6	2.1	0.40	0.90	45	*<0.01*	0.010	29	0.023	0.19	3.3	12	0.11	9.7	24	16
ABA342	R551085	CFD0563	10.0	11.0	Waste	Lower Transition	Gneiss	MxM	4.8	0.42	233	0.83	0.050	0.27	3.9	280	2.4	41	*<0.001*	0.050	0.17	2.2	0.50	1.0	19	*<0.01*	0.020	24	0.045	0.29	1.7	12	0.30	14	14	7.8
ABA343	R551107	CFD0563	30.0	31.0	Waste	Lower Transition	Gneiss	MxM	13	1.9	589	0.66	0.050	0.16	49	690	8.5	57	*<0.001*	0.11	0.20	3.1	0.20	1.0	143	*<0.01*	0.060	5.9	0.19	0.35	0.73	44	0.61	5.6	51	2.1
ABA344	R551131	CFD0563	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	16	1.9	578	0.53	0.040	0.13	28	950	3.3	63	*<0.001*	0.030	0.11	3.1	0.30	0.80	76	*<0.01*	0.040	2.1	0.24	0.38	0.29	57	0.37	5.2	54	1.8
ABA348	R304313	CFD0541	56.0	57.0	Waste	Lower Transition	Gneiss	MxM	10	1.3	641	0.26	0.070	0.080	44	680	2.5	58	*<0.001*	*<0.01*	3.2	7.3	0.80	4.9	49	*<0.01*	0.060	17	0.12	0.99	2.9	48	0.11	16	53	4.4
ABA360	R623829	CFD0555	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	2.9	0.12	123	3.8	0.050	0.25	1.4	140	5.7	23	*<0.001*	*<0.01*	0.80	0.60	0.30	0.70	6.7	*<0.01*	0.010	37	0.013	0.15	6.1	3.0	0.080	9.0	9.0	14
ABA361	R623933	CFD0555	102.0	103.0	Waste	Lower Transition	Gneiss	MxF	17	1.5	622	0.49	0.020	0.15	32	980	6.8	124	*<0.001*	0.020	1.6	6.9	0.40	2.1	195	*<0.01*	0.010	13	0.20	0.79	3.4	85	0.19	11	49	5.7
ABA362	R507027	CFD0555	185.0	186.0	Waste	Lower Transition	Gneiss	FG	3.4	0.32	221	1.4	0.030	0.14	1.2	140	4.1	26	*<0.001*	0.020	0.17	0.70	0.40	1.2	54	*<0.01*	0.010	33	0.012	0.17	2.3	3.0	0.29	11	10	8.9
ABA363	R545397	CFD0520	20.0	21.0	Waste	Lower Transition	Gneiss	FG	1.9	0.010	203	0.37	0.010	*<0.05*	1.9	210	11	5.1	*<0.001*	*<0.01*	5.7	1.4	0.40	1.1	24	*<0.01*	*<0.01*	32	*<0.005*	0.47	13	8.0	0.21	12	9.0	4.4
ABA364	R545422	CFD0520	41.0	42.0	Waste	Lower Transition	Gneiss	FG	1.9	0.010	176	0.29	0.010	0.050	1.5	110	14	9.0	*<0.001*	*<0.01*	2.0	0.70	0.60	0.90	10	*<0.01*	*<0.01*	35	*<0.005*	0.26	6.0	2.0	0.19	13	6.0	4.1
ABA366	R545552	CFD0524	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	1.5	0.030	215	1.2	0.010	0.050	0.80	70	13	10	*<0.001*	0.010	4.1	0.80	0.50	0.60	20	*<0.01*	0.010	37	*<0.005*	0.21	4.5	2.0	0.18	14	9.0	11
ABA369	R545644	CFD0526	81.0	82.0	Waste	Lower Transition	Gneiss	MxF	2.1	0.070	167	0.48	0.030	0.14	0.90	90	14	15	*<0.001*	*<0.01*	1.7	0.60	0.50	0.60	11	*<0.01*	*<0.01*	38	0.0070	0.11	3.6	3.0	0.26	15	8.0	12
ABA370	R545697	CFD0528	42.0	43.0	Waste	Lower Transition	Gneiss	MxF	3.0	0.030	120	0.38	0.040	0.050	2.2	110	6.0	14	*<0.001*	*<0.01*	4.6	0.50	0.40	1.0	9.5	*<0.01*	0.010	38	*<0.005*	0.20	8.2	3.0	0.25	11	5.0	8.6
ABA371	R271272	CFD0417	5.0	6.0	Waste	Lower Transition	Gneiss	MxF	3.7	0.12	263	1.2	0.070	0.50	1.0	130	7.8	36	*<0.001*	*<0.01*	0.97	0.60	0.50	1.2	15	*<0.01*	*<0.01*	35	0.027	0.29	2.0	2.0	0.23	12	19	10
ABA372	R271299	CFD0417	30.0	30.7	Waste	Lower Transition	Gneiss	MxF	2.3	0.030	320	0.36	0.010	*<0.05*	1.6	180	8.3	15	*<0.001*	*<0.01*	17	0.90	0.50	0.50	9.7	*<0.01*	*<0.01*	37	*<0.005*	1.1	9.2	3.0	0.20	13	16	2.1
ABA376	R279575	CFD0468	120.0	121.0	Waste	Lower Transition	Gneiss	MxF	10	0.83	333	0.86	0.060	0.41	11	240	5.3	85	*<0.001*	*<0.01*	0.20	1.9	0.50	0.90	31	0.010	0.020	34	0.077	0.45	3.8	22	0.22	15	24	16
ABA390	R278608	CFD0450	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	6.9	0.62	469	0.46	0.040	*<0.05*	52	390	8.9	42	*<0.001*	*<0.01*	5.2	6.8	0.70	1.3	12	*<0.01*	0.020	38	0.034	0.65	6.4	29	0.41	18	25	6.6
ABA391	R278677	CFD0450	71.0	72.0	Waste	Lower Transition	Gneiss	MxF	1.7	0.010	189	0.28	0.010	0.050	2.4	120	7.2	12	*<0.001*	*<0.01*	11	0.60	0.40	0.50	8.0	*<0.01*	*<0.01*	40	*<0.005*	0.19	8.7	3.0	0.33	12	7.0	3.9
ABA392	R278725	CFD0450	114.0	114.3	Waste	Lower Transition	Gneiss	MxF	1.3	0.020	170	0.79	0.010	0.070	1.0	170	7.7	16	*<0.001*	*<0.01*	8.6	0.60	0.50	1.0	12	*<0.01*	0.010	35	*<0.005*	0.25	5.0	3.0	0.35	9.1	9.0	6.0
ABA395	R545811	CFD0529	58.0	59.0	Waste	Lower Transition	Gneiss	FG	1.0	0.030	138	0.15	0.11	0.060	0.70	210	2.0	8.1	*<0.001*	*<0.01*	1.8	0.60	0.50	1.4	12	*<0.01*	*<0.01*	38	*<0.005*	0.030	2.3	2.0	0.36	12	4.0	11
ABA399	R543714	CFD0549	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	1.4	0.070	129	0.24	0.060	0.27	0.60	90	5.7	13	*<0.001*	*<0.01*	0.39	0.40	0.50	0.50	10	*<0.01*	0.010	39	0.0050	0.080	2.0	1.0	0.15	17	3.0	12
ABA400	R543741	CFD0549	53.0	54.0	Waste	Lower Transition	Gneiss	MxF	1.4	0.020	36	1.5	0.010	0.090	2.9	80	21	12	*<0.001*	*<0.01*	4.2	0.50	0.40	0.20	12	*<0.01*	0.050	41	*<0.005*	0.19	7.0	2.0	0.16	9.3	6.0	9.6
ABA402	R544003	CFD0553	80.0	81.0	Waste	Lower Transition	Gneiss	MxF	2.0	0.060	275	3.7	0.040	0.17	1.0	120	35	16	0.0010	*<0.01*	3.9	0.40	0.40	0.50	12	*<0.01*	0.050	37	0.0050	0.13	4.4	2.0	0.23	17	10	15
ABA405	R554003	CFD0501	10.0	11.0	Waste	Lower Transition	Gnei

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Fresh Facies for Gneiss Waste Rock																																				
ABA065	KAM128393	CFD0326	25.0	26.0	Waste	Fresh	Gneiss	MxM	4.5	0.35	329	0.71	0.020	0.12	4.2	440	7.5	39	*<0.001*	*<0.01*	14	2.7	0.90	1.0	18	*<0.01*	0.20	25	0.037	0.30	5.4	14	0.30	21	23	6.2
ABA066	KAM128504	CFD0326	75.0	76.0	Waste	Fresh	Gneiss	MxM	6.3	0.36	221	1.4	0.040	0.27	4.5	340	3.7	56	*<0.001*	0.010	1.8	2.2	1.0	0.80	18	*<0.01*	0.74	25	0.060	0.37	2.9	9.0	0.090	19	14	9.9
ABA071	KAM145241	CFD0338	81.0	82.0	Waste	Fresh	Gneiss	MxM	11	1.2	632	0.26	0.060	0.66	53	650	6.0	83	*<0.001*	0.050	0.53	4.8	0.80	6.3	763	0.010	*<0.01*	24	0.15	0.46	5.4	45	0.12	26	34	7.5
ABA097	KAM137325	CFR0468	88.4	89.9	Waste	Fresh	Gneiss	MxM	13	1.2	486	1.5	0.050	0.29	14	720	2.1	74	*<0.001*	0.040	0.77	2.2	0.60	1.1	34	*<0.01*	0.050	21	0.19	0.41	2.4	46	0.92	12	34	7.1
ABA099	KAM137468	CFR0469	82.3	83.8	Waste	Fresh	Gneiss	MxM	17	2.0	587	1.4	0.070	0.10	134	360	5.5	61	*<0.001*	*<0.01*	4.3	5.4	0.40	2.5	47	*<0.01*	0.40	11	0.15	0.36	1.8	50	0.43	9.5	37	4.0
ABA108	KAM139795	CFR0486	25.9	27.4	Waste	Fresh	Gneiss	MxM	5.5	0.48	341	1.3	0.070	0.22	3.8	360	2.7	35	*<0.001*	*<0.01*	1.4	2.1	0.80	1.5	9.9	*<0.01*	0.34	26	0.053	0.22	2.2	11	0.58	22	20	8.7
ABA139	KAM152151	CFR0586	61.0	62.5	Waste	Fresh	Gneiss	MxF	2.5	0.17	180	2.0	0.070	0.58	3.0	180	4.0	27	*<0.001*	0.010	1.4	1.1	0.50	3.8	30	*<0.01*	0.010	35	0.026	0.17	3.8	7.0	0.90	12	11	12
ABA140	KAM152186	CFR0586	109.7	111.3	Waste	Fresh	Gneiss	MxF	1.8	0.060	116	2.1	0.080	0.46	2.0	80	3.7	17	*<0.001*	0.010	0.22	0.60	0.40	3.4	13	*<0.01*	0.050	35	0.0080	0.090	2.8	2.0	0.82	16	6.0	13
ABA143	KAM152536	CFR0589	128.0	129.5	Waste	Fresh	Gneiss	FG	2.0	0.13	135	2.2	0.080	0.13	2.2	140	4.1	12	*<0.001*	0.20	1.0	0.70	0.40	3.5	111	*<0.01*	0.030	34	*<0.005*	0.060	6.8	3.0	1.9	12	4.0	5.3
ABA148	KAM153051	CFR0594	109.7	111.3	Waste	Fresh	Gneiss	MxF	2.3	0.15	151	3.6	0.060	0.14	2.3	160	4.9	18	*<0.001*	0.21	1.7	1.0	0.70	1.2	40	*<0.01*	0.010	37	0.0070	0.12	17	4.0	2.4	12	9.0	14
ABA285	R277457	CFD0426	16.0	17.0	Waste	Fresh	Gneiss	MxM	10	1.2	318	0.76	0.060	0.24	71	590	4.3	45	0.0010	0.010	0.34	2.4	0.90	2.1	26	*<0.01*	0.070	14	0.17	0.31	1.4	31	0.41	8.3	22	4.4
ABA286	R279452	CFD0468	11.0	12.0	Waste	Fresh	Gneiss	MxF	5.7	0.48	335	0.36	0.090	0.27	3.0	400	3.3	47	*<0.001*	0.020	0.91	1.9	0.60	1.1	14	*<0.01*	0.23	30	0.068	0.33	2.3	8.0	6.7	14	24	7.1
ABA287	R274861	CFD0472	100.0	101.0	Waste	Fresh	Gneiss	MxM	7.4	0.81	263	2.6	0.050	0.24	18	360	2.8	36	0.0010	0.47	0.19	1.7	1.3	1.1	35	*<0.01*	0.070	21	0.11	0.23	2.7	21	0.22	9.6	14	5.6
ABA288	R283657	CFD0498	82.0	83.0	Waste	Fresh	Gneiss	MxM	5.2	0.57	193	2.1	0.060	0.18	2.4	350	16	48	*<0.001*	0.020	0.47	1.7	0.50	0.70	9.9	*<0.01*	0.41	26	0.061	0.32	3.5	6.0	0.15	12	19	8.5
ABA289	Q035925	CFD0495	94.0	95.0	Waste	Fresh	Gneiss	MxM	8.7	0.84	218	4.4	0.060	0.16	2.9	390	5.8	52	*<0.001*	0.020	0.42	2.1	0.80	1.2	21	*<0.01*	0.38	27	0.061	0.32	2.2	10	0.26	22	22	9.5
ABA290	R272262	CFD0433	123.0	124.0	Waste	Fresh	Gneiss	MxF	2.5	0.080	288	0.43	0.050	0.17	1.2	190	5.8	25	*<0.001*	0.010	2.2	0.80	0.40	0.80	10	*<0.01*	0.020	36	0.013	0.17	3.4	5.0	0.28	11	17	7.1
ABA293	R276133	CFD0393	45.0	46.0	Waste	Fresh	Gneiss	MxM	15	2.4	672	0.69	0.040	0.14	47	680	3.1	61	0.0010	0.080	0.22	6.5	0.50	1.7	65	*<0.01*	0.92	5.8	0.22	0.38	0.72	55	0.21	8.7	53	1.6
ABA294	R276236	CFD0401	18.0	19.0	Waste	Fresh	Gneiss	MxM	12	1.7	524	1.0	0.060	0.18	56	810	18	47	*<0.001*	0.020	0.080	3.5	0.30	0.80	54	*<0.01*	6.1	2.6	0.23	0.28	0.27	46	0.22	4.2	56	1.2
ABA295	R271028	CFD0412	117.0	118.0	Waste	Fresh	Gneiss	MxF	1.4	0.060	216	0.63	0.050	0.14	1.1	140	4.9	17	*<0.001*	0.010	1.5	0.80	0.30	0.60	22	*<0.01*	0.010	34	0.0060	0.10	2.4	4.0	0.17	11	14	7.8
ABA297	R279539	CFD0468	89.0	90.0	Waste	Fresh	Gneiss	MxF	7.7	0.89	368	4.1	0.080	0.42	8.6	250	4.2	71	0.0060	0.040	0.11	1.7	0.50	1.0	43	0.010	0.10	31	0.088	0.42	11	18	0.47	14	18	12
ABA298	R275689	CFD0495	57.0	58.0	Waste	Fresh	Gneiss	MxM	12	1.8	550	1.4	0.090	0.29	61	780	5.2	49	*<0.001*	0.060	0.42	3.2	0.30	1.4	62	0.010	0.17	3.5	0.26	0.25	0.71	40	0.31	5.0	47	2.7
ABA299	R272239	CFD0433	57.0	58.0	Waste	Fresh	Gneiss	MxF	1.3	0.12	187	2.1	0.050	0.18	1.0	150	7.6	18	0.0030	0.080	0.18	0.70	0.40	1.6	47	*<0.01*	0.020	35	0.0050	0.10	20	4.0	0.34	11	11	8.3
ABA300	R278428	CFD0445	118.0	119.0	Waste	Fresh	Gneiss	MxF	4.2	0.17	278	0.35	0.10	0.53	1.1	150	5.9	42	*<0.001*	0.010	0.33	1.0	0.50	1.8	18	*<0.01*	0.020	35	0.032	0.21	2.0	3.0	0.17	12	18	5.6
ABA301	R273296	CFD0447	10.0	11.0	Waste	Fresh	Gneiss	FG	2.6	0.12	288	1.4	0.070	0.54	1.2	150	8.6	30	0.0010	0.010	0.050	0.60	0.40	0.70	20	*<0.01*	0.020	36	0.023	0.19	2.4	3.0	0.11	13	20	5.4
ABA302	R270935	CFD0412	35.0	36.0	Waste	Fresh	Gneiss	MxF	13	1.8	532	0.74	0.060	0.12	26	600	3.7	100	*<0.001*	0.020	0.42	3.0	0.50	0.50	33	*<0.01*	0.020	19	0.22	0.56	2.1	51	0.51	11	43	6.4
ABA346	R277538	CFD0426	87.0	88.0	Waste	Fresh	Gneiss	MxM	9.7	1.2	261	1.2	0.060	0.28	42	450	1.7	47	0.0010	0.18	0.30	3.0	0.40	1.1	25	*<0.01*	0.090	6.0	0.19	0.34	0.67	38	0.18	6.0	28	2.0
ABA347	R304284	CFD0541	30.0	31.0	Waste	Fresh	Gneiss	FG	0.90	0.040	126	0.61	0.030	0.18	1.0	100	6.0	11	*<0.001*	0.020	0.74	0.30	0.50	0.50	3.0	*<0.01*	*<0.01*	38	*<0.005*	0.070	3.1	1.0	1.3	13	5.0	7.7
ABA350	R304041	CFD0539	10.0	11.0	Waste	Fresh	Gneiss	FG	1.4	0.070	142	0.18	0.070	0.19	0.80	110	3.8	12	*<0.001*	*<0.01*	0.60	0.30	0.50	0.40	4.9	*<0.01*	0.020	40	*<0.005*	0.070	2.8	2.0	0.10	15	6.0	7.1
ABA351	R304231	CFD0539	45.0	46.0	Waste	Fresh	Gneiss	MxM	14	1.3	392	0.32	0.060	0.080	48	550	2.2	49	*<0.001*	*<0.01*	0.73	5.4	0.50	1.2	42	*<0.01*	0.040	12	0.12	0.30	0.89	47	0.13	13	32	0.80
ABA354	R304119	CFD0525	45.0	46.0	Waste	Fresh	Gneiss	MxM	10	1.1	436	0.75	0.050	0.10	45	480	3.3	55	*<0.001*	0.020	0.19	4.4	0.60	0.70	32	*<0.01*	0.020	13	0.091	0.33	1.6	33	0.11	14	36	1.4
ABA355	R304173	CFD0525	91.0	92.0	Waste	Fresh	Gneiss	FG	2.3	0.13	113	0.31	0.11	0.72	1.3	60	1.5	6.2	*<0.001*	*<0.01*	0.48	0.60	0.50	1.5	17	*<0.01*	*<0.01*	44	0.011	0.040	3.3	3.0	0.080	15	4.0	8.3
ABA356	R623617	CFD0548	10.0	11.0	Waste	Fresh	Gneiss	MxF	9.0	0.69	468	0.18	0.050	0.17	8.4	550	3.3	51	*<0.001*	*<0.01*	0.31	2.1	0.30	1.0	22	*<0.01*	0.020	6.7	0.11	0.32	1.1	17	0.16	5.3	27	1.8
ABA357	R623685	CFD0548	70.0	71.0	Waste	Fresh	Gneiss	MxF	11	0.93	391	0.21	0.070	0.16	17	270	6.3	69	*<0.001*	*<0.01*	0.19	2.4	0.40	1.9	29	*<0.01*	*<0.01*	29	0.10	0.42	1.9	24	0.11	13	26	12
ABA358	R623742	CFD0548	120.0	121.0	Waste	Fresh	Gneiss	MxF	1.2	0.080	210	0.28	0.080	0.16	1.7	70	9.8	14	*<0.001*	0.010	1.1	0.60	0.30	0.40	17	*<0.01*	*<0.01*	38	0.0050	0.090	4.7	3.0	0.18	9.8	7.0	15
ABA365	R545443	CFD0520	60.0	61.0	Waste	Fresh	Gneiss	FG	3.9	0.18	250	0.33	0.050	0.53	1.1	150	6.1	34	*<0.001*	*<0.01*	0.13	0.80	0.50	1.1	17	0.010	*<0.01*	34	0.029	0.29	2.6	4.0	0.25	13	19	8.1
ABA374	R271368	CFD0417	91.0	92.0	Waste	Fresh	Gneiss	FG	4.5	0.15	298	1.0	0.060	0.72	1.2	130	10	41	*<0.001*	*<0.01*	0.26	1.1	0.50	1.5	32	*<0.01*	*<0.01*	40	0.031	0.27	3.4	6.0	0.20	15	21	9.2
ABA378	R279593	CFD0468	135.0	136.0	Waste	Fresh	Gneiss	MxF	12	1.1	554	1.2	0.070	0.29	2.7	550	2.8	88	*<0.001*	0.070	*<0.05*	2.5	0.40	0.70	81	*<0.01*	0.010	19	0.16	0.59	4.0	29	0.24	11	36	5.5
ABA379	R279615	CFD0468	155.0	155.7	Waste	Fresh	Gneiss	MxF	13	1.5	649	3.2	0.10	0.20	19	610	2.5	62	*<0.001*	0.090	0.070	4.7	0.50	1.5	47	*<0.01*	0.19	16	0.16	0.34	2.9	48	0.48	11	48	2.5
ABA381	R511981	CFR0700	48.8	49.4	Waste	Fresh	Gneiss	MxM	7.0	0.86	553	1.4	0.040	0.52	42	650	8.6	22	*<0.001*	0.17	3.6	4.6	0.40	1.3	130	0.010	0.070	5.8	0.17	0.13	1.2	33	0.93	11	26	13
ABA387	Q034442	CFD0469	19.0	20.0	Waste	Fresh	Gneiss	MxF	6.6	0.69	332	0.67	0.080	0.19	24	330	8.8	71	*<0.001*	*<0.01*	0.66	2.2	0.50	3.0	14	*<0.01*	*<0.01*	33	0.076	0.48	4.1	18	0.29	14	23	16
ABA388	Q034516	CFD0469	102.0	103.0	Waste	Fresh	Gneiss	MxF	3.2	0.12	309	1.2	0.070	0.35	0.90	150	16	33	*<0.001*	0.030	0.55	0.80	0.70	0.60	23	*<0.01*	0.040	40	0.019	0.22	5.6	2.0	0.16	16	20	8.9
ABA389	Q034537	CFD0469	121.0	121.9	Waste	Fresh	Gneiss	MxF	2.7	0.10	142	0.30	0.060	0.22	1.4	170	7.0	25	*<0.001*	*<0.01*	3.5	1.2	0.40	1.3	8.4	*<0.01*	*<0.01*	40	0.015	0.16	3.5	5.0	0.18	14	13	6.6
ABA396	R545818	CFD0529	65.0	66.0	Waste	Fresh	Gneiss	MxF	3.5	0.24	172	0.28	0.11	0.73	1.7	210	1.5	9.0	*<0.001*	*<0.01*	0.56	1.0	0.50	5.7	22	*<0.01*	*<0.01*	34	0.030	0.040	2.5	7.0	0.16	13	7.0	9.9
ABA398	R543692	CFD0549	10.0	11.0	Waste	Fresh	Gneiss	FG	2.6	0.18	154	0.24	0.050	0.78	0.40	50	7.9	25	*<0.001*	*<0.01*	0.66	0.40	0.50	0.60	7.9	*<0.01*	0.010	43	0.0080	0.15	3.6	1.0	0.22	16	10	11
ABA401	R543957	CFD0553	40.0	41.0	Waste	Fresh	Gneiss	MxF	15	1.7	738	1.3	0.050	0.070	3.6	630	5.4	84	*<0.001*	0.16	0.15	8.9	0.60	0.90	49	*<0.01*	0.010	15	0.16	0.45	2.8	55	0.12	16	45	4.3
ABA404	R550544	CFD0553	160.0	161.0	Waste	Fresh	Gneiss	MxF	0.80	0.050	205	0.72	0.040	0.12	1.3	80	11	7.9	*<0.001*	0.010	1.7	0.60	0.50	0.60	374	*<0.01*	0.040	34	*<0.005*	0.050	2.0	7.0	0.15	18	6.0	14
ABA408	R272713	CFD0438	96.0	97.0	Waste	Fresh	Gneiss	MxF	2.3	0.12	208	0.19	0.090	0.14	0.80	190	4.5	18	*<0.001*	*<0.01*	0.50	0.60	0.30	1.4	17	*<0.01*	0.010	37	0.0090	0.11	3.4	3.0	0.44	9.1	6.0	12
ABA413	R276141	CFD0393	127.0	128.0	Waste	Fresh	Gneiss	MxM	16	2.5	781	0.81	0.030	0.11	56	670	43	35	*<0.001*	*<0.01*	0.37	8.2	0.40	1.7	71	*<0.01*	0.15	6.7	0.17	0.24	1.2	64	0.22	11	64	3.1
ABA414	R276153	CFD0393	170.0	171.0	Waste	Fresh	Gneiss	MxM	11	1.4	475	0.21	0.040	0.25	22	750	8.5	15	*<0.001*	0.060	3.5	4.2	0.40	1.6	111	*<0.01*	0.030	4.7	0.15	0.11	0.94	41	0.23	8.9	25	5.0
Statistical Summary						**Fresh**	**Gneiss**	**n**	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
								Max	17	2.5	781	4.4	0.11	0.78	134	810	43	100	0.0060	0.47	14	8.9	1.3	6.3	763	0.010	6.1	44	0.26	0.59	20	64	6.7	26	64	16
								90th PCTL	13	1.7	596	2.2	0.090	0.60	54	672	10	72	0.0010	0.16	2.5	4.9	0.80	3.1	87	0.010	0.38	40	0.19	0.43	5.4	48	0.92	18	45	13
								75th PCTL	11	1.2	475	1.4	0.070	0.35	24	550	7.6	55	*<0.001*	0.050	1.1	3.0	0.60	1.6	47	*<0.01*	0.10	35	0.15	0.34	3.5	38	0.44	15	32	9.9
								Median	5.7	0.48	298	0.76	0.060	0.20	3.0	340	5.2	39	*<0.001*	0.010	0.50	1.9	0.50	1.2	26	*<0.01*	0.020	29	0.061	0.25	2.7	10	0.22	12	20	7.1
								25th PCTL	2.5	0.13	205	0.33	0.050	0.14	1.3	150	3.3	18	*<0.001*	*<0.01*	0.22	0.80	0.40	0.80	17	*<0.01*	0.010	15	0.013	0.12	1.9	4.0	0.16	11	11	5.0
								10th PCTL	1.4	0.078	142	0.23	0.040	0.12	1.0	96	2.4	12	*<0.001*	*<0.01*	0.13	0.60	0.30	0.60	9.9	*<0.01*	*<0.01*	6.0	0.0050	0.070	0.93	2.8	0.11	8.6	6.0	2.0
								Min	0.80	0.040	113	0.18	0.020	0.070	0.40	50	1.5	6.2	*<0.001*	*<0.01*	*<0.05*	0.30	0.30	0.40	3.0	*<0.01*	*<0.01*	2.6	*<0.005*	0.040	0.27	1.0	0.080	4.2	4.0	0.80
Statistical Summary for Gneiss Waste Rock								**n**	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188
								n < DL	0	0	0	0	13	20	0	0	0	0	110	59	0	0	0	0	0	120	30	0	51	0	0	2	0	0	0	0
								Max	31	3.6	1160	6.9	0.18	1.7	134	1290	88	142	0.0060	0.47	83	20	1.3	15	763	0.010	6.1	44	0.26	3.2	29	177	6.7	28	72	23
								90th PCTL	11	1.4	563	2.3	0.080	0.53	38	616	14	71	0.0010	0.083	14	5.5	0.73	2.4	66	0.010	0.17	40	0.16	0.53	12	46	0.84	18	37	14
								75th PCTL	5.9	0.58	398	1.5	0.060	0.26	9.8	383	9.3	49	0.0010	0.030	3.9	2.5	0.50	1.5	34	0.010	0.043	37	0.072	0.37	6.6	21	0.45	15	24	10
								Median	2.7	0.15	265	0.83	0.040	0.13	2.8	180	6.7	23	*<0.001*	0.010	1.5	1.3	0.50	1.0	19	*<0.01*	0.020	34	0.014	0.24	3.7	6.5	0.23	13	16	7.3
								25th PCTL	1.6	0.040	169	0.39	0.010	0.060	1.2	120	4.3	12	*<0.001*	*<0.01*	0.48	0.60	0.40	0.60	11	*<0.01*	0.010	26	*<0.005*	0.13	2.4	3.0	0.16	11	9.0	5.0
								10th PCTL	1.3	0.020	126	0.24	0.010	*<0.05*	0.90	70	2.8	9.7	*<0.001*	*<0.01*	0.19	0.40	0.30	0.40	7.9	*<0.01*	*<0.01*	13	*<0.005*	0.090	1.5	2.0	0.11	8.7	5.7	2.5
								Min	0.60	0.010	35	0.15	*<0.01*	*<0.05*	0.40	30	1.2	4.0	*<0.001*	*<0.01*	0.050	0.20	0.20	0.20	3.0	*<0.01*	*<0.01*	0.20	*<0.005*	0.030	0.27	1.0	0.050	3.6	2.0	0.50

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Oxide Facies for Schist Waste Rock																																				
ABA005	KAM022322	CFD0110	95.0	96.0	Waste	Oxide	Schist	RQM	4.8	1.3	486	0.57	0.010	*<0.05*	44	370	13	15	*<0.001*	0.45	10	4.9	0.80	0.40	114	*<0.01*	0.020	11	*<0.005*	0.30	3.3	24	0.25	15	50	1.1
ABA026	KAM037656	CFD0096	59.0	60.0	Waste	Oxide	Schist	BtS	6.3	1.3	570	0.63	0.010	*<0.05*	22	420	11	24	*<0.001*	0.26	3.1	7.1	1.2	0.80	80	*<0.01*	0.030	18	0.011	0.19	2.2	38	0.31	20	66	4.8
ABA074	KAM146948	CFD0345	60.0	61.0	Waste	Oxide	Schist	BtS_carb	4.6	0.51	635	0.50	*<0.01*	*<0.05*	19	490	6.7	28	*<0.001*	0.030	3.0	9.5	0.70	0.60	43	*<0.01*	0.030	15	0.041	0.26	2.1	51	0.14	19	44	1.9
ABA077	J957606	CFD0350	60.0	61.0	Waste	Oxide	Schist	BtS_carb	3.4	0.17	648	0.63	0.010	0.050	12	760	6.5	13	*<0.001*	*<0.01*	11	7.2	1.0	0.80	286	*<0.01*	0.010	17	0.014	0.25	1.3	28	0.30	21	33	2.1
ABA090	KAM133632	CFR0431	71.6	73.2	Waste	Oxide	Schist	BtS	3.6	0.37	583	1.3	*<0.01*	*<0.05*	54	850	10	3.8	0.0020	0.49	13	13	1.4	0.70	31	*<0.01*	0.020	9.6	*<0.005*	1.4	3.4	49	1.2	26	63	1.9
ABA094	KAM135457	CFR0454	24.4	25.9	Waste	Oxide	Schist	BtS	1.9	0.070	494	1.9	*<0.01*	0.090	5.8	360	8.7	15	*<0.001*	0.010	44	1.7	0.70	0.40	18	*<0.01*	0.22	27	0.0050	0.28	8.1	9.0	0.64	18	26	6.3
ABA125	KAM149844	CFR0566	10.7	12.2	Waste	Oxide	Schist	BtS	2.2	0.040	159	0.77	*<0.01*	0.090	6.6	90	2.4	5.9	*<0.001*	0.020	8.5	2.3	0.50	0.20	9.1	0.010	*<0.01*	24	*<0.005*	0.15	0.63	10	0.66	13	12	9.1
ABA128	KAM149954	CFR0567	47.2	48.8	Waste	Oxide	Schist	BtS	4.5	1.4	434	1.0	*<0.01*	*<0.05*	21	140	8.8	6.3	*<0.001*	0.020	7.0	3.9	0.40	0.40	93	*<0.01*	0.020	13	*<0.005*	0.15	1.9	22	0.16	12	40	5.6
ABA129	KAM150033	CFR0567	155.5	157.0	Waste	Oxide	Schist	BtS	3.7	0.090	308	0.61	*<0.01*	*<0.05*	67	600	9.7	12	*<0.001*	0.030	28	5.0	1.0	0.40	49	*<0.01*	0.020	20	*<0.005*	0.53	4.3	24	2.2	25	67	1.2
ABA130	KAM150823	CFR0574	10.7	12.2	Waste	Oxide	Schist	BtS	2.0	0.12	738	0.94	*<0.01*	*<0.05*	22	380	4.3	5.5	*<0.001*	0.020	4.6	5.0	0.40	0.30	39	*<0.01*	0.010	15	*<0.005*	0.78	1.1	30	0.32	16	30	3.5
ABA131	KAM150859	CFR0574	61.0	62.5	Waste	Oxide	Schist	BtS	0.60	0.15	272	1.3	*<0.01*	0.050	7.1	120	7.7	12	*<0.001*	0.030	11	1.1	0.30	*<0.2*	50	*<0.01*	0.020	22	*<0.005*	0.21	0.84	3.0	0.38	5.8	19	7.5
ABA133	KAM150951	CFR0575	61.0	62.5	Waste	Oxide	Schist	BtS	3.7	0.93	659	1.2	*<0.01*	*<0.05*	57	390	11	15	*<0.001*	0.090	11	4.7	0.80	0.20	109	*<0.01*	0.030	12	*<0.005*	0.36	2.0	23	0.27	19	61	1.3
ABA201	R276929	CFD0416	13.0	14.0	Waste	Oxide	Schist	BtS	3.1	0.090	411	0.51	0.010	*<0.05*	52	430	12	12	*<0.001*	0.010	5.6	5.4	0.80	0.30	23	*<0.01*	0.010	11	*<0.005*	0.14	2.7	34	0.35	15	59	0.90
ABA202	R270012	CFD0384	13.0	14.0	Waste	Oxide	Schist	BtS_carb	2.9	0.050	364	0.34	*<0.01*	*<0.05*	7.7	650	19	7.5	*<0.001*	0.040	3.9	4.4	0.30	0.40	54	*<0.01*	*<0.01*	24	0.0050	0.61	2.0	23	0.59	17	56	9.8
ABA383	KAM068572	CFD0234	225.1	226.0	Waste	Oxide	Schist	MsS	1.3	0.010	166	0.26	0.010	0.050	1.0	120	10	7.9	*<0.01*	*<0.01*	9.1	0.70	0.30	0.70	19	*<0.01*	*<0.01*	38	*<0.005*	0.15	9.6	6.0	0.28	9.8	5.0	11
-						**Oxide**	**Schist**	**n**	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
								Max	6.3	1.4	738	1.9	0.010	0.090	67	850	19	28	0.0020	0.49	44	13	1.4	0.80	286	0.010	0.22	38	0.041	1.4	9.6	51	2.2	26	67	11
								90th PCTL	4.7	1.3	655	1.3	0.010	0.074	56	716	12	21	*<0.01*	0.37	22	8.6	1.1	0.76	112	*<0.01*	0.030	26	0.013	0.71	6.6	45	0.97	23	65	9.5
								75th PCTL	4.1	0.72	609	1.1	0.010	0.050	48	545	11	15	*<0.01*	0.065	11	6.3	0.90	0.65	86	*<0.01*	0.025	23	0.0050	0.45	3.3	32	0.62	20	60	6.9
								Median	3.4	0.15	486	0.63	*<0.01*	*<0.05*	21	390	9.7	12	*<0.01*	0.030	9.1	4.9	0.70	0.40	49	*<0.01*	0.020	17	*<0.005*	0.26	2.1	24	0.32	17	44	3.5
								25th PCTL	2.1	0.080	336	0.54	*<0.01*	*<0.05*	7.4	250	7.2	6.9	*<0.01*	0.015	5.1	3.1	0.40	0.30	27	*<0.01*	0.010	13	*<0.005*	0.17	1.6	16	0.28	14	28	1.6
								10th PCTL	1.5	0.044	208	0.40	*<0.01*	*<0.05*	6.1	120	5.2	5.7	*<0.01*	0.010	3.4	1.3	0.30	0.20	19	*<0.01*	*<0.01*	11	*<0.005*	0.15	0.93	7.2	0.20	11	15	1.1
								Min	0.60	0.010	159	0.26	*<0.01*	*<0.05*	1.0	90	2.4	3.8	*<0.01*	*0.010*	3.0	0.70	0.30	0.20	9.1	*<0.01*	*<0.01*	9.6	*<0.005*	0.14	0.63	3.0	0.14	5.8	5.0	0.90
Upper Transition Facies for Schist Waste Rock																																				
ABA004	KAM022156	CFD0107	149.0	150.0	Waste	Upper transition	Schist	RQM	3.3	0.80	463	0.90	0.020	0.060	23	360	8.6	11	*<0.001*	0.24	3.3	5.1	1.0	0.40	59	*<0.01*	0.020	18	0.0060	0.18	1.2	22	0.21	18	51	3.7
ABA027	KAM037928	CFD0099	30.0	31.0	Waste	Upper transition	Schist	BtS_carb	6.5	0.32	611	1.2	0.010	0.050	15	560	10	32	*<0.001*	0.010	2.1	6.8	0.90	0.80	89	*<0.01*	*<0.01*	17	0.026	0.20	2.4	35	1.4	22	54	1.7
ABA062	KAM081561	CFD0202	58.0	58.5	Waste	Upper transition	Schist	BtS	9.8	3.5	909	3.1	0.030	*<0.05*	35	1270	37	76	0.0060	1.1	4.1	22	1.1	1.9	60	*<0.01*	2.6	7.0	0.14	0.47	1.2	165	0.15	18	141	1.8
ABA076	KAM147059	CFD0345	160.0	161.0	Waste	Upper transition	Schist	BtS	4.3	1.9	533	0.45	0.010	*<0.05*	20	150	26	7.2	*<0.001*	0.61	8.9	4.6	0.70	0.30	108	*<0.01*	0.020	9.0	*<0.005*	0.070	2.2	28	0.24	13	52	2.9
ABA092	KAM135149	CFR0452	10.7	12.2	Waste	Upper Transition	Schist	BtS	5.2	0.32	232	2.0	0.060	0.38	4.8	370	7.3	39	*<0.001*	*<0.01*	0.95	1.8	1.0	0.70	16	*<0.01*	0.41	26	0.059	0.24	4.3	8.0	0.55	19	16	5.6
ABA124	KAM149042	CFR0559	35.1	36.6	Waste	Upper transition	Schist	BtS	4.5	0.78	435	1.4	*<0.01*	0.090	20	340	7.1	21	*<0.001*	0.040	3.6	5.3	0.70	0.80	45	*<0.01*	0.030	21	0.033	0.12	1.0	36	0.43	17	41	7.9
ABA204	R270174	CFD0388	8.0	9.0	Waste	Upper transition	Schist	MsS	5.0	0.38	426	0.53	0.010	*<0.05*	37	450	11	27	*<0.001*	0.030	4.1	9.0	0.60	0.70	35	*<0.01*	0.040	13	0.034	0.57	1.4	43	0.19	22	72	1.5
ABA205	R276797	CFD0413	115.0	116.0	Waste	Upper transition	Schist	BtS	2.9	1.0	481	0.49	0.010	*<0.05*	32	100	4.9	9.3	*<0.001*	0.010	66	5.5	0.40	0.50	87	*<0.01*	0.020	12	*<0.005*	0.11	3.5	29	0.81	11	28	2.5
ABA206	Q033613	CFD0407	52.0	53.0	Waste	Upper transition	Schist	BtS	8.7	1.6	377	0.73	0.010	*<0.05*	25	310	6.8	12	0.0010	0.080	6.8	7.0	0.70	0.70	89	*<0.01*	*<0.01*	20	0.0050	0.19	2.1	31	0.11	20	40	2.0
ABA316	R270207	CFD0390	5.0	6.0	Waste	Upper Transition	Schist	MsS	3.0	0.29	618	0.53	0.020	*<0.05*	36	450	12	15	*<0.001*	0.080	5.8	7.2	0.90	0.40	34	*<0.01*	0.030	11	0.0070	0.12	2.0	39	0.64	20	83	1.3
ABA317	R270258	CFD0390	50.0	51.0	Waste	Upper Transition	Schist	BtS_carb	4.4	0.42	286	1.2	0.050	0.060	9.8	570	4.7	41	*<0.001*	0.080	1.9	5.6	0.70	1.0	99	*<0.01*	0.020	31	0.032	0.23	1.8	32	0.080	15	36	13
ABA320	R270432	CFD0392	44.0	45.0	Waste	Upper Transition	Schist	BtS_carb	2.8	0.11	420	1.2	0.010	*<0.05*	7.0	450	8.1	16	*<0.001*	0.010	14	4.8	0.50	0.80	73	*<0.01*	*<0.01*	28	0.0070	0.15	2.6	29	0.64	16	36	9.7
ABA323	Q033713	CFD0411	24.0	25.0	Waste	Upper Transition	Schist	BtS_Carb	6.3	0.37	590	0.49	0.020	*<0.05*	31	520	11	12	*<0.001*	0.020	17	10	1.0	2.8	105	*<0.01*	0.010	11	0.0090	0.15	1.9	54	0.42	25	81	3.3
ABA332	Q033589	CFD0407	32.0	33.0	Waste	Upper Transition	schist	BtS	5.1	0.80	470	0.84	0.060	*<0.05*	35	420	5.9	17	*<0.001*	0.030	3.9	6.2	0.60	1.6	48	*<0.01*	0.010	15	0.0090	0.090	2.6	40	0.12	18	45	2.9
Statistical Summary						**Upper Transition**	**Schist**	**n**	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								Max	9.8	3.5	909	3.1	0.060	0.38	37	1270	37	76	0.0060	1.1	66	22	1.1	2.8	108	*<0.01*	2.6	31	0.14	0.57	4.3	165	1.4	25	141	13
								90th PCTL	8.0	1.8	616	1.9	0.057	0.081	36	567	21	40	0.0010	0.50	16	9.7	1.0	1.8	103	*<0.01*	0.30	27	0.052	0.40	3.3	51	0.76	22	82	9.2
								75th PCTL	6.0	0.96	576	1.2	0.028	0.058	34	503	11	30	*<0.001*	0.080	8.4	7.2	0.98	0.95	89	*<0.01*	0.030	21	0.033	0.22	2.6	40	0.62	20	68	5.1
								Median	4.8	0.60	467	0.87	0.015	*<0.05*	24	435	8.4	16	*<0.001*	0.035	4.1	5.9	0.70	0.75	67	*<0.01*	0.020	16	0.0090	0.17	2.1	34	0.33	18	48	2.9
								25th PCTL	3.6	0.33	422	0.53	0.010	*<0.05*	16	345	6.9	12	*<0.001*	0.013	3.4	5.2	0.63	0.55	46	*<0.01*	0.010	12	0.0063	0.12	1.5	29	0.16	16	37	1.9
								10th PCTL	2.9	0.30	313	0.49	0.010	*<0.05*	7.8	198	5.2	9.7	*<0.001*	0.010	2.0	4.7	0.53	0.40	35	*<0.01*	*<0.01*	9.5	*<0.005*	0.096	1.2	24	0.11	14	30	1.6
								Min	2.8	0.11	232	0.45	*<0.01*	*<0.05*	4.8	100	4.7	7.2	*<0.001*	*<0.01*	0.95	1.8	0.40	0.30	16	*<0.01*	*<0.01*	7.0	*<0.005*	0.070	1.0	8.0	0.080	11	16	1.3
Lower Transition Facies for Schist Waste Rock																																				
ABA021	KAM033153	CFD0164	148.0	149.0	Waste	Lower transition	Schist	BtS	14	2.2	584	0.42	0.11	0.090	39	630	1.6	89	*<0.001*	0.16	0.17	6.7	0.40	1.0	54	*<0.01*	0.010	4.7	0.23	0.48	1.4	72	0.27	7.2	60	1.6
ABA024	KAM036666	CFD0087	17.0	18.0	Waste	Lower transition	Schist	BtS_carb	17	1.4	551	0.61	0.10	0.17	17	990	4.9	97	*<0.001*	0.060	0.66	9.7	1.1	1.7	103	0.010	0.030	12	0.21	0.54	1.7	84	0.14	19	72	2.1
ABA025	KAM037046	CFD0091	12.0	13.0	Waste	Lower transition	Schist	BtS	15	1.3	510	0.70	0.030	0.070	26	610	8.8	73	*<0.001*	*<0.01*	0.81	8.4	0.80	0.80	154	*<0.01*	0.040	14	0.099	0.37	1.1	62	0.77	18	58	2.1
ABA031	KAM039252	CFD0116	75.0	76.0	Waste	Lower transition	Schist	RQM	16	1.3	582	0.53	0.020	0.12	30	660	7.4	78	*<0.001*	0.070	0.24	8.7	1.0	1.8	92	*<0.01*	0.020	21	0.11	0.50	1.8	49	0.14	22	49	5.0
ABA038	KAM047995	CFD0135	153.0	154.0	Waste	Lower transition	Schist	BtS	13	1.8	484	0.98	0.040	0.050	32	570	14	58	*<0.001*	0.10	2.2	6.9	0.70	1.2	65	*<0.01*	0.14	14	0.098	0.35	1.8	56	0.26	15	46	2.8
ABA054	KAM081312	CFD0198	85.0	86.0	Waste	Lower transition	Schist	BtS	0.70	0.030	127	0.32	0.080	0.25	3.6	100	4.3	10	*<0.001*	*<0.01*	4.9	0.70	0.50	0.30	8.7	*<0.01*	0.040	33	*<0.005*	0.060	2.3	4.0	0.35	12	7.0	11
ABA086	KAM133474	CFR0429	59.4	61.0	Waste	Lower transition	Schist	BtS	8.5	0.98	428	1.4	0.030	0.11	27	510	9.3	58	*<0.001*	0.18	1.4	5.3	0.60	0.60	61	*<0.01*	0.020	19	0.10	0.35	1.6	33	0.33	19	49	2.7
ABA208	R276736	CFD0413	61.0	62.0	Waste	Lower transition	Schist	BtS	16	1.2	620	0.74	0.020	0.090	33	650	8.9	67	0.0010	0.36	2.5	8.5	0.90	1.3	52	*<0.01*	0.070	13	0.12	0.41	1.7	56	0.14	20	57	1.5
ABA209	R270032	CFD0384	31.0	32.0	Waste	Lower transition	Schist	BtS_carb	8.3	0.69	523	10	0.040	0.14	18	580	7.2	43	0.0030	0.26	0.060	4.9	0.40	1.1	78	*<0.01*	0.16	16	0.090	0.28	2.2	24	0.12	19	41	3.2
ABA210	R276281	CFD0401	58.0	59.0	Waste	Lower transition	Schist	BtS	8.1	1.5	832	0.28	0.030	0.070	40	580	8.2	37	*<0.001*	*<0.01*	3.5	8.7	0.30	0.90	79	*<0.01*	0.17	17	0.037	0.31	3.2	50	0.46	21	49	2.6
ABA211	R276567	CFD0409	65.0	66.0	Waste	Lower transition	Schist	BtS	10	2.1	610	0.34	0.040	0.080	58	620	12	19	*<0.001*	0.020	1.2	11	0.20	0.50	58	*<0.01*	0.080	7.6	0.034	0.14	1.4	63	*<0.05*	9.9	53	1.4
ABA318	R270302	CFD0390	88.0	89.0	Waste	Lower Transition	Schist	BtS_carb	7.8	0.91	602	0.26	0.020	0.41	25	410	7.6	8.1	*<0.001*	0.020	0.14	3.1	0.30	2.0	355	0.010	0.030	5.0	0.11	0.050	1.2	21	0.32	7.9	48	3.9
ABA319	R270394	CFD0392	10.0	11.0	Waste	Lower Transition	Schist	BtS_carb	15	1.3	540	0.33	0.030	0.18	52	470	5.3	37	*<0.001*	*<0.01*	2.0	7.2	0.80	1.1	59	*<0.01*	0.010	13	0.060	0.22	0.93	46	0.080	19	58	1.2
ABA325	R512767	CFR0724	39.6	41.2	Waste	Lower Transition	schist	BtS	12	1.2	391	1.9	0.080	0.23	15	540	33	43	*<0.001*	0.060	1.7	5.4	0.60	1.2	53	*<0.01*	0.040	23	0.13	0.27	1.9	45	0.67	13	42	6.9
ABA333	R277487	CFD0426	43.0	44.0	Waste	Lower Transition	schist	BtS	8.1	0.71	393	0.49	0.030	0.10	19	380	5.7	54	*<0.001*	*<0.01*	3.3	3.0	0.70	3.3	14	*<0.01*	0.21	35	0.054	0.41	3.7	19	0.47	17	19	4.4
ABA335	R550437	CFD0518	25.0	26.0	Waste	Lower Transition	schist	BtS	9.8	0.88	591	0.31	0.030	0.35	40	860	12	9.1	*<0.001*	*<0.01*	2.9	6.0	0.40	1.7	273	*<0.01*	0.020	5.2	0.15	0.080	1.5	45	1.8	11	66	11
ABA336	R550471	CFD0518	55.0	56.0	Waste	Lower Transition	Schist	BtS_carb	11	0.92	681	0.30	0.030	0.11	35	1150	16	46	*<0.001*	0.13	19	7.2	1.3	2.0	231	*<0.01*	0.020	9.6	0.075	0.25	1.6	41	0.17	26	88	2.1
ABA337	R550494	CFD0518	75.0	75.0	Waste	Lower Transition	schist	BtS	16	1.1	526	0.12	0.040	0.13	46	660	12	80	*<0.001*	*<0.01*	0.94	4.9	0.70	1.2	1630	*<0.01*	0.030	12	0.13	0.52	0.89	48	0.34	16	67	2.2
ABA345	R551151	CFD0563	68.0	69.0	Waste	Lower Transition	schist	BtS	8.4	1.7	711	0.91	0.070	0.14	57	780	49	38	*<0.001*	0.050	3.0	6.2	0.30	2.0	54	*<0.01*	0.050	2.6	0.16	0.52	0.81	44	0.23	7.4	99	2.1
Statistical Summary						**Lower Transition**	**Schist**	**n**	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
								Max	17	2.2	832	10	0.11	0.41	58	1150	49	97	0.0030	0.36	19	11	1.3	3.3	1630	0.010	0.21	35	0.23	0.54	3.7	84	1.8	26	99	11
								90th PCTL	16	1.8	687	1.5	0.084	0.27	53	886	19	82	0.0010	0.20	3.8	8.9	1.0	2.0	289	0.010	0.16	25	0.17	0.52	2.4	65	0.69	21	75	7.6
								75th PCTL	15	1.5	606	0.83	0.055	0.18	40	660	12	70	*<0.001*	0.12	3.0	8.5	0.80	1.8	129	*<0.01*	0.075	18	0.13	0.45	1.9	56	0.41	19	63	4.2
								Median	11	1.2	551	0.49	0.030	0.12	32	610	8.8	46	*<0.001*	0.050	1.7	6.7	0.60	1.2	65	*<0.01*	0.040	13	0.10	0.35	1.6	46	0.27	17	53	2.6
								25th PCTL	8.4	0.92	497	0.32	0.030	0.090	22	525	6.5	37	*<0.001*	*<0.01*	0.74	5.1	0.40	0.95	54	*<0.01*	0.020	8.6	0.068	0.24	1.3	37	0.14	11	47	2.1
								10th PCTL	8.0	0.71	393	0.28	0.020	0.070	17	404	4.8	9.8	*<0.001*	*<0.01*	0.16	3.1	0.30	0.58	44	*<0.01*	0.018	4.9	0.036	0.076	0.92	21	0.11	7.8	37	1.5
								Min	0.70	0.030	127	0.12	0.020	0.050	3.6	100	1.6	8.1	*<0.001*	*<0.01*	0.060	0.70	0.20	0.30	8.7	*<0.01*	0.010	2.6	*<0.005*	0.050	0.81	4.0	*<0.05*	7.2	7.0	1.2

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Fresh Facies for Schist Waste Rock																																				
ABA082	KAM131674	CFR0401	15.2	16.8	Waste	Fresh	Schist	BtS	16	1.7	548	0.73	0.040	*<0.05*	27	1570	4.2	62	*<0.001*	0.010	1.4	7.5	0.50	0.50	51	*<0.01*	0.020	6.4	0.21	0.35	0.55	75	0.22	12	60	1.5
ABA084	KAM132888	CFR0420	32.0	33.5	Waste	Fresh	Schist	BtS	11	1.4	539	1.2	0.020	0.12	20	630	6.8	75	*<0.001*	0.010	0.22	3.8	0.80	0.80	94	*<0.01*	0.020	16	0.13	0.43	1.4	27	0.28	16	40	6.6
ABA091	KAM133659	CFR0431	109.7	111.3	Waste	Fresh	Schist	BtS	10	1.1	423	1.8	0.050	0.13	19	750	30	56	*<0.001*	1.1	0.36	3.7	0.70	1.2	136	*<0.01*	0.070	13	0.099	0.30	2.0	36	0.59	12	45	1.0
ABA093	KAM135298	CFR0453	10.7	12.2	Waste	Fresh	Schist	BtS	16	2.3	586	0.76	0.10	0.060	102	1760	2.8	95	0.0010	0.090	3.7	8.7	0.60	0.50	169	*<0.01*	0.010	8.6	0.21	0.79	2.1	101	0.27	12	41	22
ABA095	KAM135693	CFR0456	10.7	12.2	Waste	Fresh	Schist	BtS	17	1.5	452	0.88	0.030	0.10	53	450	2.2	77	*<0.001*	0.010	1.6	5.0	0.70	0.50	22	*<0.01*	0.040	11	0.18	0.45	0.70	48	0.40	12	77	1.2
ABA127	KAM149916	CFR0566	109.7	111.3	Waste	Fresh	Schist	BtS_carb	17	1.3	434	1.3	0.020	0.080	54	440	4.6	68	0.0010	0.70	3.2	7.0	1.1	0.60	125	*<0.01*	0.020	11	0.13	0.37	1.4	56	0.54	20	64	2.4
ABA132	KAM150898	CFR0574	114.3	115.8	Waste	Fresh	Schist	BtS	17	1.6	434	1.1	0.030	*<0.05*	60	520	4.9	72	0.0010	0.70	4.0	9.3	0.90	1.0	104	0.010	0.020	9.3	0.10	0.42	2.2	59	0.36	18	56	1.7
ABA134	KAM150984	CFR0575	106.7	108.2	Waste	Fresh	Schist	BtS	9.4	1.4	536	2.3	0.020	0.050	11	750	6.3	25	*<0.001*	0.090	0.69	6.1	0.80	0.80	126	*<0.01*	*<0.01*	22	0.021	0.12	2.8	42	0.27	19	46	1.8
ABA212	Q033565	CFD0407	10.0	11.0	Waste	Fresh	Schist	BtS	22	2.1	702	0.28	0.050	0.050	45	890	16	88	0.0010	0.13	0.23	10	1.0	2.1	59	*<0.01*	0.010	12	0.16	0.54	1.5	73	0.16	21	86	1.6
ABA213	R280479	CFD0497	111.0	112.0	Waste	Fresh	Schist	BtS	15	1.4	724	0.98	0.070	0.13	15	860	3.0	54	*<0.001*	0.030	0.39	2.6	0.20	0.70	51	*<0.01*	0.080	7.9	0.16	0.28	1.1	36	0.14	5.9	40	2.5
ABA214	R274802	CFD0472	47.0	48.0	Waste	Fresh	Schist	BtS	5.5	0.32	243	1.8	0.040	0.42	5.7	370	6.0	38	0.0010	0.010	1.4	1.4	0.50	0.80	15	*<0.01*	0.12	27	0.053	0.30	6.2	7.0	0.22	14	12	6.8
ABA215	R275143	CFD0482	40.0	41.0	Waste	Fresh	Schist	BtS	6.7	1.5	550	0.83	0.010	*<0.05*	76	1040	13	98	0.0010	0.020	10	17	0.70	0.80	53	*<0.01*	0.050	21	0.076	0.99	4.2	102	0.38	18	32	6.7
ABA216	R276122	CFD0393	87.0	88.0	Waste	Fresh	Schist	BtS	19	3.3	691	0.13	0.040	0.17	35	640	6.1	88	*<0.001*	*<0.01*	0.98	5.6	0.20	1.6	51	*<0.01*	0.010	3.2	0.26	0.54	0.65	67	0.25	7.0	63	1.8
ABA217	R270181	CFD0388	92.0	93.0	Waste	Fresh	Schist	BtS_carb	17	1.5	603	1.6	0.040	0.11	24	860	8.7	84	0.0010	0.35	0.11	8.6	0.90	1.0	75	*<0.01*	0.020	19	0.18	0.42	3.1	57	0.12	23	54	1.6
ABA218	R283622	CFD0498	28.0	29.0	Waste	Fresh	Schist	BtS	9.1	1.3	362	0.25	0.070	0.44	32	720	7.9	46	*<0.001*	0.020	0.32	2.9	0.40	0.70	89	0.010	11	8.1	0.25	0.26	0.71	45	0.57	5.3	31	2.3
ABA219	R276979	CFD0416	57.0	58.0	Waste	Fresh	Schist	BtS	4.7	4.1	914	0.41	0.020	*<0.05*	56	320	11	32	0.0010	0.040	4.2	12	0.40	0.60	164	*<0.01*	0.010	4.3	0.034	0.29	1.3	51	*<0.05*	12	58	1.6
ABA220	R276002	CFD0387	148.0	149.0	Waste	Fresh	Schist	BtS	15	2.1	438	0.70	0.070	0.21	78	530	11	41	*<0.001*	0.15	0.17	4.4	0.20	0.70	69	0.010	0.050	4.2	0.25	0.22	0.58	50	0.23	6.2	43	1.5
ABA221	R276317	CFD0401	129.0	130.0	Waste	Fresh	Schist	BtS	4.4	0.99	304	0.42	0.030	0.46	32	520	4.6	38	*<0.001*	0.13	0.24	2.0	*<0.2*	1.8	175	*<0.01*	0.050	9.9	0.15	0.26	1.6	26	0.26	6.1	20	2.1
ABA222	R270104	CFD0386	59.0	60.0	Waste	Fresh	Schist	BtS_carb	15	1.1	521	0.72	0.030	0.10	33	610	8.0	72	0.0010	0.27	0.27	7.0	0.90	0.90	62	*<0.01*	0.010	15	0.16	0.41	1.7	38	0.11	22	59	1.8
ABA223	R270127	CFD0386	80.0	81.0	Waste	Fresh	Schist	MsS	6.4	0.87	468	0.65	0.030	0.090	39	370	15	54	*<0.001*	0.18	0.53	6.4	0.90	1.0	201	*<0.01*	*<0.01*	17	0.082	0.38	3.5	33	0.070	21	58	2.5
ABA321	R270466	CFD0392	74.0	75.0	Waste	Fresh	Schist	BtS_carb	18	1.3	489	0.68	0.040	0.12	27	670	7.5	88	0.0010	0.14	1.6	8.4	1.0	1.2	83	*<0.01*	0.020	17	0.16	0.50	6.0	46	0.090	21	54	1.8
ABA322	R270482	CFD0392	88.0	89.0	Waste	Fresh	Schist	BtS_carb	17	1.3	516	0.49	0.030	0.11	39	550	8.0	79	*<0.001*	*<0.01*	2.8	5.9	0.70	1.5	298	*<0.01*	0.020	11	0.14	0.48	1.1	44	0.12	15	58	1.7
ABA326	R512983	CFR0731	32.0	32.4	Waste	Fresh	schist	BtS	15	2.2	528	0.68	0.040	0.15	103	630	3.7	40	*<0.001*	*<0.01*	4.8	7.7	0.40	1.1	66	*<0.01*	0.080	5.1	0.22	0.32	0.62	56	0.27	9.0	43	3.5
ABA329	R270202	CFD0388	110.0	110.2	Waste	Fresh	Schist	BtS_carb	11	1.4	551	1.3	0.070	0.73	54	1440	4.5	62	0.0010	0.19	0.83	4.0	0.50	3.5	202	0.010	0.020	8.3	0.29	0.33	2.3	53	0.32	13	38	4.5
ABA330	R276299	CFD0401	74.0	75.0	Waste	Fresh	schist	BtS	4.5	0.78	744	3.1	0.060	0.90	39	640	2.2	30	*<0.001*	0.050	0.45	2.4	0.40	2.5	94	0.010	0.13	5.4	0.18	0.18	0.98	30	0.76	6.9	38	7.9
ABA331	R276331	CFD0401	141.0	142.0	Waste	Fresh	schist	BtS	30	3.0	928	0.38	0.030	0.060	41	780	13	104	*<0.001*	*<0.01*	1.7	9.5	0.50	1.5	138	*<0.01*	0.020	6.6	0.17	0.59	3.4	109	0.11	13	134	2.0
ABA377	R279587	CFD0468	131.0	132.0	Waste	Fresh	Schist	AmBtS	4.0	0.60	741	2.6	0.050	0.62	24	340	3.1	23	*<0.001*	0.23	0.12	1.2	0.20	3.9	380	0.010	0.040	7.2	0.079	0.13	0.93	16	0.98	5.8	18	2.0
ABA415	R277001	CFD0398	49.0	50.0	Waste	Fresh	schist	BtS	11	1.6	429	0.27	0.040	0.21	62	730	2.9	46	*<0.001*	*<0.01*	1.0	2.9	0.20	0.40	46	*<0.01*	0.070	3.6	0.22	0.32	0.34	35	0.30	4.1	34	1.7
ABA416	R277017	CFD0398	64.0	65.0	Waste	Fresh	schist	BtS	16	1.8	622	0.29	0.050	0.16	29	1000	4.1	70	*<0.001*	*<0.01*	0.81	3.9	0.20	1.2	63	*<0.01*	0.030	7.4	0.21	0.45	1.1	63	0.33	7.0	57	2.5
ABA417	R277021	CFD0398	124.0	125.0	Waste	Fresh	schist	BtS	9.8	1.7	396	0.16	0.040	0.23	27	870	7.0	43	*<0.001*	*<0.01*	0.66	4.2	0.30	1.2	87	*<0.01*	0.030	6.2	0.21	0.29	0.70	41	0.30	7.1	41	2.8
ABA418	R277041	CFD0398	160.0	161.0	Waste	Fresh	schist	BtS	18	2.1	574	1.2	0.040	0.13	48	560	8.6	65	*<0.001*	0.18	0.17	3.4	0.20	0.90	40	*<0.01*	0.040	3.7	0.20	0.40	0.51	49	0.23	3.9	53	2.3
Statistical Summary						**Fresh**	**Schist**	**n**	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
								Max	30	4.1	928	3.1	0.10	0.90	103	1760	30	104	0.0010	1.1	10	17	1.1	3.9	380	0.010	11	27	0.29	0.99	6.2	109	0.98	23	134	22
								90th PCTL	18	2.3	741	1.8	0.070	0.46	76	1040	13	88	0.0010	0.35	4.0	9.5	0.90	2.1	201	0.010	0.080	19	0.25	0.54	3.5	75	0.57	21	64	6.7
								75th PCTL	17	2.0	613	1.3	0.050	0.21	54	860	8.7	78	*<0.001*	0.18	1.7	8.1	0.80	1.4	137	*<0.01*	0.050	14	0.21	0.45	2.2	58	0.35	18	58	2.7
								Median	15	1.5	536	0.73	0.040	0.12	39	640	6.3	62	*<0.001*	0.050	0.81	5.6	0.50	1.0	87	*<0.01*	0.020	8.6	0.16	0.37	1.4	48	0.27	12	46	2.0
								25th PCTL	9.3	1.3	436	0.42	0.030	0.070	27	525	4.2	42	*<0.001*	0.010	0.30	3.6	0.25	0.70	56	*<0.01*	0.020	6.3	0.12	0.29	0.71	36	0.15	7.0	39	1.7
								10th PCTL	4.7	0.87	396	0.27	0.020	*<0.05*	19	370	2.9	32	*<0.001*	*<0.01*	0.17	2.4	0.20	0.50	46	*<0.01*	0.010	4.2	0.076	0.22	0.58	27	0.11	5.8	31	1.5
								Min	4.0	0.32	243	0.13	0.010	*<0.05*	5.7	320	2.2	23	*<0.001*	*<0.01*	0.11	1.2	*<0.2*	0.40	15	*<0.01*	0.010	3.2	0.021	0.12	0.34	7.0	*<0.05*	3.9	12	1.0
Statistical Summary for Schist Waste Rock								**n**	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
								Max	30	4.1	928	10	0.11	0.90	103	1760	49	104	0.0060	1.1	66	22	1.4	3.9	1630	0.010	11	38	0.29	1.4	9.6	165	2.2	26	141	22
								90th PCTL	17	2.1	714	1.8	0.070	0.36	57	910	15	84	0.0010	0.35	11	9.5	1.0	2.0	201	0.010	0.13	25	0.21	0.54	3.6	68	0.69	22	73	8.1
								75th PCTL	15	1.6	607	1.2	0.040	0.14	44	725	11	67	0.0010	0.15	4.8	7.6	0.90	1.2	106	0.010	0.045	19	0.16	0.44	2.4	52	0.45	19	60	4.7
								Median	8.4	1.2	526	0.70	0.030	0.090	32	560	8.0	39	*<0.001*	0.030	2.5	5.6	0.70	0.80	69	*<0.01*	0.020	13	0.082	0.30	1.7	41	0.28	16	49	2.3
								25th PCTL	4.5	0.56	429	0.44	0.010	*<0.05*	19	400	5.1	15	*<0.001*	0.010	0.75	4.0	0.40	0.55	50	*<0.01*	0.015	8.2	0.0090	0.19	1.1	28	0.16	12	39	1.7
								10th PCTL	2.9	0.12	307	0.28	*<0.01*	*<0.05*	7.6	318	3.6	8.9	*<0.001*	*<0.01*	0.23	2.2	0.20	0.40	23	*<0.01*	0.010	5.1	*<0.005*	0.12	0.70	18	0.11	6.8	20	1.4
								Min	0.60	0.010	127	0.12	*<0.01*	*<0.05*	1.0	90	1.6	3.8	*<0.001*	*<0.01*	0.060	0.70	0.20	*0.20*	8.7	*<0.01*	*<0.01*	2.6	*<0.005*	0.050	0.34	3.0	*<0.05*	3.9	5.0	0.90
Oxide Facies for Granite Waste Rock																																				
ABA157	R305807	CFD0382	76.0	77.0	Waste	Oxide	Granite	GG	2.8	0.010	2360	1.2	*<0.01*	0.090	1.0	180	17	6.1	*<0.001*	*<0.01*	35	1.3	0.30	0.30	72	*<0.01*	0.020	23	*<0.005*	2.1	6.5	3.0	2.4	6.6	36	6.3
ABA158	R305808	CFD0382	79.0	80.0	Waste	Oxide	Granite	GG	2.5	*<0.01*	1150	1.2	*<0.01*	0.090	1.0	190	22	3.0	*<0.001*	*<0.01*	38	1.0	0.20	0.40	112	*<0.01*	*<0.01*	23	*<0.005*	0.94	8.0	3.0	3.3	6.7	31	6.9
ABA174	R305826	CFD0403	7.0	8.0	Waste	Oxide	Granite	GG	0.80	0.010	21	0.61	*<0.01*	0.25	0.70	70	21	10	*<0.001*	*<0.01*	12	0.50	0.20	0.20	14	*<0.01*	*<0.01*	31	*<0.005*	1.2	5.6	1.0	0.080	2.9	5.0	6.8
ABA421	I354544	CFD0053	50.3	51.0	Waste	Oxide	Granite	GG	0.70	0.020	135	0.58	0.010	0.18	1.0	80	27	12	*<0.001*	0.010	7.5	0.60	0.40	0.30	56	*<0.01*	0.010	16	*<0.005*	0.35	22	2.0	0.090	13	19	3.3
ABA423	Q033319	CFD0403	7.0	7.8	Waste	Oxide	Granite	GG	1.3	0.020	34	0.72	0.010	0.20	1.6	60	21	15	*<0.001*	*<0.01*	8.8	0.60	*<0.2*	3.3	17	*<0.01*	0.010	35	*<0.005*	2.0	5.6	1.0	0.070	3.1	5.0	7.0
ABA429	Q032778	CFD0394	39.7	40.0	Waste	Oxide	Granite	GG	6.5	0.080	982	0.97	0.050	0.82	0.90	220	7.7	31	*<0.001*	*<0.01*	0.82	1.8	0.40	1.0	7.3	*<0.01*	*<0.01*	32	0.039	0.50	5.3	6.0	0.060	10	28	10
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	6.5	0.080	2360	1.2	0.050	0.82	1.6	220	27	31	*<0.001*	0.010	38	1.8	0.40	3.3	112	*<0.01*	0.020	35	0.039	2.1	22	6.0	3.3	13	36	10
								90th PCTL	4.7	0.050	1755	1.2	0.030	0.54	1.3	205	24	23	*<0.001*	0.010	36	1.6	0.40	2.2	92	*<0.01*	0.015	33	0.022	2.1	15	4.5	2.8	12	34	8.6
								75th PCTL	2.7	0.020	1108	1.1	0.010	0.24	1.0	188	22	14	*<0.001*	*<0.01*	29	1.2	0.38	0.85	68	*<0.01*	0.010	32	*<0.005*	1.8	7.6	3.0	1.8	9.3	30	7.0
								Median	1.9	0.015	559	0.85	*<0.01*	0.19	1.0	130	21	11	*<0.001*	*<0.01*	10	0.80	0.25	0.35	36	*<0.01*	*<0.01*	27	*<0.005*	1.1	6.0	2.5	0.085	6.6	24	6.9
								25th PCTL	0.93	0.010	59	0.64	*<0.01*	0.11	0.93	73	18	7.2	*<0.001*	*<0.01*	7.8	0.60	0.20	0.30	15	*<0.01*	*<0.01*	23	*<0.005*	0.61	5.6	1.3	0.073	4.0	8.5	6.4
								10th PCTL	0.75	0.010	28	0.60	*<0.01*	0.090	0.80	65	13	4.6	*<0.001*	*<0.01*	4.1	0.55	0.20	0.25	11	*<0.01*	*<0.01*	19	*<0.005*	0.43	5.4	1.0	0.065	3.0	5.0	4.8
								Min	0.70	*<0.01*	21	0.58	*<0.01*	0.090	0.70	60	7.7	3.0	*<0.001*	*<0.01*	0.82	0.50	*0.20*	0.20	7.3	*<0.01*	*<0.01*	16	*<0.005*	0.35	5.3	1.0	0.060	2.9	5.0	3.3

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Upper Transition Facies for Granite Waste Rock																																				
ABA013	KAM025898	CFD0150	81.0	82.0	Waste	Upper transition	Granite	GG	4.4	0.040	136	0.80	0.040	0.27	1.1	150	9.9	12	<0.001	<0.01	0.53	1.6	0.80	0.80	6.7	<0.01	<0.01	34	0.0080	0.18	11	5.0	0.060	19	13	7.9
ABA151	R305801	CFD0381	13.0	14.0	Waste	Upper transition	Granite	GG	12	0.11	869	1.2	0.070	1.3	0.80	150	6.8	35	<0.001	<0.01	0.11	2.1	0.50	1.1	5.5	<0.01	0.010	33	0.054	0.38	6.4	7.0	1.7	13	30	14
ABA152	R305802	CFD0381	35.0	36.0	Waste	Upper transition	Granite	GG	6.0	0.090	506	0.45	0.020	0.48	0.70	70	14	49	<0.001	<0.01	1.0	2.0	0.50	1.1	11	<0.01	0.010	35	0.034	0.43	9.7	5.0	16	11	37	7.4
ABA167	R305818	CFD0394	30.0	31.0	Waste	Upper transition	Granite	GG	0.60	0.010	16	0.92	<0.01	0.060	0.60	70	11	11	<0.001	0.050	2.8	0.40	0.20	<0.2	8.7	<0.01	<0.01	28	<0.005	0.12	4.6	1.0	0.19	9.2	5.0	7.5
ABA169	R305821	CFD0399	20.0	21.0	Waste	Upper transition	Granite	GG	0.60	0.010	456	0.60	0.030	0.13	1.1	220	20	8.0	<0.001	0.12	0.83	0.70	0.40	0.20	9.0	<0.01	<0.01	34	<0.005	0.080	5.7	3.0	0.17	10	23	13
ABA172	R305824	CFD0396	29.0	30.0	Waste	Upper transition	Granite	GG	1.6	<0.01	56	1.5	<0.01	0.080	0.50	150	22	2.3	<0.001	<0.01	11	1.9	<0.2	0.40	18	<0.01	<0.01	31	<0.005	0.11	8.6	4.0	0.13	9.3	16	8.7
ABA178	R305831	CFD0400	11.0	12.0	Waste	Upper transition	Granite	GG	3.0	0.050	294	0.38	0.020	0.71	1.1	80	9.6	19	<0.001	<0.01	0.76	1.3	0.50	0.70	5.0	<0.01	<0.01	32	0.023	0.23	5.3	4.0	0.14	28	28	12
ABA189	CFD0399_10_20	CFD0399	10.0	20.0	Waste	Upper transition	Granite	GG	1.2	0.020	154	0.71	0.030	0.12	0.90	200	31	9.1	<0.001	0.15	3.8	1.0	0.40	0.40	17	<0.01	0.010	52	<0.005	0.18	46	3.0	0.12	12	22	17
ABA190	CFD0396_50_60	CFD0396	50.0	60.0	Waste	Upper transition	Granite	GG	2.5	0.030	319	0.74	0.040	0.48	0.50	130	15	16	<0.001	<0.01	1.2	0.90	0.40	0.60	4.1	<0.01	0.010	31	0.012	0.18	9.2	4.0	0.070	9.0	19	7.6
ABA191	CFD0394_31_41	CFD0394	31.0	41.0	Waste	Upper transition	Granite	GG	2.7	0.030	230	0.68	0.030	0.34	0.90	170	16	19	<0.001	0.050	1.9	1.2	0.30	0.60	6.6	<0.01	0.010	31	0.010	0.22	6.1	4.0	0.10	9.3	23	8.0
ABA192	CFD0394_55_66	CFD0394	55.0	66.0	Waste	Upper transition	Granite	GG	1.5	0.020	460	0.71	0.040	0.27	0.90	110	24	13	<0.001	0.010	2.0	1.0	0.40	0.50	15	<0.01	0.010	31	0.0070	0.29	7.8	4.0	0.050	12	15	7.9
ABA195	CFD0381_4_13	CFD0381	4.0	13.0	Waste	Upper transition	Granite	GG	12	0.11	853	0.94	0.080	1.4	1.4	170	7.2	39	<0.001	<0.01	0.13	2.2	0.50	1.2	6.0	<0.01	0.010	33	0.055	0.37	6.7	7.0	0.080	13	33	14
ABA196	CFD0380_36_50	CFD0380	36.0	50.0	Waste	Upper transition	Granite	GG	1.0	0.010	63	0.76	0.010	0.10	1.1	80	13	9.1	<0.001	0.010	1.3	0.90	0.30	0.70	8.1	<0.01	0.010	28	<0.005	0.10	6.4	2.0	0.10	8.2	7.0	7.8
ABA431	Q041083	CFD0380	30.0	30.2	Waste	Upper Transition	Granite	GG	1.4	0.020	114	0.74	0.040	0.18	0.70	70	11	8.3	<0.001	<0.01	1.2	1.5	0.20	1.6	5.6	<0.01	<0.01	34	<0.005	0.23	5.2	4.0	0.050	7.5	13	8.3
ABA434	Q032756	CFD0394	19.5	19.6	Waste	Upper Transition	Granite	GG	1.2	0.020	73	1.1	0.010	0.12	1.3	100	39	15	<0.001	<0.01	28	0.90	0.40	1.1	25	<0.01	<0.01	32	<0.005	1.4	11	3.0	0.17	8.1	20	4.7
ABA435	Q032826	CFD0394	81.1	81.7	Waste	Upper Transition	Granite	GG	1.7	0.030	133	0.73	0.030	0.23	0.70	110	6.9	11	<0.001	0.020	1.0	1.2	0.30	1.3	4.9	<0.01	0.010	36	0.0090	0.12	7.8	3.0	0.050	8.6	10	7.8
ABA436	Q032927	CFD0396	65.0	65.5	Waste	Upper Transition	Granite	GG	1.3	0.010	97	0.64	0.010	0.070	0.50	70	13	8.1	<0.001	0.010	1.0	1.0	0.40	0.80	4.6	<0.01	<0.01	36	<0.005	0.25	5.6	3.0	0.090	10	7.0	8.4
Statistical Summary						**Upper Transition**	**Granite**	**n**	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
								Max	12	0.11	869	1.5	0.080	1.4	1.4	220	39	49	<0.001	0.15	28	2.2	0.80	1.6	25	<0.01	0.010	52	0.055	1.4	46	7.0	16	28	37	17
								90th PCTL	8.2	0.098	645	1.1	0.052	0.96	1.2	182	27	37	<0.001	0.078	6.7	2.0	0.50	1.2	17	<0.01	0.010	36	0.042	0.40	11	5.8	0.80	15	31	14
								75th PCTL	3.0	0.040	456	0.92	0.040	0.48	1.1	150	20	19	<0.001	0.020	2.0	1.6	0.50	1.1	11	<0.01	0.010	34	0.012	0.29	9.2	4.0	0.17	12	23	12
								Median	1.6	0.020	154	0.74	0.030	0.23	0.90	110	13	12	<0.001	<0.01	1.2	1.2	0.40	0.70	6.7	<0.01	<0.01	33	<0.005	0.22	6.7	4.0	0.10	10	19	8.0
								25th PCTL	1.2	0.010	97	0.68	0.010	0.12	0.70	80	9.9	9.1	<0.001	<0.01	0.83	0.90	0.30	0.50	5.5	<0.01	<0.01	31	<0.005	0.12	5.7	3.0	0.070	9.0	13	7.8
								10th PCTL	0.84	0.010	60	0.54	0.010	0.076	0.50	70	7.1	8.1	<0.001	<0.01	0.37	0.82	0.20	0.32	4.8	<0.01	<0.01	30	<0.005	0.11	5.3	2.6	0.050	8.1	7.0	7.5
								Min	0.60	<0.01	16	0.38	<0.01	0.060	0.50	70	6.8	2.3	<0.001	<0.01	0.11	0.40	0.20	0.20	4.1	<0.01	<0.01	28	<0.005	0.080	4.6	1.0	0.050	7.5	5.0	4.7
Lower Transition Facies for Granite Waste Rock																																				
ABA010	KAM024598	CFD0137	49.0	50.0	Waste	Lower transition	Granite	GG	14	0.13	701	0.68	0.11	1.0	2.4	160	5.4	42	<0.001	<0.01	0.080	1.7	0.50	1.2	7.2	<0.01	0.010	35	0.057	0.37	6.0	8.0	0.12	16	30	14
ABA154	R305804	CFD0382	10.0	11.0	Waste	Lower transition	Granite	GG	11	0.11	668	0.97	0.060	1.5	0.90	190	5.7	34	<0.001	<0.01	0.31	1.9	0.40	1.0	4.9	<0.01	<0.01	32	0.052	0.33	6.5	7.0	19	13	37	13
ABA155	R305805	CFD0382	50.0	51.0	Waste	Lower transition	Granite	GG	11	0.11	465	0.49	0.030	0.90	1.1	70	8.8	41	<0.001	<0.01	1.8	1.6	0.20	1.1	4.9	<0.01	<0.01	33	0.052	0.94	4.4	6.0	1.1	9.4	34	9.8
ABA159	R305809	CFD0383	10.0	11.0	Waste	Lower transition	Granite	GG	14	0.13	577	0.80	0.070	1.5	0.80	190	5.4	41	<0.001	<0.01	0.69	2.1	0.50	1.1	6.6	<0.01	0.010	35	0.064	0.42	6.0	8.0	0.55	12	31	16
ABA160	R305811	CFD0383	48.0	49.0	Waste	Lower transition	Granite	GG	13	0.13	775	0.78	0.070	1.4	1.0	180	5.6	36	<0.001	<0.01	0.34	1.6	0.40	1.0	5.7	<0.01	<0.01	30	0.058	0.34	5.9	7.0	7.4	13	35	13
ABA164	R305815	CFD0389	10.0	11.0	Waste	Lower transition	Granite	GG	5.7	0.090	332	0.65	0.070	1.2	1.0	160	6.4	28	<0.001	<0.01	0.24	1.5	0.20	0.70	5.4	<0.01	<0.01	33	0.045	0.25	4.8	7.0	7.0	11	22	18
ABA166	R305817	CFD0389	45.0	46.0	Waste	Lower transition	Granite	GG	1.4	0.040	225	1.5	<0.01	0.38	4.6	220	12	36	0.0010	0.020	85	1.2	0.30	1.0	16	<0.01	0.030	34	0.014	0.34	26	6.0	1.9	12	88	10
ABA193	CFD383_115_125	CFD0383	115.0	125.0	Waste	Lower transition	Granite	GG	6.5	0.14	1000	1.0	0.070	0.72	1.7	260	9.2	24	<0.001	<0.01	0.30	1.8	0.40	0.70	6.1	<0.01	0.010	30	0.039	0.22	6.4	9.0	0.050	14	39	8.4
ABA194	CFD0382_84_94	CFD0382	84.0	94.0	Waste	Lower transition	Granite	GG	1.9	0.020	1720	1.1	0.010	0.14	1.8	240	15	20	<0.001	<0.01	6.1	1.2	0.40	0.60	17	<0.01	0.010	31	0.0050	0.84	10	5.0	0.080	13	39	7.1
ABA424	Q041284	CFD0382	4.0	5.0	Waste	Lower Transition	Granite	GG	13	0.12	612	0.91	0.10	1.2	2.2	170	5.6	40	<0.001	<0.01	0.31	2.2	0.40	1.3	7.8	<0.01	<0.01	33	0.059	0.39	4.5	8.0	0.18	12	31	16
ABA425	Q041377	CFD0382	87.0	88.0	Waste	Lower Transition	Granite	GG	1.1	0.010	55	0.69	0.010	0.060	1.7	50	7.6	6.3	<0.001	<0.01	1.4	1.2	0.40	0.60	8.6	<0.01	<0.01	34	<0.005	0.070	4.6	2.0	<0.05	9.6	4.0	8.5
ABA426	Q041396	CFD0382	103.0	104.0	Waste	Lower Transition	Granite	GG	2.3	<0.01	56	0.93	0.010	0.060	1.0	90	25	4.9	<0.001	<0.01	5.1	1.3	0.50	0.50	42	<0.01	0.010	34	<0.005	0.24	9.7	6.0	<0.05	11	7.0	8.7
ABA427	Q041404	CFD0382	110.0	111.0	Waste	Lower Transition	Granite	GG	2.8	0.040	1020	1.1	0.010	0.13	1.4	120	13	21	<0.01	<0.01	2.0	1.4	0.30	1.1	8.2	<0.01	<0.01	36	0.0080	1.5	6.1	5.0	0.050	10	29	6.1
ABA430	Q041069	CFD0380	18.0	18.1	Waste	Lower Transition	Granite	GG	0.60	0.020	86	0.76	0.010	0.11	0.70	70	19	13	<0.001	0.080	4.0	0.50	0.30	0.30	21	<0.01	0.010	27	<0.005	1.9	14	1.0	0.15	9.3	7.0	4.2
Statistical Summary						**Lower Transition**	**Granite**	**n**	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								Max	14	0.14	1720	1.5	0.11	1.5	4.6	260	25	42	0.0010	0.080	85	2.2	0.50	1.3	42	<0.01	0.030	36	0.064	1.9	26	9.0	19	16	88	18
								90th PCTL	13	0.13	1014	1.1	0.091	1.4	2.3	234	18	41	0.0010	0.017	5.8	2.0	0.50	1.2	20	<0.01	0.010	35	0.059	1.3	13	8.0	7.3	14	39	16
								75th PCTL	12	0.13	757	0.99	0.070	1.2	1.8	190	13	39	<0.01	<0.01	3.5	1.8	0.40	1.1	14	<0.01	0.010	34	0.056	0.74	8.9	7.8	1.7	13	37	13
								Median	6.1	0.10	595	0.86	0.045	0.81	1.3	165	8.2	31	<0.01	<0.01	1.1	1.6	0.40	1.0	7.5	<0.01	<0.01	33	0.042	0.36	6.0	6.5	0.17	12	31	10
								25th PCTL	2.0	0.025	252	0.71	0.010	0.13	1.0	98	5.6	20	<0.01	<0.01	0.31	1.2	0.30	0.63	5.8	<0.01	<0.01	31	0.0058	0.27	5.1	5.3	0.058	10	24	8.4
								10th PCTL	1.2	0.013	65	0.66	0.010	0.075	0.83	70	5.5	8.2	<0.01	<0.01	0.26	1.2	0.23	0.53	5.1	<0.01	<0.01	30	<0.005	0.23	4.5	2.9	<0.05	9.5	7.0	6.4
								Min	0.60	0.010	55	0.49	<0.01	0.060	0.70	50	5.4	4.9	<0.01	<0.01	0.080	0.50	0.20	0.30	4.9	<0.01	<0.01	27	<0.005	0.070	4.4	1.0	<0.05	9.3	4.0	4.2
Fresh Facies for Granite Waste Rock																																				
ABA012	KAM025798	CFD0147	260.0	261.0	Waste	Fresh	Granite	GG	9.2	0.18	792	0.82	0.090	0.77	1.3	270	9.3	26	<0.001	<0.01	0.060	2.4	0.60	0.80	17	<0.01	0.010	26	0.030	0.21	6.3	11	0.070	17	39	6.2
ABA162	R305813	CFD0385	10.0	11.0	Waste	Fresh	Granite	GG	12	0.11	552	0.78	0.060	1.2	0.80	160	5.2	34	<0.001	<0.01	0.24	1.9	0.40	1.1	4.4	<0.01	<0.01	31	0.056	0.36	6.3	7.0	8.8	10	32	15
ABA163	R305814	CFD0385	59.0	60.0	Waste	Fresh	Granite	GG	5.8	0.090	278	0.21	0.030	0.60	1.5	50	7.9	29	<0.001	<0.01	3.0	1.5	0.20	1.5	6.1	<0.01	<0.01	33	0.043	0.68	4.4	6.0	0.26	8.1	19	9.7
ABA165	R305816	CFD0389	30.0	31.0	Waste	Fresh	Granite	GG	6.1	0.090	574	0.81	0.060	1.4	0.90	150	5.4	29	<0.001	0.040	0.63	1.4	0.50	0.90	5.7	<0.01	<0.01	32	0.046	0.26	6.6	7.0	3.8	18	72	14
ABA168	R305819	CFD0394	88.0	89.0	Waste	Fresh	Granite	GG	13	0.12	546	0.88	0.050	1.4	1.3	210	6.1	37	<0.001	0.010	1.8	1.7	0.40	1.1	4.3	<0.01	0.010	33	0.061	0.37	5.3	7.0	0.75	16	44	11
ABA179	R305832	CFD0400	60.0	61.0	Waste	Fresh	Granite	GG	3.2	0.080	201	0.80	0.020	0.57	1.0	150	8.4	38	<0.001	<0.01	16	1.3	0.40	1.1	7.0	<0.01	<0.01	36	0.041	0.46	29	9.0	0.13	12	30	8.4
ABA180	CFD0396_72_81	CFD0396	72.0	81.0	Waste	Fresh	Granite	GG	1.2	0.030	686	0.72	0.010	0.10	0.70	190	15	4.7	<0.001	0.090	0.73	1.4	0.30	0.70	3.2	<0.01	0.010	37	<0.005	0.50	5.4	5.0	0.19	14	26	8.5
ABA182	CFD0394_94_104	CFD0394	94.0	104.0	Waste	Fresh	Granite	GG	1.8	0.050	1140	0.76	0.030	0.22	1.0	160	13	13	<0.001	0.19	2.7	1.0	0.30	0.40	4.4	<0.01	0.010	29	0.0050	0.24	6.6	4.0	0.070	9.6	24	7.1
ABA186	CFD0380_2_17	CFD0380	2.0	17.0	Waste	Fresh	Granite	GG	18	0.10	753	0.78	0.060	1.6	1.0	150	6.6	37	<0.001	<0.01	0.20	2.1	0.40	1.4	4.4	<0.01	0.020	31	0.049	0.35	6.5	6.0	0.090	16	37	13
ABA187	CFD0380_22_30	CFD0380	22.0	30.0	Waste	Fresh	Granite	GG	12	0.080	345	0.75	0.060	1.6	1.0	170	14	33	<0.001	<0.01	0.52	1.8	0.40	1.3	4.5	<0.01	0.010	33	0.042	0.33	7.0	6.0	0.090	13	24	10
ABA198	CFD0385_28_38	CFD0385	28.0	38.0	Waste	Fresh	Granite	GG	16	0.12	509	1.4	0.080	1.3	1.1	170	6.1	38	<0.001	0.010	0.27	1.8	0.30	1.1	5.9	<0.01	<0.01	34	0.060	0.39	7.3	8.0	0.080	12	29	16
ABA199	CFD0385_38_48	CFD0385	38.0	48.0	Waste	Fresh	Granite	GG	12	0.11	553	1.1	0.040	1.9	1.4	160	4.9	33	0.0010	<0.01	1.1	1.7	0.40	1.3	4.1	<0.01	<0.01	33	0.055	0.31	7.6	7.0	0.090	13	29	14
ABA200	CFD0385_48_58	CFD0385	48.0	58.0	Waste	Fresh	Granite	GG	11	0.10	513	0.95	0.040	1.4	1.8	130	5.5	31	<0.001	<0.01	2.7	1.6	0.30	1.7	5.2	<0.01	<0.01	32	0.050	0.30	9.1	6.0	0.080	16	25	12
ABA437	Q041055	CFD0380	5.0	6.0	Waste	Fresh	Granite	GG	20	0.12	1080	0.78	0.070	1.4	1.2	160	5.9	43	<0.001	<0.01	0.10	2.4	0.60	1.6	4.9	<0.01	<0.01	33	0.057	0.43	7.4	7.0	0.080	17	37	14
ABA438	Q041063	CFD0380	12.0	13.0	Waste	Fresh	Granite	GG	21	0.13	1080	0.78	0.070	1.5	1.2	170	5.7	45	<0.001	<0.01	0.19	2.6	0.60	1.6	5.0	<0.01	<0.01	32	0.060	0.49	6.9	7.0	0.080	17	49	16
ABA439	Q041678	CFD0385	8.0	9.0	Waste	Fresh	Granite	GG	9.5	0.080	723	1.3	0.10	0.90	1.4	160	6.1	31	<0.001	<0.01	0.28	2.0	0.40	1.2	7.2	<0.01	<0.01	32	0.040	0.31	6.7	6.0	0.070	12	33	16
ABA440	Q041699	CFD0385	27.0	28.0	Waste	Fresh	Granite	GG	13	0.10	597	1.1	0.080	1.1	0.90	170	6.8	32	<0.001	<0.01	0.090	1.8	0.50	0.90	6.2	<0.01	<0.01	32	0.046	0.31	6.6	7.0	0.15	14	29	21
ABA441	Q032423	CFD0385	92.0	92.6	Waste	Fresh	Granite	GG	8.6	0.11	352	5.0	0.040	1.3	1.6	220	5.7	29	0.0010	0.030	0.44	1.6	0.70	1.3	8.0	<0.01	<0.01	39	0.050	0.29	10	7.0	0.070	16	27	9.1
ABA442	Q032601	CFD0391	3.4	3.9	Waste	Fresh	Granite	GG	12	0.11	581	0.91	0.080	1.5	1.9	170	9.7	33	<0.001	<0.01	0.12	1.8	0.40	1.1	6.1	<0.01	<0.01	34	0.052	0.35	4.6	8.0	0.69	13	29	15
ABA443	Q033167	CFD0400	60.0	61.0	Waste	Fresh	Granite	GG	4.6	0.080	227	0.55	0.040	0.45	1.1	110	7.6	40	<0.001	<0.01	6.8	1.5	0.40	1.1	8.1	<0.01	<0.01	38	0.044	0.49	19	8.0	0.060	12	24	9.5
Statistical Summary						**Fresh**	**Granite**	**n**	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
								Max	21	0.18	1140	5.0	0.10	1.9	1.9	270	15	45	0.0010	0.19	16	2.6	0.70	1.7	17	<0.01	0.020	39	0.061	0.68	29	11	8.8	18	72	21
								90th PCTL	18	0.12	1080	1.3	0.081	1.6	1.6	211	13	40	0.0010	0.045	3.4	2.4	0.60	1.6	8.0	<0.01	0.010	37	0.060	0.49	11	8.1	1.1	17	45	16
								75th PCTL	13	0.11	731	0.98	0.073	1.4	1.4	170	8.6	37	<0.01	0.010	2.0	1.9	0.50	1.3	6.4	<0.01	0.010	34	0.055	0.44	7.4	7.3	0.21	16	37	15
								Median	11	0.10	564	0.81	0.060	1.3	1.2	160	6.4	33	<0.01	<0.01	0.48	1.8	0.40	1.1	5.5	<0.01	<0.01	33	0.048	0.35	6.7	7.0	0.090	13	29	12
								25th PCTL	6.0	0.080	470	0.78	0.040	0.73	1.0	150	5.7	29	<0.01	<0.01	0.20	1.5	0.38	1.1	4.4	<0.01	<0.01	32	0.042	0.31	6.3	6.0	0.078	12	26	9.4
								10th PCTL	3.1	0.077	273	0.70	0.029	0.43	0.89	128	5.4	24	<0.01	<0.01	0.099	1.4	0.30	0.79	4.3	<0.01	<0.01	31	0.028	0.26	5.3	5.9	0.070	10	24	8.3
								Min	1.2	0.030	201	0.21	0.010	0.10	0.70	50	4.9	4.7	<0.01	<0.01	0.060	1.0	0.20	0.40	3.2	<0.01	<0.01	26	0.0050	0.21	4.4	4.0	0.060	8.1	19	6.2

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Statistical Summary for Granite Waste Rock								**n**	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
								n < DL	0	3	0	0	6	0	0	0	0	0	54	40	0	0	2	1	0	57	32	0	17	0	0	0	2	0	0	0
								Max	21	0.18	2360	5.0	0.11	1.9	4.6	270	39	49	0.0010	0.19	85	2.6	0.80	3.3	112	*<0.01*	0.030	52	0.064	2.1	46	11	19	28	88	21
								90th PCTL	13	0.12	1044	1.2	0.080	1.5	1.7	220	22	40	*<0.01*	0.050	11	2.1	0.50	1.4	19	*<0.01*	0.010	36	0.057	1.1	12	8.0	3.5	16	39	16
								75th PCTL	12	0.11	723	0.97	0.070	1.3	1.4	180	15	36	*<0.01*	*<0.01*	3.0	1.8	0.40	1.2	11	*<0.01*	*<0.01*	34	0.052	0.46	8.6	7.0	0.26	13	33	14
								Median	4.6	0.080	506	0.78	0.040	0.57	1.0	160	9.3	28	*<0.01*	*<0.01*	1.0	1.5	0.40	1.0	6.6	*<0.01*	*<0.01*	33	0.034	0.34	6.5	6.0	0.10	12	28	9.5
								25th PCTL	1.5	0.020	154	0.71	0.010	0.14	0.90	100	6.1	12	*<0.01*	*<0.01*	0.31	1.2	0.30	0.60	5.0	*<0.01*	*<0.01*	31	*<0.005*	0.24	5.6	4.0	0.070	9.4	19	7.8
								10th PCTL	1.1	0.010	60	0.59	*<0.01*	0.090	0.70	70	5.6	7.3	*<0.01*	*<0.01*	0.13	0.82	0.20	0.36	4.4	*<0.01*	*<0.01*	28	*<0.005*	0.16	4.7	2.0	0.050	8.1	7.0	6.6
								Min	0.60	*<0.01*	16	0.21	*<0.01*	0.060	0.50	50	4.9	2.3	*<0.01*	*<0.01*	0.060	0.40	0.20	0.20	3.2	*<0.01*	*<0.01*	16	*<0.005*	0.070	4.4	1.0	*<0.05*	2.9	4.0	3.3
Oxide Facies for Other Lithologies Waste Rock																																				
KAM029389	ABA017	CFD0176	96.0	97.0	Waste	Oxide	Dykes	FC	9.4	0.040	727	0.62	0.010	*<0.05*	98	110	11	14	0.0050	*<0.01*	1.9	7.7	0.70	0.20	43	*<0.01*	0.050	3.8	*<0.005*	0.14	6.3	34	500	12	55	12
KAM029393	ABA018	CFD0176	99.0	100.0	Waste	Oxide	Dykes	FC	7.2	0.050	655	0.47	0.010	*<0.05*	1.0	360	12	14	*<0.001*	*<0.01*	3.5	8.9	0.70	0.30	23	*<0.01*	0.030	4.5	*<0.005*	0.19	6.4	39	0.24	12	52	6.6
KAM084551	ABA056	CFD0237	181.0	181.5	Waste	Oxide	HU	HU	3.2	0.20	287	1.3	0.010	*<0.05*	42	50	11	16	*<0.001*	0.020	7.6	7.1	0.50	0.40	143	*<0.01*	0.050	6.0	*<0.005*	0.47	6.2	18	0.54	8.7	31	1.1
R277468	ABA306	CFD0426	26.0	27.0	Waste	Oxide	SZ	SZ	3.2	0.34	150	0.35	0.030	0.050	13	340	5.3	15	*<0.001*	0.010	2.1	1.4	0.80	0.90	13	*<0.01*	0.030	33	0.019	0.19	3.3	11	0.24	16	11	8.1
Statistical Summary						**Oxide**	**Other Lithologies**	**n**	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
								Max	9.4	0.34	727	1.3	0.030	0.050	98	360	12	16	0.0050	0.020	7.6	8.9	0.80	0.90	143	*<0.01*	0.050	33	0.019	0.47	6.4	39	500	16	55	12
								90th PCTL	8.7	0.30	705	1.1	0.024	0.050	81	354	11	15	0.0038	0.017	6.3	8.5	0.77	0.75	113	*<0.01*	0.050	25	0.015	0.39	6.4	38	350	15	54	11
								75th PCTL	7.8	0.24	673	0.80	0.015	*<0.05*	56	345	11	15	*<0.001*	0.013	4.5	8.0	0.73	0.53	68	*<0.01*	0.050	13	*<0.005*	0.26	6.3	35	125	13	53	9.1
								Median	5.2	0.13	471	0.55	0.010	*<0.05*	27	225	11	14	*<0.001*	*<0.01*	2.8	7.4	0.70	0.35	33	*<0.01*	0.040	5.3	*<0.005*	0.19	6.2	26	0.39	12	42	7.4
								25th PCTL	3.2	0.048	253	0.44	0.010	*<0.05*	9.9	95	9.4	14	*<0.001*	*<0.01*	2.0	5.7	0.65	0.28	21	*<0.01*	0.030	4.3	*<0.005*	0.18	5.5	16	0.24	11	26	5.2
								10th PCTL	3.2	0.043	191	0.39	0.010	*<0.05*	4.5	68	6.9	14	*<0.001*	*<0.01*	1.9	3.1	0.56	0.23	16	*<0.01*	0.030	4.0	*<0.005*	0.16	4.1	13	0.24	9.7	17	2.8
								Min	3.2	0.040	150	0.35	0.010	*<0.05*	1.0	50	5.3	14	*<0.001*	*<0.01*	1.9	1.4	0.50	0.20	13	*<0.01*	0.030	3.8	*<0.005*	0.14	3.3	11	0.24	8.7	11	1.1
Upper Transition Facies for Other Lithologies Waste Rock																																				
KAM145425	ABA072	CFD0339	10.0	11.0	Waste	Upper transition	Dykes	FC	3.6	0.30	1200	1.1	*<0.01*	*<0.05*	6.5	360	16	68	*<0.001*	0.020	77	11	0.60	0.80	138	*<0.01*	0.060	11	0.022	2.1	28	64	2.0	14	63	7.5
Q033703	ABA303	CFD0411	15.0	16.0	Waste	Upper transition	dykes	DIOR	2.7	0.040	480	0.63	*<0.01*	0.14	3.1	160	17	18	*<0.001*	0.010	17	3.0	0.70	0.40	14	*<0.01*	0.050	14	0.012	0.17	1.2	4.0	0.55	13	41	53
Q034859	ABA311	CFD0473	164.0	165.0	Waste	Upper transition	dykes	FC	21	1.3	941	0.29	0.050	*<0.05*	16	1640	6.6	58	*<0.001*	*<0.01*	9.0	21	0.50	0.70	77	*<0.01*	0.020	3.0	0.14	0.41	8.6	171	0.080	18	80	12
R273647	ABA305	CFD0456	55.0	56.0	Waste	Upper transition	Fault	FLT	15	1.0	555	0.51	0.020	*<0.05*	27	550	3.3	78	*<0.001*	0.010	68	14	0.40	1.2	16	*<0.01*	0.020	1.4	0.069	0.70	14	56	1.0	15	34	1.1
KAM019714	ABA061	CFD0083	8.0	9.0	Waste	Upper transition	Metabasalt/ Amphibolite	Amph	6.8	0.65	447	0.34	0.030	0.090	22	450	4.5	46	*<0.001*	*<0.01*	1.2	2.7	0.60	0.40	18	*<0.01*	0.020	19	0.072	0.32	1.3	28	0.20	10	43	6.8
KAM035755	ABA022	CFD0080	122.0	123.0	Waste	Upper transition	YO	YO	4.6	2.1	570	0.83	0.020	*<0.05*	146	280	11	19	*<0.001*	0.54	8.6	7.6	0.90	0.80	195	*<0.01*	0.020	9.8	0.0070	0.33	3.0	35	0.39	15	50	1.5
R545623	ABA368	CFD0524	92.0	92.6	Waste	Upper Transition	Yx	Yx	6.2	0.48	423	0.39	0.040	0.050	24	290	6.0	72	*<0.001*	*<0.01*	6.0	2.9	0.50	1.2	13	*<0.01*	*<0.01*	34	0.025	0.82	17	17	0.50	12	23	9.6
Statistical Summary						**Upper Transition**	**Other Lithologies**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	21	2.1	1200	1.1	0.050	0.14	146	1640	17	78	*<0.001*	0.54	77	21	0.90	1.2	195	*<0.01*	0.060	34	0.14	2.1	28	171	2.0	18	80	53
								90th PCTL	17	1.6	1045	0.95	0.044	0.11	75	986	16	74	*<0.001*	0.23	72	16	0.78	1.2	160	*<0.01*	0.054	25	0.10	1.3	21	107	1.4	16	70	28
								75th PCTL	11	1.1	756	0.73	0.035	0.070	26	500	13	70	*<0.001*	0.015	43	12	0.65	1.0	107	*<0.01*	0.035	17	0.071	0.76	15	60	0.79	15	57	11
								Median	6.2	0.65	555	0.51	0.020	*<0.05*	22	360	6.6	58	*<0.001*	0.010	9.0	7.6	0.60	0.80	18	*<0.01*	0.020	11	0.025	0.41	8.6	35	0.50	14	43	7.5
								25th PCTL	4.1	0.39	464	0.37	0.015	*<0.05*	11	285	5.3	32	*<0.001*	*<0.01*	7.3	3.0	0.50	0.55	15	*<0.01*	0.020	6.4	0.017	0.33	2.1	23	0.30	13	38	4.2
								10th PCTL	3.2	0.20	437	0.32	*<0.01*	*<0.05*	5.1	232	4.0	18	*<0.001*	*<0.01*	4.1	2.8	0.46	0.40	14	*<0.01*	0.016	2.4	0.010	0.26	1.3	12	0.15	11	30	1.3
								Min	2.7	0.040	423	0.29	*<0.01*	*<0.05*	3.1	160	3.3	18	*<0.001*	*<0.01*	1.2	2.7	0.40	0.40	13	*<0.01*	*<0.01*	1.4	0.0070	0.17	1.2	4.0	0.080	10	23	1.1
Lower Transition Facies for Other Lithologies Waste Rock																																				
R282332	ABA312	CFD0474	37.0	38.0	Waste	Lower transition	dykes	IV	13	1.4	657	0.66	0.24	0.11	3.8	670	9.3	40	*<0.001*	0.020	0.50	11	0.50	0.50	116	*<0.01*	*<0.01*	9.3	0.097	0.35	2.0	97	0.18	13	60	26
Q035862	ABA313	CFD0491	124.0	125.0	Waste	Lower transition	dykes	IV	9.0	0.30	820	0.80	0.010	*<0.05*	4.5	660	15	41	*<0.001*	*<0.01*	7.1	15	0.40	0.80	11	*<0.01*	0.010	8.3	0.027	0.48	4.4	90	0.26	13	62	14
R283583	ABA449	CFD0496	90.0	91.0	Waste	Lower Transition	Metabasalt	MBSLT	2.5	0.97	982	3.8	0.010	*<0.05*	22	740	24	23	0.0030	0.36	2.6	4.4	0.30	1.0	188	*<0.01*	0.49	4.0	0.0060	0.24	5.4	17	1.0	9.2	70	1.2
R283583	ABA304	CFD0496	90.0	91.0	Waste	Lower transition	Metabasalt/ Amphibolite	MBSLT	2.3	1.0	981	3.8	0.010	*<0.05*	21	780	23	23	0.0020	0.39	3.0	4.4	0.50	1.0	193	*<0.01*	0.49	3.7	0.0060	0.21	4.9	17	1.1	8.1	72	1.1
Q033764	ABA308	CFD0411	70.0	71.0	Waste	Lower transition	YC	YC	5.0	1.5	558	0.31	0.020	*<0.05*	24	430	13	15	*<0.001*	0.13	3.1	6.7	0.90	0.90	163	*<0.01*	0.050	12	*<0.005*	0.12	2.7	38	0.23	21	68	1.1
R276691	ABA310	CFD0413	21.0	22.0	Waste	Lower transition	Ylim	Ylim	1.7	0.040	488	0.48	0.010	*<0.05*	5.7	310	6.6	12	*<0.001*	0.010	7.0	1.9	0.40	0.90	15	*<0.01*	0.020	21	*<0.005*	0.16	2.2	6.0	0.19	11	20	6.2
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
								Max	13	1.5	982	3.8	0.24	0.11	24	780	24	41	0.0030	0.39	7.1	15	0.90	1.0	193	*<0.01*	0.49	21	0.097	0.48	5.4	97	1.1	21	72	26
								90th PCTL	11	1.4	982	3.8	0.13	0.080	23	760	24	41	0.0025	0.38	7.0	13	0.70	1.0	191	*<0.01*	0.49	17	0.062	0.42	5.1	94	1.1	17	71	20
								75th PCTL	8.0	1.3	941	3.1	0.018	0.050	21	723	21	36	0.0018	0.30	6.1	10	0.50	0.98	182	*<0.01*	0.38	11	0.022	0.32	4.8	77	0.82	13	70	12
								Median	3.8	0.99	739	0.73	0.010	0.050	13	665	14	23	*<0.001*	0.075	3.1	5.6	0.45	0.90	140	*<0.01*	0.035	8.8	0.0060	0.23	3.5	28	0.25	12	65	3.7
								25th PCTL	2.4	0.47	583	0.53	0.010	0.050	4.8	488	10	17	*<0.001*	0.013	2.7	4.4	0.40	0.83	40	*<0.01*	0.013	5.1	0.0053	0.17	2.3	17	0.20	9.8	61	1.1
								10th PCTL	2.0	0.17	523	0.40	0.010	0.050	4.2	370	8.0	13	*<0.001*	*<0.01*	1.6	3.2	0.35	0.65	13	*<0.01*	*<0.01*	3.9	0.0050	0.14	2.1	12	0.19	8.7	40	1.1
								Min	1.7	0.040	488	0.31	0.010	*<0.05*	3.8	310	6.6	12	*<0.001*	*<0.01*	0.50	1.9	0.30	0.50	11	*<0.01*	*<0.01*	3.7	0.0050	0.12	2.0	6.0	0.18	8.1	20	1.1
Fresh Facies for Other Lithologies Waste Rock																																				
R304353	ABA349	CFD0541	90.0	91.0	Waste	Fresh	IV	IV	10	0.99	788	0.24	0.060	*<0.05*	1.1	450	10	11	*<0.001*	*<0.01*	0.96	3.1	0.50	0.30	22	*<0.01*	0.010	4.4	0.0050	0.080	1.3	30	*<0.05*	12	57	22
R304282	ABA352	CFD0539	90.0	91.0	Waste	Fresh	IV	IV	9.5	1.3	675	0.22	0.080	*<0.05*	3.8	660	7.6	23	*<0.001*	*<0.01*	0.72	11	0.40	0.50	80	*<0.01*	0.010	9.7	0.027	0.23	1.4	94	0.060	13	55	23
KAM133438	ABA087	CFR0429	10.7	12.2	Waste	Fresh	Mafic/ Ultramafic	RU	16	6.8	430	0.25	0.010	*<0.05*	603	430	3.3	82	*<0.001*	0.040	0.090	6.3	0.20	0.60	111	*<0.01*	0.010	6.1	0.089	0.52	0.39	32	0.11	4.6	37	0.80
R277453	ABA307	CFD0423	81.0	82.0	Waste	Fresh	Mafic/ Ultramafic	RU	18	3.7	477	1.2	0.020	*<0.05*	373	400	5.0	112	0.0010	0.020	0.61	8.8	0.70	1.5	41	*<0.01*	0.090	11	0.17	0.76	1.3	58	0.21	12	44	2.0
R274909	ABA447	CFD0472	143.2	144.0	Waste	Fresh	Metabasalt	MBSLT	20	3.2	564	0.48	0.020	0.070	283	170	2.4	107	*<0.001*	*<0.01*	4.9	5.5	0.30	1.7	41	*<0.01*	0.010	16	0.13	0.91	3.0	44	0.31	12	29	4.2
R274918	ABA448	CFD0472	150.0	151.0	Waste	Fresh	Metabasalt	MBSLT	1.1	0.29	227	3.0	0.020	1.2	5.6	450	1.3	7.9	*<0.001*	0.080	0.71	1.6	*<0.2*	5.1	92	0.010	0.050	2.1	0.14	0.060	0.56	11	0.39	3.2	7.0	7.0
R293475	ABA450	CFR0730	91.4	93.0	Waste	Fresh	Metabasalt	MBSLT	24	2.0	776	1.1	0.13	*<0.05*	5.2	1290	8.1	54	*<0.001*	0.22	0.32	9.4	0.50	0.80	119	*<0.01*	0.020	3.7	0.11	0.48	0.91	121	0.19	15	63	12
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	24	6.8	788	3.0	0.13	1.2	603	1290	10	112	0.0010	0.22	4.9	11	0.70	5.1	119	0.010	0.090	16	0.17	0.91	3.0	121	0.39	15	63	23
								90th PCTL	21	4.9	781	1.9	0.10	0.53	465	912	9.0	109	0.0010	0.14	2.5	10	0.58	3.1	114	0.010	0.066	13	0.15	0.82	2.1	105	0.34	14	59	22
								75th PCTL	19	3.5	726	1.2	0.070	0.060	328	555	7.9	94	*<0.001*	0.060	0.84	9.1	0.50	1.6	101	*<0.01*	0.035	10	0.13	0.64	1.4	76	0.26	13	56	17
								Median	16	2.0	564	0.48	0.020	*<0.05*	5.6	450	5.0	54	*<0.001*	0.020	0.71	6.3	0.40	0.80	80	*<0.01*	0.010	6.1	0.11	0.48	1.3	44	0.19	12	44	7.0
								25th PCTL	9.8	1.1	454	0.25	0.020	*<0.05*	4.5	415	2.9	17	*<0.001*	*<0.01*	0.47	4.3	0.25	0.55	41	*<0.01*	0.010	4.1	0.058	0.16	0.74	31	0.085	8.3	33	3.1
								10th PCTL	6.1	0.71	349	0.23	0.016	*<0.05*	2.7	308	2.0	9.6	*<0.001*	*<0.01*	0.23	2.5	0.20	0.42	33	*<0.01*	0.010	3.1	0.018	0.072	0.49	22	0.056	4.1	20	1.5
								Min	1.1	0.29	227	0.22	0.010	*<0.05*	1.1	170	1.3	7.9	*<0.001*	*<0.01*	0.090	1.6	*0.20*	0.30	22	*<0.01*	0.010	2.1	0.0050	0.060	0.39	11	*<0.05*	3.2	7.0	0.80
Statistical Summary for Other Lithologies Waste Rock								**n**	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	0	0	0	0	2	17	0	0	0	0	20	9	0	0	1	0	0	23	2	0	5	0	0	0	1	0	0	0
								Max	24	6.8	1200	3.8	0.24	1.2	603	1640	24	112	0.0050	0.54	77	21	0.90	5.1	195	0.010	0.49	34	0.17	2.1	28	171	500	21	80	53
								90th PCTL	19	2.9	969	2.5	0.074	0.10	242	768	17	81	0.0017	0.32	15	13	0.77	1.4	181	*<0.01*	0.081	21	0.13	0.80	12	96	1.1	16	69	23
								75th PCTL	13	1.4	779	1.1	0.033	0.050	31	660	12	60	*<0.001*	0.050	7.2	9.8	0.70	1.0	124	*<0.01*	0.050	12	0.091	0.49	6.2	60	0.54	14	62	12
								Median	7.0	0.98	567	0.57	0.020	*<0.05*	18	430	8.7	23	*<0.001*	0.010	3.1	6.9	0.50	0.80	60	*<0.01*	0.020	8.8	0.024	0.33	3.0	35	0.25	12	51	6.9
								25th PCTL	3.2	0.30	470	0.35	0.010	*<0.05*	5.0	305	5.2	15	*<0.001*	*<0.01*	0.90	3.1	0.40	0.48	18	*<0.01*	0.010	4.0	0.0058	0.19	1.3	17	0.19	11	33	1.4
								10th PCTL	2.4	0.043	328	0.26	0.010	*<0.05*	3.3	163	3.3	12	*<0.001*	*<0.01*	0.53	2.1	0.30	0.33	13	*<0.01*	0.010	3.2	*<0.005*	0.13	0.99	11	0.089	8.3	21	1.1
								Min	1.1	0.040	150	0.22	*<0.01*	*<0.05*	1.0	50	1.3	7.9	*<0.001*	*<0.01*	0.090	1.4	0.20	0.20	11	*<0.01*	*<0.01*	1.4	*<0.005*	0.060	0.39	4.0	*<0.05*	3.2	7.0	0.80

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.1-4: Statistical Summary of Exploration Assay Database (Au < 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t
Gneiss Waste Rock																																											
Gneiss	Oxide	**n**	3218	3218	3218	10661	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218
		n <DL	2732	0	1	487	3210	8	252	2860	30	3161	60	0	89	0	3062	2364	0	3	5	5	0	1242	1039	337	0	24	1861	495	450	0	250	2084	3214	2070	18	3179	24	-	-	-	-	-
		Max	100	4.7	4240	0.30	10	3040	3.6	21	7.8	3.5	78	377	236	11	10	6.0	2.2	1700	46	3.1	5860	9.0	0.28	392	2980	1425	1.3	531	36	1415	630	0.35	10	110	272	450	157	1851	195	39	195	*Non-reactive*
		95th PCTL	0.20	1.8	1057	0.17	*<10*	430	1.9	2.0	2.3	*<0.5*	22	78	25	4.2	*<10*	1.0	0.74	50	27	1.0	955	3.0	0.060	37	760	23	0.070	52	13	59	40	0.090	*<10*	20	79	*<10*	62	487	57	2.2	56	*Non-reactive*
		90th PCTL	0.20	1.3	687	0.10	*<10*	280	1.5	2.0	1.3	*<0.5*	16	51	19	3.3	*<10*	1.0	0.46	50	21	0.57	732	2.0	0.040	26	570	17	0.030	35	9.0	41	40	0.040	*<10*	10	57	*<10*	49	379	33	0.94	31	*Non-reactive*
		75th PCTL	*<0.2*	0.88	349	0.035	*<10*	150	1.0	*<2*	0.30	*<0.5*	8.0	20	11	2.1	*<10*	1.0	0.24	40	9.0	0.14	446	1.0	0.020	12	330	12	0.010	16	4.0	22	40	0.010	*<10*	10	25	*<10*	29	248	7.5	0.31	6.9	*Non-reactive*
		Median	*<0.2*	0.64	179	0.010	*<10*	90	0.70	*<2*	0.070	*<0.5*	3.0	9.0	5.0	1.2	*<10*	*<1*	0.17	30	3.0	0.040	279	1.0	0.010	3.0	180	9.0	*<0.01*	7.0	1.0	13	30	*<0.01*	*<10*	*<10*	8.0	*<10*	16	144	1.8	0.31	1.4	*Non-reactive*
		25th PCTL	*<0.2*	0.49	66	0.0030	*<10*	60	0.60	*<2*	0.040	*<0.5*	1.0	6.0	3.0	0.92	*<10*	*<1*	0.13	30	2.0	0.020	187	*<1*	*<0.01*	1.0	120	6.0	*<0.01*	3.0	1.0	9.0	30	*<0.01*	*<10*	*<10*	4.0	*<10*	10	55	1.0	0.31	0.44	*Non-reactive*
		10th PCTL	*<0.2*	0.38	28	0.0010	*<10*	40	0.50	*<2*	0.020	*<0.5*	1.0	4.0	1.0	0.71	*<10*	*<1*	0.10	20	1.0	0.010	121	*<1*	*<0.01*	*<1*	90	4.0	*<0.01*	*<2*	*<1*	6.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	6.0	21	0.50	0.31	0.19	1.3
		5th PCTL	*<0.2*	0.34	15	0.0010	*<10*	30	*<0.5*	*<2*	0.020	*<0.5*	1.0	3.0	1.0	0.61	*<10*	*<1*	0.080	20	1.0	0.010	78	*<1*	*<0.01*	*<1*	70	3.0	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	12	0.50	0.31	-0.063	0.63
		Min	*<0.2*	0.11	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.24	*<10*	*<1*	0.030	*<10*	*<1*	*<0.01*	9.0	*<1*	*<0.01*	*<1*	20	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.54	0.25	0.31	-11	0.63
Gneiss	Upper Transition	**n**	4367	4367	4367	16503	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367
		n <DL	3846	0	109	1982	4359	19	614	3868	8	4312	113	0	137	0	4014	3570	0	10	2	2	0	1714	536	638	0	167	1951	1831	640	0	215	1560	4364	3727	28	4283	14	-	-	-	-	-
		Max	44	5.4	4240	0.30	10	4080	4.1	11	9.8	1.0	62	577	180	7.7	10	6.0	3.5	100	47	4.0	2060	46	0.18	150	2250	1005	0.67	107	31	633	1080	0.48	10	50	227	180	131	3521	245	21	244	*Non-reactive*
		95th PCTL	0.20	2.0	583	0.11	*<10*	410	1.6	2.0	2.4	*<0.5*	17	79	23	3.4	10	1.0	1.2	50	36	1.6	741	3.0	0.090	32	830	22	0.12	25	7.0	76	40	0.16	*<10*	10	66	*<10*	52	435	61	3.8	58	*Non-reactive*
		90th PCTL	0.20	1.6	337	0.053	*<10*	270	1.3	2.0	1.7	*<0.5*	13	53	16	2.8	*<10*	1.0	0.78	50	32	1.1	594	2.0	0.080	22	610	15	0.070	16	5.0	54	40	0.10	*<10*	10	47	*<10*	40	261	42	2.2	40	*Non-reactive*
		75th PCTL	*<0.2*	0.90	125	0.016	*<10*	140	0.90	*<2*	0.77	*<0.5*	7.0	20	9.0	1.8	*<10*	*<1*	0.40	40	21	0.43	390	2.0	0.060	9.0	350	11	0.020	6.0	3.0	32	40	0.040	*<10*	*<10*	21	*<10*	25	108	19	0.63	18	*Non-reactive*
		Median	*<0.2*	0.60	38	0.0040	*<10*	80	0.70	*<2*	0.24	*<0.5*	2.0	9.0	4.0	1.1	*<10*	*<1*	0.23	30	11	0.13	253	1.0	0.030	3.0	200	7.0	0.010	2.0	1.0	17	30	0.010	*<10*	*<10*	6.0	*<10*	15	33	6.0	0.31	5.4	*Non-reactive*
		25th PCTL	*<0.2*	0.45	13	0.0010	*<10*	50	0.50		0.070	*<0.5*	1.0	6.0	2.0	0.87	*<10*	*<1*	0.16	30	5.0	0.050	175	*<1*	0.010	1.0	130	5.0	*<0.01*	*<2*	1.0	10	30	*<0.01*	*<10*	*<10*	3.0	*<10*	10	10	1.8	0.31	1.2	3.1
		10th PCTL	*<0.2*	0.35	5.0	*<0.001*	*<10*	30	*<0.5*	*<2*	0.040	*<0.5*	1.0	4.0	1.0	0.67	*<10*	*<1*	0.12	20	2.0	0.020	127	*<1*	*<0.01*	*<1*	100	3.0	*<0.01*	*<2*	*<1*	7.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	6.0	3.6	1.0	0.31	0.44	0.94
		5th PCTL	*<0.2*	0.31	3.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.030	*<0.5*	1.0	3.0	1.0	0.57	*<10*	*<1*	0.10	20	2.0	0.020	101	*<1*	*<0.01*	*<1*	80	2.0	*<0.01*	*<2*	*<1*	6.0	20	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	2.1	0.75	0.31	0.19	0.63
		Min	*<0.2*	0.040	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.19	*<10*	*<1*	0.020	*<10*	*<2*	*<0.01*	14	*<1*	*<0.01*	*<1*	10	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.32	0.25	0.31	-19	0.63
Gneiss	Lower Transition	**n**	5647	5647	5647	23440	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647
		n <DL	5227	0	390	5701	5646	16	1422	4978	0	5581	92	0	137	0	4489	5035	0	60	1	1	0	2658	170	897	0	379	1871	3879	452	0	777	617	5643	5178	21	5415	17	-	-	-	-	-
		Max	2.2	4.4	3160	0.30	10	2440	3.3	25	11	2.6	50	589	3960	7.3	10	17	3.5	110	58	4.8	1500	131	0.23	446	2340	288	2.2	109	29	667	70	0.41	10	50	212	190	540	2150	280	69	280	*Non-reactive*
		95th PCTL	0.20	2.5	174	0.040	*<10*	430	1.4	2.0	3.0	*<0.5*	20	121	26	3.6	10	1.0	1.5	50	41	2.2	750	4.0	0.10	44	920	15	0.17	8.0	7.0	95	40	0.24	*<10*	10	74	*<10*	58	128	76	5.3	73	*Non-reactive*
		90th PCTL	*<0.2*	2.1	81	0.019	*<10*	310	1.2	2.0	2.4	*<0.5*	17	86	20	3.2	10	1.0	1.2	50	39	1.8	635	3.0	0.080	34	730	12	0.12	5.0	6.0	73	40	0.20	*<10*	*<10*	60	*<10*	49	60	59	3.8	56	*Non-reactive*
		75th PCTL	*<0.2*	1.5	29	0.0050	*<10*	170	0.80	*<2*	1.4	*<0.5*	12	48	13	2.4	*<10*	*<1*	0.82	40	33	1.2	469	1.0	0.070	19	500	8.0	0.050	2.0	3.0	47	30	0.12	*<10*	*<10*	40	*<10*	35	21	35	1.6	32	*Non-reactive*
		Median	*<0.2*	0.85	10	0.0020	*<10*	80	0.60	*<2*	0.68	*<0.5*	5.0	15	6.0	1.5	*<10*	*<1*	0.40	30	24	0.45	311	1.0	0.050	5.0	280	6.0	0.010	*<2*	2.0	28	30	0.040	*<10*	*<10*	16	*<10*	21	6.8	17	0.31	16	*Non-reactive*
		25th PCTL	*<0.2*	0.50	4.0	0.0010	*<10*	50	*<0.5*	*<2*	0.26	*<0.5*	2.0	7.0	3.0	0.95	*<10*	*<1*	0.22	20	14	0.15	206	*<1*	0.040	1.0	165	3.0	*<0.01*	*<2*	1.0	17	20	0.010	*<10*	*<10*	4.0	*<10*	12	2.8	6.5	0.31	5.9	2.2
		10th PCTL	*<0.2*	0.38	2.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.090	*<0.5*	1.0	5.0	2.0	0.73	*<10*	*<1*	0.16	20	8.0	0.080	146	*<1*	0.020	*<1*	116	2.0	*<0.01*	*<2*	1.0	10	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	7.0	1.4	2.3	0.31	1.7	0.94
		5th PCTL	*<0.2*	0.33	*<2*	*<0.001*	*<10*	20	*<0.5*	*<2*	0.060	*<0.5*	1.0	4.0	1.0	0.62	*<10*	*<1*	0.13	10	5.0	0.040	116	*<1*	0.010	*<1*	90	*<2*	*<0.01*	*<2*	*<1*	8.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	5.0	0.94	1.5	0.31	0.94	0.63
		Min	*<0.2*	0.12	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	0.010	*<0.5*	*<1*	1.0	*<1*	0.22	*<10*	*<1*	0.010	*<10*	*<1*	*<0.01*	16	*<1*	*<0.01*	*<1*	20	*<2*	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.37	0.25	0.31	-60	0.63
Gneiss	Transition	**n**	10014	10014	10014	39943	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014
		n <DL	9073	0	499	7683	10005	35	2036	8846	8	9893	205	0	274	0	8503	8605	0	70	3	3	0	4372	706	1535	0	546	3822	5710	1092	0	992	2177	10007	8905	49	9698	31	-	-	-	-	-
		Max	44	5.4	4240	0.30	10	4080	4.1	25	11	2.6	62	589	3960	7.7	10	17	3.5	110	58	4.8	2060	131	0.23	446	2340	1005	2.2	109	31	667	1080	0.48	10	50	227	190	540	3521	280	69	280	*Non-reactive*
		95th PCTL	0.20	2.3	378	0.069	*<10*	420	1.4	2.0	2.8	*<0.5*	19	105	25	3.6	10	1.0	1.4	50	40	2.0	746	3.0	0.090	40	890	18	0.15	17	7.0	90	40	0.22	*<10*	10	71	*<10*	56	284	71	4.7	68	*Non-reactive*
		90th PCTL	*<0.2*	2.0	195	0.032	*<10*	290	1.2	2.0	2.1	*<0.5*	16	74	19	3.0	10	1.0	1.1	50	37	1.6	625	3.0	0.080	29	690	13	0.10	9.0	5.0	67	40	0.17	*<10*	10	56	*<10*	46	156	53	3.1	50	*Non-reactive*
		75th PCTL	*<0.2*	1.3	59	0.0090	*<10*	150	0.90	*<2*	1.1	*<0.5*	10	37	11	2.2	*<10*	*<1*	0.65	40	30	0.89	439	2.0	0.060	15	440	9.0	0.040	3.0	3.0	41	40	0.090	*<10*	*<10*	33	*<10*	31	47	28	1.3	26	*Non-reactive*
		Median	*<0.2*	0.68	17	0.0020	*<10*	80	0.60	*<2*	0.51	*<0.5*	4.0	11	5.0	1.3	*<10*	*<1*	0.30	30	17	0.24	282	1.0	0.050	4.0	230	6.0	0.010	*<2*	1.0	23	30	0.020	*<10*	*<10*	9.0	*<10*	18	13	13	0.31	12	*Non-reactive*
		25th PCTL	*<0.2*	0.47	6.0	0.0010	*<10*	50	0.50	*<2*	0.12	*<0.5*	2.0	6.0	3.0	0.91	*<10*	*<1*	0.19	20	9.0	0.090	190	*<1*	0.030	1.0	150	4.0	*<0.01*	*<2*	1.0	13	20	0.010	*<10*	*<10*	4.0	*<10*	11	4.1	3.0	0.31	2.4	2.2
		10th PCTL	*<0.2*	0.36	3.0	*<0.001*	*<10*	30	*<0.5*	*<2*	0.050	*<0.5*	1.0	5.0	1.0	0.71	*<10*	*<1*	0.14	20	4.0	0.030	137	*<1*	0.010	*<1*	100	2.0	*<0.01*	*<2*	*<1*	8.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	7.0	1.8	1.3	0.31	0.94	0.94
		5th PCTL	*<0.2*	0.31	2.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.030	*<0.5*	1.0	4.0	1.0	0.59	*<10*	*<1*	0.11	10	2.0	0.020	109	*<1*	*<0.01*	*<1*	80	*<2*	*<0.01*	*<2*	*<1*	7.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	5.0	1.2	0.75	0.31	0.44	0.63
		Min	*<0.2*	0.040	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.19	*<10*	*<1*	0.010	*<10*	*<2*	*<0.01*	14	*<1*	*<0.01*	*<1*	10	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.32	0.25	0.31	-60	0.63
Gneiss	Fresh	**n**	1073	1073	1073	7533	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073
		n <DL	997	0	120	2608	1070	8	342	977	0	1073	15	0	38	0	741	992	0	11	0	0	0	632	12	132	0	54	410	787	57	0	234	19	1071	1014	0	1042	0	-	-	-	-	-
		Max	26	4.2	1580	40	10	2250	2.5	27	6.7	*<0.5*	56	636	49	7.8	10	1.0	3.2	70	60	4.2	4950	64	0.21	416	1640	69	1.0	111	22	670	60	0.38	10	20	203	100	175	665	168	33	166	*Non-reactive*
		95th PCTL	0.20	2.6	75	0.027	*<10*	400	1.3	2.0	3.1	*<0.5*	21	145	24	3.6	10	1.0	1.6	60	44	2.5	742	4.0	0.10	53	940	14	0.19	8.0	7.0	109	40	0.26	*<10*	10	74	*<10*	61	40	78	5.9	75	*Non-reactive*
		90th PCTL	*<0.2*	2.3	39	0.010	*<10*	290	1.1	*<2*	2.6	*<0.5*	18	109	19	3.1	10	*<1*	1.3	50	42	2.1	651	2.8	0.090	41	788	11	0.13	4.0	5.0	86	40	0.23	*<10*	*<10*	62	*<10*	52	23	64	4.1	61	*Non-reactive*
		75th PCTL	*<0.2*	1.7	14	0.0030	*<10*	190	0.80	*<2*	1.4	*<0.5*	13	57	12	2.5	10	*<1*	0.91	40	36	1.4	504	1.0	0.070	22	580	7.0	0.050	2.0	3.0	55	30	0.15	*<10*	*<10*	45	*<10*	39	9.5	35	1.6	33	*Non-reactive*
		Median	*<0.2*	1.1	6.0	0.0010	*<10*	90	0.60	*<2*	0.73	*<0.5*	6.0	18	6.0	1.8	*<10*	*<1*	0.55	30	27	0.64	342	*<1*	0.050	7.0	360	5.0	0.010	*<2*	2.0	33	30	0.070	*<10*	*<10*	21	*<10*	25	4.2	18	0.31	17	*Non-reactive*
		25th PCTL	*<0.2*	0.55	3.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.36	*<0.5*	2.0	8.0	3.0	1.1	*<10*	*<1*	0.27	20	17	0.22	231	*<1*	0.040	2.0	190	3.0	*<0.01*	*<2*	1.0	21	20	0.030	*<10*	*<10*	6.0	*<10*	15	1.9	9.0	0.31	8.2	2.2
		10th PCTL	*<0.2*	0.42	*<2*	*<0.001*	*<10*	20	*<0.5*	*<2*	0.17	*<0.5*	1.0	6.0	1.0	0.80	*<10*	*<1*	0.20	10	12	0.13	170	*<1*	0.030	*<1*	130	2.0	*<0.01*	*<2*	1.0	15	*<20*	0.010	*<10*	*<10*	3.0	*<10*	9.0	1.1	4.3	0.31	3.5	0.94
		5th PCTL	*<0.2*	0.37	*<2*	*<0.001*	*<10*	20	*<0.5*	*<2*	0.12	*<0.5*	1.0	5.0	1.0	0.69	*<10*	*<1*	0.16	10	10	0.090	137	*<1*	0.020	*<1*	110	0.40	*<0.01*	*<2*	*<1*	12	*<20*	0.010	*<10*	*<10*	2.0	*<10*	7.0	0.82	3.0	0.31	2.4	0.63
		Min	*<0.2*	0.25	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	0.030	*<0.5*	*<1*	3.0	*<1*	0.26	*<10*	*<1*	0.090	*<10*	1.0	0.020	67	*<1*	*<0.01*	*<1*	60	*<2*	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	2.0	0.40	0.75	0.31	-5.2	0.63
Gneiss	All	**n**	14305	14305	14305	58137	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305
		n <DL	12802	0	620	10778	14285	51	2630	12683	38	14127	280	0	401	0	12306	11961	0	84	8	8	0	6246	1757	2004	0	624	6093	6992	1599	0	1476	4280	14292	11989	67	13919	55	-	-	-	-	-
		Max	100	5.4	4240	40	10	4080	4.1	27	11	3.5	78	636	3960	11	10	17	3.5	1700	60	4.8	5860	131	0.28	446	2980	1425	2.2	531	36	1415	1080	0.48	10	110	272	450	540	3521	280	69	280	*Non-reactive*
		95th PCTL	0.20	2.3	578	0.090	*<10*	420	1.6	2.0	2.8	*<0.5*	20	104	25	3.7	10	1.0	1.3	50	40	1.9	786	3.0	0.090	41	870	19	0.14	26	8.0	87	40	0.21	*<10*	10	73	*<10*	58	373	71	4.4	67	*Non-reactive*
		90th PCTL	0.20	1.9	337	0.041	*<10*	290	1.3	2.0	2.0	*<0.5*	16	72	19	3.1	10	1.0	1.1	50	37	1.5	644	3.0	0.080	30	680	14	0.090	16	6.0	64	40	0.16	*<10*	10	57	*<10*	47	245	51	2.8	49	*Non-reactive*
		75th PCTL	*<0.2*	1.2	118	0.011	*<10*	160	0.90	*<2*	1.0	*<0.5*	10	34	11	2.2	*<10*	*<1*	0.58	40	28	0.77	446	1.0	0.060	15	430	10	0.030	5.0	3.0	38	40	0.070	*<10*	*<10*	32	*<10*	31	94	25	0.94	24	*Non-reactive*
		Median	*<0.2*	0.68	26	0.0030	*<10*	80	0.60	*<2*	0.38	*<0.5*	4.0	11	5.0	1.3	*<10*	*<1*	0.26	30	15	0.18	284	1.0	0.040	4.0	220	7.0	0.010	2.0	1.0	21	30	0.020	*<10*	*<10*	9.0	*<10*	18	20	9.5	0.31	8.8	*Non-reactive*
		25th PCTL	*<0.2*	0.48	7.0	0.0010	*<10*	50	0.50	*<2*	0.080	*<0.5*	2.0	6.0	3.0	0.92	*<10*	*<1*	0.17	20	5.0	0.060	193	*<1*	0.010	1.0	140	4.0	*<0.01*	*<2*	1.0	12	20	*<0.01*	*<10*	*<10*	4.0	*<10*	11	4.9	2.0	0.31	1.7	24
		10th PCTL	*<0.2*	0.37	3.0	*<0.001*	*<10*	30	*<0.5*	*<2*	0.040	*<0.5*	1.0	4.0	1.0	0.71	*<10*	*<1*	0.13	20	2.0	0.020	135	*<1*	*<0.01*	*<1*	100	2.0	*<0.01*	*<2*	*<1*	8.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	7.0	2.0	1.0	0.31	0.44	7.8
		5th PCTL	*<0.2*	0.32	2.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.020	*<0.5*	1.0	4.0	1.0	0.60	*<10*	*<1*	0.10	10	1.0	0.020	104	*<1*	*<0.01*	*<1*	80	2.0	*<0.01*	*<2*	*<1*	6.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	5.0	1.3	0.50	0.31	0.19	4.4
		Min	*<0.2*	0.040	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.19	*<10*	*<1*	0.010	*<10*	*<2*	*<0.01*	9.0	*<1*	*<0.01*	*<1*	10	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.32	0.25	0.31	-60	0.042

Appendix C.1-4: Statistical Summary of Exploration Assay Database (Au < 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t
Schist Waste Rock																																												
Schist	Oxide	**n**	2355	2355	2355	4431	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355
		n <DL	2020	0	3	338	2347	0	92	1957	0	2320	1	2	10	0	2066	1430	0	11	1	1	1	0	1592	471	29	0	13	443	246	37	0	1131	1247	2347	2251	0	2352	0	-	-	-	-	-
		Max	9.2	4.6	6950	0.30	10	3490	4.3	17	25	3.6	108	1105	535	8.8	10	8.0	3.2	80	72	8.2	5460	8.0	0.090	1930	2000	215	1.2	634	33	1225	170	0.33	10	30	238	10	781	1702	625	38	625	*Non-reactive*
		95th PCTL	0.30	1.9	1360	0.14	*<10*	1200	1.6	2.0	9.5	*<0.5*	23	102	57	4.5	10	2.0	0.80	50	39	2.1	975	2.0	0.040	59	910	20	0.22	61	15	272	33	0.080	*<10*	*<10*	84	*<10*	81	464	238	6.9	234	*Non-reactive*
		90th PCTL	0.20	1.6	920	0.070	*<10*	836	1.4	2.0	6.8	*<0.5*	19	67	42	4.1	10	1.0	0.59	40	34	1.6	820	1.0	0.030	46	770	16	0.15	33	12	177	30	0.056	*<10*	*<10*	68	*<10*	69	312	170	4.7	169	*Non-reactive*
		75th PCTL	*<0.2*	1.2	368	0.018	*<10*	460	1.1	*<2*	4.6	*<0.5*	15	45	28	3.5	*<10*	1.0	0.33	40	26	1.1	659	1.0	0.020	33	620	12	0.050	14	9.0	97	20	0.020	*<10*	*<10*	50	*<10*	55	147	116	1.6	114	*Non-reactive*
		Median	*<0.2*	0.91	116	0.0050	*<10*	210	0.90	*<2*	3.0	*<0.5*	12	28	18	3.0	*<10*	*<1*	0.22	30	14	0.46	527	*<1*	0.010	23	470	9.0	0.020	7.0	6.0	55	20	*<0.01*	*<10*	*<10*	35	*<10*	44	43	75	0.63	73	5.9
		25th PCTL	*<0.2*	0.71	37	0.0020	*<10*	90	0.70	*<2*	1.3	*<0.5*	8.0	15	10	2.4	*<10*	*<1*	0.15	20	4.0	0.12	392	*<1*	0.010	13	350	7.0	0.010	3.0	4.0	29	*<20*	*<0.01*	*<10*	*<10*	19	*<10*	33	13	34	0.31	31	1.3
		10th PCTL	*<0.2*	0.54	14	0.0010	*<10*	50	0.50	*<2*	0.22	*<0.5*	5.0	7.4	5.0	1.7	*<10*	*<1*	0.10	20	2.0	0.060	257	*<1*	*<0.01*	6.0	220	5.0	*<0.01*	*<2*	2.0	17	*<20*	*<0.01*	*<10*	*<10*	10	*<10*	22	4.6	5.5	0.31	4.9	0.63
		5th PCTL	*<0.2*	0.48	8.0	*<0.001*	*<10*	40	0.50	*<2*	0.10	*<0.5*	3.0	5.0	3.0	1.2	*<10*	*<1*	0.070	10	2.0	0.040	212	*<1*	*<0.01*	3.0	140	4.0	*<0.01*	*<2*	1.0	13	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	14	2.8	2.5	0.31	2.2	0.63
		Min	*<0.2*	0.080	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.42	*<10*	*<1*	0.010	*<10*	*<1*	*<0.01*	27	*<1*	*<0.01*	*<1*	20	*<2*	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	3.0	0.59	0.25	0.31	-2.0	0.63
Schist	Upper Transition	**n**	2175	2175	2175	3456	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175
		n <DL	1833	0	19	479	2162	0	108	1869	0	2136	0	0	11	0	1296	1687	3	4	0	0	0	1405	237	17	0	36	229	582	23	1	985	301	2170	2148	1	2163	1	-	-	-	-	-
		Max	4.3	6.0	4000	0.30	10	3450	3.2	14	25	2.5	83	1340	2770	6.4	10	16	2.1	160	76	9.6	6280	18	0.35	1015	5350	323	2.6	130	32	10000	270	0.35	10	10	220	1140	217	1146	625	81	625	*Non-reactive*
		95th PCTL	0.30	2.5	633	0.096	*<10*	1249	1.5	2.0	10	*<0.5*	21	140	57	4.4	10	1.0	1.4	50	41	2.3	885	1.0	0.050	69	1000	22	0.64	18	13	428	30	0.16	*<10*	*<10*	84	*<10*	80	262	255	20	251	*Non-reactive*
		90th PCTL	0.20	2.2	326	0.050	*<10*	760	1.3	2.0	7.0	*<0.5*	18	95	43	4.0	10	1.0	1.2	50	37	1.8	778	1.0	0.040	50	820	15	0.38	11	10	297	20	0.14	*<10*	*<10*	73	*<10*	69	123	175	12	172	*Non-reactive*
		75th PCTL	*<0.2*	1.8	100	0.014	*<10*	400	1.0	*<2*	4.8	*<0.5*	15	59	28	3.5	10	*<1*	0.87	40	31	1.4	646	1.0	0.030	36	650	11	0.15	7.0	8.0	142	20	0.090	*<10*	*<10*	58	*<10*	57	37	121	4.7	117	46
		Median	*<0.2*	1.4	32	0.0040	*<10*	210	0.80	*<2*	3.2	*<0.5*	12	38	19	3.0	*<10*	*<1*	0.53	30	25	1.0	518	*<1*	0.020	25	520	8.0	0.040	3.0	6.0	81	20	0.050	*<10*	*<10*	42	*<10*	48	12	80	1.3	75	4.4
		25th PCTL	*<0.2*	0.96	13	0.0010	*<10*	120	0.70	*<2*	2.0	*<0.5*	9.0	23	11	2.5	*<10*	*<1*	0.28	30	18	0.63	405	*<1*	0.010	16	410	6.0	0.020	*<2*	4.0	49	*<20*	0.010	*<10*	*<10*	29	*<10*	38	4.2	51	0.63	47	1.3
		10th PCTL	*<0.2*	0.68	6.0	*<0.001*	*<10*	70	0.50	*<2*	1.1	*<0.5*	7.0	11	6.0	1.9	*<10*	*<1*	0.19	20	11	0.33	309	*<1*	*<0.01*	8.0	310	4.0	*<0.01*	*<2*	3.0	29	*<20*	*<0.01*	*<10*	*<10*	17	*<10*	27	1.9	27	0.31	23	0.63
		5th PCTL	*<0.2*	0.57	4.0	*<0.001*	*<10*	40	0.50	*<2*	0.47	*<0.5*	5.0	6.0	3.0	1.4	*<10*	*<1*	0.13	10	8.0	0.16	248	*<1*	*<0.01*	4.0	230	3.0	*<0.01*	*<2*	2.0	18	*<20*	*<0.01*	*<10*	*<10*	9.0	*<10*	21	1.3	12	0.31	11	0.63
		Min	*<0.2*	0.21	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.020	*<0.5*	1.0	2.0	*<1*	0.36	*<10*	*<1*	*<0.01*	*<10*	1.0	0.010	40	*<1*	*<0.01*	*<1*	20	*<2*	*<0.01*	*<2*	*<1*	*<1*	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.33	0.50	0.31	-46	0.63
Schist	Lower Transition	**n**	3330	3330	3330	6365	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330
		n <DL	2968	0	152	932	3330	0	918	2818	0	3289	2	0	12	0	1379	2750	2	219	0	0	0	2329	45	30	3	248	748	1941	16	0	2219	75	3325	3306	3	3302	0	-	-	-	-	-
		Max	6.4	5.7	2320	0.29	*<10*	3470	2.7	197	25	2.6	81	1420	279	7.1	10	2.0	2.8	120	80	14	1700	29	0.34	1620	3300	288	2.3	166	24	10000	210	0.59	10	50	212	30	540	761	625	73	625	*Non-reactive*
		95th PCTL	0.20	2.8	133	0.050	*<10*	710	1.2	2.0	6.6	*<0.5*	22	174	37	4.1	10	1.0	1.6	40	46	2.6	847	2.0	0.080	73	1060	19	0.40	8.0	10	304	30	0.26	*<10*	*<10*	87	*<10*	75	45	165	13	162	*Non-reactive*
		90th PCTL	0.20	2.6	70	0.025	*<10*	510	1.1	2.0	5.2	*<0.5*	20	139	30	3.8	10	1.0	1.5	40	44	2.3	737	1.0	0.070	55	890	13	0.27	5.0	9.0	186	20	0.23	*<10*	*<10*	74	*<10*	67	24	129	8.4	124	*Non-reactive*
		75th PCTL	*<0.2*	2.2	28	0.0090	*<10*	320	0.80	*<2*	3.2	*<0.5*	17	97	21	3.4	10	*<1*	1.2	30	39	1.8	593	1.0	0.050	41	710	8.0	0.11	2.0	6.0	102	20	0.18	*<10*	*<10*	58	*<10*	55	11	79	3.4	75	*Non-reactive*
		Median	*<0.2*	1.9	12	0.0030	*<10*	210	0.60	*<2*	1.9	*<0.5*	14	56	13	2.9	10	*<1*	0.87	20	32	1.3	467	*<1*	0.040	30	540	5.0	0.020	*<2*	4.0	58	*<20*	0.13	*<10*	*<10*	44	*<10*	44	4.6	47	0.63	44	8.8
		25th PCTL	*<0.2*	1.4	5.0	0.0010	*<10*	130	*<0.5*	*<2*	1.0	*<0.5*	10	34	7.0	2.2	*<10*	*<1*	0.56	10	27	0.99	370	*<1*	0.030	18	420	3.0	0.010	*<2*	3.0	35	*<20*	0.080	*<10*	*<10*	31	*<10*	32	2.1	26	0.31	23	1.9
		10th PCTL	*<0.2*	0.99	3.0	*<0.001*	*<10*	70	*<0.5*	*<2*	0.52	*<0.5*	7.0	16	4.0	1.6	*<10*	*<1*	0.34	10	23	0.62	296	*<1*	0.020	8.0	320	2.0	*<0.01*	*<2*	2.0	22	*<20*	0.040	*<10*	*<10*	18	*<10*	22	1.1	13	0.31	11	0.94
		5th PCTL	*<0.2*	0.80	2.0	*<0.001*	*<10*	50	*<0.5*	*<2*	0.35	*<0.5*	5.0	9.0	2.0	1.3	*<10*	*<1*	0.24	*<10*	19	0.44	250	*<1*	0.010	4.0	255	*<2*	*<0.01*	*<2*	2.0	17	*<20*	0.020	*<10*	*<10*	12	*<10*	17	0.80	8.8	0.31	7.2	0.63
		Min	*<0.2*	0.14	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.080	*<0.5*	*<1*	2.0	*<1*	0.31	*<10*	*<1*	*<0.01*	*<10*	2.0	0.020	92	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	6.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	3.0	0.45	2.0	0.31	-25	0.63
Schist	Transition	**n**	5505	5505	5505	9821	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505
		n <DL	4801	0	171	1411	5492	0	1026	4687	0	5425	2	0	23	0	2675	4437	5	223	0	0	0	3734	282	47	3	284	977	2523	39	1	3204	376	5495	5454	4	5465	1	-	-	-	-	-
		Max	6.4	6.0	4000	0.30	10	3470	3.2	197	25	2.6	83	1420	2770	7.1	10	16	2.8	160	80	14	6280	29	0.35	1620	5350	323	2.6	166	32	10000	270	0.59	10	50	220	1140	540	1146	625	81	625	*Non-reactive*
		95th PCTL	0.30	2.7	342	0.070	*<10*	918	1.4	2.0	8.3	*<0.5*	22	163	46	4.2	10	1.0	1.6	50	45	2.5	865	2.0	0.070	72	1030	20	0.49	12	11	361	30	0.24	*<10*	*<10*	86	*<10*	76	122	207	15	205	*Non-reactive*
		90th PCTL	0.20	2.5	159	0.032	*<10*	600	1.2	2.0	6.0	*<0.5*	20	131	35	3.9	10	1.0	1.4	40	42	2.2	759	1.0	0.060	53	870	14	0.30	8.0	10	228	20	0.21	*<10*	*<10*	73	*<10*	68	52	151	9.4	148	*Non-reactive*
		75th PCTL	*<0.2*	2.1	48	0.010	*<10*	350	0.90	*<2*	3.9	*<0.5*	16	79	24	3.4	10	*<1*	1.1	30	36	1.7	615	1.0	0.050	39	690	9.0	0.12	4.0	7.0	117	20	0.15	*<10*	*<10*	58	*<10*	56	17	98	3.8	93	*Non-reactive*
		Median	*<0.2*	1.7	17	0.0030	*<10*	210	0.70	*<2*	2.4	*<0.5*	13	48	15	2.9	10	*<1*	0.74	30	29	1.2	485	*<1*	0.030	28	530	6.0	0.030	2.0	5.0	67	*<20*	0.10	*<10*	*<10*	44	*<10*	46	6.5	60	0.94	55	6.6
		25th PCTL	*<0.2*	1.2	7.0	0.0010	*<10*	120	0.50	*<2*	1.3	*<0.5*	10	28	9.0	2.4	*<10*	*<1*	0.44	20	24	0.80	383	*<1*	0.020	17	420	4.0	0.010	*<2*	3.0	39	*<20*	0.040	*<10*	*<10*	30	*<10*	34	2.5	32	0.31	30	1.6
		10th PCTL	*<0.2*	0.81	3.0	*<0.001*	*<10*	70	*<0.5*	*<2*	0.61	*<0.5*	7.0	13	4.0	1.7	*<10*	*<1*	0.24	10	17	0.47	300	*<1*	0.010	8.0	320	2.0	*<0.01*	*<2*	2.0	23	*<20*	0.010	*<10*	*<10*	18	*<10*	24	1.3	15	0.31	13	0.63
		5th PCTL	*<0.2*	0.64	2.0	*<0.001*	*<10*	50	*<0.5*	*<2*	0.38	*<0.5*	5.0	8.0	3.0	1.3	*<10*	*<1*	0.18	10	12	0.28	249	*<1*	*<0.01*	4.0	250	*<2*	*<0.01*	*<2*	2.0	17	*<20*	*<0.01*	*<10*	*<10*	10	*<10*	18	0.90	9.5	0.31	7.7	0.63
		Min	*<0.2*	0.14	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.020	*<0.5*	*<1*	2.0	*<1*	0.31	*<10*	*<1*	*<0.01*	*<10*	1.0	0.010	40	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	*<1*	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.33	0.50	0.31	-46	0.63
Schist	Fresh	**n**	862	861	861	2514	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861
		n <DL	791	0	46	474	860	1	236	701	0	856	0	0	3	0	257	739	0	73	0	0	0	513	10	0	1	66	96	640	0	0	641	13	861	852	0	859	0	-	-	-	-	-
		Max	2.6	3.9	5750	17	10	3220	2.2	38	25	4.6	60	967	84	7.0	20	3.0	2.7	80	80	11	2290	11	0.17	933	3420	396	3.4	10000	23	10000	50	0.39	*<10*	10	298	10	157	1837	625	106	620	*Non-reactive*
		95th PCTL	0.20	2.9	74	0.044	*<10*	830	1.2	2.0	9.1	*<0.5*	24	216	40	4.2	10	1.0	1.8	40	49	3.0	858	2.0	0.080	96	950	17	0.60	5.0	10	404	20	0.25	*<10*	*<10*	83	*<10*	75	24	228	19	220	*Non-reactive*
		90th PCTL	*<0.2*	2.6	42	0.017	*<10*	580	1.0	2.0	5.4	*<0.5*	20	163	34	3.8	10	1.0	1.6	40	46	2.6	744	1.0	0.070	56	850	13	0.48	3.0	8.0	253	20	0.24	*<10*	*<10*	70	*<10*	67	13	135	15	124	*Non-reactive*
		75th PCTL	*<0.2*	2.3	18	0.0060	*<10*	370	0.80	*<2*	3.9	*<0.5*	17	99	24	3.4	10	*<1*	1.3	30	40	1.8	587	1.0	0.050	40	680	9.0	0.31	2.0	7.0	126	20	0.19	*<10*	*<10*	58	*<10*	57	6.6	97	9.7	90	28
		Median	*<0.2*	1.9	10	0.0020	*<10*	260	0.60	*<2*	2.5	*<0.5*	14	56	17	3.0	10	*<1*	1.0	20	32	1.4	475	*<1*	0.040	31	560	6.0	0.11	*<2*	5.0	78	*<20*	0.13	*<10*	*<10*	45	*<10*	49	3.3	63	3.4	58	9.4
		25th PCTL	*<0.2*	1.6	5.0	0.0010	*<10*	170	*<0.5*	*<2*	1.6	*<0.5*	11	39	11	2.5	*<10*	*<1*	0.73	10	28	1.1	399	*<1*	0.030	22	450	3.0	0.020	*<2*	3.0	52	*<20*	0.10	*<10*	*<10*	34	*<10*	37	1.8	40	0.63	33	3.1
		10th PCTL	*<0.2*	1.2	2.0	*<0.001*	*<10*	90	*<0.5*	*<2*	0.87	*<0.5*	8.0	25	6.0	1.9	*<10*	*<1*	0.45	10	24	0.80	330	*<1*	0.020	13	380	2.0	*<0.01*	*<2*	2.0	33	*<20*	0.060	*<10*	*<10*	25	*<10*	27	0.99	22	0.31	16	0.94
		5th PCTL	*<0.2*	0.98	*<2*	*<0.001*	*<10*	60	*<0.5*	*<2*	0.53	*<0.5*	7.0	18	4.0	1.6	*<10*	*<1*	0.29	*<10*	22	0.65	289	*<1*	0.010	9.0	330	*<2*	*<0.01*	*<2*	2.0	25	*<20*	0.040	*<10*	*<10*	19	*<10*	22	0.77	13	0.31	9.9	0.63
		Min	*<0.2*	0.25	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	0.18	*<0.5*	3.0	4.0	*<1*	0.71	*<10*	*<1*	0.010	*<10*	2.0	0.060	119	*<1*	*<0.01*	2.0	*<10*	*<2*	*<0.01*	*<2*	1.0	9.0	*<20*	*<0.01*	*<10*	*<10*	5.0	*<10*	8.0	0.49	4.5	0.31	-30	0.63
Schist	All	**n**	8722	8721	8721	16766	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721
		n <DL	7612	0	220	2223	8699	1	1354	7345	0	8601	3	2	36	0	4998	6606	5	307	1	1	0	5839	763	76	4	363	1516	3409	76	1	4976	1636	8703	8557	4	8676	1	-	-	-	-	-
		Max	9.2	6.0	6950	17	10	3490	4.3	197	25	4.6	108	1420	2770	8.8	20	16	3.2	160	80	14	6280	29	0.35	1930	5350	396	3.4	10000	33	10000	270	0.59	10	50	298	1140	781	1837	625	106	625	*Non-reactive*
		95th PCTL	0.20	2.6	742	0.087	*<10*	980	1.4	2.0	8.8	*<0.5*	22	157	48	4.3	10	1.0	1.5	50	45	2.5	880	2.0	0.070	69	1010	20	0.45	25	12	335	30	0.23	*<10*	*<10*	85	*<10*	77	275	220	14	219	*Non-reactive*
		90th PCTL	0.20	2.4	361	0.038	*<10*	680	1.2	2.0	6.2	*<0.5*	19	124	37	3.9	10	1.0	1.3	40	42	2.1	773	1.0	0.060	52	840	15	0.29	13	10	213	20	0.20	*<10*	*<10*	72	*<10*	68	136	155	9.1	152	*Non-reactive*
		75th PCTL	*<0.2*	2.0	90	0.011	*<10*	380	1.0	*<2*	4.1	*<0.5*	16	70	25	3.5	10	*<1*	1.0	30	35	1.6	624	1.0	0.040	38	670	10	0.12	6.0	8.0	113	20	0.14	*<10*	*<10*	56	*<10*	56	33	103	3.8	99	*Non-reactive*
		Median	*<0.2*	1.5	24	0.0030	*<10*	210	0.70	*<2*	2.5	*<0.5*	13	43	16	3.0	*<10*	*<1*	0.59	30	28	1.1	496	*<1*	0.030	27	520	7.0	0.030	2.0	5.0	65	*<20*	0.070	*<10*	*<10*	42	*<10*	46	8.7	64	0.94	59	82
		25th PCTL	*<0.2*	0.96	8.0	0.0010	*<10*	120	0.50	*<2*	1.3	*<0.5*	9.0	24	9.0	2.4	*<10*	*<1*	0.26	20	19	0.60	385	*<1*	0.010	16	400	4.0	0.010	*<2*	3.0	38	*<20*	0.010	*<10*	*<10*	27	*<10*	34	3.1	33	0.31	30	17
		10th PCTL	*<0.2*	0.69	4.0	*<0.001*	*<10*	60	*<0.5*	*<2*	0.51	*<0.5*	6.0	11	5.0	1.7	*<10*	*<1*	0.16	10	7.0	0.16	292	*<1*	0.010	8.0	290	3.0	*<0.01*	*<2*	2.0	22	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	23	1.5	13	0.31	11	6.8
		5th PCTL	*<0.2*	0.55	2.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.26	*<0.5*	4.0	7.0	3.0	1.3	*<10*	*<1*	0.11	10	3.0	0.080	237	*<1*	*<0.01*	4.0	210	2.0	*<0.01*	*<2*	2.0	16	*<20*	*<0.01*	*<10*	*<10*	9.0	*<10*	17	1.00	6.5	0.31	5.4	4.0
		Min	*<0.2*	0.080	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.31	*<10*	*<1*	*<0.01*	*<10*	*<1*	*<0.01*	27	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	*<1*	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.33	0.25	0.31	-46	0.30

Appendix C.1-4: Statistical Summary of Exploration Assay Database (Au < 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t
Granite Waste Rock																																												
Granite	Oxide	**n**	578	578	578	583	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578
		n <DL	528	0	3	100	578	2	262	442	2	576	68	0	9	0	577	422	0	1	29	40	0	100	198	142	0	0	406	196	14	0	29	313	575	342	1	576	3	-	-	-	-	-
		Max	0.70	2.1	6330	0.30	*<10*	370	2.9	4.0	0.46	0.50	18	21	42	10	10	3.0	0.48	60	19	0.91	16600	5.0	0.090	12	790	38	0.46	330	9.0	138	50	0.11	10	50	70	10	128	5990	12	14	11	*Non-reactive*
		95th PCTL	0.20	0.92	2715	0.19	*<10*	200	1.2	3.0	0.10	*<0.5*	5.0	13	8.0	2.9	*<10*	1.0	0.30	40	9.0	0.12	1855	3.0	0.060	3.0	310	24	0.021	36	4.0	51	40	0.060	*<10*	20	16	*<10*	52	1840	2.5	0.67	2.1	*Non-reactive*
		90th PCTL	*<0.2*	0.82	1980	0.11	*<10*	130	0.90	2.0	0.080	*<0.5*	3.0	10	6.0	2.3	*<10*	1.0	0.27	30	8.0	0.11	1148	2.0	0.050	3.0	240	21	0.020	17	2.0	34	40	0.060	*<10*	10	9.0	*<10*	43	1151	2.0	0.63	1.7	*Non-reactive*
		75th PCTL	*<0.2*	0.66	859	0.035	*<10*	90	0.70	*<2*	0.070	*<0.5*	2.0	8.0	3.0	1.5	*<10*	1.0	0.21	30	7.0	0.080	619	2.0	0.030	2.0	180	16	0.010	8.0	2.0	17	30	0.040	*<10*	10	7.0	*<10*	34	586	1.8	0.31	1.4	*Non-reactive*
		Median	*<0.2*	0.53	288	0.010	*<10*	70	0.50	*<2*	0.050	*<0.5*	1.0	6.0	2.0	1.2	*<10*	*<1*	0.14	20	2.0	0.020	371	2.0	0.010	1.0	140	10	*<0.01*	3.0	1.0	9.0	30	*<0.01*	*<10*	*<10*	5.0	*<10*	26	289	1.3	0.31	0.94	*Non-reactive*
		25th PCTL	*<0.2*	0.43	60	0.0010	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	4.0	1.0	0.92	*<10*	*<1*	0.090	20	1.0	0.010	97	1.0	*<0.01*	1.0	90	7.0	*<0.01*	*<2*	1.0	7.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	13	51	0.75	0.31	0.44	*Non-reactive*
		10th PCTL	*<0.2*	0.38	18	*<0.001*	*<10*	30	*<0.5*	*<2*	0.020	*<0.5*	*<1*	2.0	1.0	0.68	*<10*	*<1*	0.070	10	0.00	0.010	37	*<1*	*<0.01*	*<1*	70	5.0	*<0.01*	*<2*	1.0	5.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	6.7	15	0.50	0.31	0.19	1.6
		5th PCTL	*<0.2*	0.35	10	*<0.001*	*<10*	20	*<0.5*	*<2*	0.020	*<0.5*	*<1*	2.0	1.0	0.56	*<10*	*<1*	0.060	10	*<0.15*	*<0.01*	23	*<1*	*<0.01*	*<1*	60	4.0	*<0.01*	*<2*	1.0	4.0	14	*<0.01*	*<10*	*<10*	1.0	*<10*	4.0	8.0	0.50	0.31	-0.063	0.63
		Min	*<0.2*	0.25	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.29	*<10*	*<1*	0.020	*<10*	*<3*	*<0.01*	10	*<1*	*<0.01*	*<1*	50	2.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	1.5	0.25	0.31	-13	0.63
Granite	Upper Transition	**n**	140	140	140	341	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
		n <DL	136	0	6	66	140	0	108	140	1	140	16	0	19	0	140	132	0	0	3	4	0	27	6	51	0	0	120	101	0	0	1	30	140	126	0	140	1	-	-	-	-	-
		Max	0.40	1.8	6150	0.29	*<10*	250	2.8	*<2*	0.18	*<0.5*	5.0	15	19	6.1	*<10*	2.0	0.40	70	11	0.18	1340	5.0	0.11	5.0	930	30	0.31	50	5.0	123	40	0.090	*<10*	30	26	*<10*	53	8200	4.5	9.7	4.2	*Non-reactive*
		95th PCTL	*<0.2*	0.82	1460	0.094	*<10*	130	0.70	*<2*	0.12	*<0.5*	2.0	13	5.0	1.6	*<10*	1.0	0.34	40	10	0.14	865	3.0	0.080	3.0	241	16	0.020	13	2.0	20	40	0.070	*<10*	10	10	*<10*	42	623	3.0	0.64	2.7	*Non-reactive*
		90th PCTL	*<0.2*	0.70	256	0.036	*<10*	110	0.70	*<2*	0.12	*<0.5*	2.0	12	4.0	1.5	*<10*	*<1*	0.33	30	10	0.13	774	3.0	0.080	3.0	221	14	0.010	6.0	2.0	12	40	0.070	*<10*	*<10*	8.1	*<10*	39	394	3.0	0.31	2.2	*Non-reactive*
		75th PCTL	*<0.2*	0.55	95	0.0080	*<10*	90	*<0.5*	*<2*	0.090	*<0.5*	2.0	10	3.0	1.4	*<10*	*<1*	0.31	30	9.0	0.12	677	2.0	0.070	2.0	190	9.3	*<0.01*	2.0	2.0	8.0	30	0.060	*<10*	*<10*	8.0	*<10*	35	100	2.3	0.31	1.9	*Non-reactive*
		Median	*<0.2*	0.48	27	0.0020	*<10*	80	*<0.5*	*<2*	0.070	*<0.5*	1.0	7.0	2.0	1.2	*<10*	*<1*	0.28	30	8.0	0.11	545	2.0	0.050	1.0	170	6.0	*<0.01*	*<2*	2.0	7.0	30	0.050	*<10*	*<10*	7.0	*<10*	31	23	1.8	0.31	1.4	*Non-reactive*
		25th PCTL	*<0.2*	0.45	9.8	0.0010	*<10*	50	*<0.5*	*<2*	0.050	*<0.5*	1.0	5.0	1.0	0.98	*<10*	*<1*	0.13	20	5.0	0.048	290	1.0	0.020	*<1*	138	5.0	*<0.01*	*<2*	1.0	6.0	30	0.018	*<10*	*<10*	5.8	*<10*	22	7.3	1.3	0.31	0.94	*Non-reactive*
		10th PCTL	*<0.2*	0.40	4.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.030	*<0.5*	*<1*	4.0	*<1*	0.59	*<10*	*<1*	0.070	20	1.0	0.010	53	*<1*	0.010	*<1*	80	5.0	*<0.01*	*<2*	1.0	5.0	30	*<0.01*	*<10*	*<10*	4.0	*<10*	6.9	2.9	0.75	0.31	0.41	*Non-reactive*
		5th PCTL	*<0.2*	0.39	2.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.020	*<0.5*	*<1*	4.0	*<1*	0.41	*<10*	*<1*	0.060	10	1.0	0.010	31	*<1*	0.010	*<1*	70	5.0	*<0.01*	*<2*	1.0	5.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	4.0	1.7	0.50	0.31	-0.063	1.3
		Min	*<0.2*	0.32	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	3.0	*<1*	0.27	*<10*	*<1*	0.040	10	*<4*	*<0.01*	15	*<1*	*<0.01*	*<1*	60	4.0	*<0.01*	*<2*	1.0	3.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	*<2*	1.4	0.25	0.31	-8.9	0.63
Granite	Lower Transition	**n**	235	235	235	379	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235
		n <DL	224	0	11	90	234	0	169	194	13	235	8	0	9	0	233	212	0	0	17	19	0	72	4	47	0	0	144	130	2	0	2	53	235	177	0	235	0	-	-	-	-	-
		Max	0.20	2.4	10000	0.25	10	600	2.6	3.0	0.43	*<0.5*	72	16	16	6.8	10	4.0	0.51	60	11	0.19	7720	4.0	0.15	9.0	560	31	0.22	169	9.0	78	50	0.090	*<10*	30	27	*<10*	80	8264	11	6.9	8.3	*Non-reactive*
		95th PCTL	*<0.2*	1.0	1617	0.028	*<10*	143	0.80	2.0	0.12	*<0.5*	5.0	9.0	5.0	2.0	*<10*	1.0	0.40	30	10	0.14	1742	2.0	0.11	3.0	236	21	0.020	24	2.0	20	40	0.070	*<10*	10	9.0	*<10*	46	829	3.0	0.63	2.7	*Non-reactive*
		90th PCTL	*<0.2*	0.95	493	0.014	*<10*	116	0.70	2.0	0.10	*<0.5*	4.0	8.0	4.0	1.7	*<10*	*<1*	0.37	30	10	0.14	935	2.0	0.10	2.0	200	13	0.020	12	2.0	12	40	0.070	*<10*	10	8.0	*<10*	40	395	2.5	0.63	2.2	*Non-reactive*
		75th PCTL	*<0.2*	0.74	109	0.0040	*<10*	100	0.50	*<2*	0.090	*<0.5*	2.0	7.0	2.5	1.5	*<10*	*<1*	0.34	30	8.0	0.12	733	1.0	0.080	2.0	180	9.0	0.010	3.0	2.0	8.5	30	0.060	*<10*	*<10*	7.0	*<10*	35	116	2.3	0.31	1.9	*Non-reactive*
		Median	*<0.2*	0.56	32	0.0010	*<10*	90	*<0.5*	*<2*	0.070	*<0.5*	2.0	6.0	1.0	1.3	*<10*	*<1*	0.28	30	7.0	0.10	542	1.0	0.050	1.0	160	7.0	*<0.01*	*<2*	2.0	8.0	30	0.050	*<10*	*<10*	7.0	*<10*	30	28	1.8	0.31	1.4	*Non-reactive*
		25th PCTL	*<0.2*	0.48	6.0	0.0010	*<10*	60	*<0.5*	*<2*	0.050	*<0.5*	1.0	5.0	1.0	1.1	*<10*	*<1*	0.15	20	4.0	0.040	339	*<1*	0.030	1.0	130	5.0	*<0.01*	*<2*	1.0	6.0	30	0.010	*<10*	*<10*	5.0	*<10*	23	3.9	1.3	0.31	0.94	*Non-reactive*
		10th PCTL	*<0.2*	0.42	2.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.020	*<0.5*	1.0	3.0	1.0	0.75	*<10*	*<1*	0.10	10	0.00	0.010	93	*<1*	0.010	*<1*	70	5.0	*<0.01*	*<2*	1.0	6.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	8.8	1.7	0.50	0.31	0.19	4.3
		5th PCTL	*<0.2*	0.39	2.0	*<0.001*	*<10*	30	*<0.5*	*<2*	*<0.01*	*<0.5*	1.0	3.0	1.0	0.54	*<10*	*<1*	0.080	10	*<1*	*<0.01*	45	*<1*	0.010	*<1*	60	5.0	*<0.01*	*<2*	1.0	5.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	5.7	1.4	0.25	0.31	-0.38	0.63
		Min	*<0.2*	0.26	*<2*	*<0.001*	*<10*	20	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	2.0	*<1*	0.30	*<10*	*<1*	0.040	10	*<3*	*<0.01*	7.0	*<1*	*<0.01*	*<1*	40	4.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	2.0	1.3	0.25	0.31	-5.1	0.63
Granite	Transition	**n**	375	375	375	720	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375
		n <DL	360	0	17	156	374	0	277	334	14	375	24	0	28	0	373	344	0	0	20	23	0	99	10	98	0	0	264	231	2	0	3	83	375	303	0	375	1	-	-	-	-	-
		Max	0.4	2.36	10000	0.29	10	600	2.8	3	0.43	*<0.5*	72	16	19	6.84	10	4	0.51	70	11	0.19	7720	5	0.15	9	930	31	0.31	169	9	123	50	0.09	*<10*	30	27	-10	80	8264	10.75	9.6875	8.25	*Non-reactive*
		95th PCTL	*<0.2*	1.01	1616.5	0.06605	*<10*	130	0.8	2	0.12	*<0.5*	5	12	5	1.953	*<10*	1	0.39	40	10	0.14	1240	3	0.11	3	243	18.3	0.02	23	2	20.6	40	0.07	*<10*	10	9	-10	43.9	724	3	0.625	2.6875	*Non-reactive*
		90th PCTL	*<0.2*	0.896	453	0.02	*<10*	110	0.7	2	0.11	*<0.5*	3	10	4	1.6	*<10*	*<1*	0.37	30	10	0.136	885.2	2	0.09	3	210	14	0.01	8.6	2	12	40	0.07	*<10*	10	8	-10	39	397	2.75	0.3125	2.1875	*Non-reactive*
		75th PCTL	*<0.2*	0.665	103	0.005	*<10*	100	0.5	*<2*	0.09	*<0.5*	2	7	3	1.435	*<10*	*<1*	0.33	30	8	0.12	704.5	2	0.07	2	180	9	0.01	3	2	8	30	0.06	*<10*	-10	8	-10	35	113	2.25	0.3125	1.9375	*Non-reactive*
		Median	*<0.2*	0.52	30	0.002	*<10*	80	*<0.5*	*<2*	0.07	*<0.5*	1	6	1	1.25	*<10*	*<1*	0.28	30	7	0.1	542	1	0.05	1	160	7	*<0.01*	*<2*	2	7	30	0.05	*<10*	-10	7	-10	30	24	1.75	0.3125	1.4375	*Non-reactive*
		25th PCTL	*<0.2*	0.46	6	0.001	*<10*	60	*<0.5*	*<2*	0.05	*<0.5*	1	5	1	1.02	*<10*	*<1*	0.14	20	4	0.04	325.5	*<1*	0.025	*<1*	130	5	*<0.01*	*<2*	1	6	30	0.01	*<10*	-10	5	-10	22	4.9	1.25	0.3125	0.9375	*Non-reactive*
		10th PCTL	*<0.2*	0.414	3	*<0.001*	*<10*	30	*<0.5*	*<2*	0.02	*<0.5*	1	3	1	0.64	*<10*	*<1*	0.09	20	1	0.01	64.8	*<1*	0.01	*<1*	70	5	*<0.01*	*<2*	1	6	30	-0.01	*<10*	-10	3	-10	8	1.9	0.5	0.3125	0.1875	*Non-reactive*
		5th PCTL	*<0.2*	0.39	2	*<0.001*	*<10*	20	*<0.5*	*<2*	0.02	*<0.5*	*<1*	3	*<1*	0.5	*<10*	*<1*	0.067	10	*<1*	*<0.01*	34.4	*<1*	0.01	*<1*	60	5	*<0.01*	*<2*	1	5	30	-0.01	*<10*	-10	3	-10	4.7	1.5	0.5	0.3125	-0.375	0.84
		Min	*<0.2*	0.26	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	2	*<1*	0.27	*<10*	*<1*	0.04	10	*<4*	*<0.01*	7	*<1*	*<0.01*	*<1*	40	4	*<0.01*	*<2*	*<1*	3	-20	-0.01	*<10*	-10	2	-10	-2	1.3	0.25	0.3125	-8.9375	0.63
Granite	Fresh	**n**	24	24	24	143	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
		n <DL	24	0	0	55	20	0	17	22	3	24	8	0	0	0	24	15	0	0	2	2	0	8	1	2	0	0	13	2	1	0	0	18	24	21	0	24	12	-	-	-	-	-
		Max	*<0.2*	1.0	5690	7.0	10	90	0.90	2.0	0.12	*<0.5*	3.0	8.0	8.0	1.6	*<10*	1.0	0.24	40	6.0	0.10	1505	3.0	0.030	3.0	230	27	0.43	129	2.0	19	40	0.020	*<10*	20	6.0	*<10*	51	9483	3.0	13	1.8	*Non-reactive*
		95th PCTL	*<0.2*	0.94	4242	0.20	10	70	0.80	1.4	0.11	*<0.5*	2.0	8.0	4.0	1.5	*<10*	1.0	0.20	30	5.0	0.079	1317	2.0	0.029	2.9	219	25	0.15	74	1.0	17	40	0.019	*<10*	10	5.9	*<10*	45	7229	2.7	4.7	1.0	*Non-reactive*
		90th PCTL	*<0.2*	0.91	3662	0.037	10	70	0.80	*<2*	0.097	*<0.5*	2.0	8.0	4.0	1.4	*<10*	1.0	0.20	30	5.0	0.064	1175	2.0	0.020	2.0	207	22	0.14	66	1.0	14	40	0.010	*<10*	4.0	5.0	*<10*	43	6587	2.4	4.5	0.92	*Non-reactive*
		75th PCTL	*<0.2*	0.82	3163	0.0040	*<10*	50	0.63	*<2*	0.050	*<0.5*	2.0	7.0	3.0	0.93	*<10*	1.0	0.18	23	3.0	0.025	151	2.0	0.010	2.0	155	19	0.045	40	1.0	8.0	30	*<0.005*	*<10*	*<10*	4.0	*<10*	12	5303	1.3	1.4	0.25	*Non-reactive*
		Median	*<0.2*	0.74	1648	0.0010	*<10*	40	*<0.5*	*<2*	0.020	*<0.5*	1.0	4.0	1.5	0.65	*<10*	*<1*	0.15	20	2.0	0.010	35	1.0	0.010	1.0	70	14	*<0.01*	33	1.0	5.5	30	*<0.01*	*<10*	*<10*	4.0	*<10*	0.00	2258	0.50	0.31	0.063	*Non-reactive*
		25th PCTL	*<0.2*	0.49	685	*<0.001*	*<10*	30	*<0.5*	*<2*	0.010	*<0.5*	*<1*	4.0	1.0	0.51	*<10*	*<1*	0.12	20	1.0	0.010	30	*<1*	0.010	1.0	58	13	*<0.01*	6.0	1.0	4.8	30	*<0.01*	*<10*	*<10*	3.0	*<10*	*<2*	1058	0.25	0.31	-0.14	4.5
		10th PCTL	*<0.2*	0.38	76	*<0.001*	*<10*	20	*<0.5*	*<2*	0.0040	*<0.5*	*<1*	3.0	1.0	0.46	*<10*	*<1*	0.11	10	1.0	0.010	27	*<1*	0.010	1.0	50	10	*<0.01*	2.0	1.0	4.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	*<2*	73	0.25	0.31	-2.9	1.4
		5th PCTL	*<0.2*	0.37	38	*<0.001*	*<10*	20	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	3.0	1.0	0.46	*<10*	*<1*	0.093	10	1.55	0.0070	24	*<1*	0.010	0.70	50	8.3	*<0.01*	1.4	1.0	4.0	30	*<0.01*	*<10*	*<10*	2.2	*<10*	*<2*	30	0.25	0.31	-3.4	0.98
		Min	*<0.2*	0.29	23	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	3.0	1.0	0.38	*<10*	*<1*	0.060	10	*<2*	*<0.01*	21	*<1*	*<0.01*	*<1*	50	7.0	*<0.01*	*<2*	*<1*	4.0	30	*<0.01*	*<10*	*<10*	2.0	*<10*	*<2*	15	0.25	0.31	-13	0.63
Granite	All	**n**	977	977	977	1446	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977
		n <DL	912	0	20	311	972	2	556	798	19	975	100	0	37	0	974	781	0	1	51	65	0	207	209	242	0	0	683	429	17	0	32	414	974	666	1	975	16	-	-	-	-	-
		Max	0.70	2.4	10000	7.0	10	600	2.9	4.0	0.46	0.50	72	21	42	10	10	4.0	0.51	70	19	0.91	16600	5.0	0.15	12	930	38	0.46	330	9.0	138	50	0.11	10	50	70	10	128	9483	12	14	11	*Non-reactive*
		95th PCTL	0.20	0.95	2616	0.14	*<10*	160	1.1	2.0	0.11	*<0.5*	5.0	12	7.0	2.5	*<10*	1.0	0.36	40	10	0.13	1684	3.0	0.090	3.0	270	23	0.030	37	2.0	38	40	0.070	*<10*	20	12	*<10*	48	2150	2.8	0.94	2.4	*Non-reactive*
		90th PCTL	*<0.2*	0.86	1659	0.067	*<10*	120	0.80	2.0	0.090	*<0.5*	3.0	10	5.0	2.0	*<10*	1.0	0.33	30	9.0	0.13	1029	2.0	0.074	3.0	230	19	0.020	18	2.0	25	40	0.060	*<10*	10	8.0	*<10*	41	1090	2.3	0.63	1.9	*Non-reactive*
		75th PCTL	*<0.2*	0.67	591	0.014	*<10*	90	0.60	*<2*	0.080	*<0.5*	2.0	8.0	3.0	1.5	*<10*	*<1*	0.28	30	8.0	0.11	670	2.0	0.050	2.0	180	14	0.010	6.0	2.0	13	30	0.050	*<10*	10	7.0	*<10*	34	486	2.0	0.31	1.7	*Non-reactive*
		Median	*<0.2*	0.53	119	0.0030	*<10*	70	*<0.5*	*<2*	0.060	*<0.5*	1.0	6.0	2.0	1.2	*<10*	*<1*	0.17	20	5.0	0.050	443	1.0	0.020	1.0	150	8.0	*<0.01*	2.0	2.0	8.0	30	0.020	*<10*	*<10*	6.0	*<10*	28	117	1.5	0.31	1.2	*Non-reactive*
		25th PCTL	*<0.2*	0.44	23	0.0010	*<10*	40	*<0.5*	*<2*	0.040	*<0.5*	1.0	4.0	1.0	0.92	*<10*	*<1*	0.11	20	1.0	0.010	138	1.0	0.010	1.0	100	6.0	*<0.01*	*<2*	1.0	6.0	30	*<0.01*	*<10*	*<10*	4.0	*<10*	15	19	1.0	0.31	0.44	*Non-reactive*
		10th PCTL	*<0.2*	0.39	6.0	*<0.001*	*<10*	30	*<0.5*	*<2*	0.020	*<0.5*	*<1*	3.0	1.0	0.64	*<10*	*<1*	0.070	10	0.00	0.010	38	*<1*	*<0.01*	*<1*	70	5.0	*<0.01*	*<2*	1.0	5.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	6.0	4.1	0.50	0.31	0.19	2.8
		5th PCTL	*<0.2*	0.36	3.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.020	*<0.5*	*<1*	2.0	1.0	0.52	*<10*	*<1*	0.060	10	*<1*	*<0.01*	27	*<1*	*<0.01*	*<1*	60	4.0	*<0.01*	*<2*	1.0	5.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	4.0	2.3	0.50	0.31	-0.14	0.80
		Min	*<0.2*	0.25	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.27	*<10*	*<1*	0.020	*<10*	*<4*	*<0.01*	7.0	*<1*	*<0.01*	*<1*	40	2.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	1.3	0.25	0.31	-13	0.053

Appendix C.1-4: Statistical Summary of Exploration Assay Database (Au < 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t
Other Lithologies																																												
Other	Oxide	**n**	1411	1411	1411	3165	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411
		n <DL	1122	0	0	134	1406	0	84	1169	0	1390	15	8	6	0	1249	824	0	29	1	2	0	762	285	81	0	6	388	131	29	0	958	879	1406	1099	10	1387	1	-	-	-	-	-
		Max	20	4.9	5860	0.30	10	3350	4.2	18	24	2.5	87	618	314	14	10	14	1.8	1700	72	7.7	18250	9.0	0.27	643	2350	369	1.9	708	46	931	40	0.26	10	100	287	960	580	4614	593	60	592	*Non-reactive*
		95th PCTL	0.40	2.1	1995	0.22	*<10*	1220	2.3	3.0	7.9	*<0.5*	35	97	55	6.7	10	1.0	0.62	40	42	2.2	1483	2.0	0.040	63	1485	21	0.38	76	26	193	30	0.080	*<10*	30	180	*<10*	98	604	198	12	197	*Non-reactive*
		90th PCTL	0.20	1.6	1250	0.15	*<10*	890	1.9	2.0	6.4	*<0.5*	27	64	40	5.5	10	1.0	0.42	40	38	1.9	1070	2.0	0.040	47	1020	18	0.21	50	18	143	30	0.040	*<10*	20	128	*<10*	85	433	160	6.6	155	*Non-reactive*
		75th PCTL	*<0.2*	1.2	680	0.067	*<10*	460	1.3	*<2*	4.5	*<0.5*	16	39	29	3.8	*<10*	1.0	0.26	30	30	1.4	751	1.0	0.020	32	590	14	0.060	20	10	99	20	0.010	*<10*	*<10*	57	*<10*	66	252	114	1.9	111	*Non-reactive*
		Median	*<0.2*	0.85	284	0.019	*<10*	210	1.0	*<2*	2.2	*<0.5*	12	20	18	3.0	*<10*	*<1*	0.18	20	11	0.36	576	*<1*	0.010	19	370	10	0.020	8.0	7.0	51	*<20*	*<0.01*	*<10*	*<10*	37	*<10*	50	103	55	0.63	51	15
		25th PCTL	*<0.2*	0.61	70	0.0050	*<10*	90	0.70	*<2*	0.21	*<0.5*	6.0	8.0	8.0	2.1	*<10*	*<1*	0.13	10	2.0	0.060	400	*<1*	0.010	6.0	190	8.0	*<0.01*	4.0	4.0	25	*<20*	*<0.01*	*<10*	*<10*	18	*<10*	32	27	5.3	0.31	4.9	1.6
		10th PCTL	*<0.2*	0.49	26	0.0020	*<10*	50	0.50	*<2*	0.060	*<0.5*	2.0	3.0	3.0	1.3	*<10*	*<1*	0.090	10	1.0	0.030	217	*<1*	*<0.01*	1.0	110	6.0	*<0.01*	2.0	2.0	14	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	17	8.5	1.5	0.31	0.94	0.63
		5th PCTL	*<0.2*	0.43	15	0.0010	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	1.0	2.0	0.95	*<10*	*<1*	0.070	10	1.0	0.020	127	*<1*	*<0.01*	*<1*	70	5.0	*<0.01*	*<2*	1.0	11	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	10	4.8	0.75	0.31	0.44	0.63
		Min	*<0.2*	0.20	3.0	*<0.001*	*<10*	10	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.37	*<10*	*<1*	0.020	*<10*	*<1*	*<0.01*	8.0	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.94	0.25	0.31	-6.6	0.63
Other	Upper Transition	**n**	585	585	585	2943	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585
		n <DL	467	0	4	275	579	0	60	522	0	567	29	8	14	0	432	426	0	5	5	5	1	322	109	73	0	5	133	121	27	0	316	196	582	532	11	562	1	-	-	-	-	-
		Max	18	4.1	10000	0.30	10	3450	3.4	5.0	20	1.2	40	532	151	7.5	10	6.0	2.2	80	58	4.5	4440	6.0	0.22	912	2450	187	1.6	156	28	2940	50	0.46	10	30	203	110	171	7653	505	49	500	*Non-reactive*
		95th PCTL	0.40	2.5	1755	0.18	*<10*	1634	2.1	2.0	8.9	*<0.5*	25	151	37	4.8	10	1.0	1.2	50	41	2.4	1030	2.0	0.070	75	1580	28	0.38	45	17	239	40	0.16	*<10*	10	120	*<10*	88	727	223	12	219	*Non-reactive*
		90th PCTL	0.20	2.1	1157	0.12	*<10*	1176	1.7	2.0	7.6	*<0.5*	20	98	29	4.4	10	1.0	0.95	40	36	1.9	949	1.0	0.060	44	1020	20	0.26	24	13	196	30	0.11	*<10*	*<10*	97	*<10*	78	462	190	8.1	188	*Non-reactive*
		75th PCTL	*<0.2*	1.6	248	0.042	*<10*	400	1.2	*<2*	4.6	*<0.5*	15	47	19	3.5	10	1.0	0.57	30	28	1.3	743	1.0	0.040	26	700	14	0.090	9.0	10	103	20	0.070	*<10*	*<10*	66	*<10*	60	140	116	2.8	110	*Non-reactive*
		Median	*<0.2*	1.0	65	0.011	*<10*	180	0.80	*<2*	2.0	*<0.5*	10	19	11	2.7	*<10*	*<1*	0.28	30	20	0.63	548	*<1*	0.020	13	430	10	0.030	4.0	5.0	55	*<20*	0.020	*<10*	*<10*	37	*<10*	44	28	50	0.94	48	8.1
		25th PCTL	*<0.2*	0.68	23	0.0030	*<10*	90	0.60	*<2*	0.36	*<0.5*	5.0	7.0	6.0	1.7	*<10*	*<1*	0.18	20	9.0	0.18	354	*<1*	0.010	3.0	220	7.0	0.010	2.0	3.0	28	*<20*	*<0.01*	*<10*	*<10*	13	*<10*	28	9.6	9.0	0.31	7.4	1.9
		10th PCTL	*<0.2*	0.51	8.0	0.0010	*<10*	50	*<0.5*	*<2*	0.080	*<0.5*	1.0	3.0	2.0	1.1	*<10*	*<1*	0.12	10	3.0	0.040	193	*<1*	*<0.01*	*<1*	110	5.0	*<0.01*	*<2*	1.0	13	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	12	2.7	2.0	0.31	1.2	0.94
		5th PCTL	*<0.2*	0.45	5.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	1.2	1.0	0.75	*<10*	*<1*	0.080	10	2.0	0.020	101	*<1*	*<0.01*	*<1*	82	4.0	*<0.01*	*<2*	1.0	9.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	8.0	1.5	0.75	0.31	0.19	0.63
		Min	*<0.2*	0.16	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.39	*<10*	*<1*	0.010	*<10*	*<1*	*<0.01*	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.59	0.25	0.31	-19	0.63
Other	Lower Transition	**n**	710	710	710	2387	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710
		n <DL	573	0	26	284	703	0	234	598	2	698	28	5	4	0	392	548	0	63	1	1	0	421	18	75	0	60	187	370	14	0	459	102	709	670	0	679	8	-	-	-	-	-
		Max	1930	6.4	7110	0.30	10	2460	2.9	9.0	22	1.5	81	521	7700	7.0	10	7.0	2.3	130	61	4.6	1370	11	0.39	653	2440	82	1.3	123	34	1410	50	0.33	10	20	250	2990	1980	7146	540	40	538	*Non-reactive*
		95th PCTL	0.50	3.1	460	0.12	*<10*	780	1.6	3.0	6.7	*<0.5*	24	207	45	4.6	10	1.0	1.5	40	50	2.8	942	2.0	0.13	88	1556	21	0.27	25	13	174	30	0.25	*<10*	10	125	*<10*	79	223	168	8.4	160	*Non-reactive*
		90th PCTL	0.20	2.9	160	0.060	*<10*	561	1.2	2.0	4.4	*<0.5*	21	151	36	3.9	10	1.0	1.4	40	46	2.5	840	1.0	0.10	65	1390	15	0.13	10	11	142	30	0.22	*<10*	*<10*	102	*<10*	69	85	111	4.1	106	*Non-reactive*
		75th PCTL	*<0.2*	2.4	56	0.019	*<10*	340	0.90	*<2*	3.0	*<0.5*	16	85	24	3.4	10	*<1*	1.0	30	38	1.9	676	1.0	0.070	39	830	10	0.030	4.0	8.0	95	20	0.15	*<10*	*<10*	78	*<10*	57	24	74	0.94	69	*Non-reactive*
		Median	*<0.2*	1.8	18	0.0050	*<10*	230	0.60	*<2*	1.4	*<0.5*	12	30	14	2.8	*<10*	*<1*	0.57	20	29	1.2	522	*<1*	0.040	14	560	6.0	0.010	*<2*	5.0	55	*<20*	0.080	*<10*	*<10*	49	*<10*	45	7.5	36	0.31	34	*Non-reactive*
		25th PCTL	*<0.2*	1.0	8.0	0.0020	*<10*	120	*<0.5*	*<2*	0.52	*<0.5*	8.0	9.0	8.0	1.9	*<10*	*<1*	0.30	10	21	0.62	356	*<1*	0.030	4.0	310	4.0	*<0.01*	*<2*	3.0	28	*<20*	0.030	*<10*	*<10*	26	*<10*	27	2.8	13	0.31	13	1.3
		10th PCTL	*<0.2*	0.62	3.0	*<0.001*	*<10*	70	*<0.5*	*<2*	0.20	*<0.5*	3.0	5.0	4.0	1.3	*<10*	*<1*	0.17	10	11	0.16	240	*<1*	0.010	*<1*	150	2.0	*<0.01*	*<2*	1.0	16	*<20*	*<0.01*	*<10*	*<10*	11	*<10*	15	1.3	5.0	0.31	4.7	0.63
		5th PCTL	*<0.2*	0.48	2.0	*<0.001*	*<10*	50	*<0.5*	*<2*	0.060	*<0.5*	1.0	3.0	2.0	0.97	*<10*	*<1*	0.14	*<10*	3.9	0.045	161	*<1*	0.010	*<1*	80	*<2*	*<0.01*	*<2*	1.0	13	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	7.5	0.90	1.5	0.31	1.2	0.63
		Min	*<0.2*	0.24	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.30	*<10*	*<1*	0.030	*<10*	*<3*	*<0.01*	7.0	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	*<2*	0.35	0.25	0.31	-7.9	0.63
Other	Transition	**n**	1295	1295	1295	5330	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295
		n <DL	1040	0	30	559	1282	0	294	1120	2	1265	57	13	18	0	824	974	0	68	6	6	1	743	127	148	0	65	320	491	41	0	775	298	1291	1202	11	1241	9	-	-	-	-	-
		Max	1930	6.4	10000	0.30	10	3450	3.4	9.0	22	1.5	81	532	7700	7.5	10	7.0	2.3	130	61	4.6	4440	11	0.39	912	2450	187	1.6	156	34	2940	50	0.46	10	30	250	2990	1980	7653	540	49	538	*Non-reactive*
		95th PCTL	0.40	3.0	1330	0.16	*<10*	1273	1.9	2.0	8.2	*<0.5*	24	184	42	4.8	10	1.0	1.4	40	48	2.7	1010	2.0	0.11	87	1570	24	0.32	29	15	217	30	0.23	*<10*	10	122	*<10*	83	554	205	10	199	*Non-reactive*
		90th PCTL	0.20	2.7	535	0.092	*<10*	690	1.5	2.0	6.2	*<0.5*	20	133	33	4.2	10	1.0	1.2	40	44	2.3	888	1.0	0.080	61	1320	18	0.19	17	12	156	30	0.19	*<10*	*<10*	100	*<10*	72	268	155	5.8	149	*Non-reactive*
		75th PCTL	*<0.2*	2.2	121	0.031	*<10*	370	1.0	*<2*	3.4	*<0.5*	16	62	21	3.4	10	*<1*	0.85	30	33	1.6	716	1.0	0.060	33	750	12	0.060	7.0	8.0	97	20	0.11	*<10*	*<10*	73	*<10*	58	56	85	1.9	83	*Non-reactive*
		Median	*<0.2*	1.4	33	0.0080	*<10*	210	0.70	*<2*	1.6	*<0.5*	11	24	12	2.8	*<10*	*<1*	0.43	20	26	0.98	530	*<1*	0.030	14	480	8.0	0.020	2.0	5.0	55	*<20*	0.050	*<10*	*<10*	44	*<10*	45	12	40	0.63	38	18
		25th PCTL	*<0.2*	0.79	11	0.0020	*<10*	100	0.50	*<2*	0.45	*<0.5*	7.0	8.0	7.0	1.8	*<10*	*<1*	0.22	10	15	0.38	356	*<1*	0.010	3.0	260	5.0	0.010	*<2*	3.0	28	*<20*	0.010	*<10*	*<10*	20	*<10*	28	4.2	11	0.31	11	1.6
		10th PCTL	*<0.2*	0.54	5.0	*<0.001*	*<10*	60	*<0.5*	*<2*	0.14	*<0.5*	2.0	4.0	3.0	1.1	*<10*	*<1*	0.14	10	5.0	0.070	210	*<1*	0.010	*<1*	120	3.0	*<0.01*	*<2*	1.0	15	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	14	1.6	3.5	0.31	2.7	0.63
		5th PCTL	*<0.2*	0.46	3.0	*<0.001*	*<10*	50	*<0.5*	*<2*	0.040	*<0.5*	1.0	2.0	2.0	0.83	*<10*	*<1*	0.11	*<10*	2.0	0.020	112	*<1*	*<0.01*	*<1*	80	0.80	*<0.01*	*<2*	1.0	11	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	8.0	1.1	1.0	0.31	0.44	0.63
		Min	*<0.2*	0.16	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.30	*<10*	*<1*	0.010	*<10*	*<3*	*<0.01*	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.35	0.25	0.31	-19	0.63
Other	Fresh	**n**	247	241	241	796	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241
		n <DL	175	0	16	91	238	1	85	206	2	236	22	0	4	0	137	179	0	26	1	1	0	171	22	36	1	18	29	130	6	0	185	79	241	234	1	238	4	-	-	-	-	-
		Max	1.4	6.4	10000	9.3	10	1970	3.4	4.0	12	1.9	78	1475	61	5.9	10	2.0	2.3	50	81	15	7720	6.0	0.40	1505	1720	271	4.1	129	20	448	40	0.34	*<10*	10	196	10	237	9483	288	129	234	*Non-reactive*
		95th PCTL	0.60	3.9	4730	2.0	*<10*	1070	1.6	2.0	5.5	*<0.5*	63	1110	32	5.0	10	1.0	1.5	40	76	9.8	1020	2.0	0.27	991	1470	25	1.9	19	12	282	20	0.23	*<10*	*<10*	164	*<10*	76	2472	138	59	125	*Non-reactive*
		90th PCTL	0.50	3.2	3110	1.1	*<10*	700	1.3	2.0	5.0	*<0.5*	28	152	26	4.2	10	1.0	1.1	30	48	2.7	912	1.0	0.22	45	1320	16	1.5	11	11	230	20	0.19	*<10*	*<10*	123	*<10*	71	1493	125	48	110	*Non-reactive*
		75th PCTL	0.20	2.6	457	0.044	*<10*	410	1.0	*<2*	3.2	*<0.5*	16	36	17	3.6	10	1.0	0.81	20	35	1.8	683	1.0	0.12	24	690	12	0.35	5.0	8.0	133	*<20*	0.14	*<10*	*<10*	91	*<10*	58	408	79	11	57	*Non-reactive*
		Median	*<0.2*	1.4	23	0.0060	*<10*	260	0.60	*<2*	1.9	*<0.5*	12	18	11	2.8	*<10*	*<1*	0.38	20	29	1.4	537	*<1*	0.040	11	410	8.0	0.040	*<2*	5.0	82	*<20*	0.050	*<10*	*<10*	33	*<10*	40	8.5	46	1.3	39	42
		25th PCTL	*<0.2*	0.78	6.0	0.0020	*<10*	140	*<0.5*	*<2*	0.78	*<0.5*	6.0	9.0	5.0	2.2	*<10*	*<1*	0.25	10	22	0.68	371	*<1*	0.020	2.0	120	4.0	0.010	*<2*	3.0	36	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	30	1.7	20	0.31	13	3.8
		10th PCTL	*<0.2*	0.56	3.0	*<0.001*	*<10*	60	*<0.5*	*<2*	0.27	*<0.5*	1.0	4.0	2.0	0.81	*<10*	*<1*	0.16	*<10*	12	0.15	242	*<1*	0.010	*<1*	50	2.0	*<0.01*	*<2*	1.0	20	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	19	0.93	6.8	0.31	3.1	0.63
		5th PCTL	*<0.2*	0.48	*<2*	*<0.001*	*<10*	40	*<0.5*	*<2*	0.20	*<0.5*	*<1*	1.0	1.0	0.67	*<10*	*<1*	0.070	*<10*	9.0	0.10	133	*<1*	*<0.01*	*<1*	40	*<2*	*<0.01*	*<2*	1.0	17	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	15	0.66	5.0	0.31	-7.2	0.63
		Min	*<0.2*	0.050	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.49	*<10*	*<1*	0.010	*<10*	*<2*	*<0.01*	21	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.53	0.25	0.31	-67	0.63
Other	All	**n**	2953	2947	2947	9291	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947
		n <DL	2337	0	46	784	2926	1	463	2495	4	2891	94	21	28	0	2210	1977	0	123	8	9	1	1676	434	265	1	89	737	752	76	0	1918	1256	2938	2535	22	2866	14	-	-	-	-	-
		Max	1930	6.4	10000	9.3	10	3450	4.2	18	24	2.5	87	1475	7700	14	10	14	2.3	1700	81	15	18250	11	0.40	1505	2450	369	4.1	708	46	2940	50	0.46	10	100	287	2990	1980	9483	593	129	592	*Non-reactive*
		95th PCTL	0.40	2.9	1914	0.21	*<10*	1230	2.1	2.0	7.9	*<0.5*	29	150	47	5.7	10	1.0	1.3	40	46	2.6	1154	2.0	0.11	74	1527	23	0.43	56	20	216	30	0.19	*<10*	20	151	*<10*	89	703	198	13	195	*Non-reactive*
		90th PCTL	0.20	2.5	1145	0.13	*<10*	810	1.7	2.0	6.1	*<0.5*	23	104	37	4.7	10	1.0	0.98	40	41	2.1	959	2.0	0.070	51	1230	18	0.26	31	14	156	30	0.15	*<10*	10	110	*<10*	79	430	153	8.1	147	*Non-reactive*
		75th PCTL	*<0.2*	1.6	446	0.043	*<10*	400	1.2	*<2*	4.1	*<0.5*	16	45	25	3.6	0.00	1.0	0.52	30	32	1.5	724	1.0	0.040	32	690	13	0.070	12	9.0	100	20	0.070	*<10*	*<10*	67	*<10*	62	176	102	2.2	97	*Non-reactive*
		Median	*<0.2*	1.0	90	0.010	*<10*	210	0.80	*<2*	1.7	*<0.5*	11	21	14	2.9	*<10*	*<1*	0.25	20	22	0.80	556	*<1*	0.020	16	420	9.0	0.020	5.0	6.0	55	*<20*	0.010	*<10*	*<10*	39	*<10*	47	36	43	0.63	40	153
		25th PCTL	*<0.2*	0.68	21	0.0020	*<10*	100	0.60	*<2*	0.34	*<0.5*	7.0	8.0	7.0	2.0	*<10*	*<1*	0.16	10	6.0	0.13	377	*<1*	0.010	4.0	215	6.0	0.00	*<2*	3.0	27	*<20*	*<0.01*	*<10*	*<10*	19	*<10*	30	7.8	8.5	0.31	7.7	25
		10th PCTL	*<0.2*	0.51	7.0	0.0010	*<10*	60	*<0.5*	*<2*	0.080	*<0.5*	2.0	3.0	3.0	1.2	*<10*	*<1*	0.10	10	2.0	0.040	217	*<1*	*<0.01*	1.0	100	4.0	*<0.01*	*<2*	1.0	15	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	16	2.3	2.0	0.31	1.2	6.7
		5th PCTL	*<0.2*	0.45	4.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.040	*<0.5*	1.0	2.0	2.0	0.86	*<10*	*<1*	0.080	10	1.0	0.020	113	*<1*	*<0.01*	*<1*	70	2.0	*<0.01*	*<2*	1.0	11	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	9.0	1.4	1.0	0.31	0.44	2.4
		Min	*<0.2*	0.050	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.30	*<10*	*<1*	0.010	*<10*	*<3*	*<0.01*	*<5*	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.35	0.25	0.31	-67	0.030

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.2: Static Test Results for Ore

Appendix C.2-1: Acid-Base Accounting Results for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide- S	T-AP	Total-C	TIC (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Oxide Facies for Gneiss Ore																											
ABA100	KAM137583	CFR0470	39.62	41.15	Ore	Oxide	Gneiss	MxM	7.1	7.2	0.02	0.01	*<0.01*	0.60	0.040	*<0.2*	3.1	*<4.5*	6.0	8.0	2.5	5.0	7.4	5.0	7.2	9.6	13
Supremo Oxide T1	72144	Head	composite	-	Ore	Oxide	Gneiss		7.4	7.3	0.02	-	*<0.01*	0.70	0.030	0.11	2.3	2.5	5.7	11	1.6	5.0	11	3.2	3.5	7.9	16
Supremo Oxide T4	72145	Head	composite	-	Ore	Oxide	Gneiss		7.4	7.4	0.02	-	*<0.01*	0.80	0.12	0.33	8.9	7.5	11	18	8.2	11	18	12	10	15	25
ABA394	KAM030261	CFR0110	81.08	82.6	Ore	Oxide	Gneiss	MxF	6.7	6.7	0.11	0.06	0.01	3.4	0.030	*<0.2*	2.3	*<4.5*	-	-	-1.1	-	-	0.68	1.3	-	-
ABA397	L861523	CFR0134	105.16	105.187	Ore	Oxide	Gneiss	FG	7.3	7.0	0.01	*<0.01*	0.01	0.30	0.040	*<0.2*	3.1	*<4.5*	-	-	2.8	-	-	9.9	14	-	-
Statistical Summary						**Oxide**	**Gneiss**	**n**	5	5	5.00	3.00	5.00	5	5	5	5	5	3	3	5	3	3	5	5	3	3
								Max	7.4	7.4	0.11	0.06	0.01	3.4	0.12	0.30	8.9	7.5	11	18	8.2	11	18	12	14	15	25
								90th PCTL	7.4	7.3	0.08	0.05	0.01	2.4	0.090	0.30	6.6	6.3	10	17	6.0	9.0	16	11	13	14	23
								75th PCTL	7.4	7.3	0.02	0.04	0.01	0.80	0.040	*<0.2*	3.1	*<4.5*	8.6	15	2.8	7.9	14	10	10	12	20
								Median	7.3	7.2	0.02	0.01	*<0.01*	0.70	0.040	*<0.2*	3.1	*<4.5*	6.0	11	2.5	5.4	11	5.0	7.2	10	16
								25th PCTL	7.1	7.0	0.02	*<0.01*	*<0.01*	0.60	0.030	*<0.2*	2.3	*<4.5*	5.8	9.7	1.6	5.2	9.0	3.2	3.5	8.8	14
								10th PCTL	6.9	6.8	0.01	*<0.01*	*<0.01*	0.40	0.030	0.10	2.3	3.3	5.8	8.7	0.00	5.1	8.0	1.7	2.2	8.3	13
								Min	6.7	6.7	0.01	*<0.01*	*<0.01*	0.30	0.030	0.10	2.3	2.5	5.7	8.0	-1.1	5.0	7.4	0.70	1.3	7.9	13
Upper and Lower Transition Facies for Gneiss Ore																											
Supremo 80%	72146	Head	composite	-	Ore	Transition	Gneiss		7.3	7.5	0.13	-	0.09	4.0	0.44	1.5	34	33	38	44	30	34	40	8.5	8.3	9.4	11
ABA375	R271389	CFD0417	109.3	109.775	Ore	Lower Transition	Gneiss	MxF	8.7	8.6	0.01	0.01	0.01	0.30	0.31	1.0	24	23	-	-	24	-	-	77	73	-	-
ABA002	KAM004886	CFD0034	73	74	Ore	Upper transition	Gneiss	FG	7.0	6.8	*<0.01*	0.01	0.02	*<0.3*	0.10	*<0.2*	7.8	*<4.5*	4.0	5.0	7.5	4.0	4.7	26	15	13	17
ABA359	R623803	CFD0548	174	174.935	Ore	Upper Transition	Gneiss	MxF	7.3	7.4	*<0.01*	0.01	0.02	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA403	R544048	CFD0553	120	121	Ore	Upper Transition	Gneiss	MxF	8.1	7.6	*<0.01*	*<0.01*	0.01	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
Statistical Summary						**Transition**	**Gneiss**	**n**	5	5	5	4	5	5	5	5	5	5	2	2	5	2	2	5	5	2	2
								Max	8.7	8.6	0.13	0.01	0.09	4.0	0.44	1.5	34	33	38	44	30	34	40	77	73	13	17
								90th PCTL	8.5	8.2	0.08	0.01	0.06	2.5	0.39	1.3	30	29	34	41	28	31	37	57	50	13	16
								75th PCTL	8.1	7.6	0.01	0.01	0.02	0.31	0.31	1.0	24	23	29	35	24	26	31	26	15	12	15
								Median	7.3	7.5	*<0.01*	0.01	0.02	*<0.3*	0.10	*<0.2*	7.8	*<4.5*	21	25	7.5	19	23	8.5	15	11	14
								25th PCTL	7.3	7.4	*<0.01*	0.01	0.01	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	12	15	2.0	11	14	7.8	15	10	12
								10th PCTL	7.1	7.0	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.9	*<4.5*	7.4	8.9	1.6	6.7	8.3	6.2	11	9.8	12
								Min	7.0	6.8	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	4.0	5.0	1.3	3.7	4.7	5.2	8.3	9.4	11
Statistical Summary for Gneiss Ore								**n**	10	10	10	7	10	10	10	10	10	10	5	5	10	5	5	10	10	5	5
								n < DL	-	-	3	2	3	3	0	6	0	6	0	0	0	0	0	0	0	0	0
								Max	8.7	8.6	0.13	0.06	0.09	4.0	0.44	1.5	34	33	38	44	30	34	40	77	73	15	25
								90th PCTL	8.2	7.7	0.11	0.03	0.03	3.5	0.32	1.1	25	24	27	34	24	24	31	31	21	14	21
								75th PCTL	7.4	7.5	0.02	0.01	0.02	0.74	0.11	0.30	8.6	6.8	11	18	8.0	11	18	11	15	13	17
								Median	7.3	7.3	0.02	0.01	0.01	0.47	0.040	*<0.2*	3.1	*<4.5*	6.0	11	2.6	5.4	11	8.1	12	9.6	16
								25th PCTL	7.2	7.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	5.7	8.0	1.7	5.0	7.4	5.0	7.5	9.4	13
								10th PCTL	7.0	6.8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.030	0.19	2.3	4.3	4.7	6.2	1.0	4.2	5.8	3.0	3.3	8.5	12
								Min	6.7	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	0.11	1.6	2.5	4.0	5.0	-1.1	3.7	4.7	0.68	1.3	7.9	11
Oxide Facies for Schist Ore																											
DD oxide	72141	Head	composite	-	-	Oxide	Gneiss/schist		7.5	7.5	0.13	-	0.09	3.9	0.96	3.5	74	78	76	77	70	72	73	19	20	19	20
ABA089	KAM133587	CFR0431	10.67	12.19	3	Oxide	Schist	BtS	7.8	7.5	0.01	*<0.01*	*<0.01*	0.30	0.090	0.30	7.0	6.8	10	13	6.7	10	13	22	22	32	42
Latte Oxide East	72136	Head	composite	-	-	Oxide	Schist		7.5	7.5	0.09	-	0.05	2.7	1.3	4.4	97	100	58	87	94	55	84	36	37	22	32
Latte Oxide West	72135	Head	composite	-	Ore	Oxide	Schist		7.4	7.5	0.20	-	0.13	6.2	1.9	6.6	144	149	100	124	137	94	118	23	24	16	20
ABA324	Q033726	CFD0411	36	37	Ore	Oxide	schist	BtS	8.1	7.8	0.42	0.05	0.25	13	0.84	2.6	65	59	-	-	52	-	-	5.0	4.5	-	-
ABA328	KAM001234	CFD0008	52	53	Ore	Oxide	schist	BtS	8.2	8.1	0.04	0.02	*<0.01*	1.3	1.2	3.7	90	84	-	-	89	-	-	72	67	-	-
Statistical Summary						**Oxide**	**Schist**	**n**	6	6	6	3	6	6	6	6	6	6	4	4	6	4	4	6	6	4	4
								Max	8.2	8.1	0.42	0.05	0.25	13	1.9	6.6	144	149	100	124	137	94	118	72	67	32	42
								90th PCTL	8.2	8.0	0.31	0.04	0.19	10	1.6	5.5	120	125	93	113	116	87	107	54	52	29	39
								75th PCTL	8.0	7.7	0.18	0.04	0.12	5.6	1.2	4.2	95	96	82	96	93	77	92	33	34	24	35
								Median	7.7	7.5	0.11	0.02	0.07	3.3	1.1	3.6	82	81	67	82	80	64	79	23	23	20	26
								25th PCTL	7.5	7.5	0.05	0.02	0.02	1.6	0.87	2.8	68	64	46	61	57	44	58	20	20	19	20
								10th PCTL	7.4	7.5	0.03	0.01	*<0.01*	0.78	0.47	1.5	36	33	24	32	29	23	31	12	12	17	20
								Min	7.4	7.5	0.01	*<0.01*	*<0.01*	0.31	0.090	0.30	7.0	6.8	10	13	7.0	9.7	13	5.0	4.5	16	20
Upper and Lower Transition Facies for Schist Ore																											
Latte 60%	72138	Head	composite	-	Ore	Transition	Schist		7.5	7.4	0.56	-	0.47	18	1.7	6.1	131	138	93	134	114	75	117	7.4	7.8	5.3	7.6
Latte 80%'	72137	Head	composite	-	Ore	Transition	Schist		7.4	7.5	0.52	-	0.41	16	2.0	6.9	153	157	107	123	137	91	107	9.4	9.7	6.6	7.6
ABA327	KAM001014	CFD0007	50.15	50.9	Ore	Lower Transition	schist	BtS	7.9	8.1	1.81	0.19	1.31	57	1.5	5.2	119	118	-	-	62	-	-	2.1	2.1	-	-
ABA314	KAM147294	CFD0346	107	107.5	Ore	Upper Transition	Schist	BtS_carb	-	7.9	0.61	0.02	0.44	19	2.7	8.4	207	191	-	-	188	-	-	11	10	-	-
ABA315	KAM147319	CFD0346	130.2	130.3	Ore	Upper Transition	Schist	BtS_carb	7.9	7.8	2.22	0.15	1.61	69	1.4	4.7	111	107	-	-	42	-	-	1.6	1.5	-	-
Statistical Summary						**Transition**	**Schist**	**n**	4	5	5	3	5	5	5	5	5	5	2	2	5	2	2	5	5	2	2
								Max	7.9	8.1	2.22	0.19	1.61	69	2.7	8.4	207	191	107	134	188	91	117	11	10	6.6	7.6
								90th PCTL	7.9	8.0	2.06	0.18	1.49	64	2.4	7.8	186	177	106	133	168	90	116	10	10	6.5	7.6
								75th PCTL	7.9	7.9	1.81	0.17	1.31	57	2.0	6.9	153	157	104	132	137	87	114	9.4	10	6.3	7.6
								Median	7.7	7.8	0.61	0.15	0.47	19	1.7	6.1	131	138	100	129	114	83	112	7.4	7.8	5.9	7.6
								25th PCTL	7.5	7.5	0.56	0.09	0.44	18	1.5	5.2	119	118	96	126	62	79	109	2.1	2.1	5.6	7.6
								10th PCTL	7.4	7.4	0.54	0.05	0.42	17	1.5	4.9	114	111	94	124	50	77	108	1.8	1.8	5.4	7.6
								Min	7.4	7.4	0.52	0.02	0.41	16	1.4	4.7	111	107	93	123	42	75	107	1.6	1.5	5.3	7.6
Statistical Summary for Schist Ore								**n**	10	11	11	6	11	11	11	11	11	11	6	6	11	6	6	11	11	6	6
								n < DL	-	-	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
								Max	8.2	8.1	2.22	0.19	1.61	69	2.7	8.4	207	191	107	134	188	94	118	72	67	32	42
								90th PCTL	8.1	8.1	1.81	0.17	1.31	57	2.0	6.9	153	157	104	129	137	92	117	36	37	27	37
								75th PCTL	7.9	7.9	0.59	0.13	0.46	18	1.8	6.3	137	144	98	124	125	87	114	23	23	21	29
								Median	7.7	7.5	0.42	0.04	0.25	13	1.4	4.7	111	107	84	105	89	74	95	11	10	18	20
								25th PCTL	7.5	7.5	0.11	0.02	0.07	3.3	1.1	3.6	82	81	63	79	57	60	76	6.2	6.2	9.0	11
								10th PCTL	7.4	7.5	0.04	0.02	*<0.01*	1.3	0.84	2.6	65	59	34	45	42	33	43	2.1	2.1	5.9	7.6
								Min	7.4	7.4	0.01	*<0.01*	*<0.01*	0.31	0.090	0.30	7.0	6.8	10	13	6.7	9.7	13	1.6	1.5	5.3	7.6

Appendix C.2-1: Acid-Base Accounting Results for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide- S	T-AP	Total-C	TIC (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Oxide Facies for Granite Ore																											
ABA156	R305806	CFD0382	59	60	Ore	Oxide	Granite	GG	6.2	5.7	0.01	0.02	*<0.01*	0.30	*<0.01*	*<0.2*	*<0.8*	*<4.5*	1.0	3.0	0.46	1.0	2.7	2.5	14	3.2	9.6
ABA171	R305823	CFD0396	13	14	Ore	Oxide	Granite	GG	6.7	6.5	0.01	*<0.01*	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	2.0	4.0	2.0	2.0	3.7	7.5	14	6.4	13
Kona Oxide	72139	Head	composite	-	Ore	Oxide	Granite		5.7	5.9	0.03	-	0.01	0.80	0.020	0.070	1.9	1.7	0.70	7.1	1.0	0.00	6.3	2.2	2.0	0.86	8.5
ABA419	I308596	CFD0053	7	8	Ore	Oxide	Granite	GG	5.8	6.1	0.01	0.01	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	1.0	-	2.0	1.0	-	7.5	14	3.2	-
ABA420	I354541	CFD0053	47	47.24	Ore	Oxide	Granite	GG	5.8	6.2	*<0.01*	0.01	*<0.01*	*<0.3*	0.080	*<0.2*	6.2	*<4.5*	5.0	-	5.9	5.0	-	21	15	17	-
ABA422	I354552	CFD0053	57.8	58	Ore	Oxide	Granite	GG	6.2	6.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	4.0	-	2.8	4.0	-	10	15	13	-
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	5	6	6	6	6	6	6	6	3	6	6	3	6	6	6	3
								Max	6.7	6.5	0.03	0.02	0.01	0.84	0.080	*<0.2*	6.2	*<4.5*	5.0	7.1	5.9	4.7	6.3	21	15	17	13
								90th PCTL	6.5	6.5	0.02	0.02	0.01	0.58	0.060	*<0.2*	4.7	*<4.5*	4.5	6.5	4.4	4.2	5.8	16	15	15	12
								75th PCTL	6.2	6.4	0.01	0.01	*<0.01*	0.31	0.040	*<0.2*	2.9	*<4.5*	3.5	5.6	2.6	3.2	5.0	9.6	15	12	11
								Median	6.0	6.2	0.01	0.01	*<0.01*	0.31	0.030	*<0.2*	2.3	*<4.5*	1.5	4.0	2.0	1.2	3.7	7.4	14	4.8	9.6
								25th PCTL	5.8	5.9	*<0.01*	0.01	*<0.01*	*<0.3*	0.030	*<0.2*	2.0	*<4.5*	1.0	3.5	1.3	0.70	3.2	3.7	14	3.2	9.0
								10th PCTL	5.7	5.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	0.14	1.3	3.1	0.90	3.2	0.70	0.30	2.9	2.3	8.2	2.0	8.7
								Min	5.7	5.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	0.070	*<0.8*	1.7	0.70	3.0	0.50	-0.10	2.7	2.2	2.0	0.90	8.5
Upper and Lower Transition Facies for Granite Ore																											
Kona 80% CN	72140	Head	composite	-	Ore	Transition	Granite		4.4	4.9	0.15	-	0.11	4.7	0.040	0.070	3.0	1.7	0.50	7.0	-1.7	-4.0	2.3	0.64	0.35	0.10	1.5
ABA161	R305812	CFD0383	84	85	Ore	Upper transition	Granite	GG	5.4	5.2	0.01	0.01	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	1.0	3.0	2.0	1.0	2.7	7.5	14	3.2	9.6
ABA428	Q041388	CFD0382	97	98	Ore	Lower Transition	Granite	GG	6.8	6.6	*<0.01*	0.02	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	3.0	-	1.3	3.0	-	5.2	15	10	-
ABA444	Q032413	CFD0385	83	83.75	Ore	Lower Transition	Granite	GG	5.4	5.1	0.02	0.01	*<0.01*	0.60	0.010	*<0.2*	0.80	*<4.5*	1.0	-	0.15	0.00	-	1.2	7.2	1.6	-
ABA445	Q032988	CFD0399	8.85	9	Ore	Lower Transition	Granite	GG	6.8	6.5	0.01	0.01	*<0.01*	0.30	0.040	*<0.2*	3.1	*<4.5*	2.0	-	2.8	2.0	-	9.9	14	6.4	-
ABA446	Q033347	CFD0403	32	33	Ore	Lower Transition	Granite	GG	5.7	5.0	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	-	-	2.8	0.00	-	10	15	-	-
ABA432	Q041581	CFD0383	83.47	84	Ore	Upper Transition	Granite	GG	5.3	5.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	2.0	-	3.6	2.0	-	13	15	6.7	-
ABA433	Q041589	CFD0383	91.9	92	Ore	Upper Transition	Granite	GG	6.8	6.6	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	2.0	-	1.3	2.0	-	5.2	15	6.7	-
Statistical Summary						**Transition**	**Granite**	**n**	8	8	8	7	8	8	8	8	8	8	7	2	8	8	2	8	8	7	2
								Max	6.8	6.6	0.15	0.02	0.11	4.7	0.050	*<0.2*	3.9	*<4.5*	3.0	7.0	3.6	2.7	2.7	13	15	10	9.6
								90th PCTL	6.8	6.6	0.06	0.01	0.04	1.9	0.043	*<0.2*	3.3	*<4.5*	2.4	6.6	3.0	2.0	2.6	11	15	8.0	8.8
								75th PCTL	6.8	6.5	0.01	0.01	*<0.01*	0.40	0.040	*<0.2*	3.1	*<4.5*	2.0	6.0	2.8	1.7	2.6	10	15	6.7	7.6
								Median	5.6	5.4	*<0.01*	0.01	*<0.01*	*<0.3*	0.035	*<0.2*	2.7	*<4.5*	2.0	5.0	1.6	1.2	2.5	6.3	15	6.4	5.5
								25th PCTL	5.4	5.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	1.0	4.0	1.0	0.20	2.4	4.2	13	2.4	3.5
								10th PCTL	5.0	5.0	*<0.01*	0.01	*<0.01*	*<0.3*	0.017	0.16	1.3	3.7	0.79	3.4	-0.40	-1.5	2.3	1.1	5.1	1.0	2.3
								Min	4.4	4.9	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	0.070	0.80	1.7	0.48	3.0	-1.7	-4.2	2.3	0.60	0.40	0.10	1.5
Statistical Summary for Granite Ore								**n**	14	14	14	12	14	14	14	14	14	14	13	5	14	14	5	14	14	13	5
								n < DL	-	-	6	1	10	6	1	12	1	12	0	0	0	0	0	0	0	0	0
								Max	6.8	6.6	0.15	0.02	0.11	4.7	0.080	0.20	6.2	4.5	5.0	7.1	5.9	4.7	6.3	21	15	17	13
								90th PCTL	6.8	6.6	0.02	0.02	0.01	0.80	0.047	0.20	3.6	4.5	3.8	7.1	3.3	3.4	5.3	12	15	13	12
								75th PCTL	6.6	6.5	0.01	0.01	0.01	0.30	0.040	*<0.2*	3.1	*<4.5*	2.0	7.0	2.8	1.7	3.7	10	15	6.7	9.6
								Median	5.8	6.0	0.01	0.01	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	2.0	4.0	2.0	1.2	2.7	7.4	14	6.4	9.6
								25th PCTL	5.5	5.3	*<0.01*	0.01	*<0.01*	*<0.3*	0.021	*<0.2*	1.6	*<4.5*	1.0	3.0	1.1	0.50	2.7	3.2	14	3.2	8.5
								10th PCTL	5.3	5.0	*<0.01*	0.01	*<0.01*	*<0.3*	0.013	0.10	1.0	2.5	0.80	3.0	0.20	-0.20	2.5	1.5	3.5	1.0	4.3
								Min	4.4	4.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	0.10	*<0.8*	1.7	0.50	3.0	-1.7	-4.2	2.3	0.60	0.40	0.10	1.5
Oxide and Transition Facies for Other Lithologies Ore																											
ABA126	KAM149885	CFR0566	67.06	68.58	Ore	Oxide	Dykes	IV	7.1	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.090	0.20	7.0	4.5	21	24	6.7	21	24	23	15	70	80
ABA334	R550421	CFD0518	10	11	Ore	Upper Transition	HU	HU	-	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	-	-	3.6	-	-	13	15	-	-
ABA175	R305827	CFD0403	70	71	Ore	Lower transition	Dykes	DIOR	4.5	4.4	0.52	0.02	0.34	16	0.030	*<0.2*	2.3	*<4.5*	0.00	2.0	-14	-16	-14	0.14	0.28	0.00	-

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in the statistical summary
n < DL = number of samples with values below the analytical detection limit
Sulphate Sulphur determined by 25% HCL with Gravimetric Finish.
Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP-MS Finish.
T-AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material, derived from Total S * 31.25.
NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material.
Carbonate NP (CaNP) is calculated from total inorganic carbon (TIC); T-C NP* calculated from Total-C * 77.6.
Net NP (NNP) = NP - AP; Neutralization potential ratio (NPR).

Appendix C.2-2: Shake Flask Extraction Results for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Gneiss Ore																																																	
Supremo Oxide T1	72144	Head	composite		Ore	Oxide	Gneiss		7.9	-	-	-	-	-	-	2.0	0.049	0.0069	0.096	0.034	*<0.000007*	*<0.000007*	0.0077	0.0000030	4.9	0.000070	0.00022	0.0015	0.014	0.000040	0.0016	1.3	0.0047	0.00012	0.0083	0.00020	0.033	2.1	0.00011	2.1	0.0000030	3.9	0.026	0.000081	0.000070	0.00027	0.0022	0.00020	*<0.001*
Supremo Oxide T4	72145	Head	composite		Ore	Oxide	Gneiss		7.8	-	-	-	-	-	-	2.0	0.034	0.0052	0.13	0.058	*<0.000007*	*<0.000007*	0.0096	*<0.000003*	9.5	*<0.00003*	0.00022	0.0011	*<0.007*	*<0.00001*	0.0035	2.5	0.0090	0.00044	0.0051	0.00040	0.022	2.8	0.000040	2.1	0.0000030	3.1	0.042	0.00022	0.000040	0.00010	0.0072	0.00015	*<0.001*
Transition Facies for Gneiss Ore																																																
Supremo 80%	72146	Head	composite		Ore	Transition	Gneiss		7.8	-	-	-	-	-	-	45	0.027	0.0083	0.18	0.011	*<0.000007*	*<0.000007*	0.0076	*<0.000003*	20	*<0.00003*	0.00035	0.00040	*<0.007*	*<0.00001*	0.0016	5.5	0.016	0.000040	0.0066	0.00070	0.010	3.4	0.00037	1.6	*<0.000002*	2.8	0.076	0.00022	0.000020	0.000080	0.0089	0.00012	*<0.001*
ABA359	R623803	CFD0548	174	174.935	Ore	Upper Transition	Gneiss	MxF	8.1	5.9	*<0.050*	*<0.50*	0.13	0.0062	0.021	7.9	0.086	0.049	0.54	0.075	*<0.00050*	*<0.00050*	0.016	*<0.000050*	2.2	*<0.00050*	*<0.00010*	*<0.0010*	*<0.030*	*<0.00010*	*<0.0050*	0.57	*<0.00050*	0.00046	0.0014	*<0.00050*	*<0.30*	3.8	*<0.00050*	4.2	*<0.000050*	0.67	0.012	0.00028	*<0.00050*	*<0.010*	0.000060	*<0.0010*	*<0.010*
ABA403	R544048	CFD0553	120	121	Ore	Upper Transition	Gneiss	MxF	7.5	4.8	*<0.050*	*<0.50*	0.13	0.0073	0.0035	0.80	0.37	0.042	0.14	0.0082	*<0.00050*	*<0.00050*	0.014	*<0.000050*	0.44	*<0.00050*	*<0.00010*	*<0.0010*	0.16	0.00064	*<0.0050*	0.26	0.025	0.00051	0.020	*<0.00050*	*<0.30*	2.6	*<0.00050*	2.8	*<0.000050*	0.38	0.0025	*<0.00010*	*<0.00050*	*<0.010*	0.00096	*<0.0010*	*<0.010*
Oxide Facies for Schist Ore																																																
DD oxide	72141	Head	composite		Ore	Oxide	Gneiss/schist		7.8	-	-	-	-	-	-	10	0.026	0.0046	0.13	0.016	*<0.000007*	*<0.000007*	0.0081	0.0000050	10	*<0.00003*	0.00014	0.00041	*<0.007*	*<0.00001*	0.0011	4.2	0.0025	*<0.00001*	0.0045	0.00050	0.0030	2.7	0.00030	1.9	0.0000020	3.3	0.045	0.000046	0.000050	*<0.00005*	0.0011	0.00019	*<0.001*
Latte Oxide East	72136	Head	composite		Ore	Oxide	Schist		8.0	-	-	-	-	-	-	43	0.023	0.0048	0.12	0.044	*<0.000007*	*<0.000007*	0.0087	0.0000030	16	*<0.00003*	0.00016	0.0010	*<0.007*	*<0.00001*	0.0015	5.8	0.0042	*<0.00001*	0.0027	0.0018	0.010	2.9	0.00043	2.0	*<0.000002*	6.3	0.11	0.00011	0.000070	0.000060	0.00094	0.00013	*<0.001*
Latte Oxide West	72135	Head	composite		Ore	Oxide	Schist		7.8	-	-	-	-	-	-	225	0.0093	0.0037	0.086	0.017	*<0.000007*	*<0.000007*	0.0082	*<0.000003*	66	*<0.00003*	0.00035	0.0014	*<0.007*	*<0.00001*	0.0021	18	0.025	0.000020	0.0014	0.0055	*<0.003*	4.0	0.00094	1.6	0.0000020	7.6	0.33	0.00023	0.00011	*<0.00005*	0.0015	0.000050	*<0.001*
Transition Facies for Schist Ore																																																
Latte 60%	72138	Head	composite		Ore	Transition	Schist		7.8	-	-	-	-	-	-	328	0.012	0.014	0.074	0.015	*<0.000007*	*<0.000007*	0.0074	*<0.000003*	106	*<0.00003*	0.00059	0.0015	*<0.007*	*<0.00001*	0.0022	21	0.057	*<0.00001*	0.0017	0.0033	*<0.003*	4.6	0.0010	1.5	0.0000060	5.2	0.46	0.00024	0.000070	*<0.00005*	0.0027	0.00015	*<0.001*
Latte 80%'	72137	Head	composite		Ore	Transition	Schist		7.7	-	-	-	-	-	-	208	0.022	0.011	0.15	0.018	*<0.000007*	*<0.000007*	0.0075	*<0.000003*	68	*<0.00003*	0.00046	0.0013	*<0.007*	*<0.00001*	0.0015	14	0.047	*<0.00001*	0.0011	0.0047	*<0.003*	3.6	0.0011	1.3	0.0000040	2.5	0.28	0.00033	0.000090	*<0.00005*	0.0020	0.00016	*<0.001*
Oxide Facies for Granite Ore																																																
ABA156	R305806	CFD0382	59	60	Ore	Oxide	Granite	GG	6.2	-	-	-	-	-	-	9.6	3.2	0.045	1.00	0.0079	*<0.0005*	*<0.0005*	0.18	*<0.00005*	0.42	*<0.0005*	0.00024	*<0.001*	0.92	0.00052	0.0058	0.16	0.0031	0.00010	0.00058	*<0.0005*	*<0.3*	7	*<0.0005*	29	*<0.00005*	1.0	0.0038	0.00065	*<0.0005*	*<0.01*	0.0011	*<0.001*	*<0.01*
ABA171	R305823	CFD0396	13	14	Ore	Oxide	Granite	GG	7.4	-	-	-	-	-	-	1.7	18	0.17	1.8	0.077	0.00088	*<0.0005*	0.12	0.000085	0.75	0.00069	0.0017	0.0058	25	0.029	*<0.005*	0.37	0.48	0.0063	0.0084	0.0020	*<0.3*	7	*<0.0005*	34	0.00012	4.6	0.012	0.0023	0.00057	0.055	0.033	0.0041	0.042
Kona Oxide	72139	Head	composite		Ore	Oxide	Granite	-	6.1	-	-	-	-	-	-	3.0	0.092	0.020	0.51	0.00042	0.0000090	*<0.000007*	0.0099	0.0000060	0.060	*<0.00003*	0.000096	0.0042	0.019	0.00013	0.00056	0.026	0.0028	0.000030	0.00049	0.00030	0.022	0.6	0.000080	1.7	0.0000030	3.3	0.00071	0.000051	0.00010	0.00024	0.00025	0.00023	0.0040
Transition Facies for Granite Ore																																																
Kona 80% CN	72140	Head	composite			Transition	Granite		5.7	-	-	-	-	-	-	40	0.074	0.0062	1.5	0.00037	0.00027	*<0.000007*	0.014	0.000053	6.8	*<0.00003*	0.034	0.017	0.94	0.00014	0.0029	1.9	0.87	*<0.00001*	0.000080	0.0089	*<0.003*	3.2	0.00043	1.1	*<0.000002*	2.9	0.025	0.00086	0.000030	*<0.00005*	0.0026	0.000040	0.033
ABA161	R305812	CFD0383	84	85	40	Upper transition	Granite	GG	5.6	-	-	-	-	-	-	14	0.0051	0.0040	0.13	*<0.001*	*<0.0005*	*<0.0005*	0.13	*<0.00005*	0.31	*<0.0005*	0.00083	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.078	0.0037	*<0.00005*	*<0.0001*	*<0.0005*	*<0.3*	10	*<0.0005*	16	*<0.00005*	2.6	0.0016	0.00095	*<0.0005*	*<0.01*	0.00047	*<0.001*	*<0.01*
ABA444	Q032413	CFD0385	83	83.75	80	Lower Transition	Granite	GG	5.6	*<2*	*<0.050*	*<0.50*	0.031	0.018	*<0.0010*	2.8	1.4	0.023	0.22	0.0030	*<0.0005*	*<0.0005*	0.028	*<0.000050*	*<0.10*	*<0.00050*	0.00016	*<0.0010*	0.12	0.00058	*<0.0050*	*<0.050*	0.0072	0.000073	0.00053	*<0.00050*	*<0.30*	2.1	*<0.00050*	5.0	*<0.000050*	0.68	0.00081	0.00038	*<0.00050*	*<0.010*	0.00025	*<0.0010*	*<0.010*
Oxide and Transition Facies for Other Lithologies Ore																																																
ABA126	KAM149885	CFR0566	67.06	68.58	Ore	Oxide	Dykes	IV	8.2	-	-	-	-	-	-	12	*<0.005*	0.088	0.073	0.12	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	23	0.038	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	0.0067	9.9	0.0017	0.010	0.0067	0.0073	*<0.3*	5	*<0.0005*	11	*<0.00005*	0.68	0.17	0.00056	*<0.0005*	*<0.01*	0.00094	*<0.001*	*<0.01*
ABA175	R305827	CFD0403	70	71	Ore	Lower transition	Dykes	DIOR	4.2	-	-	-	-	-	-	138	2.3	0.054	25	0.072	*<0.0025*	*<0.0025*	0.18	*<0.00025*	5.7	*<0.0025*	0.52	*<0.005*	15	*<0.0005*	*<0.025*	2.1	0.11	*<0.00005*	*<0.0005*	0.083	*<0.3*	55	*<0.0025*	22	*<0.00025*	2.0	0.071	0.019	*<0.0025*	*<0.01*	0.0035	*<0.005*	*<0.05*

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in the statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.2-3: Solid Phase Element Results by Aqua Regia Digestion for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Oxide Facies for Gneiss Ore																															
ABA100	KAM137583	CFR0470	39.62	41.15	Ore	Oxide	Gneiss	MxM	0.24	1.1	940	0.40	*<10*	590	1.2	0.91	0.17	0.040	134	6.2	12	1.7	21	2.3	4.5	0.12	0.28	0.48	0.031	0.46	77
Supremo Oxide T1	72144	Head	composite		Ore	Oxide	Gneiss		0.12	0.39	789	-	*<10*	223	1.0	0.28	0.21	0.070	53	6.5	79	1.8	5.6	1.6	1.2	*<0.1*	0.17	0.55	*<0.02*	0.19	32
Supremo Oxide T4	72145	Head	composite		Ore	Oxide	Gneiss		0.10	0.47	1090	-	*<10*	173	0.90	0.14	0.43	0.050	54	4.7	88	2.1	2.5	1.5	1.4	*<0.1*	0.16	1.4	*<0.02*	0.20	33
ABA394	KAM030261	CFR0110	81.08	82.6	Ore	Oxide	Gneiss	MxF	0.22	0.49	1095	4.9	10	240	0.74	0.23	0.090	0.10	69	3.1	6.0	1.5	58	1.9	1.7	0.10	0.11	1.8	0.011	0.29	39
ABA397	L861523	CFR0134	105.16	105.187	Ore	Oxide	Gneiss	FG	0.14	0.29	238	0.90	10	480	0.53	0.17	0.030	0.060	38	1.1	7.0	0.83	2.7	0.90	0.87	0.070	0.10	0.35	*<0.005*	0.18	21
Statistical Summary						**Oxide**	**Gneiss**	**n**	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	0.20	1.1	1095	4.9	10	590	1.2	0.90	0.40	0.10	134	6.5	88	2.1	58	2.3	4.5	0.10	0.30	1.8	0.00	0.50	77
								90th PCTL	0.20	0.90	1093	4.1	10	546	1.1	0.70	0.30	0.10	108	6.4	84	2.0	43	2.1	3.4	0.10	0.20	1.6	0.00	0.40	62
								75th PCTL	0.20	0.50	1090	2.9	10	480	1.0	0.30	0.20	0.10	69	6.2	79	1.8	21	1.9	1.7	0.10	0.20	1.4	0.00	0.30	39
								Median	0.10	0.50	940	0.90	*<10*	240	0.90	0.20	0.20	0.10	54	4.7	12	1.7	5.6	1.6	1.4	0.10	0.20	0.60	*<0.02*	0.20	33
								25th PCTL	0.10	0.40	789	0.70	*<10*	223	0.70	0.20	0.10	0.10	53	3.1	7.0	1.5	2.7	1.5	1.2	*<0.1*	0.10	0.50	*<0.02*	0.20	32
								10th PCTL	0.10	0.30	458	0.50	*<10*	193	0.60	0.20	0.10	0.00	44	1.9	6.4	1.1	2.6	1.1	1.0	*<0.1*	0.10	0.40	*<0.02*	0.20	25
								Min	0.10	0.30	238	0.40	*<10*	173	0.50	0.10	0.00	0.00	38	1.1	6.0	0.80	2.5	0.90	0.90	*<0.1*	0.10	0.40	*<0.02*	0.20	21
Transition Facies for Gneiss Ore																															
Supremo 80%	72146	Head	composite		Ore	Transition	Gneiss		0.16	0.56	1700	-	*<10*	191	0.90	0.30	1.1	0.040	57	6.6	107	2.4	3.5	1.8	1.9	*<0.1*	0.17	1.2	*<0.02*	0.26	34
ABA002	KAM004886	CFD0034	73	74	Ore	Upper transition	Gneiss	FG	0.050	1.1	882	0.50	10	290	0.81	0.16	0.080	0.030	55	1.1	6.0	0.54	1.8	1.1	2.8	0.060	0.16	1.4	0.014	0.18	33
ABA375	R271389	CFD0417	109.3	109.775	Ore	Lower Transition	Gneiss	MxF	0.070	0.50	1185	0.90	10	80	0.97	0.060	0.87	0.030	78	2.2	5.0	1.6	2.5	1.6	1.9	0.10	0.25	0.61	0.011	0.24	47
ABA359	R623803	CFD0548	174	174.935	Ore	Upper Transition	Gneiss	MxF	0.10	0.37	1570	1.6	10	320	1.3	0.29	0.13	0.020	42	2.1	6.0	2.8	15	1.9	1.0	*<0.05*	0.18	0.73	*<0.005*	0.17	23
ABA403	R544048	CFD0553	120	121	Ore	Upper Transition	Gneiss	MxF	0.30	0.36	333	8.9	10	430	0.56	0.29	0.040	0.050	47	2.7	6.0	1.4	7.2	0.88	1.1	0.070	0.11	0.27	*<0.005*	0.21	28
Statistical Summary						**Transition**	**Gneiss**	**n**	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	0.30	1.1	1700	8.9	10	430	1.3	0.30	1.1	0.10	78	6.6	107	2.8	15	1.9	2.8	0.10	0.30	1.4	*<0.02*	0.30	47
								90th PCTL	0.20	0.90	1648	6.7	10	386	1.2	0.30	1.0	0.00	70	5.0	67	2.6	12	1.9	2.4	*<0.1*	0.20	1.3	*<0.02*	0.30	42
								75th PCTL	0.20	0.60	1570	3.4	10	320	1.0	0.30	0.90	0.00	57	2.7	6.0	2.4	7.2	1.8	1.9	*<0.1*	0.20	1.2	0.010	0.20	34
								Median	0.10	0.50	1185	1.3	10	290	0.90	0.30	0.10	0.00	55	2.2	6.0	1.6	3.5	1.6	1.9	0.070	0.20	0.70	0.011	0.20	33
								25th PCTL	0.10	0.40	882	0.80	10	191	0.80	0.20	0.10	0.00	47	2.1	6.0	1.4	2.5	1.1	1.1	0.060	0.20	0.60	*<0.005*	0.20	28
								10th PCTL	0.10	0.40	553	0.60	*<10*	124	0.70	0.10	0.10	0.00	44	1.5	5.4	0.90	2.1	1.0	1.0	*<0.05*	0.10	0.40	*<0.005*	0.20	25
								Min	0.10	0.40	333	0.50	*<10*	80	0.60	0.10	0.00	0.00	42	1.1	5.0	0.50	1.8	0.90	1.0	*<0.05*	0.10	0.30	*<0.005*	0.20	23
Statistical Summary for Gneiss Ore								**n**	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	10	10
								n < DL	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0	6	0	0
								Max	0.30	1.1	1700	8.9	10	590	1.3	0.91	1.1	0.10	134	6.6	107	2.8	58	2.3	4.5	0.12	0.28	1.8	0.031	0.46	77
								90th PCTL	0.25	1.1	1583	6.5	10	491	1.2	0.36	0.90	0.073	84	6.5	90	2.4	24	1.9	2.9	0.10	0.25	1.4	0.022	0.31	50
								75th PCTL	0.21	0.55	1163	3.3	10	403	0.99	0.29	0.38	0.058	66	5.8	62	2.0	13	1.8	1.9	0.10	0.18	1.3	*<0.02*	0.26	38
								Median	0.13	0.48	1015	0.90	10	265	0.90	0.26	0.15	0.045	55	2.9	6.5	1.7	4.6	1.6	1.6	*<0.1*	0.17	0.67	0.014	0.21	33
								25th PCTL	0.10	0.38	812	0.70	*<10*	199	0.76	0.16	0.083	0.033	49	2.1	6.0	1.4	2.6	1.2	1.1	0.070	0.12	0.50	0.011	0.18	29
								10th PCTL	0.068	0.35	324	0.46	*<10*	164	0.56	0.13	0.039	0.029	41	1.1	5.9	0.80	2.4	0.90	1.00	0.059	0.11	0.34	*<0.005*	0.18	23
								Min	0.050	0.29	238	0.40	*<10*	80	0.53	0.060	0.030	0.020	38	1.1	5.0	0.54	1.8	0.88	0.87	0.050	0.10	0.27	*<0.005*	0.17	21
Oxide Facies for Schist Ore																															
ABA089	KAM133587	CFR0431	10.67	12.19	Ore	Oxide	Schist	BtS	0.080	0.83	1470	0.30	*<10*	450	0.93	1.3	0.42	0.060	66	16	25	1.6	14	3.4	2.6	0.080	0.060	0.41	0.018	0.25	32
DD oxide	72141	Head	composite		Ore	Oxide	Gneiss/schist		0.18	0.60	1430	-	*<10*	322	1.1	0.77	2.4	0.10	47	12	85	2.8	12	2.7	1.8	*<0.1*	0.11	0.45	0.030	0.24	26
Latte Oxide East	72136	Head	composite		Ore	Oxide	Schist		0.22	0.47	1100	-	*<10*	438	1.0	0.44	3.2	0.11	54	9.4	79	2.4	19	2.6	1.7	*<0.1*	0.13	0.49	0.020	0.23	30
Latte Oxide West	72135	Head	composite		Ore	Oxide	Schist		0.28	0.40	1430	-	*<10*	658	1.1	0.59	4.6	0.090	49	12	93	1.8	20	2.8	1.3	*<0.1*	0.12	0.46	0.020	0.19	27
ABA324	Q033726	CFD0411	36	37	Ore	Oxide	schist	BtS	0.27	0.90	5910	2.1	10	440	1.2	0.26	2.2	0.040	89	16	19	5.1	15	4.1	3.5	0.11	0.030	1.6	0.035	0.52	47
ABA328	KAM001234	CFD0008	52	53	Ore	Oxide	schist	BtS	0.59	0.38	2920	2.6	10	1270	0.67	0.23	3.2	0.080	67	15	14	1.9	14	3.3	1.2	0.080	0.080	0.45	0.021	0.24	34
Statistical Summary						**Oxide**	**Schist**	**n**	6	6	6	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	0.60	0.90	5910	2.6	10	1270	1.2	1.3	4.6	0.11	89	16	93	5.1	20	4.1	3.5	0.11	0.13	1.6	0.035	0.52	47
								90th PCTL	0.40	0.87	4415	2.5	10	964	1.2	1.1	3.9	0.11	78	16	89	3.9	20	3.7	3.1	0.11	0.13	1.1	0.033	0.39	41
								75th PCTL	0.30	0.77	2558	2.4	10	606	1.1	0.73	3.2	0.098	66	15	84	2.7	18	3.4	2.4	*<0.1*	0.12	0.48	0.028	0.25	34
								Median	0.20	0.54	1450	2.1	*<10*	445	1.1	0.52	2.8	0.085	60	14	52	2.1	14	3.0	1.8	*<0.1*	0.095	0.46	0.021	0.24	31
								25th PCTL	0.20	0.42	1430	1.2	*<10*	439	0.95	0.31	2.2	0.065	51	12	21	1.8	14	2.7	1.4	*<0.1*	0.065	0.45	0.020	0.23	28
								10th PCTL	0.10	0.39	1265	0.66	*<10*	380	0.80	0.25	1.3	0.050	48	11	17	1.7	13	2.7	1.2	0.080	0.045	0.43	0.019	0.21	27
								Min	0.10	0.38	1100	0.30	*<10*	322	0.67	0.23	0.42	0.040	47	9.4	14	1.6	12	2.6	1.2	0.080	0.030	0.41	0.018	0.19	26
Transition Facies for Schist Ore																															
Latte 60%	72138	Head	composite		Ore	Transition	Schist		0.19	0.75	1090	-	*<10*	272	0.90	0.37	3.8	0.090	54	11	75	3.0	16	2.7	2.7	*<0.1*	0.12	0.33	0.020	0.30	30
Latte 80%'	72137	Head	composite		Ore	Transition	Schist		0.39	0.55	1340	-	*<10*	353	0.80	0.58	4.3	0.090	49	12	90	2.1	26	2.6	1.7	*<0.1*	0.090	0.60	0.020	0.24	27
ABA327	KAM001014	CFD0007	50.15	50.9	Ore	Lower Transition	schist	BtS	0.25	0.60	3150	1.0	10	140	0.46	0.16	3.0	0.070	42	12	12	0.77	13	2.9	1.7	0.060	0.030	0.20	0.017	0.41	21
ABA314	KAM147294	CFD0346	107	107.5	Ore	Upper Transition	Schist	BtS_carb	0.13	0.67	712	0.30	*<10*	30	1.2	0.74	4.9	0.080	30	14	30	1.0	21	2.7	2.5	0.050	0.11	0.17	0.032	0.16	15
ABA315	KAM147319	CFD0346	130.2	130.3	Ore	Upper Transition	Schist	BtS_carb	0.64	0.43	5130	4.0	10	50	0.84	0.24	2.8	0.070	54	8.8	7.0	3.9	10	2.6	1.4	0.070	0.26	0.50	0.027	0.23	27
Statistical Summary						**Transition**	**Schist**	**n**	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	0.60	0.75	5130	4.0	10	353	1.2	0.74	4.9	0.090	54	14	90	3.9	26	2.9	2.7	*<0.1*	0.26	0.60	0.032	0.41	30
								90th PCTL	0.50	0.72	4338	3.4	10	321	1.1	0.68	4.7	0.090	54	13	84	3.5	24	2.8	2.6	*<0.1*	0.20	0.56	0.030	0.37	29
								75th PCTL	0.40	0.67	3150	2.5	*<10*	272	0.90	0.58	4.3	0.090	54	12	75	3.0	21	2.7	2.5	*<0.1*	0.12	0.50	0.027	0.30	27
								Median	0.30	0.60	1340	1.0	*<10*	140	0.84	0.37	3.8	0.080	49	12	30	2.1	16	2.7	1.7	0.070	0.11	0.33	0.020	0.24	27
								25th PCTL	0.20	0.55	1090	0.65	*<10*	50	0.80	0.24	3.0	0.070	42	11	12	1.0	13	2.6	1.7	0.060	0.090	0.20	0.020	0.23	21
								10th PCTL	0.20	0.48	863	0.44	*<10*	38	0.60	0.19	2.9	0.070	35	9.5	9.0	0.88	11	2.6	1.5	0.054	0.054	0.18	0.018	0.19	17
								Min	0.10	0.43	712	0.30	*<10*	30	0.46	0.16	2.8	0.070	30	8.8	7.0	0.77	10	2.6	1.4	0.050	0.030	0.17	0.017	0.16	15
Statistical Summary for Schist Ore								**n**	11	11	11	6	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
								n < DL	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
								Max	0.64	0.90	5910	4.0	10	1270	1.2	1.3	4.9	0.11	89	16	93	5.1	26	4.1	3.5	0.11	0.26	1.6	0.035	0.52	47
								90th PCTL	0.59	0.83	5130	3.3	10	658	1.2	0.77	4.6	0.10	67	16	90	3.9	21	3.4	2.7	*<0.1*	0.13	0.60	0.032	0.41	34
								75th PCTL	0.34	0.71	3035	2.5	10	445	1.1	0.67	4.0	0.090	60	14	82	2.9	20	3.1	2.6	*<0.1*	0.12	0.50	0.029	0.28	31
								Median	0.25	0.60	1430	1.6	*<10*	353	0.93	0.44	3.2	0.080	54	12	30	2.1	15	2.7	1.7	*<0.1*	0.11	0.45	0.020	0.24	27
								25th PCTL	0.19	0.45	1220	0.48	*<10*	206	0.82	0.25	2.6	0.070	48	11	17	1.7	14	2.6	1.5	0.075	0.070	0.37	0.020	0.23	27
								10th PCTL	0.13	0.40	1090	0.30	*<10*	50	0.67	0.23	2.2	0.060	42	9.4	12	1.0	12	2.6	1.3	0.060	0.030	0.20	0.018	0.19	21
								Min	0.080	0.38	712	0.30	*<10*	30	0.46	0.16	0.42	0.040	30	8.8	7.0	0.77	10	2.6	1.2	0.050	0.030	0.17	0.017	0.16	15

Appendix C.2-3: Solid Phase Element Results by Aqua Regia Digestion for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Oxide Facies for Granite Ore																															
ABA156	R305806	CFD0382	59	60	Ore	Oxide	Granite	GG	0.12	0.46	3330	1.3	*<10*	40	0.24	0.16	0.050	0.020	31	0.50	5.0	1.2	1.8	0.82	1.3	0.10	0.22	0.34	0.010	0.19	18
ABA171	R305823	CFD0396	13	14	Ore	Oxide	Granite	GG	0.10	0.49	803	0.70	*<10*	90	0.51	0.19	0.060	0.060	38	1.1	4.0	1.3	2.6	1.3	1.4	0.10	0.24	8.5	0.0090	0.14	20
Kona Oxide	72139	Head	composite		Ore	Oxide	Granite		0.080	0.41	3080	-	*<10*	64	0.50	0.080	0.050	0.060	26	1.2	77	1.5	0.80	1.3	1.4	*<0.1*	0.32	0.83	*<0.02*	0.13	15
ABA419	I308596	CFD0053	7	8	Ore	Oxide	Granite	GG	0.12	0.44	7940	4.8	10	30	0.29	0.090	0.030	0.010	29	0.20	3.0	1.4	1.0	1.1	1.2	0.070	0.21	0.17	*<0.005*	0.23	17
ABA420	I354541	CFD0053	47	47.24	Ore	Oxide	Granite	GG	0.090	0.54	1070	0.90	10	70	0.71	0.090	0.060	0.090	41	6.8	2.0	1.1	2.1	1.6	1.5	0.080	0.17	1.1	0.0070	0.17	23
ABA422	I354552	CFD0053	57.8	58	Ore	Oxide	Granite	GG	0.080	0.54	714	0.90	10	80	0.67	0.070	0.070	0.040	33	5.5	2.0	1.5	1.8	1.0	1.6	0.080	0.15	1.4	0.0050	0.18	18
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	0.10	0.50	7940	4.8	*<10*	90	0.70	0.20	0.10	0.10	41	6.8	77	1.5	2.6	1.6	1.6	0.10	0.30	8.5	*<0.02*	0.20	23
								90th PCTL	0.10	0.50	5635	3.4	*<10*	85	0.70	0.20	0.10	0.10	40	6.2	41	1.5	2.4	1.5	1.6	0.10	0.30	5.0	*<0.02*	0.20	22
								75th PCTL	0.10	0.50	3268	1.3	*<10*	78	0.60	0.10	0.10	0.10	37	4.4	4.8	1.5	2.0	1.3	1.5	*<0.1*	0.20	1.3	0.010	0.20	20
								Median	0.10	0.50	2075	0.90	*<10*	67	0.50	0.10	0.10	0.10	32	1.2	3.5	1.4	1.8	1.2	1.4	0.090	0.20	1.0	0.010	0.20	18
								25th PCTL	0.10	0.40	870	0.90	*<10*	46	0.30	0.10	0.10	0.00	30	0.70	2.3	1.2	1.2	1.0	1.3	0.080	0.20	0.50	0.010	0.10	17
								10th PCTL	0.10	0.40	759	0.80	*<10*	35	0.30	0.10	0.00	0.00	28	0.40	2.0	1.1	0.90	0.90	1.2	0.080	0.20	0.30	*<0.005*	0.10	16
								Min	0.10	0.40	714	0.70	*<10*	30	0.20	0.10	0.00	0.00	26	0.20	2.0	1.1	0.80	0.80	1.2	0.070	0.20	0.20	*<0.005*	0.10	15
Transition Facies for Granite Ore																															
Kona 80% CN	72140	Head	composite		Ore	Transition	Granite		0.090	0.34	5770	-	*<10*	44	0.40	0.10	0.050	0.040	24	1.9	76	1.4	3.8	1.5	1.2	*<0.1*	0.27	4.0	*<0.02*	0.12	14
ABA161	R305812	CFD0383	84	85	Ore	Upper transition	Granite	GG	0.060	0.57	2040	4.8	*<10*	20	0.50	0.050	0.020	0.15	31	1.2	4.0	1.4	3.5	3.9	1.4	0.11	0.18	0.29	0.0080	0.22	17
ABA432	Q041581	CFD0383	83.47	84	Ore	Upper Transition	Granite	GG	0.080	0.87	5690	4.6	*<10*	50	0.63	0.060	0.020	0.31	31	2.0	5.0	2.4	5.1	5.9	2.6	0.090	0.21	1.6	0.020	0.30	16
ABA428	Q041388	CFD0382	97	98	Ore	Lower Transition	Granite	GG	0.030	0.94	603	0.50	10	90	0.45	0.080	0.040	0.020	38	0.30	3.0	0.78	0.70	0.62	2.4	0.070	0.21	0.28	0.011	0.13	20
ABA444	Q032413	CFD0385	83	83.75	Ore	Lower Transition	Granite	GG	0.060	0.46	2350	1.8	10	70	0.37	0.040	0.030	0.010	49	0.80	5.0	1.7	1.5	1.0	1.5	0.090	0.19	0.42	0.0070	0.18	28
ABA445	Q032988	CFD0399	8.85	9	Ore	Lower Transition	Granite	GG	0.10	0.87	740	0.80	*<10*	90	0.76	0.090	0.040	0.050	34	1.1	7.0	0.67	3.6	1.4	2.5	0.080	0.29	0.16	0.012	0.15	19
ABA446	Q033347	CFD0403	32	33	Ore	Lower Transition	Granite	GG	0.090	0.67	*>10000*	3.5	10	40	0.20	0.080	0.010	0.020	43	11	6.0	1.3	17	1.1	2.9	0.080	0.31	0.91	0.013	0.18	25
ABA433	Q041589	CFD0383	91.9	92	Ore	Upper Transition	Granite	GG	0.040	0.93	1470	0.90	10	80	1.0	0.050	0.050	0.030	49	1.3	3.0	1.4	2.9	2.4	2.6	0.090	0.18	0.32	0.011	0.19	27
Statistical Summary						**Transition**	**Granite**	**n**	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
								Max	0.10	0.94	10000	4.8	10	90	1.0	0.10	0.050	0.31	49	11	76	2.4	17	5.9	2.9	0.11	0.31	4.0	0.020	0.30	28
								90th PCTL	0.10	0.93	7039	4.7	10	90	0.83	0.093	0.050	0.20	49	4.6	28	1.9	8.7	4.5	2.7	0.10	0.30	2.3	*<0.02*	0.24	27
								75th PCTL	0.10	0.89	5710	4.1	10	83	0.66	0.083	0.043	0.075	45	1.9	6.3	1.5	4.1	2.8	2.6	0.093	0.28	1.1	0.015	0.20	25
								Median	0.10	0.77	2195	1.8	*<10*	60	0.48	0.070	0.035	0.035	36	1.3	5.0	1.4	3.6	1.4	2.4	0.090	0.21	0.37	0.012	0.18	20
								25th PCTL	0.10	0.54	1288	0.85	*<10*	43	0.39	0.050	0.020	0.020	31	1.0	3.8	1.1	2.6	1.1	1.4	0.080	0.19	0.29	0.010	0.15	17
								10th PCTL	0.00	0.42	699	0.68	*<10*	34	0.32	0.047	0.017	0.017	29	0.70	3.0	0.75	1.3	0.91	1.3	0.077	0.18	0.24	0.0077	0.13	15
								Min	0.00	0.34	603	0.50	*<10*	20	0.20	0.040	0.010	0.010	24	0.30	3.0	0.67	0.70	0.62	1.2	0.070	0.18	0.16	0.0070	0.12	14
Statistical Summary for Granite Ore								**n**	14	14	14	12	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								n < DL	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	0
								Max	0.12	0.94	10000	4.8	10	90	1.0	0.19	0.070	0.31	49	11	77	2.4	17	5.9	2.9	0.11	0.32	8.5	0.020	0.30	28
								90th PCTL	0.11	0.91	7289	4.8	10	90	0.75	0.14	0.060	0.13	47	6.4	55	1.6	4.7	3.4	2.6	0.10	0.30	3.2	0.020	0.23	26
								75th PCTL	0.098	0.82	5100	3.8	10	80	0.66	0.090	0.050	0.060	41	2.0	5.8	1.5	3.6	1.6	2.5	0.10	0.26	1.3	0.013	0.19	22
								Median	0.085	0.54	2195	1.1	*<10*	67	0.50	0.080	0.045	0.040	34	1.2	4.5	1.4	2.4	1.3	1.5	0.090	0.21	0.63	0.011	0.18	19
								25th PCTL	0.065	0.46	870	0.88	*<10*	41	0.38	0.063	0.030	0.020	31	0.88	3.0	1.2	1.6	1.0	1.4	0.080	0.18	0.30	0.0073	0.14	17
								10th PCTL	0.046	0.42	722	0.71	*<10*	33	0.26	0.050	0.020	0.013	27	0.36	2.3	0.88	0.86	0.87	1.2	0.073	0.17	0.20	0.0056	0.13	15
								Min	0.030	0.34	603	0.50	*<10*	20	0.20	0.040	0.010	0.010	24	0.20	2.0	0.67	0.70	0.62	1.2	0.070	0.15	0.16	*<0.005*	0.12	14
Oxide and Transition Facies for Other Lithologies Ore																															
ABA126	KAM149885	CFR0566	67.06	68.58	Ore	Oxide	Dykes	IV	0.19	0.58	1595	0.30	*<10*	350	2.3	0.14	0.82	0.060	16	124	512	2.6	6.9	6.0	3.7	0.060	0.020	1.4	0.010	0.050	8.2
ABA334	R550421	CFD0518	10	11	Ore	Upper Transition	HU	HU	0.95	0.44	2620	11	10	380	1.6	0.33	0.23	0.51	72	51	205	0.46	13	5.2	1.9	0.080	0.12	1.5	0.044	0.21	39
ABA175	R305827	CFD0403	70	71	Ore	Lower transition	Dykes	DIOR	0.090	0.58	*>10000*	1.1	*<10*	70	0.29	0.060	0.010	0.020	18	7.2	4.0	1.2	4.8	1.5	1.9	0.080	0.17	3.6	0.026	0.26	10

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in the statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.2-3: Solid Phase Element Results by Aqua Regia Digestion for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Oxide Facies for Gneiss Ore																																				
ABA100	KAM137583	CFR0470	39.62	41.15	Ore	Oxide	Gneiss	MxM	5.1	0.29	435	1.6	0.010	0.12	6.4	440	22	35	<0.001	0.020	48	3.6	0.90	0.80	26	<0.01	0.15	32	0.019	0.51	11	15	1.1	25	41	11
Supremo Oxide T1	72144	Head	composite		Ore	Oxide	Gneiss		<1	0.070	333	2.0	0.010	<0.05	23	300	12	11	-	0.010	46	3.4	<1	0.40	26	<0.05	<0.05	24	<0.01	0.46	13	17	0.60	11	25	6.3
Supremo Oxide T4	72145	Head	composite		Ore	Oxide	Gneiss		1.0	0.13	267	2.1	0.010	<0.05	11	210	15	14	-	0.010	34	2.3	<1	0.70	23	<0.05	<0.05	26	<0.01	0.90	14	12	0.30	11	26	5.1
ABA394	KAM030261	CFR0110	81.08	82.6	Ore	Oxide	Gneiss	MxF	0.60	0.020	213	1.5	0.010	<0.05	2.4	240	29	10	<0.001	0.10	9.3	1.6	0.40	0.50	92	<0.01	0.11	27	<0.005	0.50	20	8.0	0.92	7.1	9.0	4.8
ABA397	L861523	CFR0134	105.16	105.187	Ore	Oxide	Gneiss	FG	0.40	0.010	144	1.8	0.010	0.080	2.5	70	52	10	<0.001	<0.01	19	0.30	0.30	0.50	21	<0.01	0.030	35	<0.005	0.43	19	2.0	0.80	6.0	11	3.3
Statistical Summary						**Oxide**	**Gneiss**	**n**	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	5.1	0.30	435	2.1	0.010	0.12	23	440	52	35	<0.001	0.10	48	3.6	<1	0.80	92	<0.05	0.20	35	0.019	0.90	20	17	1.1	25	41	11
								90th PCTL	3.5	0.20	394	2.1	0.010	0.10	18	384	43	26	<0.001	0.10	47	3.5	<1	0.80	66	<0.05	0.10	34	<0.01	0.70	19	16	1.0	19	35	9.0
								75th PCTL	1.0	0.10	333	2.0	0.010	0.080	11	300	29	14	<0.001	0.00	46	3.4	<1	0.70	26	<0.05	0.10	32	<0.01	0.50	19	15	0.90	11	26	6.3
								Median	1.0	0.10	267	1.8	0.010	<0.05	6.4	240	22	11	<0.001	0.00	34	2.3	0.90	0.50	26	<0.01	0.10	27	<0.01	0.50	14	12	0.80	11	25	5.1
								25th PCTL	0.60	0.00	213	1.6	0.010	<0.05	2.5	210	15	10	<0.001	0.00	19	1.6	0.40	0.50	23	<0.01	0.10	26	<0.005	0.50	13	8.0	0.60	7.1	11	4.8
								10th PCTL	0.50	0.00	172	1.5	0.010	<0.05	2.4	126	13	10	<0.001	<0.01	13	0.80	0.30	0.40	22	<0.01	<0.05	25	<0.005	0.40	12	4.4	0.40	6.4	9.8	3.9
								Min	0.40	0.00	144	1.5	0.010	<0.05	2.4	70	12	10	<0.001	<0.01	9.3	0.30	0.30	0.40	21	<0.01	<0.05	24	<0.005	0.40	11	2.0	0.30	6.0	9.0	3.3
Transition Facies for Gneiss Ore																																				
Supremo 80%	72146	Head	composite		Ore	Transition	Gneiss		2.0	0.42	396	3.1	0.010	0.070	12	300	14	17	-	0.12	20	2.8	<1	0.30	49	<0.05	0.060	25	<0.01	1.2	11	14	0.20	11	27	6.1
ABA002	KAM004886	CFD0034	73	74	Ore	Upper transition	Gneiss	FG	3.8	0.030	186	0.84	0.010	0.050	1.7	160	10	11	<0.001	<0.01	50	0.80	0.40	1.7	19	<0.01	0.010	35	<0.005	0.78	19	4.0	0.29	10	10	6.8
ABA375	R271389	CFD0417	109.3	109.775	Ore	Lower Transition	Gneiss	MxF	1.7	0.090	387	2.0	0.010	0.060	1.2	110	18	16	<0.001	<0.01	11	0.90	0.40	0.50	29	<0.01	0.010	37	<0.005	0.28	16	2.0	0.42	15	24	9.4
ABA359	R623803	CFD0548	174	174.935	Ore	Upper Transition	Gneiss	MxF	0.50	0.030	112	0.55	<0.01	<0.05	5.0	70	25	9.1	<0.001	<0.01	161	0.70	0.40	0.30	14	<0.01	0.070	36	<0.005	1.1	5.7	3.0	0.32	9.6	12	5.6
ABA403	R544048	CFD0553	120	121	Ore	Upper Transition	Gneiss	MxF	0.30	0.020	1490	1.6	0.010	<0.05	2.9	80	23	11	<0.001	<0.01	108	0.30	0.20	0.50	8.3	<0.01	0.090	32	<0.005	1.1	11	3.0	2.0	6.8	15	4.0
Statistical Summary						**Transition**	**Gneiss**	**n**	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	3.8	0.40	1490	3.1	0.010	0.070	12	300	25	17	<0.001	0.12	161	2.8	<1	1.7	49	<0.05	0.10	37	<0.01	1.2	19	14	2.0	15	27	9.4
								90th PCTL	3.1	0.30	1052	2.7	0.010	0.066	9.4	244	24	17	<0.001	<0.01	139	2.0	0.80	1.2	41	<0.05	0.10	36	<0.01	1.2	18	10	1.4	13	26	8.4
								75th PCTL	2.0	0.10	396	2.0	0.010	0.060	5.0	160	23	16	<0.001	<0.01	108	0.90	0.40	0.50	29	<0.01	0.10	36	<0.005	1.1	16	4.0	0.40	11	24	6.8
								Median	1.7	0.00	387	1.6	0.010	0.050	2.9	110	18	11	<0.001	<0.01	50	0.80	0.40	0.50	19	<0.01	0.10	35	<0.005	1.1	11	3.0	0.30	10	15	6.1
								25th PCTL	0.50	0.00	186	0.80	0.010	<0.05	1.7	80	14	11	<0.001	<0.01	20	0.70	0.40	0.30	14	<0.01	0.00	32	<0.005	0.80	11	3.0	0.30	9.6	12	5.6
								10th PCTL	0.40	0.00	142	0.70	<0.01	<0.05	1.4	74	12	9.7	<0.001	<0.01	14	0.50	0.30	0.30	11	<0.01	0.00	27	<0.005	0.50	7.8	2.4	0.20	7.9	11	4.6
								Min	0.30	0.00	112	0.60	<0.01	<0.05	1.2	70	10	9.1	<0.001	<0.01	11	0.30	0.20	0.30	8.3	<0.01	0.00	25	<0.005	0.30	5.7	2.0	0.20	6.8	10	4.0
Statistical Summary for Gneiss Ore								**n**	10	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
								n < DL	1	0	0	0	1	5	0	0	0	0	7	5	0	0	3	0	0	10	2	0	9	0	0	0	0	0	0	0
								Max	5.1	0.42	1490	3.1	0.010	0.12	23	440	52	35	<0.001	0.12	161	3.6	<1	1.7	92	<0.05	0.15	37	0.019	1.2	20	17	2.0	25	41	11
								90th PCTL	3.9	0.30	541	2.2	0.010	0.084	13	314	31	19	<0.001	0.10	113	3.4	<1	0.89	53	<0.05	0.11	36	0.011	1.1	19	15	1.2	16	28	9.5
								75th PCTL	1.9	0.12	394	2.0	0.010	0.068	9.9	285	25	15	<0.001	0.018	50	2.7	0.98	0.65	28	<0.05	0.085	35	<0.01	1.1	18	14	0.89	11	26	6.7
								Median	1.0	0.050	300	1.7	0.010	0.050	4.0	185	20	11	<0.001	0.010	40	1.3	0.40	0.50	24	<0.01	0.055	32	<0.005	0.65	13	6.0	0.51	11	20	5.9
								25th PCTL	0.53	0.023	193	1.5	0.010	<0.05	2.4	88	14	10	<0.001	0.010	19	0.73	0.40	0.43	20	<0.01	0.035	26	<0.005	0.47	11	3.0	0.31	7.7	11	4.9
								10th PCTL	0.39	0.019	141	0.81	0.010	<0.05	1.7	70	12	10	<0.001	0.010	11	0.30	0.29	0.30	13	<0.01	0.010	24	<0.005	0.42	10	2.0	0.28	6.7	9.9	3.9
								Min	0.30	0.010	112	0.55	<0.01	<0.05	1.2	70	10	9.1	<0.001	0.010	9.3	0.30	0.20	0.30	8.3	<0.01	0.010	24	<0.005	0.28	5.7	2.0	0.20	6.0	9.0	3.3
Oxide Facies for Schist Ore																																				
ABA089	KAM133587	CFR0431	10.67	12.19	Ore	Oxide	Schist	BtS	2.9	0.12	844	0.62	<0.01	<0.05	34	530	12	11	<0.001	0.010	15	5.2	0.80	0.30	22	<0.01	0.040	13	<0.005	0.61	2.8	34	0.80	18	43	2.3
DD oxide	72141	Head	composite		Ore	Oxide	Gneiss/schist		2.0	0.59	551	1.4	0.010	<0.05	30	320	16	14	-	0.11	41	5.9	<1	0.40	57	<0.05	0.13	13	<0.01	0.30	5.2	22	1.0	10	41	3.6
Latte Oxide East	72136	Head	composite		Ore	Oxide	Schist		1.0	0.54	467	1.4	0.010	<0.05	38	420	16	13	-	0.080	22	4.8	<1	<0.3	130	<0.05	<0.05	13	<0.01	0.33	3.0	19	0.90	14	52	4.6
Latte Oxide West	72135	Head	composite		Ore	Oxide	Schist		<1	0.92	622	1.5	0.010	<0.05	66	430	17	11	-	0.20	19	4.8	<1	0.40	139	<0.05	0.060	11	<0.01	0.33	2.6	17	0.50	14	57	4.1
ABA324	Q033726	CFD0411	36	37	Ore	Oxide	schist	BtS	1.6	0.58	616	1.0	0.010	<0.05	23	620	15	30	<0.001	0.43	15	4.9	0.90	0.90	93	<0.01	0.020	16	0.0070	1.5	6.0	14	0.46	16	43	1.8
ABA328	KAM001234	CFD0008	52	53	Ore	Oxide	schist	BtS	0.40	0.48	718	0.91	<0.01	<0.05	27	410	20	10	<0.001	0.030	6.0	4.3	0.60	0.30	150	<0.01	0.080	17	<0.005	0.42	2.4	6.0	0.33	13	53	3.4
Statistical Summary						**Oxide**	**Schist**	**n**	6	6	6	6	6	6	6	6	6	6	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	2.9	0.92	844	1.5	0.010	<0.05	66	620	20	30	<0.001	0.43	41	5.9	<1	0.90	150	<0.05	0.13	17	<0.01	1.5	6.0	34	1.0	18	57	4.6
								90th PCTL	2.5	0.76	781	1.5	0.010	<0.05	52	575	19	22	<0.001	0.32	31	5.6	<1	0.65	145	<0.05	0.11	16	<0.01	1.1	5.6	28	0.95	17	55	4.4
								75th PCTL	1.9	0.59	694	1.4	0.010	<0.05	37	505	17	14	<0.001	0.18	21	5.1	<1	0.40	137	<0.05	0.075	15	<0.01	0.56	4.6	21	0.88	16	53	4.0
								Median	1.3	0.56	619	1.2	0.010	<0.05	32	425	16	12	<0.001	0.095	17	4.9	0.95	0.35	111	<0.01	0.055	13	0.0085	0.38	2.9	18	0.65	14	48	3.5
								25th PCTL	<1	0.50	567	0.94	<0.01	<0.05	28	413	15	11	<0.001	0.043	15	4.8	0.83	0.30	66	<0.01	0.043	13	<0.005	0.33	2.6	15	0.47	13	43	2.6
								10th PCTL	0.70	0.30	509	0.77	<0.01	<0.05	25	365	14	10	<0.001	0.020	10	4.6	0.70	0.30	40	<0.01	0.030	12	<0.005	0.32	2.5	10	0.40	12	42	2.1
								Min	0.40	0.12	467	0.62	<0.01	<0.05	23	320	12	10	<0.001	0.010	6.0	4.3	0.60	0.30	22	<0.01	0.020	11	<0.005	0.30	2.4	6.0	0.33	10	41	1.8
Transition Facies for Schist Ore																																				
Latte 60%	72138	Head	composite		Ore	Transition	Schist		3.0	1.1	506	2.3	0.020	0.070	32	450	14	18	-	0.53	49	5.4	<1	0.50	165	<0.05	<0.05	13	0.010	0.40	2.6	26	0.30	15	49	4.0
Latte 80%'	72137	Head	composite		Ore	Transition	Schist		2.0	1.4	497	3.3	0.010	<0.05	56	410	20	13	-	0.55	22	4.9	<1	0.40	164	<0.05	0.070	11	<0.01	0.73	2.6	19	0.20	13	46	2.8
ABA327	KAM001014	CFD0007	50.15	50.9	Ore	Lower Transition	schist	BtS	0.60	1.2	705	0.84	0.020	<0.05	29	380	6.8	18	0.0010	1.9	24	2.5	0.50	0.30	402	<0.01	0.060	11	<0.005	0.22	1.8	7.0	0.20	9.9	49	2.6
ABA314	KAM147294	CFD0346	107	107.5	Ore	Upper Transition	Schist	BtS_carb	4.1	1.6	469	0.69	0.020	0.050	34	270	29	9.6	0.0010	0.58	7.3	7.1	0.70	0.70	199	<0.01	0.050	9.4	<0.005	0.23	3.5	30	0.35	14	48	4.7
ABA315	KAM147319	CFD0346	130.2	130.3	Ore	Upper Transition	Schist	BtS_carb	0.30	1.2	567	1.1	0.010	<0.05	12	320	14	10	<0.001	2.1	8.7	3.6	0.50	0.30	209	<0.01	0.10	20	<0.005	0.64	3.2	6.0	0.46	14	43	11
Statistical Summary						**Transition**	**Schist**	**n**	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	4.1	1.6	705	3.3	0.020	0.070	56	450	29	18	0.0010	2.1	49	7.1	<1	0.70	402	<0.05	0.10	20	0.010	0.73	3.5	30	0.46	15	49	11
								90th PCTL	3.7	1.5	650	2.9	0.020	0.062	47	434	25	18	0.0010	2.0	39	6.4	<1	0.62	325	<0.05	0.088	17	<0.01	0.69	3.4	28	0.42	14	49	8.7
								75th PCTL	3.0	1.4	567	2.3	0.020	0.050	34	410	20	18	0.0010	1.9	24	5.4	<1	0.50	209	<0.05	0.070	13	<0.01	0.64	3.2	26	0.35	14	49	4.7
								Median	2.0	1.2	506	1.1	0.020	<0.05	32	380	14	13	0.0010	0.58	22	4.9	0.70	0.40	199	<0.01	0.060	11	<0.005	0.40	2.6	19	0.30	14	48	4.0
								25th PCTL	0.60	1.2	497	0.84	0.010	<0.05	29	320	14	10	<0.001	0.55	8.7	3.6	0.50	0.30	165	<0.01	0.050	11	<0.005	0.23	2.6	7.0	0.20	13	46	2.8
								10th PCTL	0.42	1.1	480	0.75	0.010	<0.05	19	290	9.7	9.9	<0.001	0.54	7.8	2.9	0.50	0.30	164	<0.01	0.050	9.9	<0.005	0.22	2.1	6.4	0.20	11	44	2.7
								Min	0.30	1.1	469	0.69	0.010	<0.05	12	270	6.8	9.6	<0.001	0.53	7.3	2.5	0.50	0.30	164	<0.01	0.050	9.4	<0.005	0.22	1.8	6.0	0.20	9.9	43	2.6
Statistical Summary for Schist Ore								**n**	11	11	11	11	11	11	11	11	11	11	6	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
								n < DL	1	0	0	0	2	9	0	0	0	0	4	0	0	0	5	1	0	11	2	0	9	0	0	0	0	0	0	0
								Max	4.1	1.6	844	3.3	0.020	0.070	66	620	29	30	0.0010	2.1	49	7.1	<1	0.90	402	<0.05	0.13	20	0.010	1.5	6.0	34	1.0	18	57	11
								90th PCTL	3.0	1.4	718	2.3	0.020	0.050	56	530	20	18	0.0010	1.9	41	5.9	<1	0.70	209	<0.05	0.10	17	<0.01	0.73	5.2	30	0.90	16	53	4.7
								75th PCTL	2.5	1.2	664	1.5	0.015	<0.05	36	440	18	16	<0.001	0.57	23	5.3	<1	0.45	182	<0.05	0.075	15	<0.01	0.63	3.4	24	0.65	14	51	4.4
								Median	1.6	0.92	567	1.1	0.010	<0.05	32	410	16	13	<0.001	0.43	19	4.9	0.90	0.40	150	<0.01	0.060	13	0.0070	0.40	2.8	19	0.46	14	48	3.6
								25th PCTL	0.80	0.56	502	0.88	0.010	<0.05	28	350	14	10	<0.001	0.095	12	4.6	0.65	0.30	111	<0.01	<0.05	11	<0.005	0.32	2.6	11	0.32	13	43	2.7
								10th PCTL	0.40	0.48	469	0.69	<0.01	<0.05	23	320	12	10	<0.001	0.030	7.3	3.6	0.50	0.30	57	<0.01	0.040	11	<0.005	0.23	2.4	6.0	0.20	10	43	2.3
								Min	0.30	0.12	467	0.62	<0.01	<0.05	12	270	6.8	9.6	<0.001	0.010	6.0	2.5	0.50	0.30	22	<0.01	0.020	9.4	<0.005	0.22	1.8	6.0	0.20	9.9	41	1.8

Appendix C.2-3: Solid Phase Element Results by Aqua Regia Digestion for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Oxide Facies for Granite Ore																																				
ABA156	R305806	CFD0382	59	60	Ore	Oxide	Granite	GG	1.0	0.010	20	1.2	*<0.01*	0.21	0.60	50	21	9.4	*<0.001*	0.010	26	0.40	*<0.2*	0.20	23	*<0.01*	0.010	26	*<0.005*	0.61	6.4	2.0	9.4	2.8	4.0	6.1
ABA171	R305823	CFD0396	13	14	Ore	Oxide	Granite	GG	0.90	0.010	404	1.3	*<0.01*	0.24	0.90	130	24	7.5	*<0.001*	*<0.01*	38	0.70	0.40	0.30	19	*<0.01*	0.020	26	*<0.005*	2.7	20	2.0	0.40	10	24	6.7
Kona Oxide	72139	Head	composite		Ore	Oxide	Granite		*<1*	0.020	114	1.9	*<0.01*	0.41	1.9	130	15	11	-	0.020	37	2.5	*<1*	*<0.3*	18	*<0.01*	*<0.05*	18	*<0.01*	0.56	9.6	10	0.20	7.2	18	12
ABA419	I308596	CFD0053	7	8	Ore	Oxide	Granite	GG	0.50	0.010	31	0.52	0.010	0.10	0.30	90	11	14	*<0.001*	0.010	24	0.90	*<0.2*	*<0.2*	15	*<0.01*	0.010	26	*<0.005*	0.69	1.8	6.0	0.14	1.5	3.0	7.1
ABA420	I354541	CFD0053	47	47.24	Ore	Oxide	Granite	GG	2.1	0.010	1740	0.90	0.010	0.17	3.7	160	42	8.8	*<0.001*	*<0.01*	9.0	1.2	0.50	0.20	50	*<0.01*	*<0.01*	28	*<0.005*	2.3	52	2.0	0.090	15	42	5.3
ABA422	I354552	CFD0053	57.8	58	Ore	Oxide	Granite	GG	1.2	0.020	1600	1.0	0.010	0.25	2.1	110	14	10	*<0.001*	*<0.01*	6.8	1.0	0.50	0.20	61	*<0.01*	0.020	19	*<0.005*	1.2	18	2.0	0.12	15	32	4.8
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	2.1	0.00	1740	1.9	0.010	0.40	3.7	160	42	14	*<0.001*	0.020	38	2.5	*<1*	0.30	61	*<0.01*	*<0.05*	28	*<0.005*	2.7	52	10	9.4	15	42	12
								90th PCTL	1.7	0.00	1670	1.6	0.010	0.30	2.9	145	33	13	*<0.001*	0.020	38	1.9	0.80	0.30	56	*<0.01*	0.040	27	*<0.005*	2.5	36	8.0	4.9	15	37	9.4
								75th PCTL	1.2	0.00	1301	1.3	0.010	0.20	2.1	130	23	11	*<0.001*	0.010	35	1.2	0.50	*<0.3*	43	*<0.01*	0.020	26	*<0.005*	2.0	19	5.0	0.40	14	30	7.0
								Median	*<1*	0.00	259	1.1	*<0.01*	0.20	1.4	120	18	9.7	*<0.001*	*<0.01*	25	1.0	0.50	0.20	21	*<0.01*	0.020	26	*<0.005*	0.90	14	2.0	0.20	8.8	21	6.4
								25th PCTL	0.90	0.00	52	0.90	*<0.01*	0.20	0.70	95	14	9.0	*<0.001*	*<0.01*	13	0.80	0.30	0.20	18	*<0.01*	0.010	21	*<0.005*	0.60	7.2	2.0	0.10	3.9	7.5	5.5
								10th PCTL	0.70	0.00	26	0.70	*<0.01*	0.10	0.50	70	13	8.2	*<0.001*	*<0.01*	7.9	0.60	*<0.2*	*<0.2*	16	*<0.01*	0.010	19	*<0.005*	0.60	4.1	2.0	0.10	2.2	3.5	5.1
								Min	0.50	0.00	20	0.50	*<0.01*	0.10	0.30	50	11	7.5	*<0.001*	*<0.01*	6.8	0.40	*<0.2*	*<0.2*	15	*<0.01*	*<0.01*	18	*<0.005*	0.60	1.8	2.0	0.10	1.5	3.0	4.8
Transition Facies for Granite Ore																																				
Kona 80% CN	72140	Head	composite		Ore	Transition	Granite		*<1*	0.010	217	2.3	*<0.01*	0.34	2.3	140	16	8.8	-	0.14	128	2.3	*<1*	0.30	21	*<0.05*	*<0.05*	17	*<0.01*	1.2	9.7	8.0	0.10	6.3	19	11
ABA161	R305812	CFD0383	84	85	Ore	Upper transition	Granite	GG	0.50	0.010	54	1.7	*<0.01*	0.21	1.6	280	16	11	*<0.001*	*<0.01*	26	0.60	0.30	0.30	6.7	*<0.01*	0.030	26	*<0.005*	0.70	33	7.0	0.35	5.9	17	4.3
ABA432	Q041581	CFD0383	83.47	84	Ore	Upper Transition	Granite	GG	0.70	0.020	69	4.2	*<0.01*	0.21	2.6	460	24	18	*<0.001*	0.020	146	1.6	0.50	0.60	22	*<0.01*	0.050	13	*<0.005*	1.1	53	12	0.20	7.3	20	9.7
ABA428	Q041388	CFD0382	97	98	Ore	Lower Transition	Granite	GG	3.9	0.010	54	0.90	*<0.01*	0.080	0.80	70	26	7.4	*<0.001*	*<0.01*	4.1	0.90	0.30	0.20	20	*<0.01*	*<0.01*	31	*<0.005*	0.26	15	3.0	0.060	8.8	12	5.8
ABA444	Q032413	CFD0385	83	83.75	Ore	Lower Transition	Granite	GG	0.90	0.010	66	1.2	0.010	0.12	0.70	90	14	13	*<0.001*	0.010	20	0.40	*<0.2*	0.30	36	*<0.01*	0.010	36	*<0.005*	0.85	9.2	3.0	0.060	4.0	4.0	6.0
ABA445	Q032988	CFD0399	8.85	9	Ore	Lower Transition	Granite	GG	1.9	0.020	199	1.0	0.010	0.11	1.7	150	11	11	*<0.001*	0.010	3.2	1.9	0.30	0.40	30	*<0.01*	*<0.01*	23	*<0.005*	0.24	20	8.0	0.37	7.7	16	11
ABA446	Q033347	CFD0403	32	33	Ore	Lower Transition	Granite	GG	0.30	0.010	45	0.69	0.010	0.21	1.4	140	20	9.1	*<0.001*	*<0.01*	33	0.70	0.30	3.2	29	*<0.01*	0.040	27	*<0.005*	0.71	5.1	3.0	0.35	4.2	6.0	8.6
ABA433	Q041589	CFD0383	91.9	92	Ore	Upper Transition	Granite	GG	1.8	0.020	77	1.1	0.010	0.060	2.7	310	29	11	*<0.001*	*<0.01*	5.5	1.1	0.40	0.40	19	*<0.01*	0.010	34	*<0.005*	0.83	8.8	6.0	0.060	11	18	5.3
Statistical Summary						**Transition**	**Granite**	**n**	8	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
								Max	3.9	0.020	217	4.2	0.010	0.34	2.7	460	29	18	*<0.001*	0.14	146	2.3	*<1*	3.2	36	*<0.05*	0.050	36	*<0.01*	1.2	53	12	0.37	11	20	11
								90th PCTL	2.5	0.020	204	2.9	0.010	0.25	2.6	355	27	14	*<0.001*	0.056	133	2.0	0.65	1.4	31	*<0.01*	0.050	35	*<0.01*	1.1	39	9.2	0.36	9.3	19	11
								75th PCTL	1.8	0.020	108	1.9	0.010	0.21	2.4	288	24	12	*<0.001*	0.013	57	1.7	0.43	0.45	29	*<0.01*	0.043	32	*<0.005*	0.91	23	8.0	0.35	8.0	18	9.9
								Median	0.95	0.010	68	1.1	*<0.01*	0.17	1.7	145	18	11	*<0.001*	*<0.01*	23	1.0	0.30	0.35	22	*<0.01*	0.020	27	*<0.005*	0.77	12	6.5	0.15	6.8	17	7.3
								25th PCTL	0.65	0.010	54	0.99	*<0.01*	0.10	1.3	128	15	9.0	*<0.001*	*<0.01*	5.1	0.68	0.30	0.30	19	*<0.01*	0.010	21	*<0.005*	0.59	9.1	3.0	0.060	5.5	11	5.7
								10th PCTL	0.44	0.010	51	0.84	*<0.01*	0.074	0.77	84	13	8.4	*<0.001*	*<0.01*	3.8	0.54	0.27	0.27	15	*<0.01*	0.010	16	*<0.005*	0.25	7.7	3.0	0.060	4.1	5.4	5.0
								Min	0.30	0.010	45	0.69	*<0.01*	0.060	0.70	70	11	7.4	*<0.001*	*<0.01*	3.2	0.40	*<0.2*	0.20	6.7	*<0.01*	0.010	13	*<0.005*	0.24	5.1	3.0	0.060	4.0	4.0	4.3
Statistical Summary for Granite Ore								**n**	14	14	14	14	14	14	14	14	14	14	12	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								n < DL	2	0	0	0	7	0	0	0	0	0	12	7	0	0	5	2	0	14	5	0	14	0	0	0	0	0	0	0
								Max	3.9	0.020	1740	4.2	0.010	0.41	3.7	460	42	18	*<0.001*	0.14	146	2.5	1.0	3.2	61	*<0.05*	0.050	36	*<0.01*	2.7	53	12	9.4	15	42	12
								90th PCTL	2.0	0.020	1241	2.2	0.010	0.31	2.7	301	28	14	*<0.001*	0.020	101	2.2	0.85	0.54	46	*<0.01*	0.050	33	*<0.01*	1.9	46	9.4	0.39	13	30	11
								75th PCTL	1.7	0.020	213	1.6	0.010	0.23	2.3	158	24	11	*<0.001*	0.010	36	1.5	0.50	0.38	29	*<0.01*	0.038	28	*<0.005*	1.2	20	7.8	0.35	10	20	9.4
								Median	1.0	0.010	73	1.1	*<0.01*	0.21	1.7	135	18	10	*<0.001*	*<0.01*	25	0.95	0.35	0.30	22	*<0.01*	0.015	26	*<0.005*	0.77	12	4.5	0.17	7.3	18	6.4
								25th PCTL	0.75	0.010	54	0.93	*<0.01*	0.11	0.83	95	15	8.9	*<0.001*	*<0.01*	7.3	0.70	0.30	0.20	19	*<0.01*	*<0.01*	20	*<0.005*	0.63	8.9	2.3	0.093	4.6	7.5	5.4
								10th PCTL	0.50	0.010	35	0.75	*<0.01*	0.086	0.63	76	12	7.9	*<0.001*	*<0.01*	4.5	0.46	*<0.2*	0.20	16	*<0.01*	*<0.01*	17	*<0.005*	0.35	5.5	2.0	0.060	3.2	4.0	5.0
								Min	0.30	0.010	20	0.52	*<0.01*	0.060	0.30	50	11	7.4	*<0.001*	*<0.01*	3.2	0.40	*<0.2*	0.20	6.7	*<0.01*	*<0.01*	13	*<0.005*	0.24	1.8	2.0	0.060	1.5	3.0	4.3
Oxide and Transition Facies for Other Lithologies Ore																																				
ABA126	KAM149885	CFR0566	67.06	68.58	Ore	Oxide	Dykes	IV	2.5	0.46	2400	2.0	*<0.01*	*<0.05*	2740	2570	3.3	4.1	*<0.001*	0.020	363	7.2	0.30	0.70	54	0.010	0.090	4.6	*<0.005*	2.7	3.6	29	2.9	12	25	0.60
ABA334	R550421	CFD0518	10	11	Ore	Upper Transition	HU	HU	0.80	0.11	1830	0.21	0.010	*<0.05*	727	560	22	8.9	*<0.001*	*<0.01*	47	8.1	0.60	0.30	56	*<0.01*	1.4	12	*<0.005*	0.67	3.0	56	25	17	149	6.2
ABA175	R305827	CFD0403	70	71	Ore	Lower transition	Dykes	DIOR	0.50	0.010	12	0.52	*<0.01*	0.080	2.5	150	14	15	*<0.001*	0.53	281	4.3	0.30	0.30	21	*<0.01*	0.030	3.2	*<0.005*	3.1	2.6	10	0.060	3.1	5.0	8.3

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in the statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.2-4: Statistical Summary of Exploration Assay Database (Au > 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t
Gneiss Ore																																													
Gneiss	Oxide	**n**	804	804	804	2864	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804
		n <DL	401	0	0	0	761	0	73	704	1	789	40	0	6	0	799	318	0	4	2	2	0	195	388	66	0	1	344	2	188	0	150	760	801	255	4	800	8	-	-	-	-	-	-
		Max	8.5	2.5	10000	87	10	3210	3.3	13	6.5	0.60	55	240	105	9.6	10	8.0	1.1	90	38	2.0	5630	30	0.070	158	1620	1190	1.3	1325	31	286	60	0.11	10	130	179	20	181	3300	163	42	161	325	*Non-reactive*
		95th PCTL	0.60	0.96	3766	8.3	10	858	1.9	2.0	1.7	*<0.5*	28	42	30	5.7	*<10*	3.0	0.37	50	14	0.37	1246	5.0	0.020	30	710	40	0.15	144	14	106	40	0.010	*<10*	40	66	*<10*	74	1401	42	4.6	35	33	*Non-reactive*
		90th PCTL	0.50	0.77	2834	5.5	*<10*	570	1.6	2.0	0.44	*<0.5*	17	32	21	4.4	*<10*	2.0	0.32	40	6.0	0.13	845	4.0	0.020	21	567	26	0.070	108	9.0	81	40	*<0.01*	*<10*	30	42	*<10*	59	1137	11	2.2	9.8	17	*Non-reactive*
		75th PCTL	0.30	0.60	1740	2.8	*<10*	280	1.1	*<2*	0.15	*<0.5*	9.0	16	12	2.8	*<10*	1.0	0.27	40	3.0	0.050	495	3.0	0.010	11	310	19	0.020	52	4.0	45	30	*<0.01*	*<10*	20	18	*<10*	34	750	3.8	0.63	2.9	8.0	*Non-reactive*
		Median	0.20	0.48	919	1.3	*<10*	150	0.80	*<2*	0.080	*<0.5*	4.0	9.0	6.0	1.6	*<10*	1.0	0.23	30	2.0	0.030	249	1.0	0.010	4.0	180	14	0.010	24	1.0	25	30	*<0.01*	*<10*	10	7.0	*<10*	18	515	2.0	0.31	1.4	4.8	*Non-reactive*
		25th PCTL	*<0.2*	0.40	498	0.63	*<10*	90	0.60	*<2*	0.050	*<0.5*	2.0	6.0	3.0	1.0	*<10*	*<1*	0.19	20	1.0	0.020	124	1.0	*<0.01*	2.0	110	10	*<0.01*	11	1.0	17	20	*<0.01*	*<10*	*<10*	3.0	*<10*	11	383	1.3	0.31	0.69	2.4	2.2
		10th PCTL	*<0.2*	0.34	312	0.40	*<10*	60	0.50	*<2*	0.030	*<0.5*	1.0	4.0	2.0	0.82	*<10*	*<1*	0.16	10	1.0	0.020	48	*<1*	*<0.01*	1.0	80	8.0	*<0.01*	7.0	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.3	*<10*	7.0	284	0.75	0.31	0.063	1.1	0.63
		5th PCTL	*<0.2*	0.30	263	0.35	*<10*	50	*<0.5*	*<2*	0.030	*<0.5*	1.0	3.0	2.0	0.71	*<10*	*<1*	0.14	10	1.0	0.010	30	*<1*	*<0.01*	*<1*	70	6.0	*<0.01*	5.0	*<1*	10	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	4.0	242	0.75	0.31	-0.87	0.67	0.63
		Min	*<0.2*	0.23	39	0.30	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	2.0	*<1*	0.46	*<10*	*<1*	0.090	*<10*	*<1*	*<0.01*	11	*<1*	*<0.01*	*<1*	40	*<2*	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	22	0.25	0.31	-13	0.10	0.63
Gneiss	Upper Transition	**n**	310	307	307	1983	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307
		n <DL	150	0	0	0	298	0	13	266	0	306	6	0	1	0	306	94	0	0	1	1	0	66	182	42	0	0	104	4	72	0	40	277	302	94	5	305	0	-	-	-	-	-	-
		Max	2.3	2.0	10000	42	10	2650	3.5	4.0	5.0	2.2	42	144	94	9.4	10	12	1.1	60	45	2.4	2300	27	0.070	74	1830	169	1.2	3190	22	233	70	0.15	10	70	132	30	107	4033	125	38	116	164	*Non-reactive*
		95th PCTL	0.70	0.88	3847	6.7	*<10*	877	1.9	2.0	3.1	*<0.5*	19	48	33	4.0	*<10*	4.0	0.37	50	21	0.76	802	4.7	0.020	32	721	29	0.45	124	9.7	116	40	0.010	*<10*	30	53	*<10*	60	2267	78	14	61	43	*Non-reactive*
		90th PCTL	0.50	0.74	3076	4.8	*<10*	514	1.6	2.0	1.7	*<0.5*	13	35	20	3.7	*<10*	3.0	0.31	50	13	0.28	686	3.4	0.020	19	496	24	0.24	84	7.0	81	40	*<0.01*	*<10*	20	33	*<10*	48	1871	41	7.6	38	24	*Non-reactive*
		75th PCTL	0.30	0.61	1930	2.6	*<10*	280	1.1	*<2*	0.31	*<0.5*	7.0	15	11	2.3	*<10*	2.0	0.26	40	5.5	0.070	444	2.0	0.010	8.0	290	20	0.080	41	3.0	44	30	*<0.01*	*<10*	10	15	*<10*	30	872	7.8	2.5	5.4	8.6	*Non-reactive*
		Median	0.20	0.46	1065	1.2	*<10*	160	0.90	*<2*	0.10	*<0.5*	3.0	8.0	6.0	1.4	*<10*	1.0	0.22	30	2.0	0.040	248	1.0	*<0.01*	3.0	170	16	0.020	21	1.0	26	30	*<0.01*	*<10*	10	5.0	*<10*	18	612	2.5	0.63	1.7	5.2	38
		25th PCTL	*<0.2*	0.39	568	0.60	*<10*	90	0.70	*<2*	0.060	*<0.5*	2.0	5.0	3.0	1.1	*<10*	*<1*	0.18	30	2.0	0.020	158	1.0	*<0.01*	1.0	120	12	*<0.01*	11	1.0	17	20	*<0.01*	*<10*	*<10*	3.0	*<10*	11	437	1.5	0.31	0.69	2.2	2.2
		10th PCTL	*<0.2*	0.33	301	0.38	*<10*	60	0.60	*<2*	0.040	*<0.5*	1.0	4.0	2.0	0.89	*<10*	*<1*	0.16	20	1.0	0.020	77	*<1*	*<0.01*	*<1*	90	10	*<0.01*	5.0	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	262	1.0	0.31	-1.4	0.66	0.94
		5th PCTL	*<0.2*	0.30	194	0.34	*<10*	43	0.50	*<2*	0.040	*<0.5*	1.0	3.0	1.0	0.73	*<10*	*<1*	0.14	20	1.0	0.010	46	*<1*	*<0.01*	*<1*	80	8.0	*<0.01*	3.3	*<1*	10	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	4.0	232	1.0	0.31	-4.9	0.30	0.63
		Min	*<0.2*	0.22	15	0.30	*<10*	20	*<0.5*	*<2*	0.010	*<0.5*	*<1*	1.0	*<1*	0.45	*<10*	*<1*	0.10	10	*<1*	*<0.01*	20	*<1*	*<0.01*	*<1*	30	4.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	2.0	6.0	0.25	0.31	-21	0.068	0.63
Gneiss	Lower Transition	**n**	140	140	140	917	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
		n <DL	71	0	0	0	139	0	3	114	0	138	2	0	1	0	138	58	0	0	0	0	0	35	58	15	0	0	22	1	52	0	5	114	138	50	6	128	0	-	-	-	-	-	-
		Max	9.6	2.9	7530	50	10	2140	3.9	4.0	5.5	0.50	111	164	143	5.1	10	8.0	1.5	60	45	2.4	4920	11	0.060	85	1010	728	1.9	1690	20	244	50	0.12	10	60	95	10	125	3758	137	59	114	174	*Non-reactive*
		95th PCTL	1.8	1.1	4076	6.0	*<10*	1444	1.7	2.0	2.3	*<0.5*	17	62	30	3.2	*<10*	2.0	0.65	50	29	1.2	1017	3.0	0.050	30	530	29	1.1	72	6.0	104	40	0.051	*<10*	30	41	10	52	2680	57	34	51	36	*Non-reactive*
		90th PCTL	0.80	0.80	3225	4.3	*<10*	801	1.4	2.0	1.7	*<0.5*	13	21	18	3.0	*<10*	2.0	0.44	50	27	0.83	766	3.0	0.030	24	473	23	0.87	50	4.0	74	40	0.020	*<10*	20	28	*<10*	38	2410	44	27	33	23	*Non-reactive*
		75th PCTL	0.30	0.62	2230	2.3	*<10*	310	1.1	*<2*	0.84	*<0.5*	6.3	13	10	2.2	*<10*	1.0	0.29	40	19	0.29	451	2.0	0.020	8.0	290	18	0.48	21	3.0	49	30	*<0.01*	*<10*	10	10	*<10*	27	1361	21	15	16	6.9	*Non-reactive*
		Median	*<0.2*	0.50	1010	1.1	*<10*	120	0.85	*<2*	0.24	*<0.5*	2.0	6.0	4.0	1.3	*<10*	1.0	0.25	40	5.0	0.060	276	1.0	0.010	2.0	160	13	0.070	10	1.0	31	30	*<0.01*	*<10*	10	3.0	*<10*	16	640	5.9	2.2	1.0	2.6	18
		25th PCTL	*<0.2*	0.41	445	0.58	*<10*	60	0.70	*<2*	0.070	*<0.5*	1.0	4.0	3.0	1.0	*<10*	*<1*	0.21	30	2.0	0.030	157	0.50	*<0.01*	1.0	110	10	0.010	6.0	*<1*	22	30	*<0.01*	*<10*	*<10*	1.0	*<10*	10	325	1.8	0.31	-1.1	0.80	3.1
		10th PCTL	*<0.2*	0.31	268	0.38	*<10*	40	0.60	*<2*	0.050	*<0.5*	1.0	3.0	2.0	0.80	*<10*	*<1*	0.17	20	1.9	0.020	43	*<1*	*<0.01*	*<1*	90	7.0	*<0.01*	3.0	*<1*	15	20	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	153	1.3	0.31	-10	0.28	0.94
		5th PCTL	*<0.2*	0.27	143	0.34	*<10*	30	0.50	*<2*	0.040	*<0.5*	1.0	3.0	1.0	0.75	*<10*	*<1*	0.16	20	1.0	0.020	25	*<1*	*<0.01*	*<1*	80	6.0	*<0.01*	2.0	*<1*	12	20	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	101	1.0	0.31	-27	0.16	0.63
		Min	*<0.2*	0.25	24	0.30	*<10*	20	*<0.5*	*<2*	0.030	*<0.5*	*<1*	2.0	*<1*	0.56	*<10*	*<1*	0.12	10	1.0	0.010	20	*<1*	*<0.01*	*<1*	30	4.0	*<0.01*	*<2*	*<1*	7.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	3.0	33	0.75	0.31	-44	0.082	0.63
Gneiss	Transition	**n**	**450**	447	447	2900	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447
		n <DL	**221**	0	0	0	437	0	16	380	0	444	8	0	2	0	444	152	0	0	1	1	0	101	240	57	0	0	126	5	124	0	45	391	440	144	11	433	0	-	-	-	-	-	-
		Max	**9.6**	2.9	10000	50	10	2650	3.9	4.0	5.5	2.2	111	164	143	9.4	10	12	1.5	60	45	2.4	4920	27	0.070	85	1830	728	1.9	3190	22	244	70	0.15	10	70	132	30	125	4033	137	59	116	174	*Non-reactive*
		95th PCTL	**0.96**	1.1	3927	6.6	*<10*	927	1.9	2.0	3.1	*<0.5*	18	50	32	3.9	*<10*	4.0	0.43	50	27	0.93	886	4.0	0.030	32	617	29	0.78	107	8.0	116	40	0.020	*<10*	30	47	*<10*	59	2502	76	24	60	43	*Non-reactive*
		90th PCTL	0.50	0.75	3220	4.7	*<10*	622	1.5	2.0	1.7	*<0.5*	13	33	19	3.3	*<10*	3.0	0.34	50	21	0.47	698	3.0	0.020	20	488	23	0.48	77	6.0	78	40	0.010	*<10*	20	31	*<10*	45	2139	43	15	36	24	*Non-reactive*
		75th PCTL	0.30	0.62	2030	2.5	*<10*	280	1.1	*<2*	0.57	*<0.5*	7.0	15	11	2.3	*<10*	2.0	0.27	40	8.0	0.12	448	2.0	0.010	8.0	290	20	0.13	33	3.0	45	30	*<0.01*	*<10*	10	13	*<10*	30	982	14	4.1	7.1	8.0	*Non-reactive*
		Median	0.20	0.47	1055	1.1	*<10*	150	0.90	*<2*	0.11	*<0.5*	3.0	7.0	6.0	1.4	*<10*	1.0	0.23	30	3.0	0.040	253	1.0	*<0.01*	3.0	170	15	0.020	17	1.0	28	30	*<0.01*	*<10*	10	4.0	*<10*	17	622	2.8	0.63	1.4	4.0	22
		25th PCTL	*<0.2*	0.40	534	0.59	*<10*	80	0.70	*<2*	0.070	*<0.5*	1.0	5.0	3.0	1.1	*<10*	*<1*	0.19	30	2.0	0.030	157	1.0	*<0.01*	1.0	115	12	*<0.01*	9.0	*<1*	19	30	*<0.01*	*<10*	*<10*	2.0	*<10*	10	404	1.8	0.31	0.44	1.4	2.5
		10th PCTL	*<0.2*	0.33	280	0.38	*<10*	50	0.60	*<2*	0.040	*<0.5*	1.0	3.0	2.0	0.88	*<10*	*<1*	0.16	20	1.0	0.020	69	*<1*	*<0.01*	*<1*	90	9.0	*<0.01*	4.0	*<1*	12	4.0	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	251	1.0	0.31	-4.9	0.51	0.94
		5th PCTL	*<0.2*	0.28	188	0.34	*<10*	40	0.50	*<2*	0.040	*<0.5*	1.0	3.0	1.0	0.74	*<10*	*<1*	0.15	20	1.0	0.020	33	*<1*	*<0.01*	*<1*	80	7.0	*<0.01*	3.0	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	158	1.0	0.31	-9.4	0.23	0.63
		Min	*<0.2*	0.22	15	0.30	*<10*	20	*<0.5*	*<2*	0.010	*<0.5*	*<1*	1.0	*<1*	0.45	*<10*	*<1*	0.10	10	*<1*	*<0.01*	20	*<1*	*<0.01*	*<1*	30	4.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	2.0	6.0	0.25	0.31	-44	0.068	0.63
Gneiss	All	**n**	1254	1251	1251	5764	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251
		n <DL	622	0	0	0	1198	0	89	1084	1	1233	48	0	8	0	1243	470	0	4	3	3	0	296	628	123	0	1	470	7	312	0	195	1151	1241	399	15	1233	8	-	-	-	-	-	-
		Max	9.6	2.9	10000	87	10	3210	3.9	13	6.5	2.2	111	240	143	9.6	10	12	1.5	90	45	2.4	5630	30	0.070	158	1830	1190	1.9	3190	31	286	70	0.15	10	130	179	30	181	4033	163	59	161	325	*Non-reactive*
		95th PCTL	0.70	0.98	3840	7.3	*<10*	880	1.9	2.0	2.3	*<0.5*	22	48	30	5.2	*<10*	3.0	0.39	50	22	0.57	1093	5.0	0.020	32	700	33	0.44	141	12	112	40	0.010	*<10*	40	58	*<10*	71	1993	58	14	46	36	*Non-reactive*
		90th PCTL	0.50	0.76	2910	5.1	*<10*	580	1.6	2.0	1.1	*<0.5*	15	32	20	3.9	*<10*	2.0	0.32	40	13	0.25	795	4.0	0.020	21	530	25	0.18	94	8.0	80	40	*<0.01*	*<10*	30	39	*<10*	53	1358	27	5.6	22	18	*Non-reactive*
		75th PCTL	0.30	0.61	1840	2.6	*<10*	280	1.1	*<2*	0.18	*<0.5*	9.0	16	11	2.6	*<10*	1.0	0.27	40	4.0	0.060	462	2.0	0.010	10	300	19	0.040	47	4.0	45	30	*<0.01*	*<10*	15	16	*<10*	33	811	4.5	1.3	3.4	8.0	*Non-reactive*
		Median	0.20	0.48	966	1.2	*<10*	150	0.80	*<2*	0.090	*<0.5*	3.0	8.0	6.0	1.5	*<10*	1.0	0.23	30	2.0	0.030	250	1.0	*<0.01*	3.0	170	14	0.010	21	1.0	26	30	*<0.01*	*<10*	10	6.0	*<10*	18	545	2.3	0.31	1.4	4.8	*Non-reactive*
		25th PCTL	*<0.2*	0.40	507	0.61	*<10*	80	0.70	*<2*	0.060	*<0.5*	2.0	5.0	3.0	1.0	*<10*	*<1*	0.19	20	1.0	0.020	130	1.0	*<0.01*	1.0	110	11	*<0.01*	10	1.0	17	20	*<0.01*	*<10*	*<10*	3.0	*<10*	10	393	1.5	0.31	0.69	2.2	2.6
		10th PCTL	*<0.2*	0.34	306	0.39	*<10*	50	0.50	*<2*	0.040	*<0.5*	1.0	4.0	2.0	0.83	*<10*	*<1*	0.16	20	1.0	0.020	51	*<1*	*<0.01*	1.0	80	8.0	*<0.01*	6.0	*<1*	12	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	275	1.0	0.31	-0.50	0.80	0.80
		5th PCTL	*<0.2*	0.30	235	0.34	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	3.0	1.0	0.73	*<10*	*<1*	0.14	10	1.0	0.010	31	*<1*	*<0.01*	*<1*	70	6.0	*<0.01*	4.0	*<1*	10	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	4.0	228	0.75	0.31	-4.4	0.40	0.40
		Min	*<0.2*	0.22	15	0.30	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.45	*<10*	*<1*	0.090	*<10*	*<1*	*<0.01*	11	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	6.0	0.25	0.31	-44	0.068	0.068

Appendix C.2-4: Statistical Summary of Exploration Assay Database (Au > 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t
Schist Ore																																													
Schist	Oxide	**n**	567	567	567	1201	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567
		n <DL	166	0	0	0	541	0	12	442	0	561	0	0	2	0	565	169	0	0	0	0	0	301	150	1	0	0	55	0	4	0	370	527	557	517	0	557	0	-	-	-	-	-	-
		Max	3.7	2.0	10000	63	10	3730	2.8	6.0	11	4.5	103	194	686	12	10	12	0.95	70	60	4.5	2810	7.0	0.070	501	2390	253	2.0	10000	14	676	40	0.090	10	40	108	20	253	3802	263	62	261	632	*Non-reactive*
		95th PCTL	1.4	1.0	8006	12	*<10*	2080	1.6	3.0	5.7	*<0.5*	21	52	55	4.7	*<10*	3.0	0.41	60	38	1.7	1020	2.0	0.030	60	840	37	0.54	514	9.0	293	30	0.010	*<10*	10	40	*<10*	78	2229	142	17	137	206	*Non-reactive*
		90th PCTL	0.80	0.89	5832	6.5	*<10*	1754	1.5	2.0	4.6	*<0.5*	18	38	42	4.2	*<10*	2.0	0.37	50	30	1.3	879	1.0	0.020	49	720	27	0.33	196	7.0	222	20	*<0.01*	*<10*	*<10*	34	*<10*	70	1752	116	10	109	121	*Non-reactive*
		75th PCTL	0.50	0.74	3610	3.0	*<10*	800	1.2	*<2*	2.9	*<0.5*	15	22	29	3.6	*<10*	1.0	0.33	40	18	0.62	663	1.0	0.010	35	560	18	0.10	72	5.0	129	20	*<0.01*	*<10*	*<10*	19	*<10*	57	1110	72	3.1	68	47	24
		Median	0.30	0.60	2450	1.5	*<10*	350	0.90	*<2*	1.3	*<0.5*	12	15	19	3.1	*<10*	1.0	0.28	30	5.0	0.14	506	*<1*	0.010	24	440	13	0.050	27	4.0	72	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	47	786	33	1.6	26	17	2.8
		25th PCTL	*<0.2*	0.47	1340	0.69	*<10*	160	0.80	*<2*	0.33	*<0.5*	8.0	9.0	11	2.5	*<10*	*<1*	0.24	30	2.0	0.070	361	*<1*	*<0.01*	14	330	10	0.020	12	3.0	42	*<20*	*<0.01*	*<10*	*<10*	8.0	*<10*	35	538	8.3	0.63	6.4	5.6	1.3
		10th PCTL	*<0.2*	0.38	802	0.44	*<10*	98	0.60	*<2*	0.20	*<0.5*	5.0	6.0	6.8	1.7	*<10*	*<1*	0.21	20	2.0	0.050	252	*<1*	*<0.01*	5.0	198	8.0	0.010	7.0	2.0	29	*<20*	*<0.01*	*<10*	*<10*	5.0	*<10*	22	348	5.0	0.31	3.4	2.9	0.63
		5th PCTL	*<0.2*	0.34	584	0.38	*<10*	70	0.50	*<2*	0.14	*<0.5*	4.0	4.0	4.0	1.4	*<10*	*<1*	0.18	20	1.0	0.040	201	*<1*	*<0.01*	3.0	150	7.0	*<0.01*	5.0	1.0	21	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	16	273	3.5	0.31	2.1	1.6	0.63
		Min	*<0.2*	0.23	184	0.30	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	2.0	*<1*	0.66	*<10*	*<1*	0.12	10	0.00	0.020	43	*<1*	*<0.01*	*<1*	40	4.0	*<0.01*	2.0	*<1*	12	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	154	0.75	0.31	-16	0.48	0.63
Schist	Upper Transition	**n**	227	227	227	506	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227
		n <DL	69	0	0	0	209	0	11	201	0	225	0	0	0	0	222	108	0	0	0	0	0	113	60	4	0	0	6	5	3	0	141	183	227	220	0	217	0	-	-	-	-	-	-
		Max	206	3.7	10000	79	10	2030	2.1	7.0	15	1.8	37	324	1180	5.7	10	15	1.4	60	59	3.1	1575	10	0.040	274	1150	63	4.3	537	19	723	30	0.13	*<10*	10	120	1350	379	4831	380	135	364	176	*Non-reactive*
		95th PCTL	1.8	1.4	7693	11	10	1070	1.4	2.0	6.6	*<0.5*	24	87	86	4.4	*<10*	2.0	0.54	40	40	2.3	1055	2.0	0.030	71	774	33	2.5	121	10	443	20	0.047	*<10*	*<10*	45	*<10*	88	2582	165	77	142	64	118
		90th PCTL	1.3	1.1	6294	7.4	*<10*	686	1.3	2.0	5.4	*<0.5*	19	50	53	4.0	*<10*	2.0	0.41	40	38	2.1	873	2.0	0.020	52	704	26	2.3	64	8.0	324	20	0.010	*<10*	*<10*	38	*<10*	74	1970	136	70	107	36	74
		75th PCTL	0.60	0.81	4720	3.3	*<10*	340	1.1	*<2*	3.8	*<0.5*	15	25	26	3.6	*<10*	1.0	0.35	30	32	1.4	630	1.0	0.020	36	550	17	1.5	33	6.0	224	20	*<0.01*	*<10*	*<10*	27	*<10*	61	1331	95	46	66	8.8	49
		Median	0.30	0.60	2530	1.3	*<10*	200	0.90	*<2*	2.7	*<0.5*	11	15	17	3.0	*<10*	1.0	0.29	30	27	0.99	515	1.0	0.010	22	430	12	0.82	16	4.0	149	*<20*	*<0.01*	*<10*	*<10*	13	*<10*	45	916	68	26	39	2.5	28
		25th PCTL	*<0.2*	0.47	1433	0.61	*<10*	100	0.70	*<2*	2.1	*<0.5*	8.0	8.5	10	2.4	*<10*	*<1*	0.25	20	19	0.67	393	*<1*	*<0.01*	14	330	10	0.25	7.5	2.0	105	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	34	547	53	7.7	18	1.6	8.8
		10th PCTL	*<0.2*	0.38	752	0.39	*<10*	70	0.50	*<2*	1.2	*<0.5*	6.0	6.0	6.0	1.9	*<10*	*<1*	0.23	10	12	0.36	300	*<1*	*<0.01*	6.2	210	7.0	0.050	5.0	1.6	65	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	23	303	31	1.6	2.6	1.1	2.7
		5th PCTL	*<0.2*	0.33	404	0.35	*<10*	43	0.50	*<2*	0.85	*<0.5*	4.0	4.0	5.0	1.3	*<10*	*<1*	0.20	10	7.0	0.19	229	*<1*	*<0.01*	4.0	170	6.0	0.030	4.0	1.0	42	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	18	231	21	0.94	-9.3	0.88	0.94
		Min	*<0.2*	0.26	116	0.31	*<10*	30	*<0.5*	*<2*	0.070	*<0.5*	1.0	2.0	2.0	0.67	*<10*	*<1*	0.080	10	2.0	0.030	93	*<1*	*<0.01*	*<1*	30	2.0	*<0.01*	*<2*	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	6.0	29	1.8	0.31	-36	0.51	0.63
Schist	Lower Transition	**n**	62	62	62	215	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
		n <DL	25	0	0	0	59	0	4	52	0	61	0	0	0	0	51	31	0	0	0	0	0	35	22	0	0	0	4	2	0	0	52	35	62	59	0	61	0	-	-	-	-	-	-
		Max	1.7	3.1	10000	66	10	1010	2.5	3.0	25	0.60	41	178	58	7.7	10	3.0	2.1	40	90	4.8	1135	20	0.080	133	1190	67	3.6	887	22	2680	20	0.20	*<10*	10	94	30	141	2618	625	111	623	429	*Non-reactive*
		95th PCTL	0.90	2.7	7908	11	*<10*	662	2.1	3.0	5.9	*<0.5*	23	102	48	4.5	10	2.0	1.7	40	46	2.8	1125	9.6	0.040	48	868	43	3.2	104	12	482	20	0.17	*<10*	*<10*	81	*<10*	102	2387	147	101	134	302	*Non-reactive*
		90th PCTL	0.80	2.5	5573	5.8	*<10*	416	1.5	2.0	5.3	*<0.5*	20	88	35	4.2	10	1.0	1.4	30	40	2.4	1119	1.0	0.030	47	697	38	3.0	68	11	385	20	0.14	*<10*	*<10*	77	*<10*	94	1897	132	95	102	249	*Non-reactive*
		75th PCTL	0.38	1.1	3650	2.6	*<10*	250	1.2	*<2*	3.7	*<0.5*	18	56	25	3.8	*<10*	1.0	0.47	30	34	1.7	754	1.0	0.030	35	560	19	2.0	35	8.0	291	*<20*	0.038	*<10*	*<10*	54	*<10*	62	1181	91	61	76	41	101
		Median	0.20	0.72	2100	0.94	*<10*	140	0.90	*<2*	3.0	*<0.5*	14	19	16	3.1	*<10*	0.00	0.36	20	28	1.2	615	*<1*	0.015	26	410	11	1.1	13	5.0	160	*<20*	*<0.01*	*<10*	*<10*	22	*<10*	48	624	74	35	38	2.6	52
		25th PCTL	*<0.2*	0.57	895	0.46	*<10*	90	0.80	*<2*	2.4	*<0.5*	10	11	9.0	2.7	*<10*	*<1*	0.28	20	24	0.95	487	*<1*	*<0.01*	19	333	8.0	0.023	7.0	3.0	108	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	36	285	60	0.70	9.6	1.2	28
		10th PCTL	*<0.2*	0.50	293	0.36	*<10*	60	0.50	*<2*	1.4	*<0.5*	5.1	10	7.0	2.0	*<10*	*<1*	0.20	10	19	0.55	354	*<1*	*<0.01*	12	251	6.0	0.010	5.0	2.0	43	*<20*	*<0.01*	*<10*	*<10*	7.1	*<10*	26	73	34	0.31	-15	0.83	2.5
		5th PCTL	*<0.2*	0.43	25	0.33	*<10*	50	*<0.5*	*<2*	0.41	*<0.5*	4.0	6.0	6.0	1.5	*<10*	*<1*	0.17	10	3.5	0.27	294	*<1*	*<0.01*	7.2	230	3.1	*<0.01*	2.2	2.0	32	*<20*	*<0.01*	*<10*	*<10*	7.0	*<10*	21	6.0	10	0.31	-18	0.78	0.64
		Min	*<0.2*	0.15	7.0	0.30	*<10*	40	*<0.5*	*<2*	0.17	*<0.5*	1.0	4.0	1.0	0.51	*<10*	*<1*	0.080	10	2.0	0.050	212	*<1*	*<0.01*	3.0	110	3.0	*<0.01*	*<2*	1.0	13	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	10	2.4	4.3	0.31	-67	0.31	0.63
Schist	Transition	**n**	289	289	289	721	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289
		n <DL	94	0	0	0	268	0	15	253	0	286	0	0	0	0	273	139	0	0	0	0	0	148	82	4	0	0	10	7	3	0	193	218	289	279	0	278	0	-	-	-	-	-	-
		Max	206	3.7	10000	79	10	2030	2.5	7.0	25	1.8	41	324	1180	7.7	10	15	2.1	60	90	4.8	1575	20	0.080	274	1190	67	4.3	887	22	2680	30	0.20	*<10*	10	120	1350	379	4831	625	135	623	429	*Non-reactive*
		95th PCTL	1.5	2.0	7990	11	10	1034	1.5	2.0	6.6	*<0.5*	24	90	77	4.5	10	2.0	0.84	40	41	2.5	1110	2.0	0.030	68	800	39	2.7	106	11	470	20	0.060	*<10*	*<10*	70	*<10*	97	2563	164	85	143	93	*Non-reactive*
		90th PCTL	1.0	1.3	6162	7.1	*<10*	650	1.3	2.0	5.4	*<0.5*	20	63	48	4.1	*<10*	2.0	0.50	40	38	2.2	965	2.0	0.030	48	700	26	2.3	68	9.0	342	20	0.032	*<10*	*<10*	51	*<10*	74	1953	134	70	107	62	101
		75th PCTL	0.60	0.88	4670	3.0	*<10*	320	1.1	*<2*	3.8	*<0.5*	15	26	26	3.6	*<10*	1.0	0.36	30	33	1.4	666	1.0	0.020	35	550	18	1.6	34	6.0	237	20	*<0.01*	*<10*	*<10*	29	*<10*	61	1306	95	49	67	11	56
		Median	0.20	0.63	2390	1.2	*<10*	180	0.90	*<2*	2.9	*<0.5*	11	15	17	3.0	*<10*	1.0	0.29	20	27	1.1	525	*<1*	0.010	24	430	12	0.83	14	4.0	156	*<20*	*<0.01*	*<10*	*<10*	14	*<10*	46	895	73	26	38	2.6	31
		25th PCTL	*<0.2*	0.49	1310	0.56	*<10*	100	0.70	*<2*	2.1	*<0.5*	8.0	9.0	10	2.4	*<10*	*<1*	0.25	20	20	0.67	412	*<1*	*<0.01*	15	330	9.0	0.21	7.0	2.0	107	*<20*	*<0.01*	*<10*	*<10*	7.0	*<10*	34	478	53	6.6	15	1.5	10
		10th PCTL	*<0.2*	0.41	521	0.38	*<10*	68	0.50	*<2*	1.3	*<0.5*	6.0	6.0	6.0	1.9	*<10*	*<1*	0.22	10	13	0.37	314	*<1*	*<0.01*	7.0	220	7.0	0.030	5.0	2.0	60	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	23	246	32	0.94	1.0	1.0	2.5
		5th PCTL	*<0.2*	0.33	293	0.34	*<10*	44	*<0.5*	*<2*	0.60	*<0.5*	4.0	4.0	5.0	1.4	*<10*	*<1*	0.19	10	7.0	0.20	240	*<1*	*<0.01*	4.0	170	6.0	0.010	3.4	1.0	38	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	18	130	15	0.31	-16	0.80	0.94
		Min	*<0.2*	0.15	7.0	0.30	*<10*	30	*<0.5*	*<2*	0.070	*<0.5*	1.0	2.0	1.0	0.51	*<10*	*<1*	0.080	10	2.0	0.030	93	*<1*	*<0.01*	*<1*	30	2.0	*<0.01*	*<2*	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	6.0	2.4	1.8	0.31	-67	0.31	0.63
Schist	All	**n**	856	856	856	1922	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856
		n <DL	260	0	0	0	809	0	27	695	0	847	0	0	2	0	838	308	0	0	0	0	0	449	232	5	0	0	65	7	7	0	563	745	846	796	0	835	0	-	-	-	-	-	-
		Max	206	3.7	10000	79	10	3730	2.8	7.0	25	4.5	103	324	1180	12	10	15	2.1	70	90	4.8	2810	20	0.080	501	2390	253	4.3	10000	22	2680	40	0.20	10	40	120	1350	379	4831	625	135	623	632	*Non-reactive*
		95th PCTL	1.4	1.2	8070	12	10	1903	1.6	3.0	6.1	*<0.5*	23	66	59	4.7	*<10*	3.0	0.47	50	40	2.2	1065	2.0	0.030	65	840	37	2.0	391	10	338	30	0.020	*<10*	10	47	*<10*	80	2351	154	62	139	174	*Non-reactive*
		90th PCTL	0.90	0.99	5900	6.7	*<10*	1380	1.4	2.0	5.1	*<0.5*	19	45	43	4.1	*<10*	2.0	0.40	40	35	1.6	888	2.0	0.020	48	710	27	1.5	150	8.0	266	20	0.010	*<10*	*<10*	38	*<10*	73	1768	126	46	107	100	*Non-reactive*
		75th PCTL	0.50	0.78	3805	3.0	*<10*	610	1.2	*<2*	3.4	*<0.5*	15	24	28	3.6	*<10*	1.0	0.34	40	27	1.1	665	1.0	0.010	35	560	18	0.49	54	6.0	170	20	*<0.01*	*<10*	*<10*	23	*<10*	59	1181	84	15	67	35	65
		Median	0.30	0.60	2450	1.3	*<10*	270	0.90	*<2*	2.1	*<0.5*	12	15	18	3.1	*<10*	1.0	0.29	30	14	0.48	515	*<1*	0.010	24	435	13	0.070	22	4.0	101	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	46	808	51	2.2	33	9.9	11
		25th PCTL	*<0.2*	0.48	1315	0.64	*<10*	130	0.80	*<2*	0.60	*<0.5*	8.0	9.0	10	2.5	*<10*	*<1*	0.25	20	3.0	0.080	372	*<1*	*<0.01*	14	330	10	0.020	10	3.0	50	*<20*	*<0.01*	*<10*	*<10*	8.0	*<10*	34	522	15	0.63	7.4	2.9	2.9
		10th PCTL	*<0.2*	0.38	756	0.41	*<10*	80	0.60	*<2*	0.22	*<0.5*	5.0	6.0	6.0	1.8	*<10*	*<1*	0.21	20	2.0	0.050	267	*<1*	*<0.01*	5.0	210	8.0	0.010	6.0	2.0	32	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	22	317	5.5	0.31	2.9	1.4	1.4
		5th PCTL	*<0.2*	0.33	516	0.36	*<10*	60	0.50	*<2*	0.18	*<0.5*	4.0	4.0	4.0	1.4	*<10*	*<1*	0.19	10	1.0	0.040	204	*<1*	*<0.01*	3.0	160	6.0	*<0.01*	5.0	1.0	24	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	16	238	4.4	0.31	0.56	1.0	1.0
		Min	*<0.2*	0.15	7.0	0.30	*<10*	30	*<0.5*	*<2*	0.030	*<0.5*	1.0	2.0	*<1*	0.51	*<10*	*<1*	0.080	10	0.00	0.020	43	*<1*	*<0.01*	*<1*	30	2.0	*<0.01*	*<2*	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	2.4	0.75	0.31	-67	0.31	0.31

Appendix C.2-4: Statistical Summary of Exploration Assay Database (Au > 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t
Granite Ore																																													
Granite	Oxide	**n**	144	141	141	150	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141
		n <DL	99	0	0	0	131	1	59	114	8	141	27	0	3	0	140	47	0	0	5	5	0	25	97	29	0	0	58	0	35	0	22	141	140	44	1	141	7	-	-	-	-	-	-
		Max	9.4	1.2	10000	20	10	430	2.1	4.0	0.23	<0.5	11	10	21	11	10	5.0	0.33	30	4.0	0.060	23700	8.0	0.020	6.0	940	59	0.81	468	7.0	124	40	<0.01	10	160	24	<10	165	8543	5.8	25	3.4	11	*Non-reactive*
		95th PCTL	0.30	0.77	7410	8.3	10	190	1.1	2.0	0.10	<0.5	7.0	7.0	9.0	4.3	<10	3.0	0.25	30	2.0	0.020	2730	3.0	0.010	4.0	280	36	0.070	171	4.0	60	30	<0.01	<10	60	15	<10	58	4367	2.5	2.2	2.2	8.0	*Non-reactive*
		90th PCTL	0.20	0.68	4770	4.5	<10	150	0.90	2.0	0.090	<0.5	6.0	7.0	5.0	3.6	<10	2.0	0.23	30	2.0	0.020	1785	3.0	0.010	2.0	220	29	0.040	90	3.0	48	30	<0.01	<10	40	11	<10	48	3493	2.3	1.3	1.7	6.4	*Non-reactive*
		75th PCTL	0.20	0.55	3150	2.4	<10	100	0.70	<2	0.070	<0.5	3.0	6.0	3.0	2.2	<10	1.0	0.21	20	1.0	0.020	603	2.0	0.010	2.0	170	24	0.020	34	1.0	36	30	<0.01	<10	20	4.0	<10	33	2452	1.8	0.63	1.4	5.6	*Non-reactive*
		Median	<0.2	0.48	2030	1.2	<10	60	0.50	<2	0.060	<0.5	2.0	4.0	2.0	1.5	<10	1.0	0.17	20	1.0	0.010	138	1.0	<0.01	1.0	120	19	0.010	16	1.0	21	20	<0.01	<10	10	2.0	<10	20	1121	1.5	0.31	0.94	4.0	*Non-reactive*
		25th PCTL	<0.2	0.39	1185	0.64	<10	40	<0.5	<2	0.040	<0.5	1.0	3.0	2.0	1.1	<10	<1	0.14	20	1.0	0.010	45	1.0	<0.01	1.0	80	16	<0.01	10	1.0	14	20	<0.01	<10	<10	2.0	<10	8.0	651	1.0	0.31	0.31	1.6	1.3
		10th PCTL	<0.2	0.34	925	0.44	<10	30	<0.5	<2	0.010	<0.5	<1	2.0	1.0	0.85	<10	<1	0.12	10	0.00	0.010	24	<1	<0.01	<1	60	14	<0.01	7.0	<1	11	<20	<0.01	<10	<10	1.0	<10	3.0	511	0.25	0.31	-0.38	0.40	0.63
		5th PCTL	<0.2	0.32	711	0.34	<10	20	<0.5	<2	<0.01	<0.5	<1	1.0	1.0	0.78	<10	<1	0.10	10	0.00	0.010	19	<1	<0.01	<1	60	13	<0.01	5.0	<1	10	<20	<0.01	<10	<10	1.0	<10	2.0	464	0.25	0.31	-1.9	0.16	0.63
		Min	<0.2	0.17	581	0.30	<10	<10	<0.5	<2	<0.01	<0.5	<1	1.0	<1	0.38	<10	<1	0.060	10	<1	<0.01	11	<1	<0.01	<1	40	10	<0.01	2.0	<1	5.0	<20	<0.01	<10	<10	<1	<10	<2	341	0.25	0.31	-20	0.035	0.63
Granite	Upper Transition	**n**	28	20	20	60	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
		n <DL	13	0	0	0	11	0	8	18	7	20	4	0	3	0	20	7	0	0	0	0	0	9	13	8	0	0	2	0	11	3	1	20	20	6	2	20	1	-	-	-	-	-	-
		Max	6.9	1.1	10000	17	10	90	1.9	2.0	0.060	<0.5	4.0	8.0	8.0	5.8	<10	10	0.31	30	2.0	0.030	234	3.0	0.010	2.0	590	32	0.91	268	2.0	29	40	<0.01	<10	50	12	<10	60	8850	1.5	28	1.2	4.8	*Non-reactive*
		95th PCTL	4.2	0.97	6390	8.6	10	90	1.1	2.0	0.060	<0.5	3.1	8.0	4.2	4.5	<10	2.4	0.29	21	2.0	0.021	224	3.0	0.010	2.0	476	30	0.70	160	2.0	22	31	<0.01	<10	31	9.2	<10	37	4825	1.5	22	1.2	4.8	*Non-reactive*
		90th PCTL	2.2	0.96	5777	5.3	10	72	1.1	<2	0.060	<0.5	3.0	8.0	4.0	3.9	<10	1.1	0.29	20	2.0	0.020	201	3.0	0.010	2.0	344	30	0.52	48	1.1	21	30	<0.01	<10	21	7.2	<10	34	3949	1.5	16	0.96	4.1	*Non-reactive*
		75th PCTL	0.72	0.60	3325	2.7	10	50	0.83	<2	0.050	<0.5	2.3	6.3	2.0	1.8	<10	1.0	0.24	20	1.3	0.020	124	2.0	0.010	2.0	225	27	0.31	24	1.0	16	30	<0.01	<10	10	6.3	<10	20	3037	1.3	9.8	-0.047	1.0	2521
		Median	0.20	0.48	2008	1.3	<10	40	0.50	<2	0.020	<0.5	2.0	5.0	2.0	1.3	<10	1.0	0.22	20	1.0	0.010	69	1.0	<0.01	1.0	130	20	0.15	12	<1	9.5	30	<0.01	<10	10	2.0	<10	15	2148	0.50	4.7	-3.9	0.11	11
		25th PCTL	<0.2	0.43	1733	0.80	<10	30	<0.5	<2	<0.01	<0.5	1.0	3.8	1.8	0.99	<10	<1	0.20	18	1.0	0.010	31	<1	<0.01	<1	70	14	0.018	8.5	<1	5.8	28	<0.01	<10	<10	1.0	<10	4.5	1132	0.25	0.55	-9.5	0.034	4.8
		10th PCTL	<0.2	0.38	1510	0.43	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.54	<10	<1	0.17	10	0.00	0.010	20	<1	<0.01	<1	60	12	0.0080	4.8	<1	<1	20	<0.01	<10	<10	0.80	<10	2.0	582	0.25	0.31	-16	0.028	1.8
		5th PCTL	<0.2	0.34	1470	0.40	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.53	<10	<1	0.16	10	0.00	0.010	20	<1	<0.01	<1	59	12	<0.01	3.0	<1	<1	18	<0.01	<10	<10	<1	<10	1.8	470	0.25	0.31	-21	0.019	1.2
		Min	<0.2	0.32	719	0.35	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.42	<10	<1	0.12	10	0.00	0.010	19	<1	<0.01	<1	40	9.0	<0.01	3.0	<1	<1	<20	<0.01	<10	<10	<1	<10	<2	396	0.25	0.31	-27	0.016	0.63
Granite	Lower Transition	**n**	17	7.0	7.0	33	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
		n <DL	5	0	0	0	5	0	4	7	3	7	1	0	1	0	7	3	0	0	3	3	0	1	1	0	0	0	0	0	0	0	2	7	7	4	0	7	0	-	-	-	-	-	-
		Max	8.9	0.94	5820	11	10	90	0.80	<2	0.51	<0.5	2.0	15	9.0	2.1	<10	5.0	0.19	30	8.0	0.13	719	3.0	0.030	2.0	220	34	0.36	117	8.0	30	30	<0.01	<10	70	13	<10	48	5578	13	11	6.5	5.6	*Non-reactive*
		95th PCTL	8.9	0.84	5697	10.0	10	84	0.74	<2	0.38	<0.5	2.0	13	8.4	1.9	<10	3.8	0.18	27	6.5	0.100	539	2.7	0.027	2.0	202	31	0.33	103	7.4	29	30	<0.01	<10	52	13	<10	41	5481	9.4	10	5.0	4.9	*Non-reactive*
		90th PCTL	8.9	0.75	5574	9.4	10	78	0.68	<2	0.25	<0.5	2.0	11	7.8	1.7	<10	2.6	0.18	24	5.0	0.070	359	2.4	0.024	2.0	184	27	0.29	89	6.8	27	30	<0.01	<10	34	13	<10	35	5383	6.2	9.2	3.5	4.2	*Non-reactive*
		75th PCTL	3.9	0.56	5020	4.6	0.00	70	0.55	<2	0.055	<0.5	1.5	8.5	5.5	1.3	<10	1.0	0.16	20	2.5	0.025	94	1.5	0.015	2.0	150	21	0.23	69	3.5	24	30	<0.01	<10	10	9.5	<10	19	5113	1.4	7.0	1.1	2.6	5006
		Median	1.2	0.48	3290	1.8	<10	50	<0.5	<2	0.040	<0.5	1.0	7.0	2.0	1.0	<10	1.0	0.13	20	1.0	0.010	54	1.0	0.010	2.0	110	18	0.19	62	1.0	21	20	<0.01	<10	<10	4.0	<10	11	4062	1.0	5.9	-0.69	0.27	7.8
		25th PCTL	<0.2	0.43	1048	0.67	<10	40	<0.5	<2	<0.01	<0.5	1.0	4.0	2.0	0.82	<10	<1	0.11	10	<1	<0.01	14	1.0	0.010	1.0	75	16	0.020	26	1.0	19	0.00	<0.01	<10	<10	3.0	<10	3.0	802	0.25	0.63	-6.6	0.065	6.1
		10th PCTL	<0.2	0.32	662	0.47	<10	36	<0.5	<2	<0.01	<0.5	0.20	2.6	0.80	0.75	<10	<1	0.096	10	<1	<0.01	11	0.20	0.0020	1.0	66	15	0.010	4.2	1.0	13	<20	<0.01	<10	<10	2.6	<10	3.0	600	0.25	0.31	-8.6	0.038	3.9
		5th PCTL	<0.2	0.28	632	0.43	<10	33	<0.5	<2	<0.01	<0.5	<0.4	2.3	<1	0.70	<10	<1	0.093	10	<1	<0.01	10	<0.4	<0.01	1.0	63	15	0.010	3.6	1.0	8.9	<20	<0.01	<10	<10	2.3	<10	3.0	542	0.25	0.31	-9.4	0.035	2.4
		Min	<0.2	0.23	603	0.30	<10	30	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.65	<10	<1	0.090	10	<1	<0.01	10	<1	<0.01	1.0	60	14	0.010	3.0	1.0	5.0	<20	<0.01	<10	<10	2.0	<10	3.0	483	0.25	0.31	-10	0.032	0.94
Granite	Transition	**n**	45	27	27	93	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
		n <DL	18	0	0	0	16	0	12	25	10	27	5	0	4	0	27	10	0	0	3	3	0	10	14	8	0	0	2	0	11	3	3	27	27	10	2	27	1	-	-	-	-	-	-
		Max	8.9	1.1	10000	17	10	90	1.9	2.0	0.51	<0.5	4.0	15	9.0	5.8	<10	10	0.31	30	8.0	0.13	719	3.0	0.030	2.0	590	34	0.91	268	8.0	30	40	<0.01	<10	70	13	<10	60	8850	13	28	6.5	5.6	*Non-reactive*
		95th PCTL	8.5	0.96	6086	10.0	10	90	1.1	0.80	0.067	<0.5	3.0	8.7	7.7	4.3	<10	4.1	0.29	27	2.7	0.030	231	3.0	0.017	2.0	428	31	0.63	143	4.8	28	30	<0.01	<10	44	13	<10	44	5481	1.7	20	1.4	4.8	*Non-reactive*
		90th PCTL	4.9	0.95	5766	6.9	10	78	0.98	<2	0.060	<0.5	3.0	8.0	5.2	3.0	<10	1.4	0.28	20	2.0	0.024	208	3.0	0.010	2.0	330	30	0.49	89	2.0	23	30	<0.01	<10	24	10	<10	35	5086	1.5	15	1.2	4.3	*Non-reactive*
		75th PCTL	2.1	0.61	3715	3.3	10	55	0.75	<2	0.050	<0.5	2.0	7.0	2.5	1.6	<10	1.0	0.23	20	2.0	0.020	119	2.0	0.010	2.0	205	27	0.27	42	1.0	21	30	<0.01	<10	10	6.5	<10	20	3465	1.3	8.3	0.19	1.6	5014
		Median	0.20	0.48	2200	1.5	<10	40	0.50	<2	0.020	<0.5	1.0	5.0	2.0	1.2	<10	1.0	0.21	20	1.0	0.010	67	1.0	<0.01	1.0	110	19	0.16	12	1.0	12	30	<0.01	<10	10	3.0	<10	12	2181	0.50	5.0	-3.4	0.12	8.8
		25th PCTL	<0.2	0.42	1650	0.72	<10	30	<0.5	<2	<0.01	<0.5	1.0	3.5	2.0	0.83	<10	<1	0.17	10	1.0	0.010	26	<1	<0.01	<1	70	15	0.015	8.0	<1	6.5	20	<0.01	<10	<10	1.0	<10	3.0	960	0.25	0.47	-8.0	0.038	5.5
		10th PCTL	<0.2	0.36	1125	0.44	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.61	<10	<1	0.12	10	<1	0.0020	18	<1	<0.01	<1	60	12	0.010	4.2	<1	0.20	4.0	<0.01	<10	<10	1.0	<10	2.0	550	0.25	0.31	-15	0.031	1.6
		5th PCTL	<0.2	0.33	706	0.40	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.54	<10	<1	0.11	10	<1	<0.01	13	<1	<0.01	<1	60	12	<0.01	3.0	<1	<1	<20	<0.01	<10	<10	<0.4	<10	2.0	477	0.25	0.31	-19	0.022	1.0
		Min	<0.2	0.23	603	0.30	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.42	<10	<1	0.090	10	<1	<0.01	10	<1	<0.01	<1	40	9.0	<0.01	3.0	<1	<1	<20	<0.01	<10	<10	<1	<10	<2	396	0.25	0.31	-27	0.016	0.63
Granite	All	**n**	189	168	168	243	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168
		n <DL	117	0	0	0	147	1	71	139	18	168	32	0	7	0	167	57	0	0	8	8	0	35	111	37	0	0	60	0	46	3	25	168	167	54	3	168	8	-	-	-	-	-	-
		Max	9.4	1.2	10000	20	10	430	2.1	4.0	0.51	<0.5	11	15	21	11	10	10	0.33	30	8.0	0.13	23700	8.0	0.030	6.0	940	59	0.91	468	8.0	124	40	<0.01	10	160	24	<10	165	8850	13	28	6.5	11	*Non-reactive*
		95th PCTL	3.4	0.91	7190	8.9	10	177	1.1	2.0	0.10	<0.5	7.0	8.0	8.7	4.3	<10	3.0	0.27	30	2.7	0.030	2619	3.0	0.010	3.0	330	35	0.25	169	4.7	59	30	<0.01	<10	60	15	<10	57	4687	2.5	7.8	2.2	6.9	*Non-reactive*
		90th PCTL	0.94	0.69	5494	5.5	10	143	0.90	2.0	0.083	<0.5	5.0	7.0	5.0	3.7	<10	2.0	0.24	23	2.0	0.020	1551	3.0	0.010	2.0	233	30	0.15	93	3.0	48	30	<0.01	<10	40	11	<10	48	3867	2.1	4.8	1.7	6.4	*Non-reactive*
		75th PCTL	0.20	0.55	3293	2.7	<10	90	0.70	<2	0.070	<0.5	3.0	6.0	3.0	2.1	<10	1.0	0.21	20	1.0	0.020	485	2.0	0.010	2.0	170	24	0.030	36	1.0	32	30	<0.01	<10	20	4.0	<10	32	2606	1.8	0.94	1.4	5.6	*Non-reactive*
		Median	<0.2	0.48	2035	1.3	<10	55	0.50	<2	0.060	<0.5	2.0	4.5	2.0	1.5	<10	1.0	0.18	20	1.0	0.010	117	1.0	<0.01	1.0	120	19	0.010	15	1.0	20	30	<0.01	<10	10	2.0	<10	19	1201	1.5	0.31	0.94	3.2	*Non-reactive*
		25th PCTL	<0.2	0.39	1353	0.67	<10	40	<0.5	<2	0.030	<0.5	1.0	3.0	2.0	1.0	<10	<1	0.14	20	1.0	0.010	37	1.0	<0.01	1.0	80	16	<0.01	10	<1	13	20	<0.01	<10	<10	1.0	<10	5.8	674	0.75	0.31	-0.13	0.80	0.80
		10th PCTL	<0.2	0.34	901	0.44	<10	30	<0.5	<2	<0.01	<0.5	<1	2.0	1.0	0.80	<10	<1	0.12	10	0.00	0.010	21	<1	<0.01	<1	60	14	<0.01	6.7	<1	9.0	<20	<0.01	<10	<10	1.0	<10	3.0	509	0.25	0.31	-3.7	0.12	0.12
		5th PCTL	<0.2	0.32	707	0.38	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	1.0	0.74	<10	<1	0.10	10	0.00	0.010	18	<1	<0.01	<1	60	12	<0.01	5.0	<1	7.4	<20	<0.01	<10	<10	1.0	<10	2.0	464	0.25	0.31	-7.6	0.046	0.046
		Min	<0.2	0.17	581	0.30	<10	<10	<0.5	<2	<0.01	<0.5	<1	1.0	<1	0.38	<10	<1	0.060	10	<1	<0.01	10	<1	<0.01	<1	40	9.0	<0.01	2.0	<1	<1	<20	<0.01	<10	<10	<1	<10	<2	341	0.25	0.31	-27	0.016	0.016

Appendix C.2-4: Statistical Summary of Exploration Assay Database (Au > 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t
Other Lithologies																																													
Other	Oxide	**n**	902	901	901	2153	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901
		n <DL	288	0	0	0	859	0	76	760	0	879	27	2	5	0	894	321	0	16	0	0	0	319	288	76	0	2	236	1	63	0	630	840	896	503	5	875	3	-	-	-	-	-	-
		Max	4.3	2.9	10000	106	10	3480	5.3	5.0	12	1.1	111	193	148	11	10	8.0	1.5	60	68	5.1	28100	12	0.070	251	1890	194	4.0	10000	33	713	50	0.12	10	160	272	20	221	9178	290	125	289	712	*Non-reactive*
		95th PCTL	1.0	1.0	6270	21	*<10*	1190	2.1	2.0	6.5	*<0.5*	33	53	44	6.9	*<10*	3.0	0.38	40	42	2.1	1475	5.0	0.030	44	950	30	0.63	390	17	278	30	0.010	*<10*	50	89	*<10*	98	2027	163	20	154	218	*Non-reactive*
		90th PCTL	0.80	0.86	4700	12	*<10*	660	1.8	2.0	4.9	*<0.5*	27	41	35	5.9	*<10*	2.0	0.34	30	34	1.5	1135	4.0	0.020	36	740	24	0.32	232	14	205	30	*<0.01*	*<10*	30	67	*<10*	85	1357	121	10	117	136	*Non-reactive*
		75th PCTL	0.50	0.66	3310	4.5	*<10*	370	1.4	*<2*	2.4	*<0.5*	16	20	23	4.1	*<10*	1.0	0.29	30	14	0.47	760	2.0	0.010	22	540	17	0.080	103	7.0	124	20	*<0.01*	*<10*	20	32	*<10*	64	853	59	2.5	48	26	*Non-reactive*
		Median	0.20	0.52	1925	1.8	*<10*	200	1.0	*<2*	0.20	*<0.5*	10	12	12	2.8	*<10*	1.0	0.25	20	2.0	0.060	523	1.0	0.010	11	280	13	0.020	41	4.0	63	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	39	588	5.0	0.63	3.7	7.0	23
		25th PCTL	*<0.2*	0.41	924	0.85	*<10*	110	0.60	*<2*	0.080	*<0.5*	4.0	6.0	6.0	1.9	*<10*	*<1*	0.20	10	1.0	0.030	243	*<1*	*<0.01*	3.0	160	10	*<0.01*	17	2.0	33	*<20*	*<0.01*	*<10*	*<10*	7.0	*<10*	21	421	2.0	0.31	1.2	2.7	1.9
		10th PCTL	*<0.2*	0.34	440	0.48	*<10*	60	0.50	*<2*	0.040	*<0.5*	2.0	4.0	3.0	1.1	*<10*	*<1*	0.16	10	1.0	0.020	63	*<1*	*<0.01*	1.0	90	7.0	*<0.01*	9.0	1.0	21	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	11	306	1.0	0.31	0.063	1.1	0.63
		5th PCTL	*<0.2*	0.30	312	0.38	*<10*	50	*<0.5*	*<2*	0.030	*<0.5*	1.0	3.0	2.0	0.89	*<10*	*<1*	0.15	10	0.00	0.010	40	*<1*	*<0.01*	*<1*	70	6.0	*<0.01*	6.0	*<1*	16	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	8.0	239	0.75	0.31	-1.8	0.48	0.63
		Min	*<0.2*	0.17	117	0.30	*<10*	20	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.42	*<10*	*<1*	0.080	*<10*	0.00	0.010	8.0	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	129	0.25	0.31	-52	0.0048	0.63
Other	Upper Transition	**n**	350	327	327	1204	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327
		n <DL	76	0	0	0	308	0	81	264	0	314	76	1	1	0	327	198	0	3	0	0	1	152	126	98	0	1	58	0	79	0	256	318	325	274	8	323	0	-	-	-	-	-	-
		Max	206	2.0	10000	109	10	1430	2.2	4.0	10	2.1	37	197	1180	5.8	*<10*	33	1.1	60	59	4.0	4130	34	0.040	342	1150	122	4.2	5020	18	509	40	0.10	10	110	64	1350	379	8772	250	132	250	800	*Non-reactive*
		95th PCTL	1.2	0.86	6367	9.5	10	570	1.6	3.0	6.8	*<0.5*	20	44	34	4.4	*<10*	2.0	0.40	40	46	2.8	912	3.0	0.030	53	771	53	1.6	595	8.7	340	20	*<0.01*	*<10*	20	32	*<10*	77	2189	171	48	149	168	*Non-reactive*
		90th PCTL	1.0	0.73	5418	6.9	*<10*	406	1.4	2.0	5.5	*<0.5*	17	33	28	3.9	*<10*	1.0	0.37	30	42	2.2	832	2.0	0.020	36	564	32	1.2	208	8.0	278	20	*<0.01*	*<10*	10	28	*<10*	63	1488	138	37	120	70	*Non-reactive*
		75th PCTL	0.60	0.61	2655	3.5	*<10*	255	1.0	*<2*	3.8	*<0.5*	11	16	17	2.9	*<10*	1.0	0.32	30	32	1.3	714	1.0	0.010	20	400	23	0.55	45	4.0	164	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	48	928	96	17	70	14	*Non-reactive*
		Median	0.38	0.50	1465	1.5	*<10*	160	0.70	*<2*	0.52	*<0.5*	7.0	8.0	9.0	2.3	*<10*	*<1*	0.28	30	6.0	0.11	424	1.0	0.010	6.0	170	16	0.030	18	2.0	55	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	35	669	13	0.94	11	4.0	34
		25th PCTL	0.20	0.45	452	0.79	*<10*	90	0.50	*<2*	0.060	*<0.5*	1.0	3.0	4.0	0.88	*<10*	*<1*	0.24	20	2.0	0.020	83	*<1*	*<0.01*	*<1*	80	12	0.010	10	1.0	21	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	15	521	1.5	0.31	0.94	2.4	6.1
		10th PCTL	*<0.2*	0.35	259	0.47	*<10*	56	*<0.5*	*<2*	0.040	*<0.5*	*<1*	2.0	3.0	0.54	*<10*	*<1*	0.19	10	1.0	0.010	40	*<1*	*<0.01*	*<1*	70	8.0	*<0.01*	6.0	*<1*	14	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	8.0	377	1.0	0.31	0.13	1.1	0.63
		5th PCTL	*<0.2*	0.30	218	0.38	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	*<1*	2.0	2.0	0.46	*<10*	*<1*	0.17	10	1.0	0.010	26	*<1*	*<0.01*	*<1*	60	7.0	*<0.01*	5.0	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	310	0.75	0.31	-1.7	0.44	0.63
		Min	*<0.2*	0.24	117	0.30	*<10*	20	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.37	*<10*	*<1*	0.080	*<10*	0.00	0.010	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	2.0	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	2.0	66	0.25	0.31	-47	0.0053	0.63
Other	Lower Transition	**n**	111	76	76	368	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
		n <DL	24	0	0	0	66	0	9	67	2	76	2	0	0	0	74	26	0	1	0	0	0	33	24	21	0	0	2	1	4	0	68	62	73	56	4	75	0	-	-	-	-	-	-
		Max	19	2.9	10000	121	10	1450	2.7	3.0	5.4	*<0.5*	111	178	73	7.7	10	33	1.5	50	46	2.5	4920	4.0	0.080	71	1600	66	4.0	2180	22	449	40	0.19	10	140	95	10	125	5874	134	125	134	429	*Non-reactive*
		95th PCTL	10	1.5	10000	13	10	425	1.8	2.0	4.0	*<0.5*	28	56	58	5.0	*<10*	20	0.57	30	36	1.9	944	3.0	0.033	39	753	30	2.2	1275	17	233	23	0.090	*<10*	23	70	*<10*	63	5525	100	69	62	40	*Non-reactive*
		90th PCTL	4.5	1.2	9460	8.2	10	315	1.2	2.0	3.8	*<0.5*	16	30	46	3.9	*<10*	2.0	0.50	30	36	1.5	828	2.0	0.030	26	640	30	1.8	439	9.0	179	0.00	0.030	*<10*	20	52	*<10*	60	5318	96	57	55	31	*Non-reactive*
		75th PCTL	1.1	0.93	6300	3.8	*<10*	203	1.0	*<2*	3.5	*<0.5*	11	20	28	2.8	*<10*	1.0	0.40	20	31	1.3	702	1.0	0.020	15	563	20	1.5	109	6.3	129	*<20*	*<0.01*	*<10*	10	20	*<10*	48	3103	88	46	32	2.7	57
		Median	0.40	0.67	2720	1.7	*<10*	150	0.80	*<2*	0.45	*<0.5*	7.5	6.0	13	2.4	*<10*	1.0	0.31	20	12	0.28	380	1.0	0.010	2.0	250	14	1.1	39	4.0	59	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	38	1049	11	35	6.9	1.3	43
		25th PCTL	0.20	0.55	1518	0.81	*<10*	98	0.50	*<2*	0.21	*<0.5*	2.0	2.0	6.8	1.9	*<10*	*<1*	0.24	10	3.0	0.10	70	*<1*	*<0.01*	*<1*	160	11	0.13	11	2.0	29	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	24	541	5.3	3.9	-21	0.19	29
		10th PCTL	*<0.2*	0.45	208	0.42	*<10*	60	*<0.5*	*<2*	0.010	*<0.5*	1.0	1.0	4.5	1.5	*<10*	*<1*	0.18	10	1.0	0.010	22	*<1*	*<0.01*	*<1*	115	8.0	0.010	6.5	1.0	23	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.5	151	0.25	0.31	-33	0.036	3.4
		5th PCTL	*<0.2*	0.44	111	0.36	*<10*	50	*<0.5*	*<2*	0.010	*<0.5*	1.0	1.0	2.0	1.1	*<10*	*<1*	0.16	10	1.0	0.010	17	*<1*	*<0.01*	*<1*	78	6.0	0.010	4.8	0.50	19	*<20*	*<0.01*	*<10*	*<10*	0.50	*<10*	3.8	47	0.25	0.31	-41	0.019	0.94
		Min	*<0.2*	0.40	7.0	0.31	*<10*	30	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	2.0	0.67	*<10*	*<1*	0.10	*<10*	0.00	0.010	10	*<1*	*<0.01*	*<1*	40	3.0	*<0.01*	*<2*	*<1*	13	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	3.0	2.4	0.25	0.31	-43	0.0058	0.63
Other	Transition	**n**	461	403	403	1572	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403
		n <DL	100	0	0	0	374	0	90	331	2	390	78	1	1	0	401	224	0	4	0	0	1	185	150	119	0	1	60	1	83	0	324	380	398	330	12	398	0	-	-	-	-	-	-
		Max	206	2.9	10000	121	10	1450	2.7	4.0	10	2.1	111	197	1180	7.7	10	33	1.5	60	59	4.0	4920	34	0.080	342	1600	122	4.2	5020	22	509	40	0.19	10	140	95	1350	379	8772	250	132	250	800	*Non-reactive*
		95th PCTL	3.2	1.0	9249	11	10	570	1.6	2.0	6.7	*<0.5*	20	48	38	4.4	*<10*	3.0	0.47	40	45	2.7	933	3.0	0.030	51	777	47	1.8	715	9.0	312	20	0.010	*<10*	20	43	*<10*	76	4479	168	55	142	128	*Non-reactive*
		90th PCTL	1.2	0.84	6270	7.0	*<10*	390	1.4	2.0	5.2	*<0.5*	17	32	32	3.9	*<10*	2.0	0.40	30	39	2.2	835	2.0	0.020	36	600	31	1.5	254	8.0	267	20	*<0.01*	*<10*	10	31	*<10*	62	2464	131	46	113	57	*Non-reactive*
		75th PCTL	0.70	0.68	3275	3.6	*<10*	240	1.0	*<2*	3.7	*<0.5*	11	16	19	2.9	*<10*	1.0	0.33	30	32	1.3	710	1.0	0.020	20	415	22	0.84	54	5.0	158	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	48	1107	93	26	59	11	*Non-reactive*
		Median	0.40	0.53	1570	1.5	*<10*	160	0.70	*<2*	0.46	*<0.5*	7.0	8.0	9.0	2.3	*<10*	*<1*	0.29	20	6.0	0.13	417	1.0	0.010	4.0	200	16	0.080	18	3.0	56	*<20*	*<0.01*	*<10*	*<10*	7.0	*<10*	36	675	12	2.5	9.2	3.9	39
		25th PCTL	0.20	0.46	512	0.79	*<10*	90	0.50	*<2*	0.060	*<0.5*	1.0	3.0	4.0	1.2	*<10*	*<1*	0.24	20	2.0	0.020	80	*<1*	*<0.01*	*<1*	80	12	0.010	10	1.0	26	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	15	527	1.5	0.31	0.69	1.6	7.7
		10th PCTL	*<0.2*	0.37	254	0.47	*<10*	60	*<0.5*	*<2*	0.040	*<0.5*	*<1*	2.0	3.0	0.55	*<10*	*<1*	0.19	10	1.0	0.010	39	*<1*	*<0.01*	*<1*	70	8.0	*<0.01*	6.0	*<1*	15	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	8.0	361	1.0	0.31	-3.6	0.33	0.94
		5th PCTL	*<0.2*	0.31	207	0.37	*<10*	40	*<0.5*	*<2*	0.010	*<0.5*	*<1*	1.0	2.0	0.47	*<10*	*<1*	0.17	10	1.0	0.010	23	*<1*	*<0.01*	*<1*	60	7.0	*<0.01*	5.0	*<1*	12	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	6.1	246	0.25	0.31	-24	0.12	0.63
		Min	*<0.2*	0.24	7.0	0.30	*<10*	20	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.37	*<10*	*<1*	0.080	*<10*	0.00	0.010	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	2.0	2.4	0.25	0.31	-47	0.0053	0.63
Other	All	**n**	1363	1304	1304	3725	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304
		n <DL	388	0	0	0	1233	0	166	1091	2	1269	105	3	6	0	1295	545	0	20	0	0	1	504	438	195	0	3	296	2	146	0	954	1220	1294	833	17	1273	3	-	-	-	-	-	-
		Max	206	2.9	10000	121	10	3480	5.3	5.0	12	2.1	111	197	1180	11	10	33	1.5	60	68	5.1	28100	34	0.080	342	1890	194	4.2	10000	33	713	50	0.19	10	160	272	1350	379	9178	290	132	289	800	*Non-reactive*
		95th PCTL	1.2	1.0	6762	17	10	920	2.0	2.0	6.6	*<0.5*	31	53	41	6.4	*<10*	3.0	0.40	40	43	2.3	1347	5.0	0.030	46	878	35	1.4	433	16	289	30	0.010	*<10*	50	78	*<10*	94	2747	165	45	152	214	*Non-reactive*
		90th PCTL	0.90	0.85	5190	9.6	*<10*	570	1.7	2.0	5.0	*<0.5*	23	39	34	5.3	*<10*	2.0	0.36	30	37	1.6	1035	3.0	0.020	36	710	26	0.87	242	11	221	20	*<0.01*	*<10*	30	53	*<10*	82	1518	125	27	117	111	*Non-reactive*
		75th PCTL	0.50	0.66	3315	4.1	*<10*	330	1.3	*<2*	3.0	*<0.5*	14	20	22	3.7	*<10*	1.0	0.30	30	23	0.85	745	2.0	0.010	22	500	19	0.17	93	7.0	132	20	*<0.01*	*<10*	10	27	*<10*	57	919	75	5.3	54	22	*Non-reactive*
		Median	0.30	0.52	1793	1.7	*<10*	180	0.90	*<2*	0.26	*<0.5*	9.0	10	11	2.6	*<10*	1.0	0.26	20	3.0	0.070	500	1.0	0.010	10	260	14	0.020	32	3.0	60	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	37	620	6.4	0.63	4.3	6.0	59
		25th PCTL	*<0.2*	0.43	828	0.82	*<10*	110	0.60	*<2*	0.070	*<0.5*	3.0	6.0	5.0	1.7	*<10*	*<1*	0.21	10	1.0	0.030	172	*<1*	*<0.01*	2.0	130	11	0.010	14	2.0	29	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	20	446	1.8	0.31	0.94	2.4	2.6
		10th PCTL	*<0.2*	0.34	340	0.47	*<10*	60	*<0.5*	*<2*	0.040	*<0.5*	1.0	3.0	3.0	0.89	*<10*	*<1*	0.17	10	1.0	0.020	50	*<1*	*<0.01*	*<1*	80	8.0	*<0.01*	8.0	*<1*	18	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	9.3	318	1.0	0.31	-0.42	0.89	0.89
		5th PCTL	*<0.2*	0.31	255	0.38	*<10*	50	*<0.5*	*<2*	0.030	*<0.5*	*<1*	2.0	2.0	0.57	*<10*	*<1*	0.15	10	1.0	0.010	32	*<1*	*<0.01*	*<1*	60	6.0	*<0.01*	6.0	*<1*	14	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	239	0.75	0.31	-4.1	0.28	0.28
		Min	*<0.2*	0.17	7.0	0.30	*<10*	20	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.37	*<10*	*<1*	0.080	*<10*	0.00	0.010	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	2.4	0.25	0.31	-52	0.0048	0.0048

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.3: Static Test Results for Leach Tailings

Appendix C.3-1: Acid-Base Accounting Results for Leach Tailings Solids

Metallurgical ID (leach tailings)	Head Sample ID (ore)	Oxidation Facies	Lithology	Sample Description	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	Insoluble-S	T-AP	S-AP	Total-C	TIC	CaNP	Sobek NP	Siderite NP	CaNNP	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
					s.u.	s.u.	%	%	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	CaNP/T-AP	CaNP/S-AP	Sobek/T-AP	Siderite/T-AP
Tailings derived from Gneiss Oxide Ore																								
73004	72134	Oxide	Gneiss	Supremo Mine Block (1")	9.7	9.2	0.01	*<0.01*	*<0.01*	0.01	0.22	*<0.3*	0.042	0.020	1.7	3.5	12	1.4	3.5	12	7.6	5.6	16	55
73013	72142	Oxide	Gneiss	Supremo #1	9.6	9.3	0.01	*<0.01*	*<0.01*	0.01	0.44	*<0.3*	0.041	0.020	1.7	6.2	13	1.2	6.2	13	3.8	5.6	14	29
73022	72143	Oxide	Gneiss	Supremo #2	9.7	9.3	0.02	*<0.01*	*<0.01*	0.02	0.47	*<0.3*	0.041	0.020	1.7	2.2	8.7	1.2	2.2	8.7	3.6	5.6	4.7	19
73028	72144	Oxide	Gneiss	Supremo Oxide T1	9.6	9.3	0.03	0.01	*<0.01*	0.02	1.0	0.31	0.12	0.11	9.2	12	18	8.1	12	17	8.9	29	11	17
73034	72145	Oxide	Gneiss	Supremo Oxide T4	9.7	9.2	0.02	0.01	*<0.01*	0.01	0.69	0.31	0.37	0.36	30	30	36	29	29	36	44	96	43	53
Tailings derived from GneissTransition Ore																								
73040	72146	Transition	Gneiss	Supremo 80%	9.5	9.2	0.10	0.05	0.02	0.03	3.0	1.6	0.43	0.42	35	38	44	32	36	42	12	22	12	14
Tailings derived from Schist/Gneiss Oxide Ore																								
72186	72141	Oxide	Schist/Gneiss	DD oxide	9.6	9.3	0.13	0.1	0.01	0.02	4.0	3.1	1.0	1.0	84	79	83	80	76	80	21	27	20	21
Tailings derived from Schist Oxide Ore																								
72117	72101	Oxide	Schist	Latte -583150 Trench (6")	9.6	9.1	0.04	*<0.01*	0.02	0.02	1.1	*<0.3*	0.81	0.78	65	65	69	64	65	69	59	217	59	63
72123	72102	Oxide	Schist	Latte 583350 Trench (6")	9.7	9.2	0.05	0.02	0.02	0.01	1.5	0.63	1.2	1.2	97	96	119	95	95	118	64	155	64	79
73001	72133	Oxide	Schist	Latte mine block (1")	9.5	8.9	0.05	*<0.01*	0.04	0.01	1.6	*<0.3*	0.039	0.020	1.7	5.6	15	0.073	5.6	15	1.0	5.6	3.5	9.3
72150	72135	Oxide	Schist	Latte Oxide West	8.6	8.6	0.11	0.07	0.02	0.02	3.4	2.2	1.7	1.6	137	124	154	133	122	151	40	62	36	45
72156	72136	Oxide	Schist	Latte Oxide East	9.6	9.1	0.09	0.06	0.02	0.01	2.7	1.9	1.1	1.0	83	79	85	81	78	83	31	44	29	31
Tailings derived from Schist Transition Ore																								
72162	72137	Transition	Schist	Latte 80%'	8.9	8.4	0.41	0.33	0.04	0.04	13	10	2.1	1.9	158	146	175	146	136	165	12	15	11	14
72168	72138	Transition	Schist	Latte 60%	8.9	8.6	0.47	0.39	0.03	0.05	15	12	1.6	1.6	130	127	155	115	114	143	8.9	11	8.7	11
Tailings derived from Granite Oxide Ore																								
72174	72139	Oxide	Granite	Kona Oxide	9.7	9.2	0.03	0.02	*<0.01*	0.01	1.0	0.63	0.034	0.020	1.7	0.37	8.3	0.64	-0.26	7.7	1.6	2.7	0.35	8.1
Tailings derived from Granite Transition Ore																								
72180	72140	Transition	Granite	Kona 80% CN	9.7	8.9	0.18	0.14	0.01	0.03	5.5	4.4	0.045	0.030	2.5	0.61	7.6	-3.0	-3.8	3.2	0.45	0.57	0.11	1.4

Notes: all values in grey italics are below the analytical detection limit.
All samples are composed of the 12.5 mm particle size fraction of leach tailings
Sulphate Sulphur determined by 25% HCL with Gravimetric Finish.
Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP-MS Finish.
AP = Acid potential in tonnes CaCO3 equivalent per 1000 tonnes of material, T-AP is derived from Total-S*31.25 and S-AP is derived from Sulphide-S*31.25.
NP = Neutralization potential in tonnes CaCO3 equivalent per 1000 tonnes of material.
Carbonate NP (CaNP) is calculated from total inorganic carbon (TIC); T-C NP* calculated from Total-C * 77.6.
Net NP (NNP) = NP - AP; Neutralization potential ratio (NPR).

Appendix C.3-2: Solid Phase Element Results by Aqua Regia Digestion for Leach Tailings Solids

Metallurgical ID (leach tailings)	Head Sample ID (ore)	Oxidation Facies	Lithology	Sample Description	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
					ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Tailings derived from Gnaiess Oxide Ore																																																												
73004	72101	Oxide	Gneiss	Supremo Mine Block (1")	0.25	0.45	2660	*<10*	318	1.0	0.45	0.21	0.20	74	15	122	1.7	20	4.4	1.6	*<0.1*	0.070	1.4	0.030	0.29	38	*<1*	0.17	0.070	682	6.5	0.060	*<0.1*	58	0.040	9.3	14	*<0*	97	4.7	*<1*	0.50	17	*<0.1*	0.51	0.22	13	*<0*	3.3	23	26	0.60	11	1.1	40	2.5
73013	72102	Oxide	Gneiss	Supremo #1	0.12	0.77	1060	*<10*	337	0.90	0.23	0.22	0.12	47	13	137	1.9	8.5	2.9	2.4	*<0.1*	0.15	0.56	0.030	0.29	25	3.0	0.16	0.27	793	4.7	0.050	0.070	70	0.041	14	16	0.010	41	8.9	*<1*	0.50	19	*<0.1*	0.37	0.10	17	0.010	1.6	20	36	0.40	10	1.1	42	6.7
73022	72133	Oxide	Gneiss	Supremo #2	0.060	0.48	588	*<10*	147	0.80	0.49	0.12	0.070	49	6.3	93	0.82	11	1.8	1.6	*<0.1*	0.20	0.13	*<0.02*	0.17	27	2.0	0.14	0.10	281	5.0	0.030	0.080	12	0.026	11	10	*<0*	40	3.5	*<1*	0.40	20	*<0.1*	0.33	0.17	24	*<0*	0.28	6.9	25	0.40	9.7	1.0	21	7.5
73028	72135	Oxide	Gneiss	Supremo Oxide T1	0.090	0.49	969	*<10*	196	1.2	0.32	0.38	0.090	63	8.5	98	1.6	7.7	2.3	1.6	*<0.1*	0.18	0.60	*<0.02*	0.26	34	2.0	0.19	0.16	472	4.8	0.030	0.070	14	0.036	14	14	0.030	55	4.4	*<1*	0.50	42	*<0.1*	0.43	0.090	25	*<0*	0.56	18	24	0.80	12	1.3	41	6.5
73034	72136	Oxide	Gneiss	Supremo Oxide T4	0.15	0.46	1040	*<10*	187	1.0	0.18	1.3	0.060	58	4.4	110	2.0	6.6	1.5	1.5	*<0.1*	0.13	1.1	*<0.02*	0.22	34	1.0	0.16	0.14	315	5.4	0.040	0.060	16	0.020	13	13	0.020	31	2.3	*<1*	1.4	30	*<0.1*	0.34	*<0.1*	27	*<0*	1.0	12	11	0.40	11	1.1	21	4.5
Tailings derived from Gneiss Transition Ore																																																											
73040	72137	Transition	Gneiss	Supremo 80%	0.060	0.70	1760	*<10*	302	0.90	0.57	1.2	0.080	64	6.8	126	2.6	2.3	2.0	2.3	*<0.1*	0.16	1.1	0.020	0.37	36	4.0	0.17	0.52	488	6.4	0.040	0.12	23	0.029	13	22	0.090	22	2.8	*<1*	0.80	46	*<0.1*	0.39	0.23	25	0.020	2.0	12	18	0.40	11	1.1	29	5.7
Tailings derived from Schist/Gneiss Oxide Ore																																																											
72186	72138	Oxide	Schist/Gneiss	DD oxide	0.060	0.76	1410	*<10*	291	1.2	0.80	2.7	0.11	53	13	120	2.9	10	3.2	2.5	*<0.1*	0.12	0.41	0.030	0.29	29	3.0	0.16	0.81	569	4.1	0.050	0.050	34	0.032	14	17	0.12	43	5.9	*<1*	0.60	63	*<0.1*	0.41	0.16	16	*<0*	0.29	4.9	27	1.6	11	1.1	42	4.0
Tailings derived from Schist Oxide Ore																																																											
72117	72139	Oxide	Schist	Latte -583150 Trench (6")	0.070	0.76	1120	*<10*	822	0.90	0.82	2.3	0.080	70	14	102	2.2	33	3.3	2.5	*<0.1*	0.12	0.20	0.020	0.30	35	4.0	0.24	0.54	552	3.8	0.050	0.060	43	0.057	12	15	0.030	138	5.5	*<1*	0.30	62	*<0.1*	0.64	0.070	12	0.010	0.47	1.7	30	0.30	18	1.6	62	5.0
72123	72140	Oxide	Schist	Latte 583350 Trench (6")	0.080	0.53	1580	*<10*	926	0.60	0.50	3.7	0.15	66	13	88	1.7	25	3.2	2.0	*<0.1*	0.13	0.57	0.030	0.27	35	2.0	0.20	0.44	723	3.6	0.040	0.080	30	0.070	16	13	0.050	53	4.9	*<1*	*<0.3*	90	*<0.1*	0.51	0.080	13	*<0*	0.75	2.1	24	1.0	14	1.3	58	4.8
73001	72134	Oxide	Schist	Latte mine block (1")	0.64	0.44	9020	*<10*	636	0.90	0.50	0.50	0.13	85	11	90	2.4	25	3.9	1.2	*<0.1*	0.060	0.81	0.040	0.23	46	1.0	0.23	0.050	627	3.6	0.050	*<0.1*	33	0.058	16	10	0.040	243	5.3	*<1*	*<0.3*	103	*<0.1*	0.62	0.33	10	*<0*	1.4	4.5	13	0.50	16	1.5	75	1.7
72150	72142	Oxide	Schist	Latte Oxide West	0.13	0.40	1380	*<10*	310	1.1	0.37	4.1	0.10	54	12	126	1.6	21	2.7	1.3	*<0.1*	0.12	0.31	*<0.02*	0.21	29	1.0	0.16	1.0	488	4.0	0.030	*<0.1*	102	0.033	14	9.9	0.11	26	3.9	*<1*	*<0.3*	115	*<0.1*	0.40	0.070	12	*<0*	0.24	2.1	16	1.3	12	1.1	46	3.7
72156	72143	Oxide	Schist	Latte Oxide East	0.060	0.52	1280	*<10*	387	1.1	0.39	2.9	0.15	59	12	109	2.5	12	2.8	2.0	*<0.1*	0.12	0.26	0.020	0.26	31	2.0	0.20	0.56	501	4.3	0.040	*<0.1*	56	0.039	15	13	0.090	27	4.5	*<1*	0.50	92	*<0.1*	0.52	0.060	12	*<0*	0.31	2.6	21	1.2	16	1.4	55	4.0
Tailings derived from Schist Transition Ore																																																											
72162	72144	Transition	Schist	Latte 80%'	0.11	0.65	1710	*<10*	329	0.80	0.45	5.0	0.090	57	13	88	2.0	15	2.5	2.2	*<0.1*	0.080	0.36	0.020	0.27	29	3.0	0.19	1.0	466	3.4	0.030	0.070	59	0.045	15	13	0.43	21	4.3	*<1*	0.40	133	*<0.1*	0.50	0.060	12	*<0*	0.61	2.6	20	0.40	14	1.3	50	2.5
72168	72145	Transition	Schist	Latte 60%	0.080	0.83	932	*<10*	344	0.90	0.46	4.0	0.10	57	11	103	3.1	20	2.8	3.1	*<0.1*	0.16	0.28	0.030	0.35	30	5.0	0.19	1.1	518	4.3	0.040	0.14	41	0.044	13	18	0.48	56	5.4	*<1*	0.60	144	*<0.1*	0.48	0.060	15	0.020	0.35	2.4	28	0.40	13	1.3	49	5.0
Tailings derived from Granite Oxide Ore																																																											
72174	72146	Oxide	Granite	Kona Oxide	0.030	0.44	4170	*<10*	91	0.60	0.080	0.12	0.050	28	1.4	93	1.2	2.2	1.5	1.5	*<0.1*	0.34	0.55	0.020	0.13	14	1.0	0.12	0.020	97	4.8	0.040	0.31	5.0	0.015	16	9.4	0.030	48	3.4	*<1*	0.40	23	*<0.1*	0.22	*<0.1*	24	*<0*	0.65	8.8	14	0.20	6.4	0.70	17	12
Tailings derived from Granite Transition Ore																																																											
72180	72141	Transition	Granite	Kona 80% CN	0.060	0.34	5880	*<10*	44	0.30	0.11	0.090	0.040	25	1.4	103	1.2	1.6	1.2	1.1	*<0.1*	0.26	3.0	*<0.02*	0.14	13	1.0	0.090	0.010	194	5.5	0.040	0.29	5.4	0.013	20	8.0	0.17	86	2.1	*<1*	0.30	20	*<0.1*	0.19	*<0.1*	18	*<0*	1.2	7.4	8.0	0.20	5.3	0.60	12	9.7

Notes: all values in grey italics are below the analytical detection limit.
All samples are composed of the 12.5 mm particle size fraction of leach tailings

Appendix C.3-3: Total and Dissolved Elements in Final Leachate from Cyanide Leach Tailings Columns

Lithology	Pit/Weathering Facies	Column ID	Head Sample ID	Column Particle size (p80)	Column mass	Conductivity	Hardness (as $CaCO_3$)	pH	TSS	TDS	T-Alk.	NH_3-N	Br	Cl	F	NO_3-N	NO_2-N	T-N	SO_4	WAD-CN	Total CN	Cyanate	SCN	T-Al	T-Sb	T-As	T-Ba	T-Be	T-Bi	T-Bo	T-Cd	T-Ca	T-Cs
				mm	kg	uS/cm	mg/L	s.u.	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Gneiss	Supremo #1	73010	72142	80	83	2570	8.8	9.8	275	1710	517	68	*<1*	21	*<0.4*	0.55	0.77	125	9.6	98	100	159	2.4	0.19	0.030	0.90	0.089	*<0.0002*	*<0.0001*	*<0.02*	0.0047	17	0.00020
Gneiss	Supremo #1	73013	72142	12.5	43	1530	11	10	277	869	491	43	*<0.5*	22	0.89	0.50	0.28	127	12	166	172	150	1.1	0.080	0.020	0.70	0.030	*<0.0002*	*<0.0001*	*<0.02*	0.00020	19	0.00020
Gneiss	Supremo #1	73007	72142	150	718	2340	132	9.9	328	1540	468	50	*<1*	15	*<0.4*	0.66	0.32	140	6.9	171	168	80	1.4	0.27	0.010	0.20	0.35	*<0.0002*	*<0.0001*	*<0.02*	0.038	98	0.00010
Gneiss	Supremo #2	73019	72143	80	86	2910	13	9.9	498	1950	883	79	*<1*	22	0.52	0.93	0.66	139	11	86	90	131	2.5	0.40	0.050	2.0	0.047	*<0.0005*	*<0.00025*	*<0.05*	0.0035	50	0.00010
Gneiss	Supremo #2	73022	72143	12.5	44	2010	8.0	10	286	1120	473	56	*<1*	192	0.65	0.58	0.28	124	12	129	134	200	1.4	0.30	0.020	0.70	0.024	*<0.0002*	*<0.0001*	0.037	0.00	22	0.00010
Gneiss	Supremo #2	73016	72143	150	741	2360	15	9.9	76	1570	678	74	*<1*	16	0.41	1.6	0.40	143	8.1	119	124	84	1.8	0.43	0.030	1.1	0.037	*<0.0002*	*<0.0001*	*<0.02*	0.027	18	0.00
Gneiss	Supremo Oxide T1	73025	72144	80	99	2600	3.8	9.9	701	1640	738	68	*<1*	22	*<0.4*	0.27	0.65	140	45	123	124	127	2.1	0.21	0.13	5.2	0.038	*<0.0002*	*<0.0001*	0.028	0.0029	57	0.0024
Gneiss	Supremo Oxide T1	73028	72144	12.5	50	1540	3.9	10	270	894	492	43	*<0.5*	24	0.76	0.32	0.35	109	42	123	126	168	1.3	0.13	0.040	3.6	0.033	*<0.0002*	*<0.0001*	0.023	0.00030	67	0.00010
Gneiss	Supremo Oxide T4	73031	72145	80	95	3130	7.8	9.8	595	2040	644	75	*<1*	25	*<0.4*	0.28	0.65	175	58	167	170	138	3.1	0.070	0.070	2.9	0.067	*<0.0005*	*<0.00025*	*<0.05*	0.0019	38	0.0011
Gneiss	Supremo Oxide T4	73034	72145	12.5	49	1540	7.7	10	310	911	418	56	*<0.5*	25	0.50	0.20	0.66	142	63	157	161	192	1.3	0.050	0.030	2.9	0.015	*<0.0002*	*<0.0001*	*<0.02*	0.00030	11	0.00010
Gneiss	Supremo Mine Block (1")	73004	72134	12.5	46	1770	9.2	10	58	992	676	40	*<0.5*	18	0.95	0.20	0.23	105	8.8	109	113	132	1.5	0.060	0.030	1.5	0.0050	*<0.0002*	*<0.0001*	*<0.02*	0.00060	2.7	0.00010
Gneiss	Supremo 80%	73037	72146	80	94	4250	6.5	9.8	690	2810	1180	80	*<1*	27	0.67	0.31	0.75	158	444	128	136	96	13	0.090	0.27	14	0.0070	*<0.0005*	*<0.00025*	*<0.05*	0.00090	1.6	0.0061
Gneiss	Supremo 80%	73040	72146	12.5	50	2780	17	10	305	1760	374	53	*<1*	30	0.94	0.20	0.72	136	744	150	156	188	7.8	0.080	0.18	7.4	0.0030	*<0.0002*	*<0.0001*	*<0.02*	0.00010	5.6	0.0010
Gneiss/Schist	DD oxide	72183	72141	80	95	3250	9.6	9.8	541	2230	564	89	*<1*	41	0.47	0.37	0.91	175	220	132	134	222	6.1	0.030	0.090	2.6	0.018	*<0.0005*	*<0.00025*	*<0.05*	0.0034	4.7	0.0033
Gneiss/Schist	DD oxide	72186	72141	12.5	50	1810	4.5	10	337	1060	439	60	*<1*	30	0.53	0.22	0.48	133	177	141	142	204	1.8	0.060	0.030	1.9	0.0040	*<0.0002*	*<0.0001*	*<0.02*	0.00010	1.8	0.00010
Schist	Latte mine block (1")	73001	72133	12.5	48	1450	9.6	10	50	820	458	40	*<0.5*	19	0.69	0.25	0.35	98	43	105	101	166	1.1	0.060	0.080	16	0.012	*<0.0002*	*<0.0001*	*<0.02*	0.00010	11	0.00020
Schist	Latte Oxide East	72153	72136	80	101	4300	8.2	9.8	18	3040	590	77	*<1*	26	0.71	0.65	1.3	156	725	117	119	149	6.4	0.050	0.090	6.2	0.014	*<0.0005*	*<0.00025*	*<0.05*	0.0076	6.5	0.0024
Schist	Latte Oxide East	72156	72136	12.5	50	2410	11	9.9	279	1520	366	60	*<1*	23	0.76	0.45	0.43	143	547	145	144	214	3.3	0.090	0.030	2.5	0.015	*<0.0002*	*<0.0001*	*<0.02*	0.00060	73	0.00040
Schist	Latte 80%'	72159	72137	80	94	7380	295	9.5	317	5630	322	103	*<2.5*	27	*<1*	0.26	1.0	198	2980	112	125	114	15	0.14	0.16	3.8	0.020	*<0.001*	*<0.0005*	*<0.1*	0.0037	209	0.010
Schist	Latte 80%'	72162	72137	12.5	50	5420	814	9.8	264	4040	301	61	*<2.5*	*<25*	*<1*	*0.25*	0.35	146	2370	157	168	215	6.5	0.080	0.040	1.1	0.011	*<0.0005*	*<0.00025*	*<0.05*	0.00010	381	0.0010
Schist	Latte 60%	72165	72138	80	84	6730	609	9.5	348	5280	229	87	*<2.5*	*<25*	*<1*	0.55	0.82	172	2570	86	99	204	34	0.13	0.22	2.6	0.025	*<0.0005*	*<0.00025*	*<0.05*	0.0023	361	0.0027
Schist	Latte 60%	72168	72138	12.5	49	5760	745	9.6	155	4510	223	83	*<2.5*	*<25*	*<1*	*0.25*	0.37	167	2670	119	134	262	7.4	0.040	0.050	0.60	0.0090	*<0.0005*	*<0.00025*	*<0.05*	0.00010	337	0.00090
Granite	Kona Oxide	72171	72139	80	104	3380	7.1	9.8	147	2340	738	83	*<1*	27	3.4	1.0	0.85	173	57	114	139	139	6.8	0.38	0.27	56	0.013	*<0.001*	*<0.0005*	*<0.1*	0.0061	50	0.0038
Granite	Kona Oxide	72174	72139	12.5	50	1790	5.4	10	246	1130	580	42	*<0.5*	21	3.4	0.55	0.30	129	38	149	164	163	2.0	0.43	0.17	41	0.0070	*<0.0005*	*<0.00025*	*<0.05*	0.00020	87	0.00010
Granite	Kona 80% CN	72177	72140	80	98	4050	9.2	9.7	286	2960	661	69	*<1*	23	1.8	0.23	0.74	194	666	125	179	140	48	0.59	0.78	75	0.018	*<0.001*	*<0.0005*	*<0.1*	0.0028	87	0.0054
Granite	Kona 80% CN	72180	72140	12.5	50	2670	15	10	193	1890	570	47	*<1*	22	2.4	0.33	0.47	144	424	123	168	172	15	1.5	1.1	98	0.0040	*<0.002*	*<0.001*	*<0.2*	*<0.0001*	56	0.00030

Notes: all values in grey italics are below the analytical detection limit

Appendix C.3-3: Total and Dissolved Elements in Final Leachate from Cyanide Leach Tailings Columns

Lithology	Pit/Weathering Facies	Column ID	T-Cr	T-Co	T-Cu	T-Fe	T-Pb	T-Li	T-Mg	T-Mn	T-Hg	T-Mo	T-Ni	T-P	T-K	T-Rb	T-Se	T-Si	T-Ag	T-Na	T-Sr	T-S	T-Te	T-Tl	T-Sn	T-Ti	T-W	T-U	T-V	T-Zn	T-Zr	D-Al	D-Sb	D-As	D-Ba	D-Be	D-Bi	D-Bo
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Gneiss	Supremo #1	73010	0.014	0.35	0.60	1.0	0.00062	*<0.002*	0.34	0.0030	0.0015	0.22	0.0045	0.19	6.2	0.0016	0.0016	4.2	0.000050	582	0.071	5.9	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.010	0.16	0.0023	0.43	*<0.0006*	0.18	0.028	0.81	0.064	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo #1	73013	0.014	0.080	0.17	1.2	0.00045	*<0.002*	0.79	0.71	0.00080	0.17	0.0053	0.55	14	0.026	0.00090	3.7	0.000040	315	0.049	5.4	*<0.0004*	*<0.00002*	*<0.0002*	0.00079	0.010	0.46	0.0023	0.038	*<0.0006*	0.056	0.015	0.71	0.0067	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo #1	73007	0.037	0.67	1.8	0.54	0.0043	*<0.002*	0.26	0.010	0.060	0.19	0.16	0.10	6.9	0.0011	0.0016	3.7	0.0013	454	0.24	4.1	*<0.0004*	0.00013	0.00021	0.0016	0.010	0.0050	0.0013	1.1	*<0.0006*	0.19	0.0097	0.17	0.29	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo #2	73019	0.025	0.56	0.61	1.2	0.0015	*<0.005*	0.29	0.010	0.00070	0.27	0.0028	1.1	11	0.0023	0.0040	5.5	0.000060	675	0.070	6.4	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.040	0.75	0.012	0.43	*<0.0015*	0.34	0.047	2.0	0.014	*<0.0005*	*<0.00025*	*<0.05*
Gneiss	Supremo #2	73022	0.014	0.19	0.090	1.3	0.0013	0.0086	0.51	0.38	0.00010	0.15	*<0.001*	0.27	11	0.0034	0.0018	4.6	0.000040	387	0.042	5.8	*<0.0004*	*<0.00002*	*<0.0002*	0.0024	0.020	0.17	0.0072	0.022	*<0.0006*	0.18	0.020	0.67	0.0029	*<0.0002*	*<0.0001*	0.036
Gneiss	Supremo #2	73016	0.053	1.2	1.8	1.7	0.0051	*<0.002*	0.16	0.010	0.015	0.44	0.068	0.36	5.5	0.0013	0.0053	5.7	0.00064	498	0.040	5.0	*<0.0004*	0.000031	0.00026	0.0014	0.030	0.16	0.011	1.2	*<0.0006*	0.37	0.028	1.0	0.026	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo Oxide T1	73025	0.023	0.53	1.1	0.42	0.0018	*<0.002*	0.33	0.030	0.0029	0.42	0.0029	0.59	13	0.013	0.00090	7.4	0.00024	551	0.071	19	*<0.0004*	0.000037	*<0.0002*	0.0011	0.12	0.42	0.0049	0.64	*<0.0006*	0.16	0.13	5.1	0.0097	*<0.0002*	*<0.0001*	0.026
Gneiss	Supremo Oxide T1	73028	0.021	0.31	0.32	0.32	0.00096	*<0.002*	0.32	0.080	0.0024	0.36	0.0027	0.46	9.2	0.0058	0.0010	6.2	0.00024	307	0.12	16	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.11	0.40	0.0049	0.062	*<0.0006*	0.11	0.036	3.6	0.0062	*<0.0002*	*<0.0001*	0.023
Gneiss	Supremo Oxide T4	73031	0.013	0.81	1.1	0.35	0.0011	*<0.005*	0.68	0.21	0.0043	0.24	*<0.0025*	0.23	15	0.0063	0.00090	6.3	0.000050	677	0.11	22	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.080	0.16	*<0.0025*	0.69	*<0.0015*	0.052	0.073	2.8	0.038	*<0.0005*	*<0.00025*	*<0.05*
Gneiss	Supremo Oxide T4	73034	0.014	0.44	0.22	0.28	0.00072	0.0029	0.87	0.37	0.0038	0.19	*<0.001*	0.21	9.5	0.0061	0.00090	5.0	0.000050	317	0.056	23	*<0.0004*	0.000039	*<0.0002*	*<0.0006*	0.060	0.28	0.0015	0.028	*<0.0006*	0.040	0.033	2.8	0.0066	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo Mine Block (1")	73004	0.010	0.080	0.28	1.9	*<0.0001*	*<0.002*	0.70	0.15	0.0044	0.13	0.0030	0.99	5.4	0.0068	0.0011	2.8	0.00014	375	0.016	4.5	*<0.0004*	0.000044	*<0.0002*	*<0.0006*	0.010	2.0	0.0011	0.054	*<0.0006*	0.054	0.026	1.4	0.0026	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo 80%	73037	0.012	0.62	1.0	2.2	*<0.00025*	*<0.005*	1.0	0.020	0.0031	0.25	0.0040	1.0	31	0.034	0.0072	9.9	0.00046	909	0.025	157	*<0.001*	0.00012	*<0.0005*	*<0.0015*	0.040	0.46	0.0053	0.60	*<0.0015*	0.087	0.27	13	0.0068	*<0.0005*	*<0.00025*	*<0.05*
Gneiss	Supremo 80%	73040	0.0020	0.51	0.32	2.0	*<0.0001*	0.0027	1.1	0.62	0.0021	0.27	0.0018	0.11	19	0.012	0.0060	5.3	0.00022	551	0.080	240	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.030	0.059	0.0018	0.037	*<0.0006*	0.061	0.18	7.5	0.0025	*<0.0002*	*<0.0001*	*<0.02*
Gneiss/Schist	DD oxide	72183	0.0040	0.99	3.3	0.44	*<0.00025*	*<0.005*	0.63	0.020	0.0028	0.32	0.016	0.10	18	0.012	0.0096	5.3	0.00036	753	0.088	82	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.82	0.0040	*<0.0025*	1.1	*<0.0015*	0.028	0.089	2.6	0.017	*<0.0005*	*<0.00025*	*<0.05*
Gneiss/Schist	DD oxide	72186	0.013	0.41	0.40	0.11	*<0.0001*	*<0.002*	0.20	0.020	0.00010	0.17	*<0.001*	0.12	9.2	0.0025	0.0061	5.4	0.000040	372	0.048	63	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.34	0.00	0.0021	0.068	*<0.0006*	0.058	0.035	1.9	0.0037	*<0.0002*	*<0.0001*	*<0.02*
Schist	Latte mine block (1")	73001	0.013	0.040	0.21	0.56	0.00047	*<0.002*	1.0	0.14	0.00080	0.030	0.0018	0.27	3.7	0.0054	0.00060	3.6	0.00038	291	0.038	17	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.00	0.032	*<0.001*	0.063	*<0.0006*	0.035	0.082	16	0.0044	*<0.0002*	*<0.0001*	*<0.02*
Schist	Latte Oxide East	72153	0.0060	0.65	2.8	0.89	*<0.00025*	*<0.005*	0.48	0.040	0.0057	0.15	0.021	0.21	17	0.011	0.0051	8.1	0.00041	978	0.11	233	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.38	0.0060	0.0027	1.7	*<0.0015*	0.045	0.085	6.0	0.012	*<0.0005*	*<0.00025*	*<0.05*
Schist	Latte Oxide East	72156	0.0080	0.36	0.73	0.57	0.00071	*<0.002*	0.86	0.51	0.0050	0.090	0.025	0.16	14	0.0048	0.0038	3.5	0.0013	489	0.22	185	*<0.0004*	0.000044	*<0.0002*	*<0.0006*	0.17	0.0020	0.0017	0.16	*<0.0006*	0.064	0.036	2.4	0.0064	*<0.0002*	*<0.0001*	*<0.02*
Schist	Latte 80%'	72159	0.0030	1.1	5.2	4.4	0.0020	*<0.01*	2.9	0.030	0.0046	0.080	0.030	0.22	44	0.059	0.019	4.8	0.00034	1680	1.1	916	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.090	0.00	*<0.005*	1.5	*<0.003*	0.074	0.15	3.0	0.0069	*<0.001*	*<0.0005*	*<0.1*
Schist	Latte 80%'	72162	0.0020	0.68	1.6	3.5	0.00063	*<0.005*	9.1	1.5	0.00060	0.060	0.0029	0.13	50	0.021	0.014	2.7	*<0.00005*	981	1.4	782	*<0.001*	*<0.00005*	*<0.0005*	0.0020	0.020	0.00	*<0.0025*	0.097	*<0.0015*	0.028	0.042	0.87	0.0055	*<0.0005*	*<0.00025*	*<0.05*
Schist	Latte 60%	72165	0.0020	0.86	5.1	6.3	0.0018	0.0060	2.5	0.020	0.0022	0.080	0.024	0.16	48	0.033	0.018	3.9	0.00020	1340	1.7	868	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.070	0.00	0.0032	1.1	*<0.0015*	0.086	0.21	1.8	0.010	*<0.0005*	*<0.00025*	*<0.05*
Schist	Latte 60%	72168	0.0020	0.61	2.2	6.0	0.00034	*<0.005*	9.0	0.81	0.00030	0.070	0.0026	*<0.1*	44	0.016	0.0099	2.1	*<0.00005*	1090	1.5	828	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.020	0.00	*<0.0025*	0.12	*<0.0015*	0.019	0.049	0.53	0.0049	*<0.0005*	*<0.00025*	*<0.05*
Granite	Kona Oxide	72171	0.0050	0.58	1.7	8.3	0.0019	*<0.01*	0.28	0.040	0.0049	0.080	*<0.005*	0.45	19	0.043	0.0023	4.2	*<0.0001*	704	0.077	23	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.19	1.2	*<0.005*	1.9	*<0.003*	0.33	0.26	55	0.0035	*<0.001*	*<0.0005*	*<0.1*
Granite	Kona Oxide	72174	0.012	0.22	0.28	4.6	0.0013	*<0.005*	0.26	1.0	0.0014	0.040	*<0.0025*	0.42	11	0.011	0.0011	2.8	*<0.00005*	347	0.072	13	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.10	0.57	0.0047	0.10	*<0.0015*	0.39	0.17	40	*<0.00025*	*<0.0005*	*<0.00025*	*<0.05*
Granite	Kona 80% CN	72177	0.0020	1.5	2.2	18	0.0026	*<0.01*	0.46	0.14	0.021	0.060	*<0.005*	0.56	25	0.050	0.0082	3.6	*<0.0001*	857	0.065	216	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.18	0.83	0.0084	1.4	*<0.003*	0.53	0.78	75	0.0044	*<0.001*	*<0.0005*	*<0.1*
Granite	Kona 80% CN	72180	*<0.002*	1.1	0.64	15	*<0.001*	*<0.02*	0.25	1.9	0.0038	0.050	*<0.01*	0.31	16	0.015	0.0047	1.6	*<0.0002*	517	0.038	137	*<0.004*	*<0.0002*	*<0.002*	*<0.006*	0.15	0.52	0.015	0.14	*<0.006*	1.2	0.93	85	*<0.001*	*<0.002*	*<0.001*	*<0.2*

Notes: all values in grey italics are below the analytical detection limit

Appendix C.3-3: Total and Dissolved Elements in Final Leachate from Cyanide Leach Tailings Columns

Lithology	Pit/Weathering Facies	Column ID	D-Cd	D-Ca	D-Cs	D-Cr	D-Co	D-Cu	D-Fe	D-Pb	D-Li	D-Mg	D-Mn	D-Hg	D-Mo	D-Ni	D-P	D-K	D-Rb	D-Se	D-Si	D-Ag	D-Na	D-Sr	D-S	D-Te	D-Tl	D-Sn	D-Ti	D-W	D-U	D-V	D-Zn	D-Zr
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Gneiss	Supremo #1	73010	0.0046	3.0	0.00018	0.013	0.33	0.55	0.97	*<0.0001*	*<0.002*	0.31	0.0023	0.0015	0.21	0.0043	0.16	5.9	0.0015	0.0015	4.1	0.000038	561	0.048	5.6	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.012	0.14	0.0021	0.41	*<0.0006*
Gneiss	Supremo #1	73013	0.00017	3.1	0.00014	0.013	0.081	0.16	1.1	*<0.0001*	*<0.002*	0.73	0.32	0.00078	0.16	0.0049	0.52	14	0.027	0.00087	3.7	0.000036	311	0.030	5.4	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.012	0.47	0.0020	0.036	*<0.0006*
Gneiss	Supremo #1	73007	0.037	53	0.00012	0.037	0.67	1.9	0.40	*<0.0001*	*<0.002*	0.19	0.0082	0.060	0.18	0.15	*<0.05*	6.6	0.0011	0.0016	3.5	0.0011	447	0.19	3.9	*<0.0004*	0.00011	0.00023	*<0.0006*	0.0055	0.0045	*<0.001*	1.1	*<0.0006*
Gneiss	Supremo #2	73019	0.0033	4.9	0.000069	0.024	0.55	0.57	1.1	*<0.00025*	*<0.005*	0.25	0.0052	0.00065	0.27	0.0027	1.0	11	0.0020	0.0040	5.4	*<0.00005*	662	0.022	6.3	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.037	0.74	0.012	0.41	*<0.0015*
Gneiss	Supremo #2	73022	0.000043	2.6	0.000035	0.013	0.20	0.090	1.1	*<0.0001*	0.0089	0.39	0.055	0.00011	0.15	*<0.001*	0.25	11	0.0032	0.0019	4.4	0.000022	396	0.023	5.8	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.019	0.17	0.0069	0.021	*<0.0006*
Gneiss	Supremo #2	73016	0.026	5.7	*<0.00002*	0.051	1.2	1.5	1.5	0.00011	*<0.002*	0.10	0.0087	0.015	0.40	0.065	0.33	5.3	0.0012	0.0050	5.4	0.00045	484	0.027	4.9	*<0.0004*	*<0.00002*	0.00024	*<0.0006*	0.024	0.15	0.0099	1.1	*<0.0006*
Gneiss	Supremo Oxide T1	73025	0.0029	1.2	0.0024	0.022	0.52	1.1	0.36	*<0.0001*	*<0.002*	0.22	0.026	0.0027	0.42	0.0028	0.51	13	0.012	0.00083	7.1	0.00022	546	0.020	18	*<0.0004*	0.000032	*<0.0002*	*<0.0006*	0.12	0.41	0.0045	0.64	*<0.0006*
Gneiss	Supremo Oxide T1	73028	0.00030	1.1	0.00011	0.021	0.31	0.32	0.29	*<0.0001*	*<0.002*	0.26	0.071	0.0023	0.36	0.0028	0.39	9.0	0.0056	0.0011	6.1	0.00019	312	0.022	16	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.11	0.41	0.0046	0.064	*<0.0006*
Gneiss	Supremo Oxide T4	73031	0.0019	2.1	0.0010	0.012	0.78	1.1	0.33	*<0.00025*	*<0.005*	0.63	0.19	0.0045	0.24	*<0.0025*	0.19	15	0.0059	0.00079	6.3	*<0.00005*	649	0.062	22	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.076	0.15	*<0.0025*	0.66	*<0.0015*
Gneiss	Supremo Oxide T4	73034	0.00027	1.8	0.00012	0.013	0.42	0.21	0.25	*<0.0001*	0.0028	0.81	0.26	0.0040	0.18	*<0.001*	0.18	9.2	0.0056	0.00083	4.8	0.000044	305	0.037	22	*<0.0004*	0.000030	*<0.0002*	*<0.0006*	0.054	0.27	0.0014	0.027	*<0.0006*
Gneiss	Supremo Mine Block (1")	73004	0.00053	2.6	0.00012	0.0091	0.072	0.29	1.9	*<0.0001*	*<0.002*	0.66	0.019	0.0055	0.13	0.0031	0.97	5.2	0.0068	0.0012	2.7	0.00015	360	0.015	4.4	*<0.0004*	0.000040	*<0.0002*	*<0.0006*	0.0074	1.9	0.0011	0.056	*<0.0006*
Gneiss	Supremo 80%	73037	0.00096	1.2	0.0061	0.012	0.61	1.0	2.2	*<0.00025*	*<0.005*	0.88	0.019	0.0032	0.25	0.0041	1.0	30	0.034	0.0071	9.5	0.00041	898	0.025	153	*<0.001*	0.000084	*<0.0005*	*<0.0015*	0.045	0.46	0.0050	0.59	*<0.0015*
Gneiss	Supremo 80%	73040	0.000064	5.2	0.00099	0.0015	0.51	0.32	1.9	*<0.0001*	0.0028	1.1	0.57	0.0024	0.26	0.0019	0.12	19	0.011	0.0063	5.3	0.00021	553	0.078	220	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.027	0.058	0.0017	0.039	*<0.0006*
Gneiss/Schist	DD oxide	72183	0.0033	2.8	0.0030	0.0042	0.97	3.2	0.44	*<0.00025*	*<0.005*	0.61	0.017	0.0027	0.31	0.015	0.089	18	0.011	0.0098	5.2	0.00038	731	0.084	77	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.81	0.0040	*<0.0025*	1.1	*<0.0015*
Gneiss/Schist	DD oxide	72186	0.000076	1.5	0.00014	0.013	0.39	0.39	0.098	*<0.0001*	*<0.002*	0.20	0.019	0.00012	0.17	*<0.001*	0.11	9.0	0.0024	0.0057	5.4	0.000041	365	0.049	61	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.35	0.00032	0.0020	0.068	*<0.0006*
Schist	Latte mine block (1")	73001	0.00011	2.3	0.00023	0.012	0.040	0.21	0.50	*<0.0001*	*<0.002*	0.97	0.020	0.0012	0.035	0.0016	0.24	3.5	0.0054	0.00059	3.5	0.00037	283	0.028	16	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.0051	0.033	*<0.001*	0.061	*<0.0006*
Schist	Latte Oxide East	72153	0.0075	2.5	0.0022	0.0060	0.63	2.8	0.84	*<0.00025*	*<0.005*	0.44	0.032	0.0069	0.14	0.020	0.19	16	0.011	0.0044	7.7	0.00034	941	0.095	223	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.37	0.0059	*<0.0025*	1.6	*<0.0015*
Schist	Latte Oxide East	72156	0.00057	3.0	0.00042	0.0078	0.35	0.75	0.50	*<0.0001*	*<0.002*	0.75	0.48	0.0055	0.092	0.024	0.075	13	0.0047	0.0039	3.3	0.0013	476	0.11	175	*<0.0004*	0.000028	*<0.0002*	*<0.0006*	0.17	0.0015	0.0014	0.16	*<0.0006*
Schist	Latte 80%'	72159	0.0032	114	0.0093	0.0023	0.99	4.9	4.3	*<0.0005*	*<0.01*	2.8	0.014	0.0047	0.076	0.028	*<0.1*	43	0.056	0.018	4.7	0.00027	1590	0.95	909	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.085	0.00026	*<0.005*	1.4	*<0.003*
Schist	Latte 80%'	72162	0.000089	311	0.00089	0.0014	0.67	1.5	3.3	*<0.00025*	*<0.005*	9.0	1.2	0.00069	0.055	0.0028	*<0.1*	49	0.021	0.014	2.6	*<0.00005*	965	1.3	768	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.022	0.00012	*<0.0025*	0.096	*<0.0015*
Schist	Latte 60%	72165	0.0022	240	0.0026	0.0019	0.84	4.6	5.6	*<0.00025*	0.0054	2.2	0.0088	0.0024	0.079	0.022	*<0.1*	43	0.031	0.019	3.4	0.00016	1330	1.5	850	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.067	0.000081	0.0027	1.0	*<0.0015*
Schist	Latte 60%	72168	0.00010	284	0.00083	0.0014	0.60	2.1	5.7	*<0.00025*	*<0.005*	8.7	0.52	0.00036	0.068	*<0.0025*	*<0.1*	42	0.016	0.010	2.1	*<0.00005*	1080	1.4	810	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.017	0.000076	*<0.0025*	0.12	*<0.0015*
Granite	Kona Oxide	72171	0.0059	2.5	0.0036	0.0044	0.57	1.8	7.9	*<0.0005*	*<0.01*	0.20	0.019	0.0054	0.078	*<0.005*	0.37	18	0.041	0.0025	3.9	*<0.0001*	703	0.030	22	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.18	1.1	*<0.005*	1.9	*<0.003*
Granite	Kona Oxide	72174	0.00020	1.9	0.000056	0.012	0.22	0.28	4.6	*<0.00025*	*<0.005*	0.17	0.20	0.0017	0.037	*<0.0025*	0.32	11	0.011	0.0012	2.8	*<0.00005*	349	0.0090	13	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.096	0.58	0.0046	0.10	*<0.0015*
Granite	Kona 80% CN	72177	0.0026	3.1	0.0053	0.0017	1.5	2.3	19	*<0.0005*	*<0.01*	0.34	0.064	0.022	0.061	*<0.005*	0.40	24	0.050	0.0076	3.4	*<0.0001*	877	0.024	214	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.18	0.83	0.0091	1.4	*<0.003*
Granite	Kona 80% CN	72180	*<0.0001*	5.8	*<0.0002*	*<0.002*	0.94	0.54	15	*<0.001*	*<0.02*	0.21	0.79	0.0048	0.039	*<0.01*	0.26	15	0.012	0.0043	1.4	*<0.0002*	456	0.014	135	*<0.004*	*<0.0002*	*<0.002*	*<0.006*	0.13	0.45	0.013	0.12	*<0.006*

Notes: all values in grey italics are below the analytical detection limit

Appendix C.4: Static Test Results for Overburden

Appendix C.4-1: Acid-Base Accounting Results for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Fizz rating	Rinse-pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	Insoluble-S	T-AP	S-AP	TIC	Inorg. CO_2	CaNP	Sobek NP	Sobek NNP	NPR	NPR
				Unity	s.u.	s.u.	%	%	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	Sobek/T-AP	Sobek/S-AP
Overburden Overlying Gneiss Bedrock																			
KAM106801	CFR0320	DD Pit	gneiss	1	8	8	0.12	0.01	0.11	0.01	3.8	0.30	0.070	0.30	5.8	11	7.0	2.9	35
R281758	CFR0836	DD Pit	gneiss	1	6.5	6.5	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
R283938	CFR0825	DD Pit	gneiss	1	7.7	7.7	0.01	0.01	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	10	10	33	32
R288218	CFR0694	DD Pit	gneiss	1	6.8	6.7	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R298598	CFR0716	DD Pit	gneiss	1	7.5	7.5	*<0.01*	0.01	0.02	*<0.01*	*<0.3*	0.30	*<0.05*	*<0.2*	*<4.2*	12	12	40	38
KAM018321	CFR0102	Supremo Pit	gneiss	1	7	7	0.04	0.01	0.02	0.02	1.3	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	2.3	9.6
KAM104165	CFR0288	Supremo Pit	gneiss	1	7.2	7.2	*<0.01*	0.01	*<0.01*	*<0.01*	*<0.3*	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R280751	CFR0805	Supremo Pit	gneiss	1	7.6	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R281909	CFR0839	Supremo Pit	gneiss	1	8.4	8.4	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	13	13	43	42
R281971	CFR0841	Supremo Pit	gneiss	1	6.7	6.8	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R284001	CFR0804	Supremo Pit	gneiss	1	7.4	7.4	*<0.01*	0.02	*<0.01*	*<0.01*	*<0.3*	0.60	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	11
R285461	CFR0757	Supremo Pit	gneiss	1	8.1	8	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
R285552	CFR0759	Supremo Pit	gneiss	1	7.5	7.5	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	0.10	0.40	8.3	7.0	7.0	23	22
R286151	CFR0776	Supremo Pit	gneiss	1	7.9	7.8	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
R286219	CFR0779	Supremo Pit	gneiss	1	8.1	8.1	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
R286345	CFR0782	Supremo Pit	gneiss	1	8.4	8.3	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R287156	CFR0802	Supremo Pit	gneiss	1	6.9	6.9	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
R513919	CFR0872	Supremo Pit	gneiss	1	7	6.9	*<0.01*	*<0.01*	0.03	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R514753	CFR0783	Supremo Pit	gneiss	1	7	6.8	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R514902	CFR0786	Supremo Pit	gneiss	1	8.3	8	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	11	11	37	35
R515335	CFR0797	Supremo Pit	gneiss	1	7.1	7.1	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R515458	CFR0799	Supremo Pit	gneiss	1	7.1	7	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R540708	CFR0864	Supremo Pit	gneiss	1	8.1	8	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
R540846	CFR0866	Supremo Pit	gneiss	1	7.6	7.5	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R541274	CFR0877	Supremo Pit	gneiss	1	6.7	6.7	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R541396	CFR0881	Supremo Pit	gneiss	1	6.9	6.8	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R541524	CFR0884	Supremo Pit	gneiss	1	7.1	6.9	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R542611	CFR0909	Supremo Pit	gneiss	1	7.7	7.6	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R542736	CFR0912	Supremo Pit	gneiss	1	8.1	8	*<0.01*	0.02	0.02	*<0.01*	*<0.3*	0.60	*<0.05*	*<0.2*	*<4.2*	10	10	33	16
R543125	CFR0924	Supremo Pit	gneiss	1	7.7	7.6	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R543393	CFR0933	Supremo Pit	gneiss	1	7.6	7.7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	0.14	0.50	12	3.0	3.0	10	9.6
R546991	CFR0905	Supremo Pit	gneiss	1	6.8	6.7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R547067	CFR0908	Supremo Pit	gneiss	1	8.3	8.2	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	0.070	0.30	5.8	11	11	37	35
R548052	CFR0944	Supremo Pit	gneiss	1	6.2	6.1	0.02	*<0.01*	0.01	0.01	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	5.0	10	19
R618573	CFR0846	Supremo Pit	gneiss	1	7.1	7.1	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	11	11	37	35
R618876	CFR0860	Supremo Pit	gneiss	1	8.1	8.1	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	0.10	0.40	8.3	18	18	60	58
R619123	CFR0867	Supremo Pit	gneiss	1	7.1	7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R620371	CFR0910	Supremo Pit	gneiss	1	7.9	7.9	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R620448	CFR0911	Supremo Pit	gneiss	1	5.5	5.3	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	1.0	1.0	3.3	3.2
R620797	CFR0923	Supremo Pit	gneiss	1	5.9	5.9	0.02	0.02	*<0.01*	0.02	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	6.0	5.0	10	9.6
R290225	CFR0614	West WRSF	gneiss	1	7.7	7.7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
Statistical Summary for Overburden overlying Gneiss Bedrock (n = 41)			**Max**	-	8.4	8.4	0.12	0.02	0.11	0.02	3.8	0.60	0.14	0.50	12	18	18	60	58
			90th PCTL	-	8.1	8.1	0.01	0.01	0.02	0.01	0.30	0.30	0.070	0.30	5.8	11	11	37	35
			75th PCTL	-	7.9	7.9	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	7.0	23	22
			Median	-	7.5	7.5	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
			25th PCTL	-	7	6.9	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	10	11
			10th PCTL	-	6.7	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
			Min	-	5.5	5.3	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	1.0	1.0	2.3	3.2

Appendix C.4-1: Acid-Base Accounting Results for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Fizz rating	Rinse-pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	Insoluble-S	T-AP	S-AP	TIC	Inorg. CO_2	CaNP	Sobek NP	Sobek NNP	NPR	NPR
				Unity	s.u.	s.u.	%	%	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	Sobek/T-AP	Sobek/S-AP
Overburden Overlying Schist Bedrock																			
R288438	CFR0698	DD Pit	schist	1	7.3	7.3	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
R298516	CFR0713	DD Pit	schist	1	7.7	7.6	*<0.01*	0.01	0.02	*<0.01*	*<0.3*	0.30	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R294148	CFR0624	Latte Pit	schist	2	8.3	8.3	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	0.91	3.3	76	86	86	287	275
R297797	CFR0676	North WRSF	schist	2	8.4	8.4	0.02	0.01	0.01	0.01	0.60	0.30	0.20	0.80	17	31	30	52	99
R549926	CFR0981	North WRSF	schist	1	7.5	7.5	0.01	*<0.01*	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	11	11	37	35
R550015	CFR0984	North WRSF	schist	1	7.3	7.3	0.02	*<0.01*	*<0.01*	0.02	0.60	*<0.3*	*<0.05*	0.20	4.2	11	10	18	35
R550083	CFR0985	North WRSF	schist	1	8.2	8.2	0.02	0.01	0.02	*<0.01*	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	13	12	22	42
17551	SRK-15TP-47	ROM/Plant	schist	1	6.4	6.4	0.02	0.02	0.02	*<0.01*	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	7.0	6.0	12	11
17552	SRK-15TP-46	ROM/Plant	schist	1	6.3	6.2	0.02	0.01	0.02	*<0.01*	0.60	0.30	*<0.05*	*<0.2*	*<4.2*	5.0	4.0	8.3	16
17553	SRK-15TP-45	ROM/Plant	schist	1	6	5.9	0.04	0.02	0.02	0.02	1.3	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	2.3	4.8
17554	SRK-15TP-22	ROM/Plant	schist	1	6.8	6.9	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	10	9.0	17	16
17556	SRK-15TP-24	ROM/Plant	schist	1	7.4	7.5	0.02	*<0.01*	0.01	0.01	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	11	10	18	35
R547969	CFR0939	South WRSF	schist	1	8.4	8.4	0.03	0.01	0.02	0.01	0.90	0.30	*<0.05*	*<0.2*	*<4.2*	11	10	12	35
R553319	CFB027	South WRSF	schist	3	7.4	7.4	0.03	0.02	0.03	*<0.01*	0.90	0.60	0.90	3.3	75	115	114	128	184
R281332	CFR0816	Supremo Pit	schist	1	7.6	7.6	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R281383	CFR0818	Supremo Pit	schist	1	6.7	6.7	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
R294487	CFR0633	Supremo Pit	schist	1	7.4	7.3	0.07	0.05	0.02	0.05	2.2	1.6	0.050	0.20	4.2	14	12	6.4	9.0
R296213	CFR0651	Supremo Pit	schist	3	8.1	8.1	0.02	*<0.01*	0.02	*<0.01*	0.60	*<0.3*	1.1	3.9	88	134	133	223	429
R299233	CFR0737	Supremo Pit	schist	1	7.9	7.9	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R299489	CFR0746	Supremo Pit	schist	1	7.6	7.5	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	11	11	37	35
R510641	CFR0752	Supremo Pit	schist	2	8.8	8.8	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	0.15	0.60	13	75	75	250	240
R510976	CFR0761	Supremo Pit	schist	1	7.9	7.6	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	15	15	50	48
R511133	CFR0680	Supremo Pit	schist	3	8.2	8.1	0.02	*<0.01*	0.01	0.01	0.60	*<0.3*	0.85	3.1	71	91	90	152	291
R511474	CFR0686	Supremo Pit	schist	3	8.3	8.3	0.14	0.03	0.04	0.10	4.4	0.90	2.9	11	241	253	249	58	270
R511702	CFR0693	Supremo Pit	schist	1	8	7.9	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
R511762	CFR0695	Supremo Pit	schist	1	8	7.9	0.01	0.01	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	9.0	9.0	30	29
R620878	CFR0925	Supremo Pit	schist	2	-	8.2	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	0.16	0.60	13	24	24	80	77
R622028	CFR0956	Supremo Pit	schist	1	7.2	7.1	0.02	0.02	0.02	*<0.01*	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	11	10	18	18
R622095	CFR0957	Supremo Pit	schist	1	6.6	6.6	0.02	*<0.01*	0.01	0.01	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	7.0	13	26
R289071	CFR0599	West WRSF	schist	1	7.4	7.4	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
R290074	CFR0612	West WRSF	schist	1	7.4	7.3	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	0.10	0.40	8.3	10	10	33	32
R549729	CFR0978	West WRSF	schist	1	6.6	6.6	0.09	0.07	0.01	0.08	2.8	2.2	0.10	0.40	8.3	8.0	5.0	2.9	3.7
R621156	CFR0937	West WRSF	schist	1	7.9	7.9	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
Statistical Summary for Overburden overlying Schist Bedrock (n = 33)			**Max**	-	8.8	8.8	0.14	0.07	0.04	0.10	4.4	2.2	2.9	11	241	253	249	287	429
			90th PCTL	-	8.3	8.3	0.04	0.02	0.02	0.02	1.2	0.60	0.89	3.3	74	90	89	147	264
			75th PCTL	-	8.0	8.1	0.02	0.01	0.02	0.01	0.60	0.30	0.10	0.40	8.3	15	15	50	48
			Median	-	7.6	7.5	0.02	*<0.01*	0.02	*<0.01*	0.60	*<0.3*	0.050	0.20	4.2	11	10	23	29
			25th PCTL	-	7.3	7.3	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	13	16
			10th PCTL	-	6.6	6.6	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	4.2	9.0	12
			Min	-	6.0	5.9	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	2.3	3.7

Appendix C.4-1: Acid-Base Accounting Results for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Fizz rating	Rinse-pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	Insoluble-S	T-AP	S-AP	TIC	Inorg. CO_2	CaNP	Sobek NP	Sobek NNP	NPR	NPR
				Unity	s.u.	s.u.	%	%	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	Sobek/T-AP	Sobek/S-AP
Overburden Overlying Granite Bedrock																			
17557	SRK-15TP-07	Event Pond	granite	1	5.8	5.8	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	4.8
KNB-1	KNB-1	Event Pond	granite	1	7.4	7.8	0.01	0.01	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	6.4
KNB-2	KNB-2	Event Pond	granite	1	6.9	7.4	0.01	0.02	0.01	*<0.01*	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	3.2
KNB-3	KNB-3	Event Pond	granite	1	7.8	7.7	0.01	0.02	0.01	*<0.01*	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	3.2
KAM013553	CFR0055	Kona Pit	granite	1	7.1	6.8	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
R297165	CFR0663	Kona Pit	granite	1	6.5	6.3	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	1.0	1.0	3.3	3.2
R297232	CFR0665	Kona Pit	granite	1	8.9	8.7	*<0.01*	0.01	*<0.01*	*<0.01*	*<0.3*	0.30	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
R297375	CFR0666	Kona Pit	granite	1	7	6.9	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
17558	SRK-15TP-44	Leach Pad	granite	1	6.4	6.2	0.01	0.01	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	6.4
17559	SRK-15TP-06	Leach Pad	granite	1	6.8	6.8	0.02	0.03	*<0.01*	0.02	0.60	0.90	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	3.2
17560	SRK-15TP-43	Leach Pad	granite	1	6.4	6.5	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17561	SRK-15TP-05	Leach Pad	granite	1	6.6	6.6	0.01	0.02	*<0.01*	0.01	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	4.8
17562	SRK-15TP-04	Leach Pad	granite	1	6.8	6.8	0.02	0.01	0.01	0.01	0.60	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	9.6
17565	SRK-15TP-03	Leach Pad	granite	1	6.2	6.1	0.02	0.01	0.01	0.01	0.60	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	9.6
17566	SRK-15TP-17	Leach Pad	granite	1	6.6	6.6	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17567	SRK-15TP-02	Leach Pad	granite	1	6.3	6.3	0.02	0.03	0.01	0.01	0.60	0.90	*<0.05*	*<0.2*	*<4.2*	4.0	3.0	6.7	4.3
17570	SRK-15TP-16	Leach Pad	granite	1	6.5	6.7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17571	SRK-15TP-15	Leach Pad	granite	1	6.2	6.4	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
17572	SRK-15TP-14	Leach Pad	granite	1	5.7	5.9	0.02	0.01	0.01	0.01	0.60	0.30	0.050	0.20	4.2	2.0	1.0	3.3	6.4
17573	SRK-15TP-13	Leach Pad	granite	1	6.2	6.6	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	6.4
17574	SRK-15TP-12	Leach Pad	granite	1	6.2	6	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	2.0	1.0	3.3	3.2
17575	SRK-15TP-11	Leach Pad	granite	1	7.3	7.2	0.02	*<0.01*	0.02	*<0.01*	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	3.0	6.7	13
17576	SRK-15TP-18	Leach Pad	granite	1	6	6	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17577	SRK-15TP-42	Leach Pad	granite	1	7	6.9	0.01	0.02	0.01	*<0.01*	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	4.8
17578	SRK-15TP-10	Leach Pad	granite	1	6.6	6.5	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17579	SRK-15TP-09	Leach Pad	granite	1	6.5	6.4	0.01	0.02	*<0.01*	0.01	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	6.4
17580	SRK-15TP-41	Leach Pad	granite	1	7	6.9	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
17581	SRK-15TP-08	Leach Pad	granite	1	6.5	6.5	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	4.8
Statistical Summary for Overburden overlying Granite Bedrock (n = 28)			**Max**	-	8.9	8.7	0.02	0.03	0.02	0.02	0.60	0.90	0.050	0.20	4.2	8.0	8.0	27	26
			90th PCTL	-	7.3	7.5	0.02	0.02	0.02	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	4.6	4.6	15	15
			75th PCTL	-	7.0	6.9	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
			Median	-	6.6	6.6	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	6.7	6.4
			25th PCTL	-	6.3	6.3	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	5.0	4.8
			10th PCTL	-	6.1	6.0	0.01	*<0.01*	*<0.01*	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	2.0	1.7	4.5	3.2
			Min	-	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	1.0	1.0	3.3	3.2
Overburden Overlying Meta-Gabbro Bedrock (n = 3)																			
17555	SRK-15TP-23	ROM/Plant	meta-gabbro	1	5.2	5.1	0.06	0.03	0.01	0.05	1.9	0.90	*<0.05*	*<0.2*	*<4.2*	3.0	1.0	1.6	3.2
R553404	CFB030	South WRSF	meta-gabbro	3	9.2	9.2	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	1.3	4.8	108	138	138	460	442
R553602	CFB035	South WRSF	meta-gabbro	1	7.4	7.4	0.01	*<0.01*	0.03	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26

Notes: all values in grey italics are below the analytical detection limit.
n = number of samples included in the statistical summary
Sulphate Sulphur determined by 25% HCL with Gravimetric Finish.
Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP-MS Finish.
AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material, T-AP derived from Total S * 31.25; S-AP derived from Sulphide-S *31.25.
NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material; carbonate NP (CaNP) is calculated from inorganic CO2.
Net NP (NNP) = NP - AP; Neutralization potential ratio (NPR)

Appendix C.4-2: Shake Flask Extraction Results for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Moisture	T-Alkalinity	Br	Cl	F	Nitrate-N	Nitrite-N	pH	Sulfate	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
				%	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Overburden overlying Gneiss Bedrock																																													
R281758	CFR0836	DD Pit	gneiss	*<0.25*	14	*<0.05*	*<0.5*	0.18	0.92	0.033	6.1	1.8	0.88	0.0012	0.013	0.053	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.2	0.0034	0.0029	0.0058	0.81	0.00034	*<0.005*	1.4	0.20	*<0.00005*	0.0012	0.0053	*<0.3*	2.0	*<0.0005*	4.5	*<0.00005*	1.9	0.026	*<0.0001*	*<0.0005*	0.021	0.00018	0.0020	*<0.01*
R283938	CFR0825	DD Pit	gneiss	*<0.25*	17	*<0.05*	*<0.5*	0.23	0.027	0.0054	7.3	0.75	1.2	0.0025	0.0054	0.040	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	0.0026	0.00070	0.0047	1.0	0.00054	*<0.005*	0.67	0.032	*<0.00005*	0.0018	0.0030	*<0.3*	1.6	*<0.0005*	4.7	*<0.00005*	2.1	0.014	*<0.0001*	*<0.0005*	0.031	0.00019	0.0031	*<0.01*
R280751	CFR0805	Supremo Pit	gneiss	*<0.25*	11	*<0.05*	*<0.5*	0.15	0.060	0.0030	7.8	1.0	0.56	0.0024	0.026	0.026	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.6	0.00074	0.00022	0.0075	0.58	0.00046	*<0.005*	0.65	0.028	*<0.00005*	0.0028	0.00086	*<0.3*	1.9	*<0.0005*	3.1	*<0.00005*	1.7	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.00045	0.0015	*<0.01*
R281971	CFR0841	Supremo Pit	gneiss	*<0.25*	15	*<0.05*	*<0.5*	0.048	0.19	0.0059	6.1	0.69	1.0	0.0015	0.013	0.078	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.4	0.0029	0.0025	0.0069	0.91	0.00023	*<0.005*	1.1	0.18	*<0.00005*	0.0015	0.0055	*<0.3*	2.1	*<0.0005*	5.2	*<0.00005*	2.1	0.027	*<0.0001*	*<0.0005*	0.024	0.00042	0.0021	*<0.01*
R513919	CFR0872	Supremo Pit	gneiss	*<0.25*	6.6	*<0.05*	*<0.5*	0.061	0.083	0.0051	6.3	0.55	0.66	0.00035	0.0046	0.024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.4	0.0017	0.00051	0.0058	0.42	0.00027	*<0.005*	0.32	0.088	*<0.00005*	0.0018	0.0019	*<0.3*	0.96	*<0.0005*	3.9	*<0.00005*	2.8	0.0095	*<0.0001*	*<0.0005*	0.013	0.00031	0.0013	*<0.01*
R540708	CFR0864	Supremo Pit	gneiss	*<0.25*	6.0	*<0.05*	*<0.5*	0.16	0.018	0.0029	7.0	0.66	2.1	0.00085	0.010	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.0	0.0048	0.0010	0.0091	2.1	0.0010	*<0.005*	0.65	0.050	*<0.00005*	0.0036	0.0058	*<0.3*	1.1	*<0.0005*	6.6	*<0.00005*	2.7	0.0068	*<0.0001*	*<0.0005*	0.065	0.00059	0.0067	*<0.01*
R540846	CFR0866	Supremo Pit	gneiss	*<0.25*	39	*<0.05*	*<0.5*	0.14	0.035	0.0052	7.3	0.60	0.51	0.00095	0.012	0.044	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.0012	0.00030	0.0040	0.81	0.00045	*<0.005*	1.8	0.041	*<0.00005*	0.0020	0.0020	*<0.3*	1.7	*<0.0005*	4.0	*<0.00005*	2.1	0.054	*<0.0001*	*<0.0005*	0.016	0.00027	0.0023	*<0.01*
R542611	CFR0909	Supremo Pit	gneiss	*<0.25*	8.9	*<0.05*	*<0.5*	0.14	0.031	0.013	8.1	0.68	0.94	0.0084	0.096	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.5	0.0018	0.00038	0.0021	1.1	0.00094	*<0.005*	0.32	0.021	0.000066	0.0023	0.0010	*<0.3*	2.0	*<0.0005*	5.3	*<0.00005*	0.62	0.0090	*<0.0001*	*<0.0005*	0.020	0.0014	0.0020	*<0.01*
R543125	CFR0924	Supremo Pit	gneiss	*<0.25*	11	*<0.05*	*<0.5*	0.20	0.019	0.0025	7.2	0.64	1.1	0.00035	0.0041	0.024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.6	0.0024	0.0010	0.0081	1.2	0.00072	*<0.005*	0.62	0.057	*<0.00005*	0.0023	0.0029	*<0.3*	0.96	*<0.0005*	5.0	*<0.00005*	3.5	0.011	*<0.0001*	*<0.0005*	0.036	0.00080	0.0036	*<0.01*
R547067	CFR0908	Supremo Pit	gneiss	*<0.25*	41	*<0.05*	*<0.5*	0.18	1.0	0.010	8.4	0.73	0.16	0.00090	0.014	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	13	*<0.0005*	*<0.0001*	0.0044	0.049	*<0.0001*	*<0.005*	1.3	0.028	*<0.00005*	0.0042	*<0.0005*	*<0.3*	2.0	*<0.0005*	2.8	*<0.00005*	4.0	0.056	*<0.0001*	*<0.0005*	*<0.01*	0.0015	0.0032	*<0.01*
R618876	CFR0860	Supremo Pit	gneiss	*<0.25*	48	*<0.05*	*<0.5*	0.14	0.013	0.0039	7.7	*<0.5*	0.26	0.00086	0.0067	0.037	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	9.5	0.0045	0.00016	0.0053	0.46	0.00019	*<0.005*	2.9	0.019	*<0.00005*	0.0021	0.0071	*<0.3*	7.3	*<0.0005*	3.1	*<0.00005*	2.4	0.021	*<0.0001*	*<0.0005*	*<0.01*	0.00016	0.0013	*<0.01*
R619123	CFR0867	Supremo Pit	gneiss	*<0.25*	4.8	*<0.05*	*<0.5*	0.097	0.020	0.0028	6.6	0.53	0.81	0.0018	0.053	0.013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.87	0.0021	0.00059	0.0050	0.60	0.00024	*<0.005*	0.30	0.015	0.00026	0.00069	0.0015	*<0.3*	1.9	*<0.0005*	5.2	*<0.00005*	1.5	0.0065	*<0.0001*	*<0.0005*	0.011	0.00046	0.0016	*<0.01*
Statistical Summary forOverburden overlying Gneiss bedrock (n = 11)			**Max**	-	48	*<0.05*	*<0.5*	0.23	1.0	0.033	8.4	1.8	2.1	0.0084	0.096	0.078	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	13	0.0048	0.0029	0.0091	2.1	0.0010	*<0.005*	2.9	0.20	0.00026	0.0042	0.0071	*<0.3*	7.3	*<0.0005*	6.6	*<0.00005*	4.0	0.056	*<0.0001*	*<0.0005*	0.065	0.0015	0.0067	*<0.01*
			90th PCTL	-	40	*<0.05*	*<0.5*	0.20	0.84	0.013	8.1	1.0	1.1	0.0025	0.050	0.052	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.0044	0.0023	0.0080	1.1	0.00092	*<0.005*	1.8	0.17	0.000064	0.0036	0.0058	*<0.3*	2.1	*<0.0005*	5.3	*<0.00005*	3.4	0.051	*<0.0001*	*<0.0005*	0.036	0.0013	0.0036	*<0.01*
			75th PCTL	-	22	*<0.05*	*<0.5*	0.18	0.11	0.0070	7.7	0.74	1.0	0.0019	0.017	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.2	0.0030	0.0010	0.0071	1.1	0.00059	*<0.005*	1.3	0.065	*<0.00005*	0.0024	0.0053	*<0.3*	2.0	*<0.0005*	5.2	*<0.00005*	2.7	0.026	*<0.0001*	*<0.0005*	0.026	0.00064	0.0031	*<0.01*
			Median	-	13	*<0.05*	*<0.5*	0.15	0.033	0.0052	7.2	0.67	0.85	0.0011	0.013	0.039	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.1	0.0022	0.00055	0.0056	0.81	0.00040	*<0.005*	0.66	0.037	*<0.00005*	0.0020	0.0025	*<0.3*	1.9	*<0.0005*	4.6	*<0.00005*	2.1	0.014	*<0.0001*	*<0.0005*	0.018	0.00044	0.0021	*<0.01*
			25th PCTL	-	8.3	*<0.05*	*<0.5*	0.13	0.020	0.0030	6.6	0.59	0.55	0.00086	0.0064	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.3	0.0016	0.00028	0.0046	0.55	0.00024	*<0.005*	0.55	0.026	*<0.00005*	0.0017	0.0014	*<0.3*	1.5	*<0.0005*	3.7	*<0.00005*	1.9	0.0094	*<0.0001*	*<0.0005*	0.011	0.00025	0.0016	*<0.01*
			10th PCTL	-	6.1	*<0.05*	*<0.5*	0.065	0.018	0.0028	6.1	0.53	0.29	0.00040	0.0047	0.024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.1	0.00079	0.00017	0.0040	0.43	0.00019	*<0.005*	0.32	0.019	*<0.00005*	0.0012	0.00088	*<0.3*	0.97	*<0.0005*	3.1	*<0.00005*	1.5	0.0070	*<0.0001*	*<0.0005*	*<0.01*	0.00018	0.0013	*<0.01*
			Min	-	4.8	*<0.05*	*<0.5*	0.048	0.013	0.0025	6.1	*<0.5*	0.16	0.00035	0.0041	0.013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.87	*<0.0005*	*<0.0001*	0.0021	0.049	*<0.0001*	*<0.005*	0.30	0.015	0.000050	0.00069	*<0.0005*	*<0.3*	0.96	*<0.0005*	2.8	*<0.00005*	0.62	0.0065	*<0.0001*	*<0.0005*	*<0.01*	0.00016	0.0013	*<0.01*
Overburden overlying Schist Bedrock																																												
17552	SRK-15TP-46	ROM/Plant	schist	*<0.25*	7.6	*<0.05*	*<0.5*	0.064	0.016	0.0018	6.2	0.84	1.5	0.00025	0.0039	0.030	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.3	0.0031	0.00096	0.0070	0.98	0.00050	*<0.005*	0.59	0.079	*<0.00005*	0.00077	0.0021	*<0.3*	2.1	*<0.0005*	12	*<0.00005*	1.9	0.015	*<0.0001*	*<0.0005*	0.036	0.0011	0.0026	*<0.01*
17554	SRK-15TP-22	ROM/Plant	schist	*<0.25*	5.3	*<0.05*	*<0.5*	0.11	*<0.005*	0.0013	6.5	2.7	1.9	0.00023	0.0020	0.032	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.5	0.0043	0.0010	0.0089	1.4	0.0011	*<0.005*	0.64	0.038	*<0.00005*	0.0015	0.0051	*<0.3*	2.2	*<0.0005*	13	*<0.00005*	1.7	0.011	*<0.0001*	*<0.0005*	0.054	0.00078	0.0034	*<0.01*
17556	SRK-15TP-24	ROM/Plant	schist	*<0.25*	27	*<0.05*	*<0.5*	0.28	*<0.005*	*<0.001*	7.7	3.1	1.6	0.0016	0.0085	0.052	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	10	0.0043	0.00087	0.0078	2.0	0.0012	*<0.005*	0.75	0.042	0.00012	0.0016	0.0056	*<0.3*	2.6	0.00064	9.6	*<0.00005*	1.3	0.026	*<0.0001*	*<0.0005*	0.041	0.00014	0.0053	*<0.01*
R622028	CFR0956	Supremo Pit	schist	*<0.25*	23	*<0.05*	*<0.5*	0.19	0.033	0.0063	7.1	1.0	1.1	0.0026	0.015	0.10	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	12	0.0028	0.00086	0.0067	1.1	0.00042	*<0.005*	0.68	0.10	*<0.00005*	0.0045	0.0056	*<0.3*	1.1	*<0.0005*	5.5	*<0.00005*	1.2	0.039	*<0.0001*	*<0.0005*	0.032	0.00011	0.0031	*<0.01*
R281332	CFR0816	Supremo Pit	schist	*<0.25*	6.3	*<0.05*	*<0.5*	0.11	0.030	0.0028	7.0	0.54	1.2	0.0031	0.015	0.023	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.68	0.0012	0.00028	0.0044	0.74	0.00049	*<0.005*	0.23	0.039	*<0.00005*	0.0021	0.0014	*<0.3*	1.2	*<0.0005*	4.5	*<0.00005*	2.9	0.0038	*<0.0001*	*<0.0005*	0.018	0.0011	0.0021	*<0.01*
R621156	CFR0937	West WRSF	schist	*<0.25*	8.0	*<0.05*	*<0.5*	0.22	0.049	0.0013	7.4	0.84	1.4	0.00083	0.013	0.037	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.7	0.0030	0.00078	0.019	1.4	0.0014	*<0.005*	0.57	0.049	*<0.00005*	0.0017	0.0023	*<0.3*	1.1	*<0.0005*	5.9	*<0.00005*	3.2	0.0085	*<0.0001*	*<0.0005*	0.050	0.00068	0.0043	*<0.01*
R550015	CFR0984	North WRSF	schist	*<0.25*	45	*<0.05*	*<0.5*	0.25	0.028	0.0047	7.6	1.2	0.71	0.0075	0.041	0.061	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	14	0.0038	0.00078	0.016	0.90	0.00035	*<0.005*	2.2	0.32	*<0.00005*	0.012	0.0056	*<0.3*	3.1	*<0.0005*	4.6	*<0.00005*	4.6	0.042	*<0.0001*	*<0.0005*	0.026	0.00063	0.0091	*<0.01*
Statistical Summary forOverburden overlying Schist bedrock (n = 11)			**Max**	-	*45*	*<0.05*	*<0.5*	*0.28*	*0.049*	*0.0063*	*7.7*	*3.1*	*1.9*	*0.0075*	*0.041*	*0.10*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*14*	*0.0043*	*0.0010*	*0.019*	*2.0*	*0.0014*	*<0.005*	*2.2*	*0.32*	*0.00012*	*0.012*	*0.0056*	*<0.3*	*3.1*	*0.00064*	*13*	*<0.00005*	*4.6*	*0.042*	*<0.0001*	*<0.0005*	*0.054*	*0.0011*	*0.0091*	*<0.01*
			90th PCTL	-	*35*	*<0.05*	*<0.5*	*0.26*	*0.039*	*0.0053*	*7.6*	*2.9*	*1.7*	*0.0048*	*0.026*	*0.078*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*13*	*0.0043*	*0.00098*	*0.017*	*1.7*	*0.0013*	*<0.005*	*1.3*	*0.19*	*0.000077*	*0.0073*	*0.0056*	*<0.3*	*2.8*	*0.00056*	*12*	*<0.00005*	*3.7*	*0.040*	*<0.0001*	*<0.0005*	*0.052*	*0.0011*	*0.0068*	*<0.01*
			75th PCTL	-	*25*	*<0.05*	*<0.5*	*0.24*	*0.031*	*0.0038*	*7.5*	*2.0*	*1.6*	*0.0029*	*0.015*	*0.057*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*11*	*0.0040*	*0.00092*	*0.012*	*1.4*	*0.0011*	*<0.005*	*0.72*	*0.089*	*<0.00005*	*0.0033*	*0.0056*	*<0.3*	*2.4*	*<0.0005*	*11*	*<0.00005*	*3.0*	*0.033*	*<0.0001*	*<0.0005*	*0.046*	*0.00092*	*0.0048*	*<0.01*
			Median	-	*8.0*	*<0.05*	*<0.5*	*0.19*	*0.028*	*0.0018*	*7.1*	*1.0*	*1.4*	*0.0016*	*0.013*	*0.037*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*2.3*	*0.0031*	*0.00086*	*0.0078*	*1.1*	*0.00050*	*<0.005*	*0.64*	*0.049*	*<0.00005*	*0.0017*	*0.0051*	*<0.3*	*2.1*	*<0.0005*	*5.9*	*<0.00005*	*1.9*	*0.015*	*<0.0001*	*<0.0005*	*0.036*	*0.00068*	*0.0034*	*<0.01*
			25th PCTL	-	*7.0*	*<0.05*	*<0.5*	*0.11*	*0.011*	*0.0013*	*6.8*	*0.84*	*1.1*	*0.00054*	*0.0062*	*0.031*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*1.6*	*0.0029*	*0.00078*	*0.0069*	*0.94*	*0.00046*	*<0.005*	*0.58*	*0.040*	*<0.00005*	*0.0016*	*0.0022*	*<0.3*	*1.2*	*<0.0005*	*5.0*	*<0.00005*	*1.5*	*0.0097*	*<0.0001*	*<0.0005*	*0.029*	*0.00038*	*0.0029*	*<0.01*
			10th PCTL	-	*5.9*	*<0.05*	*<0.5*	*0.090*	*<0.005*	*0.0012*	*6.4*	*0.72*	*0.95*	*0.00024*	*0.0031*	*0.027*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*1.2*	*0.0022*	*0.00058*	*0.0058*	*0.84*	*0.00039*	*<0.005*	*0.44*	*0.038*	*<0.00005*	*0.0012*	*0.0018*	*<0.3*	*1.1*	*<0.0005*	*4.5*	*<0.00005*	*1.2*	*0.0066*	*<0.0001*	*<0.0005*	*0.023*	*0.00013*	*0.0024*	*<0.01*
			Min	-	*5.3*	*<0.05*	*<0.5*	*0.064*	*<0.005*	*<0.001*	*6.2*	*0.54*	*0.71*	*0.00023*	*0.0020*	*0.023*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*0.68*	*0.0012*	*0.00028*	*0.0044*	*0.74*	*0.00035*	*<0.005*	*0.23*	*0.038*	*<0.00005*	*0.00077*	*0.0014*	*<0.3*	*1.1*	*<0.0005*	*4.5*	*<0.00005*	*1.2*	*0.0038*	*<0.0001*	*<0.0005*	*0.018*	*0.00011*	*0.0021*	*<0.01*
Overburden overlying Granite Bedrock																																												
17560	SRK-15TP-43	Leach Pad	granite	*<0.25*	5.2	*<0.05*	*<0.5*	0.17	*<0.005*	*<0.001*	6.1	*<0.5*	1.4	0.00025	0.0011	0.019	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.0	0.0033	0.00046	0.0068	1.3	0.00075	*<0.005*	0.36	0.045	*<0.00005*	0.0011	0.0026	*<0.3*	0.79	*<0.0005*	11	*<0.00005*	2.2	0.0077	*<0.0001*	*<0.0005*	0.072	0.0016	0.0038	*<0.01*
17561	SRK-15TP-05	Leach Pad	granite	*<0.25*	4.1	*<0.05*	*<0.5*	0.079	*<0.005*	*<0.001*	6.2	0.56	0.98	0.00015	0.0011	0.014	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.59	0.0019	0.00049	0.0031	0.74	0.00062	*<0.005*	0.16	0.072	*<0.00005*	0.0011	0.0015	*<0.3*	0.90	*<0.0005*	7.5	0.000071	2.5	0.0051	*<0.0001*	*<0.0005*	0.029	0.0023	0.0018	*<0.01*
17565	SRK-15TP-03	Leach Pad	granite	*<0.25*	4.9	*<0.05*	*<0.5*	0.084	0.0098	0.0017	5.9	0.87	1.7	0.00021	0.0028	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.3	0.0029	0.00096	0.0052	1.6	0.0011	*<0.005*	0.35	0.15	*<0.00005*	0.00052	0.0022	*<0.3*	0.98	*<0.0005*	10	0.000079	2.3	0.011	*<0.0001*	*<0.0005*	0.054	0.0035	0.0034	*<0.01*
17566	SRK-15TP-17	Leach Pad	granite	*<0.25*	4.9	*<0.05*	*<0.5*	0.083	*<0.005*	*<0.001*	6.4	*<0.5*	0.90	0.00023	0.0016	0.013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.86	0.0018	0.00029	0.0045	0.99	0.00070	*<0.005*	0.25	0.052	0.000065	0.0011	0.0022	*<0.3*	1.1	*<0.0005*	9.3	*<0.00005*	1.9	0.0077	*<0.0001*	*<0.0005*	0.033	0.0024	0.0022	*<0.01*
17571	SRK-15TP-15	Leach Pad	granite	*<0.25*	5.0	*<0.05*	*<0.5*	0.066	0.0080	0.0010	6.1	*<0.5*	1.3	0.00019	0.0023	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.94	0.0027	0.00079	0.0048	1.0	0.00070	*<0.005*	0.27	0.15	*<0.00005*	0.00054	0.0020	*<0.3*	0.94	*<0.0005*	10	*<0.00005*	2.1	0.0087	*<0.0001*	*<0.0005*	0.049	0.0015	0.0028	*<0.01*
17572	SRK-15TP-14	Leach Pad	granite	*<0.25*	3.9	*<0.05*	*<0.5*	0.047	0.058	0.0022	5.9	*<0.5*	0.74	0.00069	0.026	0.014	*<0.0005*	*<0.0005*	0.024	*<0.00005*	0.64	0.0015	0.00043	0.0040	0.44	0.00032	*<0.005*	0.17	0.054	*<0.00005*	0.00040	0.0015	*<0.3*	1.8	*<0.0005*	7.4	*<0.00005*	1.1	0.0059	*<0.0001*	*<0.0005*	0.011	0.0025	0.0010	*<0.01*
17575	SRK-15TP-11	Leach Pad	granite	*<0.25*	5.0	*<0.05*	*<0.5*	0.11	*<0.005*	0.0017	6.5	*<0.5*	0.79	0.00027	0.0025	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.38	0.0017	0.00020	0.0035	0.75	0.00069	*<0.005*	0.11	0.042	*<0.00005*	0.0015	0.0014	*<0.3*	0.91	*<0.0005*	7.4	*<0.00005*	2.2	0.0032	*<0.0001*	*<0.0005*	0.026	0.0041	0.0020	*<0.01*
17580	SRK-15TP-41	Leach Pad	granite	*<0.25*	5.8	*<0.05*	*<0.5*	0.13	*<0.005*	*<0.001*	6.5	*<0.5*	1.9	0.00027	0.0016	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.84	0.0037	0.00059	0.0077	1.9	0.0016	*<0.005*	0.44	0.084	*<0.00005*	0.0025	0.0036	*<0.3*	0.89	*<0.0005*	13	0.00014	2.3	0.0069	*<0.0001*	*<0.0005*	0.077	0.0015	0.0059	*<0.01*
KNB-1	KNB-1	Event Pond	granite	*<0.25*	*<2*	*<0.05*	*<0.5*	*<0.02*	0.13	*<0.001*	6.5	*<0.5*	0.11	0.00016	*<0.001*	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*<0.1*	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	0.00010	*<0.005*	*<0.05*	0.0016	*<0.00005*	0.0027	*<0.0005*	*<0.3*	0.53	*<0.0005*	2.0	*<0.00005*	0.55	*<0.0005*	*<0.0001*	*<0.0005*	*<0.01*	0.0023	*<0.001*	*<0.01*
KNB-2	KNB-2	Event Pond	granite	*<0.25*	*<2*	*<0.05*	*<0.5*	0.022	0.029	*<0.001*	6.4	*<0.5*	0.11	0.00015	*<0.001*	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*<0.1*	*<0.0005*	*<0.0001*	*<0.001*	0.046	0.00023	*<0.005*	*<0.05*	0.0025	*<0.00005*	0.00084	*<0.0005*	*<0.3*	0.48	*<0.0005*	2.2	*<0.00005*	0.61	*<0.0005*	*<0.0001*	*<0.0005*	*<0.01*	0.0017	*<0.001*	*<0.01*
KNB-3	KNB-3	Event Pond	granite	*<0.25*	*<2*	*<0.05*	*<0.5*	*<0.02*	0.41	*<0.001*	6.3	1.4	0.081	0.00013	0.0011	0.0029	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*<0.1*	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	0.00031	*<0.005*	*<0.05*	0.0034	*<0.00005*	0.00012	*<0.0005*	*<0.3*	0.98	*<0.0005*	2.5	*<0.00005*	0.75	*<0.0005*	*<0.0001*	*<0.0005*	*<0.01*	0.0011	*<0.001*	*<0.01*
Statistical Summary forOverburden overlying Granite bedrock (n = 11)			**Max**	-	5.8	*<0.05*	*<0.5*	0.17	0.41	0.0022	6.5	1.4	1.9	0.00069	0.026	0.025	*<0.0005*	*<0.0005*	0.024	*<0.00005*	1.3	0.0037	0.00096	0.0077	1.9	0.0016	*<0.005*	0.44	0.15	0.000065	0.0027	0.0036	*<0.3*	1.8	*<0.0005*	13	0.00014	2.5	0.011	*<0.0001*	*<0.0005*	0.077	0.0041	0.0059	*<0.01*
			90th PCTL	-	5.2	*<0.05*	*<0.5*	0.13	0.13	0.0017	6.5	0.87	1.7	0.00027	0.0028	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.0	0.0033	0.00079	0.0068	1.6	0.0011	*<0.005*	0.36	0.15	*<0.00005*	0.0025	0.0026	*<0.3*	1.1	*<0.0005*	11	0.000079	2.3	0.0087	*<0.0001*	*<0.0005*	0.072	0.0035	0.0038	*<0.01*
			75th PCTL	-	5.0	*<0.05*	*<0.5*	0.098	0.043	0.0014	6.5	0.53	1.4	0.00026	0.0024	0.022	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.90	0.0028	0.00054	0.0050	1.1	0.00073	*<0.005*	0.31	0.078	*<0.00005*	0.0013	0.0022	*<0.3*	0.98	*<0.0005*	10	0.000061	2.2	0.0077	*<0.0001*	*<0.0005*	0.052	0.0024	0.0031	*<0.01*
			Median	-	4.9	*<0.05*	*<0.5*	0.079	*<0.008*	*<0.001*	6.3	*<0.5*	0.90	0.00021	0.0016	0.014	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.64	0.0018	0.00043	0.0040	0.75	0.00069	*<0.005*	0.17	0.052	*<0.00005*	0.0011	0.0015	*<0.3*	0.91	*<0.0005*	7.5	*<0.00005*	2.1	0.0059	*<0.0001*	*<0.0005*	0.029	0.0023	0.0020	*<0.01*
			25th PCTL	-	3.0	*<0.05*	*<0.5*	0.035	*<0.005*	*<0.001*	6.1	*<0.5*	0.42	0.00016	0.0011	0.0073	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.24	0.0010	0.00015	0.0021	0.24	0.00032	*<0.005*	0.081	0.023	*<0.00005*	0.00053	0.00096	*<0.3*	0.84	*<0.0005*	4.9	*<0.00005*	0.93	0.0019	*<0.0001*	*<0.0005*	0.011	0.0015	0.0010	*<0.01*
			10th PCTL	-	*<2*	*<0.05*	*<0.5*	0.020	*<0.005*	*<0.001*	5.9	*<0.5*	0.11	0.00015	*<0.001*	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*<0.1*	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	0.00023	*<0.005*	*<0.05*	0

Appendix C.4-3: Solid Phase Element Results by Aqua Regia Digestion for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
				ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Overburden Overlying Gneiss Bedrock																																																									
KAM106801	CFR0320	DD Pit	gneiss	0.18	0.58	481	2.8	<10	3100	0.99	0.22	0.52	0.020	56	5.8	9.0	1.7	5.4	1.5	1.4	0.060	0.060	0.48	0.011	0.26	32	0.90	0.090	352	0.63	0.010	<0.05	11	310	11	12	<0.001	0.080	5.9	2.2	0.40	0.30	54	<0.01	0.12	20	<0.005	0.29	1.2	7.0	0.71	8.5	11	2.6
R281758	CFR0836	DD Pit	gneiss	0.070	1.5	106	<0.2	<10	210	0.43	0.25	0.49	0.080	27	14	69	1.1	16	2.6	4.9	0.090	0.020	0.090	0.018	0.26	14	9.1	0.84	530	1.7	0.040	1.2	27	520	10	22	<0.001	0.010	6.1	3.9	0.30	1.1	34	<0.01	0.090	5.4	0.092	0.21	0.94	48	2.2	6.4	39	0.90
R283938	CFR0825	DD Pit	gneiss	0.050	1.6	39	<0.2	<10	190	0.54	0.25	0.53	0.050	36	12	53	1.1	12	2.4	5.3	0.090	0.060	0.030	0.017	0.33	19	9.0	0.82	442	1.2	0.060	1.2	22	470	8.2	30	<0.001	0.010	5.8	4.0	0.60	1.0	38	<0.01	0.050	11	0.11	0.20	1.2	43	2.0	8.5	35	2.8
R288218	CFR0694	DD Pit	gneiss	0.040	1.5	47	<0.2	<10	150	0.40	0.63	0.51	0.030	25	13	79	1.4	14	2.5	4.1	0.060	0.020	0.030	0.015	0.24	13	7.7	0.84	500	0.69	0.040	0.89	37	510	6.0	22	<0.001	0.010	2.6	3.1	0.60	0.80	29	<0.01	0.28	6.1	0.095	0.17	0.69	37	0.52	6.0	33	0.70
R298598	CFR0716	DD Pit	gneiss	0.030	1.8	44	<0.2	<10	220	0.76	0.31	0.34	0.050	62	10	33	2.1	10	2.7	6.3	0.12	0.13	0.020	0.019	0.61	32	10	0.81	502	1.2	0.050	0.94	20	610	9.3	43	<0.001	0.010	3.4	4.3	0.60	0.80	21	0.010	0.040	15	0.075	0.31	0.85	36	0.84	11	44	5.0
KAM018321	CFR0102	Supremo Pit	gneiss	0.18	0.81	894	1.2	<10	180	0.68	0.14	0.18	0.12	49	6.0	17	1.3	14	2.0	2.7	0.070	0.070	0.86	0.019	0.22	27	3.8	0.12	379	1.3	0.020	0.22	9.2	300	14	14	<0.001	0.040	17	3.4	0.50	0.80	33	<0.01	0.050	25	0.012	0.96	8.3	21	1.2	8.5	30	4.4
KAM104165	CFR0288	Supremo Pit	gneiss	0.060	0.45	372	1.3	<10	130	0.89	0.10	0.090	0.080	79	2.0	8.0	0.67	5.4	1.1	2.2	0.090	0.070	0.57	0.016	0.20	45	1.5	0.050	363	1.2	0.010	0.30	4.1	140	15	17	<0.001	<0.01	25	1.1	0.40	0.50	11	<0.01	0.040	27	<0.005	0.55	8.7	7.0	1.3	7.0	16	3.6
R280751	CFR0805	Supremo Pit	gneiss	0.030	0.55	145	<0.2	<10	100	0.52	0.17	0.080	0.080	67	3.6	18	1.1	22	1.4	2.2	0.080	0.17	0.050	0.011	0.17	38	2.4	0.10	336	3.2	0.020	0.39	11	180	8.8	17	0.0010	0.010	8.9	1.4	0.40	0.80	9.7	<0.01	0.010	25	0.018	0.19	4.3	13	3.3	8.5	36	3.6
R281909	CFR0839	Supremo Pit	gneiss	0.020	2.2	33	<0.2	<10	350	0.55	0.38	0.79	0.050	35	18	94	1.5	12	2.7	7.4	0.10	0.070	0.020	0.016	0.81	18	11	1.9	404	0.90	0.080	0.36	44	690	7.4	43	<0.001	0.010	3.2	3.7	0.40	1.8	34	<0.01	0.14	8.2	0.17	0.32	1.0	48	1.6	6.8	47	2.7
R281971	CFR0841	Supremo Pit	gneiss	0.050	1.2	83	<0.2	<10	170	0.40	0.36	0.34	0.040	44	8.4	28	0.88	13	2.1	4.2	0.070	0.030	0.13	0.017	0.23	24	7.0	0.39	358	1.3	0.050	1.1	15	340	6.0	23	<0.001	0.010	5.6	2.6	0.60	1.3	25	<0.01	0.14	14	0.061	0.18	1.5	30	2.3	9.3	25	1.1
R284001	CFR0804	Supremo Pit	gneiss	0.050	0.97	87	0.20	<10	130	0.70	0.11	0.24	0.080	62	5.6	25	1.0	23	1.8	3.6	0.10	0.070	0.080	0.016	0.24	41	4.8	0.21	403	3.1	0.060	1.2	12	310	9.4	23	<0.001	0.010	8.1	2.5	0.60	1.2	23	0.020	0.010	20	0.051	0.20	4.4	27	1.7	11	38	3.1
R285461	CFR0757	Supremo Pit	gneiss	0.070	0.94	15	<0.2	<10	100	0.33	0.20	0.34	0.090	28	6.6	30	0.49	7.2	1.7	3.0	0.060	0.14	0.010	0.012	0.27	16	4.0	0.38	294	1.1	0.060	0.50	15	360	7.9	20	<0.001	<0.01	0.58	1.8	0.60	1.1	28	<0.01	0.050	15	0.080	0.14	1.3	25	0.34	6.1	25	6.7
R285552	CFR0759	Supremo Pit	gneiss	0.020	2.0	104	<0.2	<10	230	0.84	0.47	0.36	0.040	89	12	55	2.5	11	2.9	7.0	0.18	0.13	0.050	0.016	1.1	49	11	1.3	453	0.79	0.040	0.86	13	590	6.4	84	<0.001	<0.01	2.2	3.7	0.80	1.6	27	0.010	0.12	20	0.14	0.61	2.6	43	0.71	16	41	6.2
R286151	CFR0776	Supremo Pit	gneiss	0.020	1.0	27	<0.2	<10	110	0.38	0.14	0.27	0.050	32	7.4	34	0.59	19	1.9	3.6	0.070	0.050	0.010	0.011	0.28	15	5.7	0.43	326	2.4	0.060	0.74	19	310	8.3	25	0.0010	<0.01	0.73	2.6	0.40	0.90	29	<0.01	0.030	16	0.071	0.14	1.3	30	1.3	7.0	23	3.2
R286219	CFR0779	Supremo Pit	gneiss	0.030	0.87	228	<0.2	<10	110	0.48	0.34	0.23	0.10	44	7.2	23	0.83	11	1.7	3.3	0.080	0.23	0.040	0.013	0.22	25	4.0	0.27	262	1.4	0.050	0.55	13	340	5.2	18	<0.001	<0.01	4.4	2.6	0.70	1.0	23	0.030	0.14	22	0.046	0.16	2.0	24	1.2	8.7	20	10
R286345	CFR0782	Supremo Pit	gneiss	0.020	0.88	38	<0.2	<10	100	0.34	0.24	0.27	0.030	85	5.1	12	0.87	9.5	1.8	4.5	0.10	0.19	0.020	0.011	0.45	43	4.8	0.31	267	1.4	0.050	0.75	6.6	400	4.4	46	<0.001	<0.01	1.4	1.9	0.70	0.90	22	<0.01	0.13	23	0.094	0.34	4.3	17	0.79	11	21	7.6
R287156	CFR0802	Supremo Pit	gneiss	0.040	0.94	121	<0.2	<10	110	0.61	0.19	0.18	0.070	55	6.5	19	1.1	8.9	1.9	2.9	0.080	0.12	0.040	0.015	0.21	34	4.4	0.21	409	0.81	0.040	0.45	9.9	350	7.5	19	<0.001	<0.01	4.6	2.6	0.40	0.70	18	<0.01	0.010	21	0.041	0.19	2.3	29	0.69	9.0	27	3.2
R513919	CFR0872	Supremo Pit	gneiss	0.030	1.1	91	<0.2	<10	120	0.49	0.090	0.18	0.070	38	8.1	27	1.0	12	1.8	3.1	0.060	0.12	0.060	0.013	0.19	20	5.3	0.30	372	1.5	0.040	0.24	17	240	8.8	15	<0.001	<0.01	3.3	2.6	0.50	0.80	16	<0.01	0.020	22	0.047	0.14	1.8	28	1.9	8.2	24	6.7
R514753	CFR0783	Supremo Pit	gneiss	0.040	0.89	117	<0.2	<10	160	0.42	0.12	0.25	0.10	36	7.4	21	0.54	12	1.9	2.8	0.060	0.20	0.030	0.015	0.15	19	4.7	0.23	414	1.2	0.030	0.48	13	290	6.7	12	<0.001	0.010	4.4	2.5	0.60	0.90	20	<0.01	0.030	17	0.044	0.090	1.9	31	1.5	7.3	23	2.2
R514902	CFR0786	Supremo Pit	gneiss	0.020	1.9	43	<0.2	<10	220	0.52	0.14	0.65	0.040	17	15	84	0.94	8.0	2.6	4.7	0.090	0.22	0.020	0.011	0.68	9.1	11	1.4	537	0.82	0.060	0.24	25	540	4.2	43	<0.001	<0.01	7.6	3.0	0.40	1.1	30	<0.01	0.050	11	0.15	0.30	1.1	42	0.78	5.6	30	5.2
R515335	CFR0797	Supremo Pit	gneiss	0.040	1.0	71	<0.2	<10	120	0.49	0.12	0.24	0.070	46	6.9	20	0.78	13	1.8	3.2	0.060	0.080	0.060	0.015	0.17	25	5.2	0.27	343	0.76	0.050	0.41	12	360	5.6	14	<0.001	<0.01	4.5	3.0	0.50	1.1	20	<0.01	0.030	21	0.054	0.11	2.4	31	0.87	9.4	24	4.3
R515458	CFR0799	Supremo Pit	gneiss	0.040	1.4	45	<0.2	<10	150	0.50	0.10	0.32	0.060	46	8.4	33	0.84	14	2.0	4.3	0.060	0.030	0.030	0.014	0.26	26	8.6	0.54	315	0.68	0.060	0.80	17	410	5.3	20	<0.001	0.010	3.1	3.2	0.60	1.0	24	<0.01	0.030	16	0.089	0.16	1.8	40	2.1	8.9	28	1.7
R540708	CFR0864	Supremo Pit	gneiss	0.040	1.5	44	<0.2	<10	150	0.62	0.090	0.42	0.030	41	9.6	42	1.2	18	2.4	4.3	0.090	0.14	0.050	0.013	0.35	23	8.4	0.63	408	3.9	0.060	0.57	19	390	6.5	32	0.0010	0.010	3.4	3.9	0.50	0.90	27	0.010	0.020	20	0.11	0.23	2.2	42	1.1	14	31	5.8
R540846	CFR0866	Supremo Pit	gneiss	0.050	1.2	108	<0.2	<10	110	1.0	0.38	0.31	0.050	53	7.0	26	1.6	13	1.9	5.1	0.15	0.17	0.12	0.016	0.20	28	5.9	0.30	381	1.6	0.040	0.79	15	280	8.5	27	<0.001	<0.01	3.4	4.2	0.70	1.4	21	0.060	0.020	31	0.045	0.28	2.4	29	0.93	13	25	8.8
R541274	CFR0877	Supremo Pit	gneiss	0.030	0.70	83	<0.2	<10	80	0.39	0.10	0.11	0.070	39	5.2	16	0.64	7.8	1.4	2.2	0.050	0.030	0.040	0.0090	0.16	20	3.4	0.18	326	1.7	0.030	0.44	9.8	190	11	13	<0.001	<0.01	3.9	1.4	0.60	0.60	12	<0.01	0.020	20	0.032	0.11	2.1	20	1.9	6.7	19	1.8
R541396	CFR0881	Supremo Pit	gneiss	0.020	0.50	99	<0.2	<10	60	0.40	0.11	0.070	0.090	31	2.8	15	0.38	5.4	0.85	1.6	0.050	0.040	0.030	0.0060	0.15	18	1.9	0.060	221	1.8	0.020	0.34	8.2	150	6.6	12	0.0010	<0.01	6.3	0.90	0.40	0.40	9.4	<0.01	0.010	27	0.011	0.090	2.9	10	0.59	8.0	13	3.1
R541524	CFR0884	Supremo Pit	gneiss	0.030	0.58	53	<0.2	<10	70	0.36	0.10	0.12	0.080	32	3.8	15	0.45	7.6	1.2	2.0	0.050	0.080	0.090	0.010	0.13	17	3.1	0.15	233	1.2	0.030	0.41	8.6	160	5.5	12	<0.001	<0.01	3.4	1.3	0.40	0.50	12	<0.01	0.020	25	0.033	0.10	2.1	18	1.1	8.8	17	4.1
R542611	CFR0909	Supremo Pit	gneiss	0.040	0.88	562	<0.2	<10	110	0.69	0.11	0.15	0.050	61	4.2	18	0.77	6.7	1.5	2.4	0.070	0.17	0.39	0.010	0.19	38	3.8	0.13	246	1.3	0.010	0.11	8.6	270	10	17	<0.001	<0.01	42	1.7	0.60	0.70	16	<0.01	0.020	29	0.021	0.57	12	16	2.0	12	19	9.3
R542736	CFR0912	Supremo Pit	gneiss	0.020	1.1	27	<0.2	<10	200	0.80	0.19	0.45	0.020	69	8.7	28	2.0	9.8	1.8	3.5	0.090	0.20	0.030	0.016	0.31	41	6.2	0.47	366	1.0	0.050	0.36	15	340	4.4	32	<0.001	0.010	1.9	2.9	0.60	1.3	27	<0.01	0.020	24	0.079	0.26	1.5	27	1.4	13	25	11
R543125	CFR0924	Supremo Pit	gneiss	0.020	0.85	16	<0.2	<10	90	0.31	0.16	0.23	0.050	31	6.6	24	0.49	8.0	1.5	2.7	0.050	0.090	0.010	0.011	0.22	15	4.6	0.34	305	1.1	0.050	0.52	13	280	4.6	18	<0.001	<0.01	0.57	1.9	0.40	0.80	15	<0.01	0.060	20	0.052	0.11	2.0	25	3.0	7.4	20	4.6
R543393	CFR0933	Supremo Pit	gneiss	0.020	0.44	150	<0.2	<10	50	0.35	0.14	0.11	0.090	35	3.5	12	0.74	6.0	1.4	1.7	0.050	0.090	0.10	0.0080	0.13	21	2.0	0.090	203	1.5	0.030	0.42	5.8	220	6.7	12	<0.001	<0.01	6.9	1.1	0.30	0.80	9.6	<0.01	0.020	25	0.017	0.12	2.1	11	2.9	6.7	17	4.3
R546991	CFR0905	Supremo Pit	gneiss	0.050	1.3	165	<0.2	<10	150	0.68	0.12	0.26	0.17	53	7.0	25	0.83	16	1.9	3.8	0.080	0.11	0.18	0.015	0.18	31	7.0	0.30	380	1.2	0.040	0.63	14	340	18	15	<0.001	0.010	3.2	3.5	0.70	0.60	35	<0.01	0.040	20	0.062	0.26	4.4	38	3.5	12	34	6.2
R547067	CFR0908	Supremo Pit	gneiss	0.040	0.67	32	<0.2	<10	90	0.44	0.14	0.44	0.040	57	4.2	17	0.75	11	1.4	2.7	0.060	0.28	0.030	0.012	0.19	35	4.7	0.25	289	1.6	0.050	0.42	8.1	270	10	18	<0.001	0.010	1.6	2.0	0.50	1.3	24	<0.01	0.030	27	0.043	0.14	2.3	20	2.8	13	22	14
R548052	CFR0944	Supremo Pit	gneiss	0.070	1.4	50	<0.2	<10	170	0.82	0.39	0.31	0.080	59	7.2	22	2.6	13	2.2	4.6	0.10	0.080	0.070	0.019	0.18	33	7.9	0.28	666	1.7	0.040	1.8	12	360	9.2	26	<0.001	0.010	2.2	3.3	0.90	1.5	23	0.030	0.040	16	0.057	0.24	10	33	3.2	15	45	2.9
R618573	CFR0846	Supremo Pit	gneiss	0.040	2.2	94	<0.2	<10	220	0.81	0.22	0.57	0.040	45	16	78	2.3	19	3.2	7.1	0.14	0.20	0.070	0.024	0.49	22	12	1.3	630	2.5	0.070	1.2	41	530	5.2	41	<0.001	0.010	20	5.2	0.60	2.0	40	0.030	0.060	13	0.16	0.34	1.1	54	2.0	9.9	41	5.0
R618876	CFR0860	Supremo Pit	gneiss	0.020	1.9	72	<0.2	<10	150	0.56	0.16	0.46	0.030	46	19	345	3.7	22	2.2	5.2	0.11	0.12	0.030	0.014	0.70	24	12	2.2	427	2.0	0.040	0.55	266	210	6.5	51	0.0010	<0.01	1.6	6.4	0.60	2.2	17	0.030	0.020	21	0.063	0.42	1.7	33	1.1	11	26	5.8
R619123	CFR0867	Supremo Pit	gneiss	0.040	1.5	880	0.20	<10	150	0.96	0.35	0.15	0.020	54	17	50	4.7	17	3.0	5.7	0.13	0.070	1.4	0.027	0.55	26	6.1	0.51	319	1.9	0.030	0.37	38	280	4.7	36	<0.001	0.020	20	5.7	0.80	2.1	31	0.010	0.060	9.9	0.050	0.75	2.9	34	0.80	11	40	2.5
R620371	CFR0910	Supremo Pit	gneiss	0.010	0.34	20	<0.2	<10	40	0.24	0.070	0.23	0.010	51	1.5	10	0.78	7.7	0.97	2.0	0.060	0.12	0.030	0.0060	0.17	29	2.4	0.10	194	1.7	0.030	1.2	5.3	130	7.4	19	<0.001	<0.01	1.1	0.60	0.30	1.3	12	<0.01	0.010	31	0.018	0.16	2.2	5.0	2.5	8.6	12	5.4
R620448	CFR0911	Supremo Pit	gneiss	0.030	0.69	64	<0.2	<10	50	0.32	0.16	0.090	0.080	26	4.5	15	0.65	9.3	1.6	2.7	0.060	0.020	0.050	0.013	0.12	15	3.7	0.13	251	1.4	0.030	0.75	7.8	280	7.6	11	<0.001	0.010	2.9	1.4	0.30	1.0	18	<0.01	0.020	14	0.030	0.10	2.1	23	1.1	6.5	19	0.90
R620797	CFR0923	Supremo Pit	gneiss	0.070	0.94	64	<0.2	<10	100	0.38	0.16	0.20	0.060	30	5.9	30	0.59	89	2.1	3.1	0.060	0.040	0.060	0.014	0.13	18	12	0.23	357	1.8	0.040	0.94	12	430	13	12	<0.001	0.010	9.8	2.1	0.40	7.5	16	0.030	0.020	12	0.046	0.12	2.0	32	1.0	6.5	37	1.4
R290225	CFR0614	West WRSF	gneiss	0.040	0.71	84	<0.2	<10	140	0.43	0.57	0.19	0.080	45	3.7	14	0.80	12	1.6	3.1	0.060	0.030	0.040	0.016	0.21	25	3.4	0.19	179	1.9	0.020	0.75	8.7	280	6.3	19	0.0010	0.010	1.3	2.0	0.40	0.80	27	<0.01	0.14	16	0.032	0.14	1.3	17	1.3	8.2	24	1.8
Statistical Summary for Overburden overlying Gneiss Bedrock (n = 41)			**Max**	0.18	2.2	894	2.8	<10	3100	1.0	0.63	0.79	0.17	89	19	345	4.7	89	3.2	7.4	0.18	0.28	1.4	0.027	1.1	49	12	2.2	666	3.9	0.080	1.8	266	690	18	84	0.0010	0.080	42	6.4	0.90	7.5	54	0.060	0.28	31	0.17	0.96	12	54	3.5	16	47	14
			90th PCTL	0.070	1.9	372	0.20	<10	220	0.84	0.38	0.52	0.090	67	15	78	2.3	19	2.7	5.7	0.12	0.20	0.39	0.019	0.61	41	11	1.3	502	2.4	0.060	1.2	37	530	11	43	0.0010	0.010	17	4.2	0.70	1.8	34	0.030	0.14	27	0.11	0.55	4.4	43	2.9	13	41	8.8
			75th PCTL	0.050	1.5	117	<0.2	<10	170	0.69	0.25	0.42	0.080	56	9.6	34	1.4	14	2.2	4.6	0.090	0.14	0.090	0.016	0.31	32	8.4	0.54	409	1.7	0.050	0.86	19	400	9.3	30	<0.001	0.010	6.3	3.5	0.60	1.3	29	<0.01	0.060	24	0.080	0.30	2.6	36	2.0	11	35	5.8
			Median	0.040	0.97	83	<0.2	<10	130	0.50	0.16	0.26	0.060	45	7.0	25	0.88	12	1.9	3.3	0.070	0.090	0.050	0.014	0.22	25	5.2	0.30	358	1.4	0.040	0.55	13	310	7.4	19	<0.001	0.010	3.4	2.6	0.50	1.0	23	<0.01	0.030	20	0.051	0.19	2.1	29	1.3	8.6	25	4.1
			25th PCTL	0.020	0.71	44	<0.2	<10	100	0.40	0.12	0.18	0.040	35	5.1	17	0.74	8.0	1.5	2.7	0.060	0.060	0.030	0.011	0.18	18	3.8	0.18	294	1.1	0.030	0.39	9.2	270	6.0	15	<0.001	<0.01	2.2	1.9	0.40	0.80	16	<0.01	0.020	15	0.032	0.14	1.3	20	0.87	7.0	20	2.6
			10th PCTL	0.020	0.55	27	<0.2	<10	70	0.34	0.10	0.11	0.030	28	3.6	12	0.54	6.7	1.4	2.0	0.050	0.030	0.020	0.010	0.15	15	2.4	0.10	233	0.79	0.020	0.24	7.8	180	4.7	12	<0.001	<0.01	1.3	1.3	0.40	0.60	12	<0.01	0.010	11	0.017	0.11	1.1	11	0.71	6.5	17	1.4
			Min	0.010	0.34	15	<0.2	<10	40	0.24	0.070	0.070	0.010	17	1.5	8.0	0.38	5.4	0.85	1.4	0.050	0.020	0.010	0.0060	0.12	9.1	0.90	0.050	179	0.63	0.010	<0.05	4.1	130	4.2	11	<0.001	<0.01	0.57	0.60	0.30	0.30	9.4	<0.01	0.010	5.4	<0.005	0.090	0.69	5.0	0.34	5.6	11	0.70

Appendix C.4-3: Solid Phase Element Results by Aqua Regia Digestion for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
				ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Overburden Overlying Schist Bedrock																																																									
R288438	CFR0698	DD Pit	schist	0.050	1.8	160	0.20	<10	180	0.58	0.22	0.45	0.080	57	12	69	1.8	15	2.5	4.8	0.070	0.040	0.050	0.016	0.51	26	11	1.1	591	0.85	0.030	0.36	33	460	9.9	34	0.0010	0.010	9.8	3.7	0.70	0.70	18	<0.01	0.030	10	0.063	0.31	1.0	30	7.5	8.4	58	1.9
R298516	CFR0713	DD Pit	schist	0.040	0.54	1440	<0.2	<10	190	0.67	0.13	0.25	0.060	93	4.3	14	1.3	7.2	1.8	2.3	0.11	0.11	0.26	0.010	0.22	59	1.9	0.14	308	1.5	0.010	0.28	9.8	240	13	16	0.0010	0.010	11	2.1	0.90	0.30	19	<0.01	0.030	27	0.0060	0.23	3.1	11	2.5	12	20	5.3
R294148	CFR0624	Latte Pit	schist	0.030	1.7	130	<0.2	<10	210	0.51	0.16	3.7	0.080	45	13	53	1.2	21	2.8	6.7	0.13	0.15	0.030	0.020	0.65	28	10	0.85	469	0.69	0.040	1.1	31	640	4.9	51	<0.001	0.010	1.9	5.8	1.0	0.90	130	0.020	0.020	9.4	0.13	0.31	0.76	46	0.86	13	46	4.5
R297797	CFR0676	North WRSF	schist	0.010	1.0	7.2	<0.2	<10	170	0.33	0.050	0.99	0.010	35	5.8	13	1.0	14	1.7	3.9	0.060	0.080	<0.01	0.0080	0.69	19	5.9	0.63	210	1.8	0.070	0.27	8.3	380	1.3	41	<0.001	0.020	0.61	2.2	0.40	1.2	23	<0.01	<0.01	9.1	0.098	0.23	1.5	21	3.0	8.1	12	2.6
R549926	CFR0981	North WRSF	schist	0.030	0.90	69	<0.2	<10	110	0.43	0.17	0.28	0.070	38	4.7	15	0.60	7.7	1.7	3.2	0.060	0.020	0.070	0.012	0.24	24	4.3	0.26	253	1.0	0.050	0.77	8.3	270	4.3	18	<0.001	<0.01	5.3	2.0	0.60	1.0	19	<0.01	0.010	18	0.040	0.13	2.3	21	2.5	9.1	20	1.0
R550015	CFR0984	North WRSF	schist	0.030	1.3	85	<0.2	<10	190	0.69	0.25	0.42	0.11	33	9.6	38	1.6	13	2.3	4.3	0.070	0.030	0.070	0.018	0.39	18	6.5	0.55	328	1.1	0.040	0.55	19	520	4.5	28	<0.001	0.010	9.6	5.2	0.60	1.6	19	<0.01	0.040	12	0.067	0.23	1.6	45	4.1	9.4	30	1.3
R550083	CFR0985	North WRSF	schist	0.040	2.5	34	<0.2	<10	470	0.89	0.14	0.72	0.050	16	21	86	1.1	27	3.8	8.4	0.15	0.090	0.010	0.026	1.2	7.6	18	2.0	663	1.2	0.080	0.41	40	830	2.5	74	<0.001	<0.01	1.2	7.4	0.70	5.2	29	<0.01	0.020	3.6	0.21	0.42	1.3	94	1.2	9.4	51	3.7
17551	SRK-15TP-47	ROM/Plant	schist	0.050	1.5	300	<0.2	<10	180	0.62	0.33	0.37	0.10	43	14	36	1.3	24	2.3	4.8	0.13	0.040	0.59	0.031	0.10	22	8.0	0.38	525	0.61	0.030	0.79	30	410	15	9.9	<0.001	0.010	8.4	4.8	0.70	0.60	22	<0.01	0.030	5.7	0.057	0.48	1.0	47	0.72	12	58	1.5
17552	SRK-15TP-46	ROM/Plant	schist	0.040	1.9	22	<0.2	<10	110	0.87	0.15	0.33	0.080	55	8.3	29	1.3	14	2.3	7.2	0.15	0.060	0.010	0.027	0.39	30	14	0.87	415	0.83	0.040	2.0	14	430	7.3	40	<0.001	0.010	0.25	4.5	0.70	1.2	28	<0.01	0.020	13	0.11	0.30	1.7	43	0.40	13	48	2.5
17553	SRK-15TP-45	ROM/Plant	schist	0.14	1.5	48	<0.2	<10	110	0.97	0.24	0.11	0.090	42	6.8	29	1.5	14	1.8	4.5	0.11	0.16	0.020	0.017	0.22	24	11	0.44	300	2.2	0.020	0.83	13	170	15	26	<0.001	0.040	0.44	2.4	0.40	0.70	14	<0.01	0.010	17	0.042	0.35	2.5	24	0.17	4.8	52	7.2
17554	SRK-15TP-22	ROM/Plant	schist	0.040	2.4	9.3	<0.2	<10	150	1.6	0.22	0.71	0.070	71	9.6	82	2.6	19	2.0	8.3	0.16	0.090	<0.01	0.022	0.58	37	19	1.2	392	0.46	0.13	1.1	36	540	17	65	<0.001	0.020	0.19	4.5	0.70	1.6	58	<0.01	0.010	18	0.14	0.47	1.9	38	0.26	10	61	3.6
17556	SRK-15TP-24	ROM/Plant	schist	0.070	2.4	63	<0.2	<10	230	1.3	0.23	0.84	0.14	60	18	73	3.3	34	3.3	8.4	0.16	0.090	0.29	0.039	0.41	27	12	0.79	508	0.55	0.090	0.80	61	570	13	43	<0.001	0.010	1.7	10	0.80	1.1	47	<0.01	0.020	11	0.12	0.68	1.2	58	0.27	14	71	3.6
R547969	CFR0939	South WRSF	schist	0.16	1.8	29	0.20	<10	290	0.50	0.26	0.34	0.070	34	13	59	2.8	25	2.9	6.5	0.090	0.070	<0.01	0.018	1.1	16	14	1.2	397	1.3	0.020	0.16	39	620	5.8	72	<0.001	0.020	1.0	3.9	0.70	0.90	19	<0.01	0.020	6.2	0.13	0.41	1.1	40	0.93	11	57	2.1
R553319	CFB027	South WRSF	schist	0.070	2.0	28	<0.2	<10	300	0.53	0.090	4.6	0.14	42	14	59	1.5	24	2.6	6.5	0.10	0.050	0.040	0.017	0.45	23	12	1.0	407	0.67	0.040	2.3	34	650	8.5	42	<0.001	0.030	0.92	4.4	0.70	0.70	159	<0.01	0.030	6.1	0.12	0.25	1.3	47	3.2	9.3	52	2.0
R281332	CFR0816	Supremo Pit	schist	0.030	1.0	48	<0.2	<10	130	0.76	0.090	0.14	0.030	69	4.3	18	0.86	8.0	1.4	3.2	0.080	0.14	0.050	0.0090	0.35	37	5.2	0.25	294	0.85	0.050	0.43	12	270	5.1	28	<0.001	<0.01	5.4	1.7	0.60	1.5	12	<0.01	0.010	30	0.038	0.19	3.5	16	1.3	14	18	7.0
R281383	CFR0818	Supremo Pit	schist	0.060	1.0	264	0.20	<10	150	0.83	0.12	0.14	0.11	38	6.6	20	0.78	11	2.1	3.0	0.060	0.030	0.16	0.016	0.22	24	4.2	0.17	347	1.3	0.030	0.54	12	300	6.4	16	<0.001	0.010	24	3.2	0.60	1.1	19	<0.01	0.020	18	0.031	0.17	6.2	32	1.7	11	27	1.4
R294487	CFR0633	Supremo Pit	schist	0.030	1.5	110	<0.2	<10	230	0.34	0.13	0.59	0.070	40	8.8	52	1.1	17	2.9	6.0	0.090	0.080	0.060	0.018	0.53	20	11	0.88	441	1.3	0.050	1.3	24	570	5.4	29	<0.001	0.060	3.7	4.2	0.60	1.1	29	<0.01	0.020	10	0.094	0.23	0.99	50	0.49	9.2	41	3.4
R296213	CFR0651	Supremo Pit	schist	0.040	1.8	39	<0.2	<10	350	0.81	0.21	3.1	0.060	69	11	46	4.0	25	3.3	7.4	0.16	0.080	0.13	0.034	0.77	40	10	1.1	502	1.9	0.020	0.47	24	590	9.8	44	<0.001	<0.01	4.3	7.9	0.90	1.1	72	<0.01	0.010	13	0.082	0.29	1.3	44	1.9	18	59	3.6
R299233	CFR0737	Supremo Pit	schist	0.040	0.87	123	<0.2	<10	120	0.39	0.38	0.27	0.060	38	5.9	22	0.84	8.3	1.9	3.0	0.070	0.17	0.050	0.013	0.26	23	4.0	0.27	270	1.6	0.040	0.69	9.7	320	7.4	20	<0.001	<0.01	3.5	1.9	0.50	1.1	20	<0.01	0.11	17	0.050	0.18	1.7	22	0.71	7.3	22	5.8
R299489	CFR0746	Supremo Pit	schist	0.020	2.4	190	<0.2	<10	370	0.54	0.14	0.49	0.030	38	18	47	2.9	26	3.7	6.2	0.090	0.070	0.020	0.011	1.1	20	15	1.6	750	1.4	0.030	0.14	27	610	3.2	64	<0.001	<0.01	3.0	4.5	0.70	0.50	20	<0.01	0.040	7.7	0.14	0.40	2.3	58	0.49	10	58	2.5
R510641	CFR0752	Supremo Pit	schist	0.020	2.2	99	<0.2	<10	250	0.30	0.040	1.2	0.020	2.5	20	66	2.2	35	3.2	4.3	0.070	0.040	0.010	0.010	0.95	1.2	10	1.7	542	0.59	0.080	<0.05	36	180	1.5	37	<0.001	<0.01	1.0	7.2	0.30	0.60	28	<0.01	0.010	0.80	0.095	0.29	0.25	68	0.16	2.8	35	1.0
R510976	CFR0761	Supremo Pit	schist	0.090	3.1	348	<0.2	<10	530	0.93	0.30	0.64	0.020	60	20	94	12	28	5.3	10	0.18	0.28	0.18	0.041	0.94	33	20	1.8	879	0.46	0.040	0.34	62	1560	7.1	55	<0.001	<0.01	30	15	1.2	0.90	34	<0.01	0.050	8.6	0.090	1.5	2.2	116	0.29	18	60	17
R511133	CFR0680	Supremo Pit	schist	0.030	1.4	747	<0.2	<10	340	1.1	0.15	3.0	0.040	63	11	41	1.3	15	2.8	5.4	0.18	0.060	0.45	0.027	0.31	33	7.1	0.34	499	0.71	0.020	0.88	24	450	10	21	<0.001	0.010	7.0	6.3	1.1	0.80	49	0.040	0.020	13	0.031	0.37	2.0	39	0.83	19	41	3.2
R511474	CFR0686	Supremo Pit	schist	0.060	0.83	90	<0.2	<10	2220	1.1	0.19	6.0	0.13	59	15	64	0.67	29	3.8	3.8	0.16	0.040	0.44	0.050	0.13	30	3.6	1.4	801	0.67	0.020	0.36	29	790	25	7.1	0.0010	0.11	5.2	17	1.4	0.80	187	<0.01	0.030	8.7	0.0090	0.17	0.75	122	3.0	23	65	1.6
R511702	CFR0693	Supremo Pit	schist	0.14	0.91	274	<0.2	<10	360	0.72	0.38	0.40	0.18	68	13	24	0.95	39	3.0	3.2	0.12	0.10	0.42	0.022	0.30	38	4.6	0.28	602	0.69	0.020	0.28	29	790	16	21	<0.001	<0.01	18	4.5	0.80	0.50	59	<0.01	0.040	10	0.031	0.28	1.5	32	5.3	13	46	2.9
R511762	CFR0695	Supremo Pit	schist	0.25	0.79	2370	0.60	<10	350	0.79	0.27	0.32	0.15	62	17	27	1.7	25	3.8	3.1	0.12	0.13	0.36	0.023	0.39	32	2.0	0.10	744	0.98	0.010	0.18	39	630	13	23	<0.001	<0.01	20	4.3	0.70	0.40	45	0.020	0.060	11	0.0060	0.44	2.6	17	1.0	12	51	1.8
R620878	CFR0925	Supremo Pit	schist	0.050	1.4	64	<0.2	<10	320	0.78	0.11	0.72	0.040	53	3.9	18	0.64	34	1.6	3.8	0.070	0.12	0.080	0.012	0.45	32	5.4	0.13	319	3.9	0.070	0.54	14	210	6.5	27	<0.001	0.010	3.0	1.5	0.70	3.2	23	<0.01	0.010	26	0.024	0.20	3.3	14	5.1	15	16	5.9
R622028	CFR0956	Supremo Pit	schist	0.060	1.3	132	<0.2	<10	350	0.54	0.21	0.63	0.080	44	12	37	1.6	22	2.8	4.7	0.080	0.050	0.070	0.021	0.27	25	8.1	0.43	503	1.0	0.030	0.85	26	420	8.5	23	<0.001	0.010	2.9	3.7	0.70	1.0	47	<0.01	0.030	6.7	0.060	0.18	1.0	37	2.3	14	40	2.1
R622095	CFR0957	Supremo Pit	schist	0.040	1.0	13	<0.2	<10	80	0.39	0.14	0.20	0.060	27	4.6	26	0.57	11	2.0	3.6	0.090	0.070	0.020	0.011	0.18	10	5.0	0.27	227	1.4	0.050	1.3	11	260	6.5	20	<0.001	0.010	0.43	2.1	0.50	0.70	17	0.010	0.030	16	0.051	0.12	1.5	25	1.7	5.0	22	2.6
R289071	CFR0599	West WRSF	schist	0.15	0.76	1630	0.20	<10	150	0.91	0.41	0.19	0.31	62	10	23	0.46	23	2.3	2.4	0.090	0.070	1.1	0.021	0.28	33	1.9	0.15	497	1.1	0.010	0.060	25	280	25	15	0.0010	<0.01	26	5.4	0.80	0.50	25	<0.01	0.020	14	<0.005	0.35	2.7	28	1.4	12	42	3.9
R290074	CFR0612	West WRSF	schist	0.030	2.6	36	<0.2	<10	420	0.44	0.080	0.36	0.040	17	18	51	1.8	39	3.0	6.9	0.070	0.040	<0.01	0.010	1.0	11	16	1.6	437	0.84	0.050	0.18	35	210	6.0	68	<0.001	<0.01	0.42	4.3	0.30	0.50	72	<0.01	0.020	5.8	0.11	0.43	0.45	47	0.86	2.6	46	1.5
R549729	CFR0978	West WRSF	schist	0.13	0.95	122	<0.2	<10	100	0.48	0.36	0.28	0.050	34	5.8	22	0.60	14	2.1	3.4	0.070	0.020	<0.01	0.015	0.15	20	4.6	0.25	317	2.8	0.030	0.88	13	330	6.9	13	0.0020	0.080	1.2	2.9	0.60	0.70	21	<0.01	0.26	11	0.037	0.16	1.7	27	220	8.0	24	0.60
R621156	CFR0937	West WRSF	schist	0.030	1.1	59	<0.2	<10	130	0.58	0.53	0.31	0.050	75	7.2	27	1.2	23	1.9	4.6	0.12	0.14	0.030	0.015	0.37	44	6.5	0.51	326	1.0	0.040	0.76	11	430	7.2	35	<0.001	<0.01	1.7	3.2	0.90	1.7	30	0.020	0.20	21	0.075	0.24	2.2	27	1.7	14	29	7.1
Statistical Summary for Overburden overlying Schist Bedrock (n = 33)			**Max**	0.25	3.1	2370	0.60	<10	2220	1.6	0.53	6.0	0.31	93	21	94	12	39	5.3	10	0.18	0.28	1.1	0.050	1.2	59	20	2.0	879	3.9	0.13	2.3	62	1560	25	74	0.0020	0.11	30	17	1.4	5.2	187	0.040	0.26	30	0.21	1.5	6.2	122	220	23	71	17
			90th PCTL	0.14	2.4	667	0.20	<10	410	1.1	0.38	3.1	0.14	69	18	72	2.9	34	3.7	8.1	0.16	0.15	0.44	0.033	1.0	38	16	1.6	728	1.9	0.078	1.2	39	762	16	65	0.0010	0.038	19	7.8	0.98	1.6	72	0.018	0.058	20	0.13	0.46	3.0	66	4.9	17	60	6.8
			75th PCTL	0.070	1.9	190	<0.2	<10	350	0.87	0.26	0.72	0.10	62	14	59	1.8	26	3.0	6.5	0.13	0.11	0.18	0.023	0.65	33	12	1.1	525	1.4	0.050	0.85	34	610	13	43	<0.001	0.010	8.4	5.4	0.80	1.1	47	<0.01	0.030	17	0.11	0.40	2.3	47	2.5	14	57	3.9
			Median	0.040	1.4	90	<0.2	<10	210	0.67	0.19	0.42	0.070	44	11	37	1.3	22	2.5	4.6	0.090	0.070	0.050	0.018	0.39	25	8.0	0.55	437	1.0	0.040	0.54	25	430	7.2	28	<0.001	0.010	3.0	4.3	0.70	0.90	28	<0.01	0.020	11	0.063	0.29	1.6	38	1.3	11	46	2.6
			25th PCTL	0.030	1.0	39	<0.2	<10	150	0.50	0.13	0.28	0.050	38	6.6	23	0.86	14	2.0	3.4	0.070	0.040	0.020	0.012	0.26	20	4.6	0.27	319	0.69	0.020	0.28	13	280	5.4	20	<0.001	<0.01	1.0	2.9	0.60	0.70	19	<0.01	0.020	8.6	0.037	0.20	1.1	25	0.71	9.1	27	1.8
			10th PCTL	0.030	0.84	23	<0.2	<10	110	0.39	0.090	0.19	0.030	28	4.6	18	0.61	8.8	1.7	3.0	0.070	0.032	<0.01	0.010	0.19	12	3.7	0.15	275	0.59	0.020	0.16	10.0	216	3.4	15	<0.001	<0.01	0.43	2.0	0.42	0.50	18	<0.01	0.010	5.9	0.012	0.17	0.81	18	0.27	5.5	20	1.3
			Min	0.010	0.54	7.2	<0.2	<10	80	0.30	0.040	0.11	0.010	2.5	3.9	13	0.46	7.2	1.4	2.3	0.060	0.020	<0.01	0.0080	0.10	1.2	1.9	0.10	210	0.46	0.010	<0.05	8.3	170	1.3	7.1	<0.001	<0.01	0.19	1.5	0.30	0.30	12	<0.01	<0.01	0.80	<0.005	0.12	0.25	11	0.16	2.6	12	0.60

Appendix C.4-3: Solid Phase Element Results by Aqua Regia Digestion for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
				ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Overburden Overlying Granite Bedrock																																																									
17557	SRK-15TP-07	Event Pond	granite	0.050	1.4	12	*<0.2*	*<10*	110	0.43	0.15	0.22	0.060	37	6.4	25	0.98	13	1.8	4.3	0.12	0.060	0.12	0.023	0.070	19	8.2	0.30	450	1.0	0.030	1.5	12	320	8.5	7.7	*<0.001*	0.010	0.33	4.4	0.60	0.60	18	*<0.01*	0.010	17	0.074	0.16	4.0	42	0.17	10	39	2.3
KNB-1	KNB-1	Event Pond	granite	0.010	0.30	1.6	*<0.2*	*<10*	10	0.12	0.050	0.010	0.010	21	0.30	2.0	1.4	0.50	0.50	1.5	0.090	0.92	0.010	0.013	0.14	11	2.2	0.020	182	1.1	0.060	3.3	0.50	30	4.4	18	*<0.001*	*<0.01*	0.070	1.4	0.20	0.90	1.0	*<0.01*	*<0.01*	40	0.015	0.16	5.8	1.0	0.12	3.8	11	22
KNB-2	KNB-2	Event Pond	granite	0.010	0.23	1.1	*<0.2*	*<10*	10	0.090	0.040	0.010	0.010	21	0.20	2.0	0.73	0.40	0.46	1.1	0.090	0.53	0.010	0.0070	0.10	12	1.1	0.010	79	0.32	0.050	2.0	0.30	20	5.0	6.8	*<0.001*	*<0.01*	0.070	1.2	0.20	0.50	0.80	*<0.01*	*<0.01*	37	0.0050	0.060	2.6	1.0	0.16	4.7	6.0	14
KNB-3	KNB-3	Event Pond	granite	0.020	0.31	2.8	*<0.2*	*<10*	10	0.32	0.060	0.010	0.010	44	0.20	2.0	0.43	0.60	0.51	1.0	0.11	0.52	0.010	0.017	0.10	22	0.40	*<0.01*	39	0.18	0.070	0.82	0.80	60	8.5	5.4	*<0.001*	*<0.01*	0.16	1.4	0.40	0.80	1.1	*<0.01*	*<0.01*	44	*<0.005*	0.060	4.9	1.0	0.12	8.2	8.0	13
KAM013553	CFR0055	Kona Pit	granite	0.070	0.54	*>10000*	3.1	*<10*	110	0.37	0.090	0.14	0.070	19	2.1	9.0	0.85	7.4	2.2	2.9	0.080	0.25	1.3	0.033	0.13	11	3.3	0.080	146	1.6	0.010	0.26	2.8	250	12	14	*<0.001*	*<0.01*	86	7.0	0.40	0.30	50	*<0.01*	0.030	5.5	0.0060	0.74	3.5	28	0.83	4.7	16	12
R297165	CFR0663	Kona Pit	granite	0.020	1.2	1665	*<0.2*	*<10*	90	0.37	0.080	0.030	0.010	25	0.60	6.0	0.21	1.8	0.65	2.8	0.070	0.40	0.86	0.016	0.030	13	5.0	0.010	50	1.4	0.010	0.11	2.4	140	25	2.3	*<0.001*	*<0.01*	7.7	1.5	0.20	0.40	59	*<0.01*	*<0.01*	25	*<0.005*	0.17	3.6	4.0	1.3	4.1	4.0	11
R297232	CFR0665	Kona Pit	granite	0.030	0.49	11	*<0.2*	*<10*	110	0.26	0.060	0.080	0.020	51	1.8	5.0	2.7	14	1.5	3.3	0.14	0.59	*<0.01*	0.017	0.31	28	17	0.12	1200	1.4	0.060	1.9	2.2	160	7.0	45	*<0.001*	*<0.01*	0.21	2.6	0.50	1.3	14	0.070	*<0.01*	30	0.055	0.39	4.3	8.0	2.0	12	36	17
R297375	CFR0666	Kona Pit	granite	0.060	1.0	923	0.40	10	180	0.93	0.11	0.070	0.080	38	5.7	14	0.99	15	2.6	2.9	0.090	0.18	0.59	0.011	0.33	18	2.9	0.040	1240	3.2	0.010	0.25	5.3	230	17	22	*<0.001*	*<0.01*	8.7	2.3	0.40	0.50	24	0.010	*<0.01*	21	*<0.005*	0.81	15	9.0	1.5	7.7	28	9.2
17558	SRK-15TP-44	Leach Pad	granite	0.020	0.77	5.3	*<0.2*	*<10*	60	0.33	0.14	0.13	0.060	28	4.3	14	1.1	6.6	1.3	2.9	0.11	0.030	0.010	0.016	0.080	15	4.6	0.16	453	0.68	0.040	2.1	6.9	220	8.6	8.7	*<0.001*	*<0.01*	0.20	2.3	0.60	0.70	11	*<0.01*	0.010	17	0.046	0.10	3.0	23	0.14	10	28	1.0
17559	SRK-15TP-06	Leach Pad	granite	0.030	0.52	6.5	*<0.2*	*<10*	70	0.31	0.12	0.090	0.080	31	3.0	10	0.89	4.1	0.99	2.1	0.11	0.080	0.010	0.011	0.080	16	3.2	0.10	563	0.60	0.040	1.6	4.4	150	8.4	8.7	*<0.001*	*<0.01*	0.18	1.7	0.50	0.60	7.8	*<0.01*	0.010	23	0.030	0.11	3.8	14	0.14	12	22	3.1
17560	SRK-15TP-43	Leach Pad	granite	0.030	0.99	4.6	*<0.2*	*<10*	110	0.45	0.23	0.21	0.060	38	5.8	17	3.3	8.3	1.7	4.1	0.13	0.070	0.010	0.025	0.15	22	14	0.26	705	0.76	0.040	3.2	9.0	330	6.7	31	*<0.001*	0.010	0.24	3.8	0.70	1.6	16	*<0.01*	*<0.01*	17	0.083	0.34	3.5	30	0.19	14	37	3.1
17561	SRK-15TP-05	Leach Pad	granite	0.030	0.56	4.8	*<0.2*	*<10*	70	0.34	0.13	0.10	0.030	32	3.8	10	1.7	3.9	1.2	2.5	0.090	0.040	0.25	0.017	0.11	13	7.2	0.12	667	0.70	0.040	2.2	3.8	200	7.2	16	*<0.001*	*<0.01*	0.16	1.9	0.40	0.80	8.1	*<0.01*	*<0.01*	16	0.040	0.21	3.6	16	0.15	9.4	25	1.3
17562	SRK-15TP-04	Leach Pad	granite	0.020	0.65	6.0	*<0.2*	*<10*	70	0.35	0.21	0.12	0.030	27	3.2	11	1.4	4.0	1.2	2.6	0.10	0.10	0.050	0.016	0.11	16	7.1	0.14	363	0.72	0.040	1.6	4.4	220	7.3	15	0.0010	*<0.01*	0.19	2.2	0.40	0.80	11	*<0.01*	0.010	22	0.044	0.16	4.9	18	0.14	9.6	24	4.1
17565	SRK-15TP-03	Leach Pad	granite	0.050	0.77	9.3	*<0.2*	*<10*	70	0.32	0.13	0.13	0.050	31	4.3	13	1.3	6.2	1.5	3.2	0.10	0.030	0.050	0.017	0.10	20	6.0	0.15	516	0.85	0.040	2.3	5.3	300	7.7	13	*<0.001*	0.010	0.24	2.7	0.50	0.70	12	*<0.01*	0.010	14	0.042	0.16	4.2	21	0.14	11	29	1.2
17566	SRK-15TP-17	Leach Pad	granite	0.030	0.68	9.2	*<0.2*	*<10*	70	0.57	0.090	0.15	0.060	48	3.2	12	1.3	6.5	1.5	2.7	0.11	0.15	0.090	0.020	0.10	24	4.5	0.13	673	0.82	0.030	0.85	6.0	260	9.3	13	*<0.001*	*<0.01*	0.26	2.9	0.60	0.60	12	*<0.01*	*<0.01*	23	0.042	0.27	3.9	19	0.090	14	35	6.2
17567	SRK-15TP-02	Leach Pad	granite	0.040	1.1	26	*<0.2*	*<10*	130	0.42	0.11	0.22	0.090	44	6.5	19	1.2	13	1.9	4.0	0.13	0.070	0.020	0.020	0.10	23	7.0	0.27	647	0.74	0.030	1.3	12	400	7.7	12	*<0.001*	0.010	0.42	4.3	0.70	0.60	18	*<0.01*	0.010	17	0.071	0.21	3.1	35	0.13	12	37	2.8
17570	SRK-15TP-16	Leach Pad	granite	0.030	0.76	28	*<0.2*	*<10*	90	0.48	0.060	0.17	0.080	47	4.2	13	1.3	9.2	1.5	3.2	0.11	0.10	0.050	0.020	0.11	24	6.6	0.18	588	1.1	0.040	1.3	9.1	290	9.6	17	*<0.001*	*<0.01*	0.53	3.1	0.80	0.70	15	*<0.01*	*<0.01*	22	0.058	0.25	3.7	24	0.13	13	35	4.0
17571	SRK-15TP-15	Leach Pad	granite	0.020	0.90	8.9	*<0.2*	*<10*	90	0.35	0.080	0.14	0.070	41	4.4	15	1.2	7.3	1.5	3.5	0.11	0.080	0.040	0.017	0.11	21	8.2	0.19	542	0.83	0.040	2.2	7.4	240	7.1	17	*<0.001*	*<0.01*	0.23	2.8	0.60	0.60	12	*<0.01*	*<0.01*	19	0.065	0.20	2.4	26	0.12	12	31	3.1
17572	SRK-15TP-14	Leach Pad	granite	0.050	0.70	386	0.30	*<10*	130	0.52	0.090	0.090	0.33	40	4.5	12	0.67	6.1	1.3	2.2	0.10	0.030	0.19	0.014	0.13	21	2.9	0.10	763	1.0	0.020	1.1	5.5	190	15	7.9	*<0.001*	0.010	3.3	1.6	0.40	0.30	13	*<0.01*	*<0.01*	20	0.015	0.22	6.1	16	0.13	7.9	32	1.1
17573	SRK-15TP-13	Leach Pad	granite	0.030	0.52	19	*<0.2*	*<10*	80	0.79	0.060	0.040	0.040	53	1.4	6.0	1.3	2.1	0.82	1.8	0.11	0.22	0.30	0.010	0.12	31	1.3	0.020	551	0.93	0.010	0.20	2.2	120	27	8.7	*<0.001*	*<0.01*	0.56	1.3	0.50	0.30	9.1	*<0.01*	*<0.01*	37	*<0.005*	0.14	6.5	4.0	0.060	12	19	7.4
17574	SRK-15TP-12	Leach Pad	granite	0.030	0.83	43	*<0.2*	*<10*	90	0.51	0.080	0.11	0.10	37	4.7	13	1.0	6.9	1.5	3.3	0.11	0.020	0.090	0.016	0.090	20	5.2	0.16	642	0.72	0.030	1.5	7.2	260	9.0	11	*<0.001*	0.010	1.0	2.1	0.40	0.50	11	*<0.01*	0.010	12	0.046	0.22	3.5	25	0.15	9.7	33	0.60
17575	SRK-15TP-11	Leach Pad	granite	0.020	0.59	15	*<0.2*	*<10*	110	0.57	0.20	0.10	0.050	65	2.7	8.0	2.4	4.4	1.4	2.9	0.12	0.34	0.010	0.015	0.15	37	4.3	0.11	895	0.86	0.050	0.96	4.0	200	9.7	20	*<0.001*	*<0.01*	0.50	2.0	0.70	0.70	10	*<0.01*	0.010	30	0.037	0.24	5.8	13	0.15	16	34	10
17576	SRK-15TP-18	Leach Pad	granite	0.030	1.4	6.1	*<0.2*	*<10*	140	0.53	0.15	0.20	0.050	47	5.8	21	2.6	12	1.9	4.3	0.13	0.080	0.030	0.023	0.12	27	11	0.31	546	0.79	0.030	2.0	11	340	7.1	21	*<0.001*	0.010	0.28	4.7	0.90	0.90	17	*<0.01*	0.010	18	0.078	0.24	3.4	37	0.16	15	37	2.8
17577	SRK-15TP-42	Leach Pad	granite	0.030	0.71	15	*<0.2*	*<10*	90	0.75	0.21	0.13	0.050	53	3.1	11	4.2	5.6	1.3	3.6	0.15	0.17	0.020	0.049	0.15	27	9.2	0.14	616	0.64	0.050	3.6	5.6	190	9.2	45	*<0.001*	*<0.01*	0.38	4.6	1.1	2.2	13	*<0.01*	*<0.01*	23	0.044	0.46	5.1	17	0.20	26	51	5.6
17578	SRK-15TP-10	Leach Pad	granite	0.030	0.86	15	*<0.2*	*<10*	100	0.58	0.40	0.16	0.040	44	4.1	13	4.1	7.3	1.5	3.4	0.11	0.15	0.040	0.022	0.13	22	11	0.20	570	0.81	0.040	1.9	6.9	240	6.8	22	*<0.001*	*<0.01*	0.34	3.3	0.50	1.5	13	*<0.01*	*<0.01*	20	0.061	0.30	2.6	25	0.17	12	31	5.6
17579	SRK-15TP-09	Leach Pad	granite	0.040	1.0	5.4	*<0.2*	*<10*	100	0.59	0.25	0.17	0.050	41	5.7	17	2.1	9.9	1.7	4.0	0.13	0.040	0.020	0.020	0.10	22	9.4	0.25	575	0.58	0.040	2.1	9.5	260	8.1	15	*<0.001*	0.010	0.28	3.6	0.70	1.0	15	*<0.01*	0.010	15	0.068	0.18	3.5	32	0.18	16	33	1.5
17580	SRK-15TP-41	Leach Pad	granite	0.040	0.90	5.6	*<0.2*	*<10*	90	0.45	0.10	0.26	0.12	45	5.2	19	1.1	11	1.7	3.4	0.14	0.15	0.030	0.020	0.11	25	5.5	0.24	727	1.2	0.050	1.5	11	330	10	13	*<0.001*	*<0.01*	0.25	4.0	0.80	0.60	20	*<0.01*	0.010	25	0.071	0.14	3.9	32	0.15	15	39	6.2
17581	SRK-15TP-08	Leach Pad	granite	0.050	0.87	110	*<0.2*	*<10*	80	0.50	0.14	0.17	0.070	36	3.9	16	1.3	8.4	1.4	3.2	0.11	0.090	0.070	0.019	0.11	21	7.1	0.18	334	0.58	0.030	1.5	7.5	230	15	14	*<0.001*	0.010	0.36	3.3	0.60	0.70	15	*<0.01*	*<0.01*	23	0.052	0.18	8.5	24	0.14	14	31	3.7
Statistical Summary for Overburden overlying Granite Bedrock (n = 28)			**Max**	0.070	1.4	10000	3.1	10	180	0.93	0.40	0.26	0.33	65	6.5	25	4.2	15	2.6	4.3	0.15	0.92	1.3	0.049	0.33	37	17	0.31	1240	3.2	0.070	3.6	12	400	27	45	0.0010	0.010	86	7.0	1.1	2.2	59	0.070	0.030	44	0.083	0.81	15	42	2.0	26	51	22
			90th PCTL	0.050	1.2	547	0.23	*<10*	130	0.64	0.22	0.21	0.093	51	5.8	19	2.9	13	1.9	4.1	0.13	0.52	0.39	0.024	0.15	27	11	0.26	803	1.4	0.053	2.6	11	330	16	25	*<0.001*	0.010	4.6	4.5	0.80	1.4	21	*<0.01*	0.010	37	0.072	0.41	6.2	33	0.96	15	38	13
			75th PCTL	0.040	0.92	26	*<0.2*	*<10*	110	0.54	0.15	0.17	0.073	46	4.8	15	1.8	9.4	1.7	3.4	0.12	0.23	0.098	0.020	0.13	24	8.2	0.19	669	1.0	0.043	2.1	7.9	268	9.8	18	*<0.001*	0.010	0.51	3.7	0.70	0.83	16	*<0.01*	0.010	25	0.062	0.26	5.0	27	0.17	14	35	9.4
			Median	0.030	0.77	10	*<0.2*	*<10*	90	0.44	0.11	0.13	0.055	39	4.0	13	1.3	6.8	1.5	3.1	0.11	0.10	0.040	0.017	0.11	21	5.8	0.14	567	0.82	0.040	1.5	5.6	230	8.5	14	*<0.001*	*<0.01*	0.28	2.7	0.50	0.70	13	*<0.01*	*<0.01*	21	0.044	0.21	3.8	20	0.15	12	31	4.1
			25th PCTL	0.020	0.56	5.6	*<0.2*	*<10*	70	0.34	0.080	0.088	0.038	31	2.6	8.8	0.99	4.1	1.2	2.6	0.10	0.068	0.010	0.016	0.10	16	3.3	0.095	428	0.70	0.030	1.0	3.6	183	7.2	8.7	*<0.001*	*<0.01*	0.21	1.9	0.40	0.58	11	*<0.01*	*<0.01*	17	0.015	0.16	3.5	12	0.13	9.1	24	2.7
			10th PCTL	0.020	0.44	4.1	*<0.2*	*<10*	45	0.30	0.060	0.024	0.010	24	0.51	4.1	0.71	1.4	0.61	1.7	0.090	0.030	0.010	0.011	0.080	12	1.9	0.017	126	0.58	0.010	0.26	1.8	102	6.8	7.4	*<0.001*	*<0.01*	0.16	1.4	0.34	0.37	5.8	*<0.01*	*<0.01*	14	*<0.005*	0.11	2.8	3.1	0.12	4.7	10	1.2
			Min	0.010	0.23	1.1	*<0.2*	*<10*	10	0.090	0.040	0.010	0.010	19	0.20	2.0	0.21	0.40	0.46	1.0	0.070	0.020	0.010	0.0070	0.030	11	0.40	*<0.01*	39	0.18	0.010	0.11	0.30	20	4.4	2.3	*<0.001*	*<0.01*	0.070	1.2	0.20	0.30	0.80	*<0.01*	*<0.01*	5.5	*<0.005*	0.060	2.4	1.0	0.060	3.8	4.0	0.60
Overburden Overlying Meta-Gabbro Bedrock (n = 3)																																																								
17555	SRK-15TP-23	ROM/Plant	meta-gabbro	0.10	2.2	9.0	*<0.2*	*<10*	130	0.60	0.22	0.49	0.10	33	6.9	49	1.6	19	2.3	7.4	0.13	0.020	0.030	0.023	0.24	19	11	0.70	270	0.89	0.080	1.9	21	550	8.9	29	*<0.001*	0.050	1.3	5.0	0.60	1.0	33	*<0.01*	0.030	3.8	0.11	0.24	1.6	53	0.36	7.7	51	0.50
R553404	CFB030	South WRSF	meta-gabbro	0.010	2.3	3.8	*<0.2*	*<10*	590	0.30	0.090	4.0	0.010	16	14	29	2.3	14	3.5	6.4	0.080	0.030	*<0.01*	0.0060	1.6	7.6	17	1.5	635	0.76	0.020	0.12	18	970	1.3	75	*<0.001*	*<0.01*	0.14	2.5	0.30	0.50	125	*<0.01*	0.020	3.0	0.22	0.40	0.49	66	0.29	4.2	50	0.70
R553602	CFB035	South WRSF	meta-gabbro	0.030	1.7	66	*<0.2*	*<10*	220	0.85	0.50	0.29	0.070	47	13	36	3.3	17	2.9	5.6	0.070	0.040	0.040	0.023	0.57	18	8.8	0.59	477	0.83	0.020	0.59	26	540	11	44	*<0.001*	*<0.01*	1.2	5.7	0.90	0.90	19	*<0.01*	0.040	13	0.086	0.30	1.3	40	1.3	11	49	2.1

Notes: all values in grey italics are below the analytical detection limit.
n = number of samples included in the statistical summary

Appendix D: Kinetic Test Results

Appendix D.1: Kinetic Test Results for Waste Rock

Appendix D.2: Kinetic Test Results for Ore

Appendix D.3: Kinetic Test Results for Leach Tailings

GOLDCORP

APPENDIX D.1: KINETIC TEST RESULTS FOR WASTE ROCK

Appendix D.1-1: Overview of Operating Procedures for the Coffee Gold Mine Waste Rock Kinetic Tests

Test ID	Test Sample Description	Duplicate Tests	Type of Test	Lithology	Weathering Facies	Column Dimensions			Dry Wt. of Sample (kg)	Temp (°C)	Operation Procedure	Sampling Frequency	Total Volume of Initial Flushings (mL)	Flushing Rate/ Weekly Input* (mL)	Start Date	Test Status	Cycles/ Weeks	Recirculation Cycles
						Inner Diameter (cm)	Length (cm)	Height (cm)										
Col 3	SO	-	Unsaturated Column	Schist	Oxide	21.0	20.5		10	4°	Trickle Leach	Biweekly	1500	variable	16-Jul-14	active	86	45-77
Col 4	ST	-	Unsaturated Column	Schist	Transition	21.0	20.5		10	4°	Trickle Leach	Biweekly	1300	variable	16-Jul-14	active	86	45-77
Col 5	GO	-	Unsaturated Column	Gneiss	Oxide	21.0	20.5		10	4°	Trickle Leach	Biweekly	1500	variable	16-Jul-14	active	86	45-77
Col 6	GT	-	Unsaturated Column	Gneiss	Transition	21.0	20.5		10	4°	Trickle Leach	Biweekly	1200	variable	30-Jul-14	active	84	43-75
Col 13	OKY Master	-	Unsaturated Column	Granite	Transition	21.0	20.5		10	4°	Trickle Leach	Biweekly	2000	variable	20-May-15	active	41	-
Col 14	OKY Master (Fresh)	-	Unsaturated Column	Granite	Fresh	21.0	20.5		10	4°	Trickle Leach	Biweekly	2000	variable	20-May-15	active	41	-
HC 1	ST	Col 4	Humidity Cell	Schist	Transition		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	25-Jun-14	terminated	87	46-73
HC 2	SS	-	Humidity Cell	Schist	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	25-Jun-14	terminated	87	46-73
HC 3	GT	Col 6	Humidity Cell	Gneiss	Transition		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	25-Jun-14	terminated	87	46-73
HC 4	GS	-	Humidity Cell	Gneiss	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	25-Jun-14	terminated	87	46-73
HC 5	OKY Master	Col 13	Humidity Cell	Granite	Transition		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	6-May-15	active	42	-
HC 6	OKY Master (Fresh)	Col 14	Humidity Cell	Granite	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	6-May-15	active	42	-
HC 7	KAM036824	-	Humidity Cell	Schist	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	12-Aug-15	active	28	-
HC 8	KAM092488	-	Humidity Cell	Gneiss	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	12-Aug-15	active	28	-
FB-GO	Gneiss Oxide composite	Col 5	Field Bin	Gneiss	Oxide	45.0		80	183.1	site conditions	natural precipitation	3x's / field season	28	natural precipitation	17-Jun-14	active	70	-
FB-GT	Gneiss Transition composite	Col 6 & HC3	Field Bin	Gneiss	Transition	45.0		80	229.4				28		17-Jun-14	active	70	-
FB-GS	Gneiss Fresh composite	HC4	Field Bin	Gneiss	Fresh	45.0		80	190.1				28		17-Jun-14	active	70	-
FB-SO	Schist Oxide composite	Col 3	Field Bin	Schist	Oxide	45.0		80	171.3				28		17-Jun-14	active	70	-
FB-ST	Schist Transition composite	Col 4 & HC1	Field Bin	Schist	Transition	45.0		80	164.8				27.6		17-Jun-14	active	70	-
FB-SS	Schist Fresh composite	HC2	Field Bin	Schist	Fresh	45.0		80	201.5				28		17-Jun-14	active	70	-
FB-GGT	Granite Transition composite	Col 13 & HC5	Field Bin	Granite	Transition	45.0		80	165.5				26		17-Jun-15	active	18	-
FB-GGS	Granite Fresh composite	Col 14 & HC6	Field Bin	Granite	Fresh	45.0		80	134.4				22		17-Jun-15	active	18	-

Notes:
Columns and humidity cells are composed of Plexiglas with an acrylic perforated disk & nylon mesh
No sample preparation was conducted prior to leachate sampling for any tests
* generally 400-500 mL for columns, see individual leachate results in Appendix D.1-3 for specific input volumes

Appendix D.1-1: Overview of Operating Procedures for the Coffee Gold Mine Waste Rock Kinetic Tests

Construction of Field Bins

Field Bin ID	Bag #	Hole ID	Length (m)	Lithology	% Fresh	Weight (Kg)
FB-GO	20	CFD0152	48-52, 92-95, 96-100	65% MG, 35% FG	0	32
	25	CFD0149	170-175, 211-213	76% MG, 24% MxM	0	23
	34	CFD0175	126-130, 193-196	100% FG	0	24
	35	CFD0175	205-211,230-233	100% FG	0	28
	46	CFD0004	20.86-26.86	100% FG	0	21
	47	CFD0004	43-49	100% FG	0	19
	48	CFD0004	76-83	100% FG	0	23
	49	CFD0003	163-167	100% FG	0	13
	62	CFD0209	66-72, 15-19	100% MxM	2.3	20
	63	CFD0209	52.5-58	100% MxM	0	14
	64	CFD0176	12-18, 149-152	100% MxF	0	23
	79	CFD0267	109-122	100% MxF	0	20
	83	CFD0176	164-170	100% MxF	0	17
	84	CFD0176	170-175	100% MxF	0	22
FB-GT	16	CFD0142	134-139	100% MG	30	17
	17	CFD0142	139-144	100% MG	30	17
	26	CFD0175	47-54	100% FG	70	21
	27	CFD0175	54-61	100% FG	70	23
	28	CFD0175	61-68	100% FG	47	23
	29	CFD0175	68-75	100% FG	30	23
	30	CFD0175	75-82	100% FG	30	25
	31	CFD0175	82-89	100% FG	53	26
	32	CFD0175	89-93	100% FG	70	16
	33	CFD0175	44-46	100% FG	70	7
	65	CFD0270	252-258	100% MxF	70	25
	66	CFD0270	258-264	100% MxF	43	24
	67	CFD0270	264-271	100% MxF	36	19
	68	CFD0270	237-240, 241-243	40% FG, 60% MxF	30	16
	91	CFD0272	89-92, 93-95, 96-97, 98-99	100% FG	30	20
	92	CFD0272	76-80, 224-225, 239-245	46% FG, 54% MxF	30	24
	93	CFD0272	228-238	100% MxF	30	27
FB-GS	56	CFD0020	263-270	100% FG	100	23
	57	CFD0020	270-277	100% FG	100	22
	58	CFD0020	277-283	100% FG	100	18
	59	CFD0071	187-195	100% FG	100	27
	60	CFD0071	202-210	100% FG	100	33
	61	CFD0071	210-217	100% FG	100	27
	69	CFD0249	234.5-239	100% MxM	99.3	27
	70	CFD0249	262-269	100% MxM	98.4	18
	71	CFD0249	271-280.5	46% MxM, 54% MxF	99.4	20
	72	CFD0249	286-290	100% MxM	100	18
	73	CFD0249	271-280.5	46% MxM, 54% MxF	99.4	21
	74	CFD0249	292-298	100% MxF	100	35
	75	CFD0249	298-304	17% FG, 83% MxF	100	27
	76	CFD0273	245-254	100% MxM	70	28
	77	CFD0273	240-243	100% MxM	70	8
	78	CFD0170	391-399	100% MxM	100	30
FB-SO	1	CFD0131	57-63	100% MsS	0	19
	2	CFD0131	63-69	31% MsS, 69% RQM	0	21
	3	CFD0131	69-74	100% RQM	0	17
	4	CFD0131	77-81	100% RQM	0	13
	5	CFD0131	87-93	50% MsS, 50% RQM	0	20
	6	CFD0131	93-99	100% MsS	0	20
	7	CFD0131	99-105	41% MsS, 59% RQM	0	21
	36	CFD0084	43-49	100% RQM	0	19
	37	CFD0084	49-55	100% RQM	0	19
	38	CFD0084	55-61	100% RQM	0	22
	39	CFD0008	2.13-9	100% BtS	0	13
	40	CFD0008	42248	100% BtS	0	19
	41	CFD0008	15-21	100% BtS	0	21
	42	CFD0007	2.13-10	100% BtS	0	27
	43	CFD0007	42644	100% BtS	0	21
	44	CFD0007	16-21	100% BtS	0	18
	45	CFD0007	31-36	100% BtS	0	16

Appendix D.1-1: Overview of Operating Procedures for the Coffee Gold Mine Waste Rock Kinetic Tests

Construction of Field Bins

Field Bin ID	Bag #	Hole ID	Length (m)	Lithology	% Fresh	Weight (Kg)
FB-ST	18	CFD0146	57-62	100% BtS	70	17
	19	CFD0146	65-72	100% BtS	70	21
	21	CFD0145	70-80	100% BtS_Carb	30	37
	22	CFD0145	43009	100% BtS_Carb	70	25
	23	CFD0145	17-25	80% BtS_Carb, 20% YO	44	28
	24	CFD0145	25-32	15% BtS_Carb, 85% YO	4.3	23
	80	CFD0172	123-129	100% BtS	50	23
	81	CFD0172	129-135	100% BtS	50	21
	82	CFD0172	160-166	100% BtS	50	20
	85	CFD0142	16-22	100% BtS	70	25
	86	CFD0142	22-28	100% BtS	70	20
	87	CFD0142	28-34	100% BtS	70	18
	88	CFD0142	34-39	100% BtS	70	19
	89	CFD0265	246-256	100% BtS	54	30
	90	CFD0265	212-215, 220-228	100% BtS	70	30
FB-SS	8	CFD0096	167-173, 203-205	74% RQM, 26% BtS	100	16
	9	CFD0096	220-233	100% RQM	100	25
	10	CFD0096	233-239	100% RQM	100	13
	11	CFD0127	276-283	100% BtS	100	21
	12	CFD0127	283-290	100% BtS	100	23
	13	CFD0127	290-297	100% BtS	100	22
	14	CFD0127	297-304	100% BtS	100	18
	15	CFD0127	304-309	100% BtS	100	15
	50	CFD0040	230-237.4	100% BtS	100	24
	51	CFD0040	237.4-244	100% BtS	100	22
	52	CFD0040	244-250	100% BtS	100	24
	53	CFD0040	256-262	100% BtS	100	21
	54	CFD0040	262-268	100% BtS	100	21
	55	CFD0040	268-273	100% BtS	100	16
FB-GGT	1	CFD0380_36-50 (Bag 1 + 2)	*NA*	granite	10	13.59
	2	CFD0380_36-50 (Bag 3 +4)	*NA*	granite	10	16.761
	3	CFD0383_115-125 (Bag 1)	*NA*	granite	76	12.231
	4	CFD0383_115-125 (Bag 2)	*NA*	granite	76	14.496
	5	CFD0381_4-13 (Bag 1)	*NA*	granite	37	9.06
	6	CFD0381_4-13 (Bag 2)	*NA*	granite	37	12.684
	7	CFD0403_204-217 (Bag 1)	*NA*	granite	80	9.966
	8	CFD0403_204-217 (Bag 2)	*NA*	granite	80	13.137
	9	CFD0403_204-217 (Bag 3)	*NA*	granite	80	10.419
	10	CFD0396_50-60 (Bag 1)	*NA*	granite	40	13.59
	11	CFD0396_50-60 (Bag 2)	*NA*	granite	40	9.513
	12	CFD0394_31-41 (Bag 1)	*NA*	granite	38	13.137
	13	CFD0394_31-41 (Bag 2)	*NA*	granite	38	13.137
	14	CFD0394_55-66 (Bag 1)	*NA*	granite	50	12.231
	15	CFD0394_55-66 (Bag 2)	*NA*	granite	50	14.043
		CFD0389_34_38	*NA*	granite	100	6.3
		CFD0396_81_87	*NA*	granite	100	14.9
FB-GGS	1	CFD0380_22-30 (Bag 1 +2)	*NA*	granite	100	17.214
	2	CFD0383_182-194 (Bag 1)	*NA*	granite	99	10.872
	3	CFD0383_182-194 (Bag 2)	*NA*	granite	99	10.872
	4	CFD0383_182-194 (Bag 3)	*NA*	granite	99	12.231
	5	CFD0381_69-79 (Bag 1)	*NA*	granite	95	15.855
	6	CFD0381_69-79 (Bag 2)	*NA*	granite	95	11.325
	7	CFD0385_28-38 (Bag 1)	*NA*	granite	95	12.684
	8	CFD0385_28-38 (Bag 2)	*NA*	granite	95	14.043
	9	CFD0385_38-48 (Bag 1)	*NA*	granite	95	13.137
	13	CFD0394_99-104 (Bag 1)	*NA*	granite	95	11.325
	14	CFD0396_91-101 (Bag 1)	*NA*	granite	100	9.513
	15	CFD0396_91-101 (Bag 2)	*NA*	granite	100	11.778
	16	CFD0396_72-81 (Bag 1)	*NA*	granite	100	6.795
	17	CFD0396_72-81 (Bag 2)	*NA*	granite	100	10.872

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101A/MI4521-JUN14*
ARD Number	*1416 Kaminak Coffee Proj*
Reporting Date:	*June 30, 2014*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Semi-Quantitative XRD Results
4) XRD Pattern(s)

Bernie C. Yeung, B.Sc.
Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

Method Summary

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	ST JUN4521-01 (wt %)	GO JUN4521-02 (wt %)	SO JUN4521-03 (wt %)	GS JUN4521-04 (wt %)	GT JUN4521-05 (wt %)	SS JUN4521-06 (wt %)
Quartz	31.1	46.8	55.2	39.4	45.7	32.9
Microcline	7.8	19.0	0.7	12.2	16.3	11.1
Albite	20.3	7.5	1.2	17.2	9.7	8.7
Biotite	7.0	1.0	1.3	3.0	1.2	4.4
Muscovite	6.2	7.9	13.9	9.6	5.3	10.6
Chlorite	3.5	4.1	5.3	2.8	3.6	5.0
Actinolite	2.3	0.3	0.4	0.4	0.0	0.3
Diopside	3.9	1.7	0.6	2.1	1.3	1.8
Calcite	14.6	1.7	3.9	2.3	1.0	10.6
Ankerite	1.8	1.3	4.3	4.5	4.4	9.0
Kaolinite	1.4	8.7	13.1	6.7	11.6	5.6
TOTAL	100	100	100	100	100	100

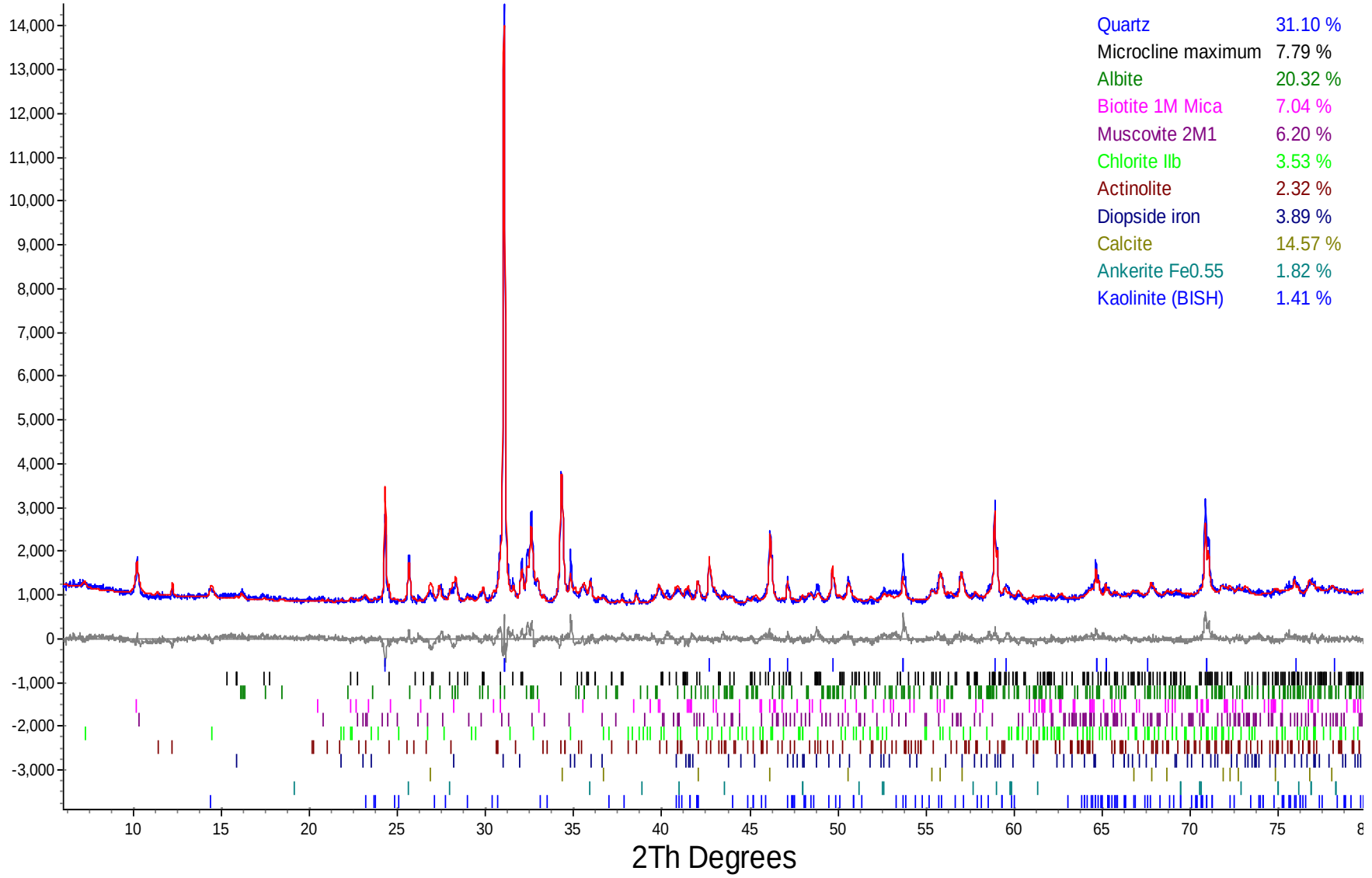
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

Mineral/Compound	Formula
Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Albite	$NaAlSi_3O_8$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Diopside	$CaMgSi_2O_6$
Calcite	$CaCO_3$
Ankerite	$CaFe(CO_3)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$

SGS Canada Inc
14094-101A/MI4521-JUN14
06/30/2014

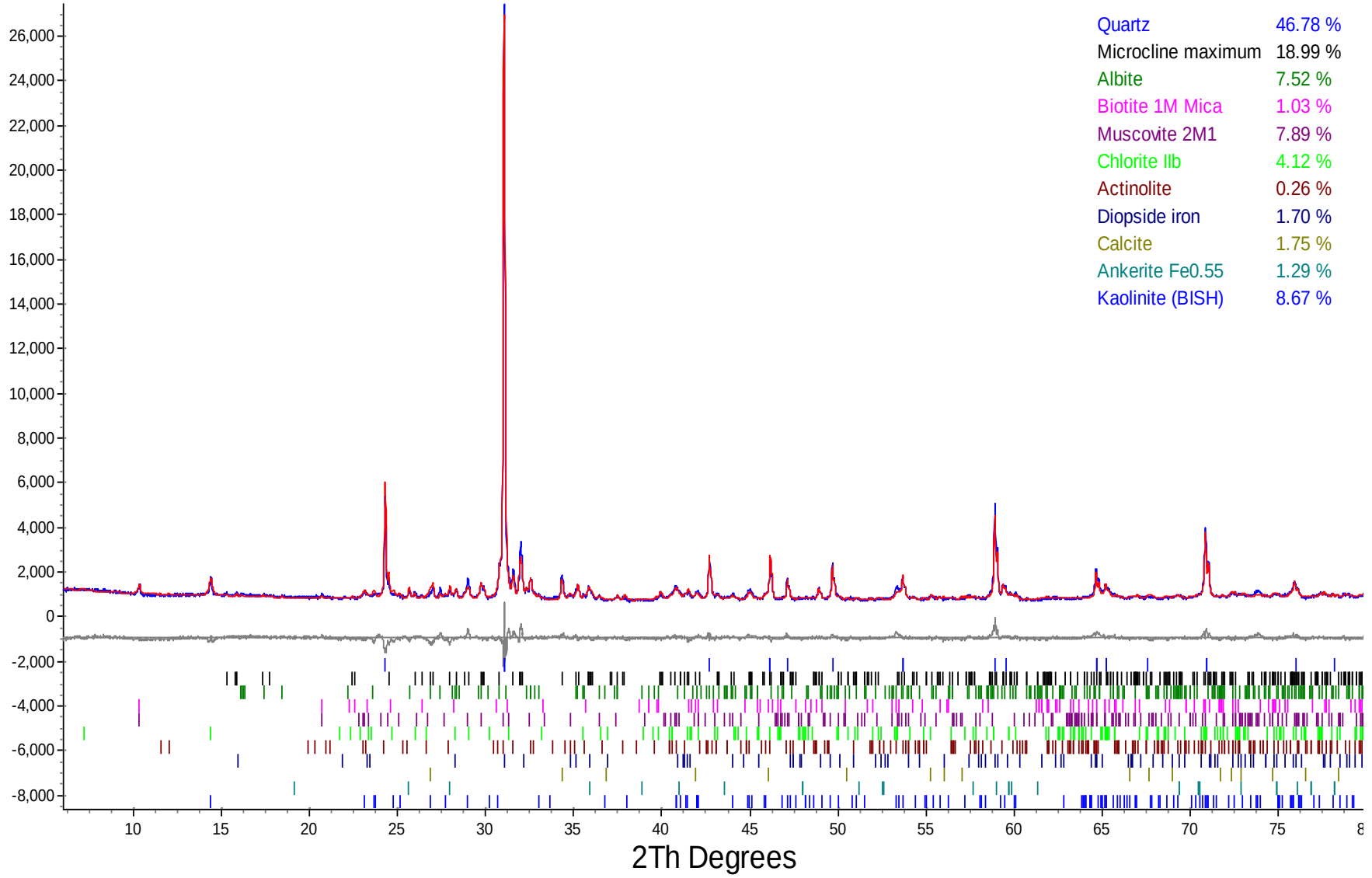
Jun4521-1 riet.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

SGS Canada Inc
14094-101A/MI4521-JUN14
06/30/2014

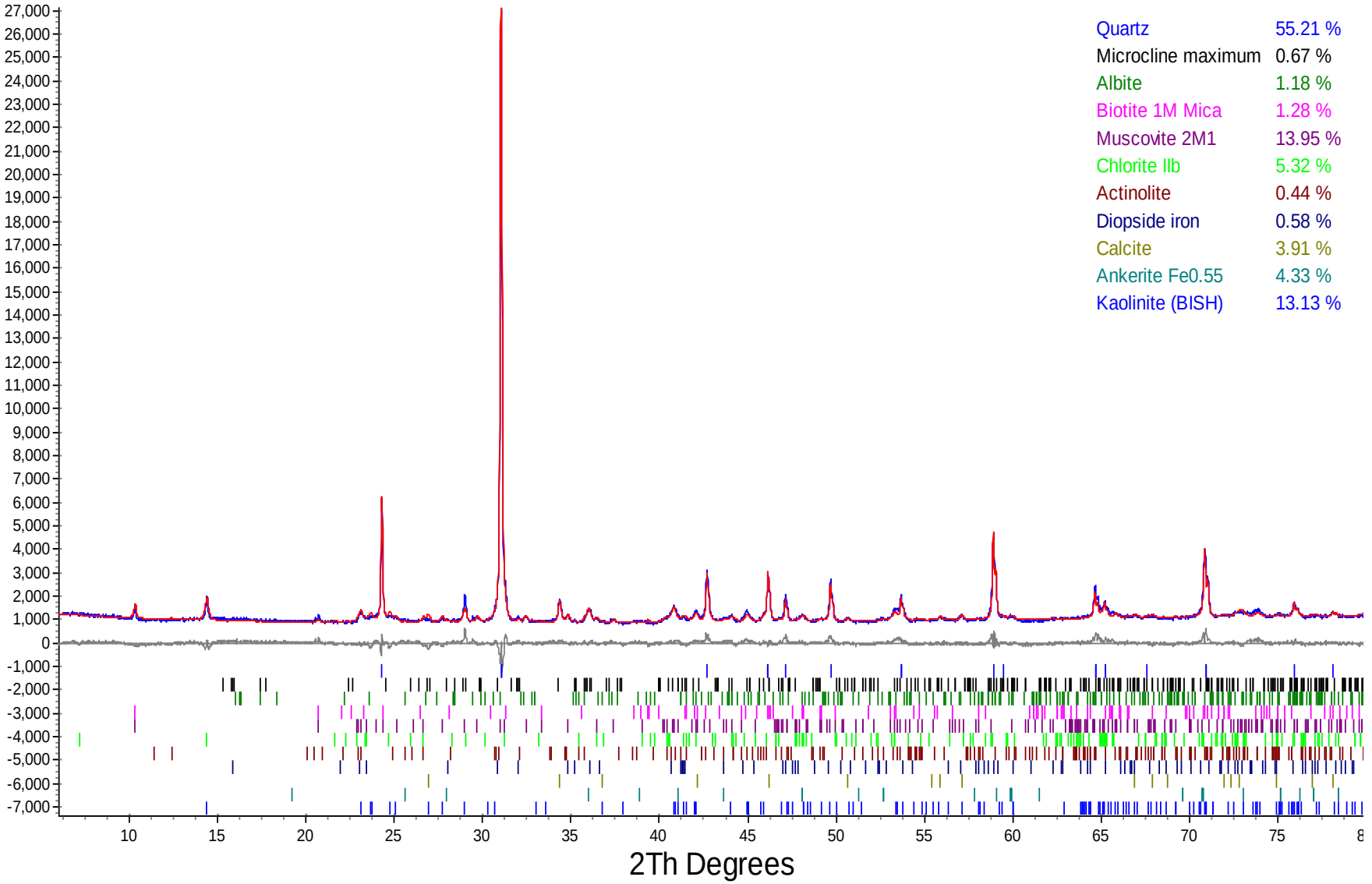
Jun4521-2 riet.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

SGS Canada Inc
14094-101A/MI4521-JUN14
06/30/2014

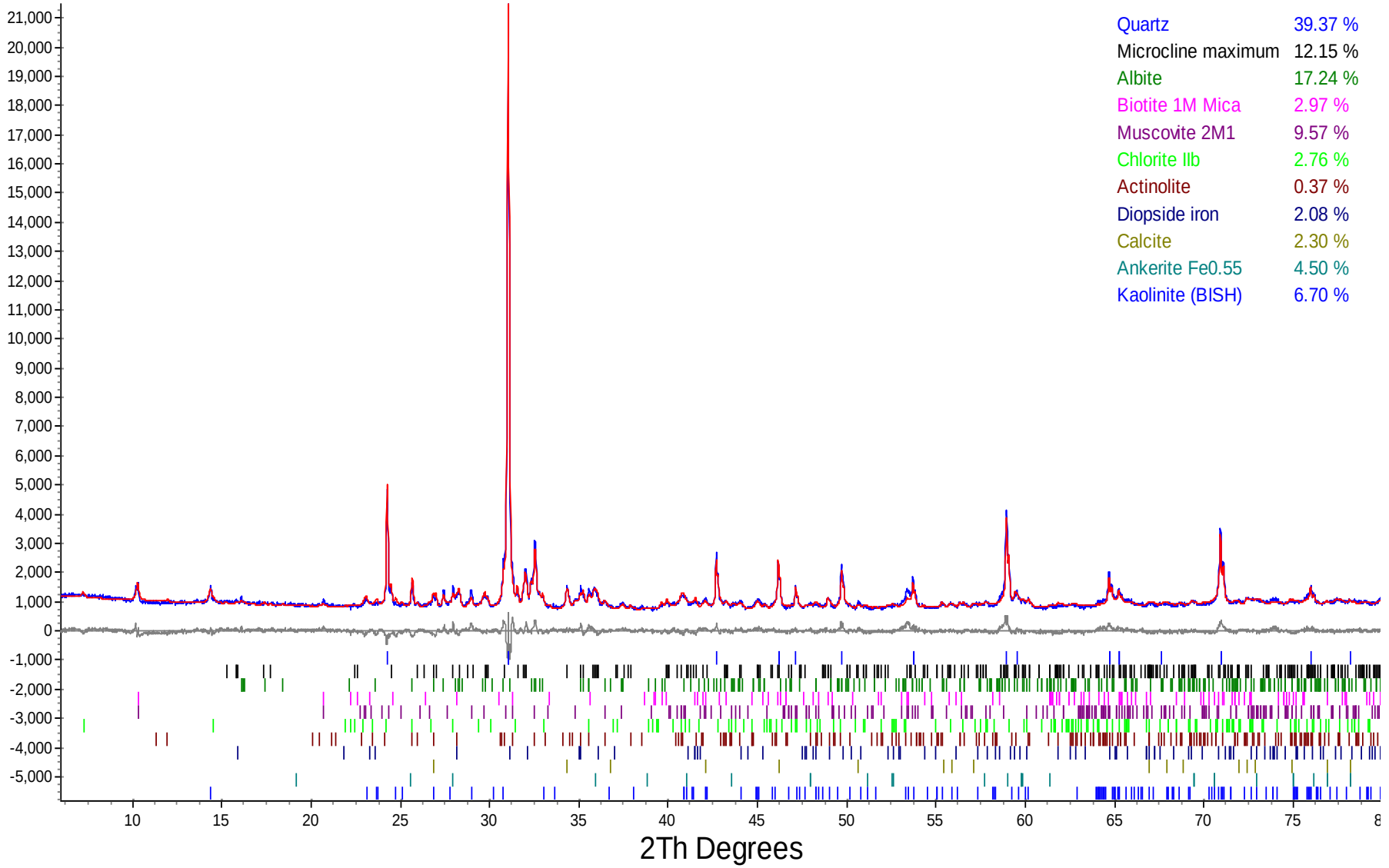
Jun4521-3 riet.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

SGS Canada Inc
14094-101A/MI4521-JUN14
06/30/2014

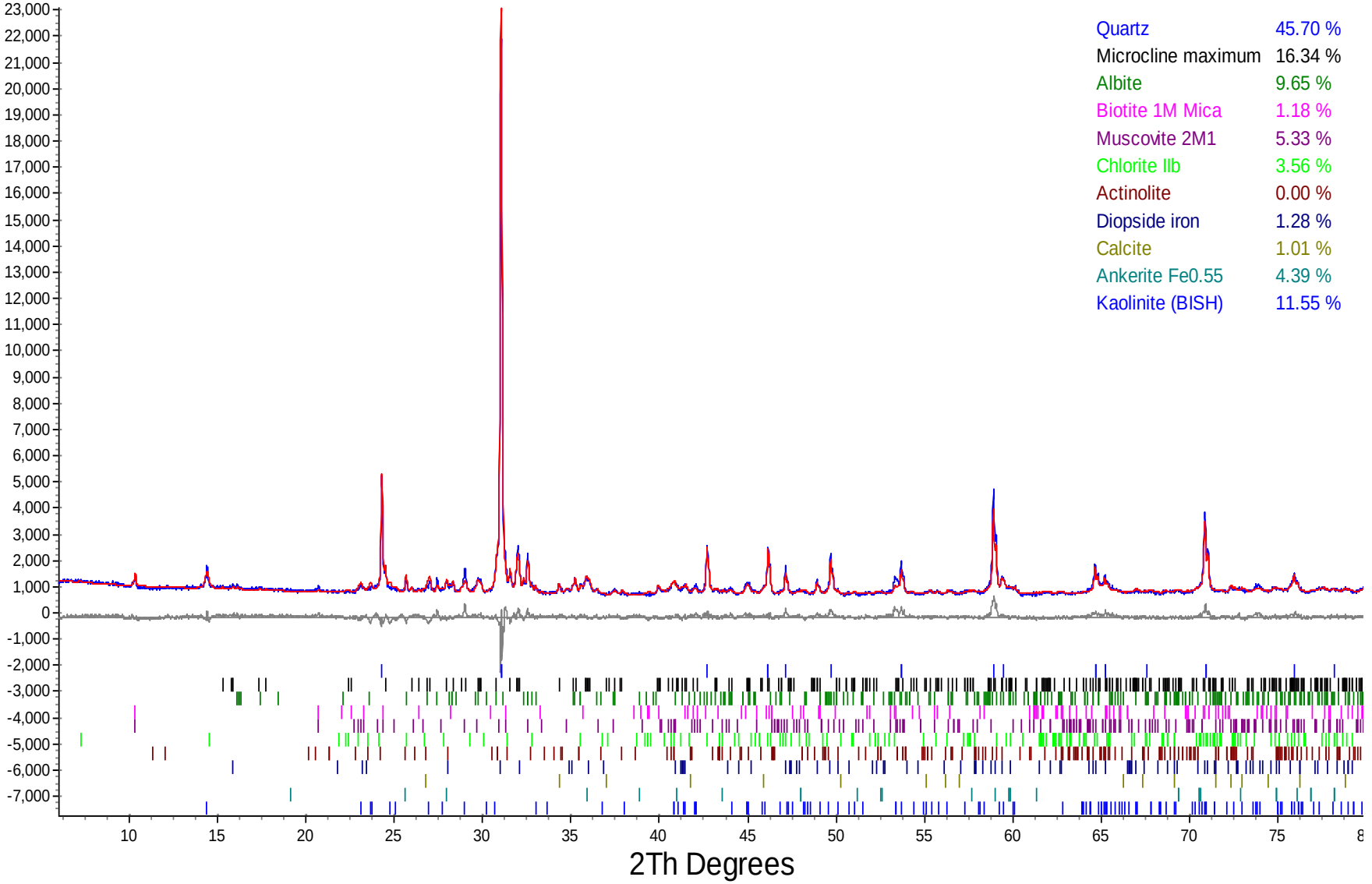
Jun4521-4 riet.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

SGS Canada Inc
14094-101A/MI4521-JUN14
06/30/2014

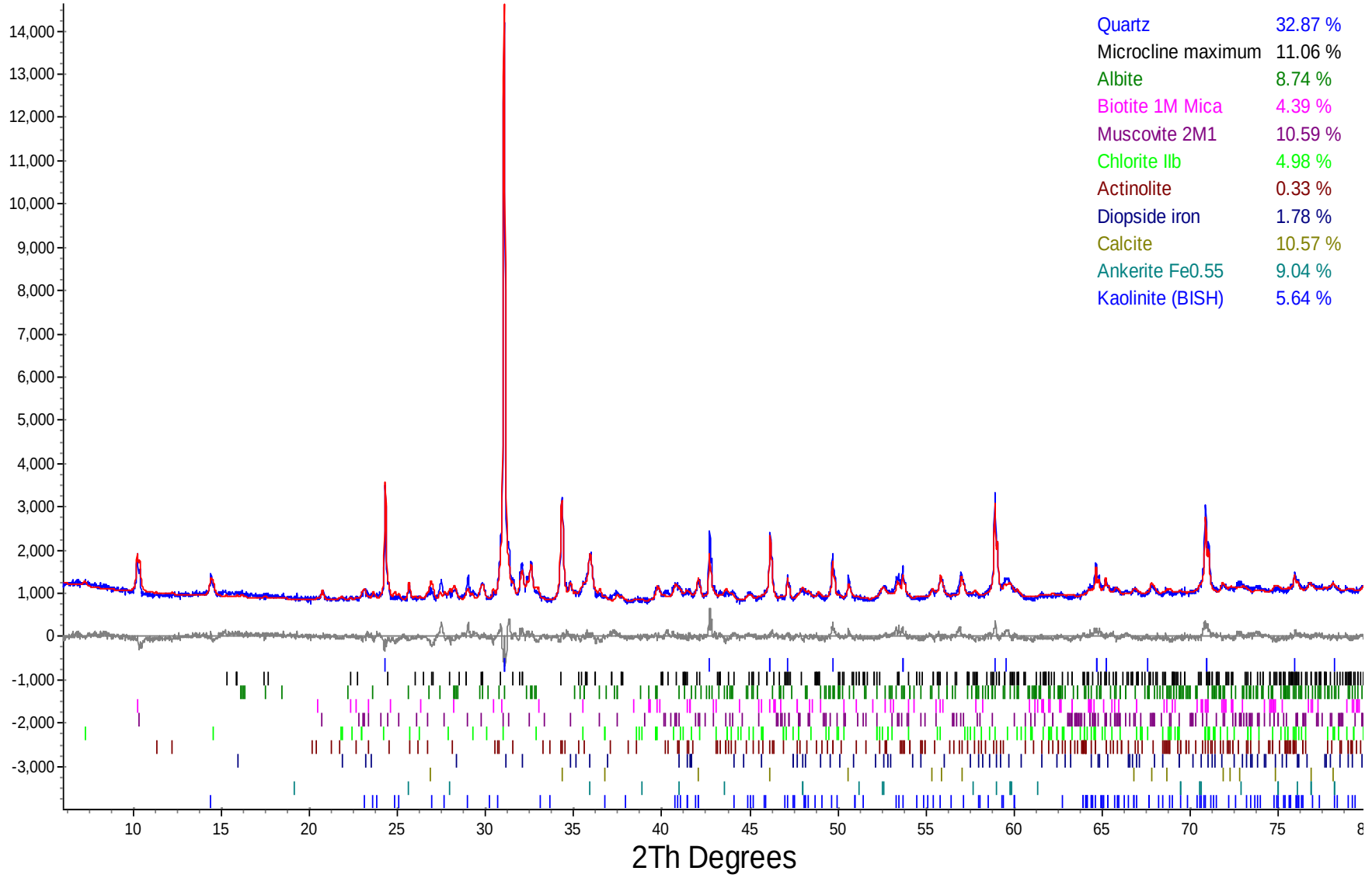
Jun4521-5 riet.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

SGS Canada Inc
14094-101A/MI4521-JUN14
06/30/2014

Jun4521-6 riet.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101B/MI4511-AUG15*
Batch No.	*1416 Kaminak*
Sample Receipt:	*August 14, 2015*
Sample Analysis:	*August 17, 2015*
Reporting Date:	*September 10, 2015*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations:	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit:	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Assemblages
3) Quantitative XRD Results
4) XRD Pattern(s)

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Minerals Services Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada - Minerals Services - Lakefield: http://palcan.scc.ca/SpecsSearch/GLSearchForm.do.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

DISCLAIMER: This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

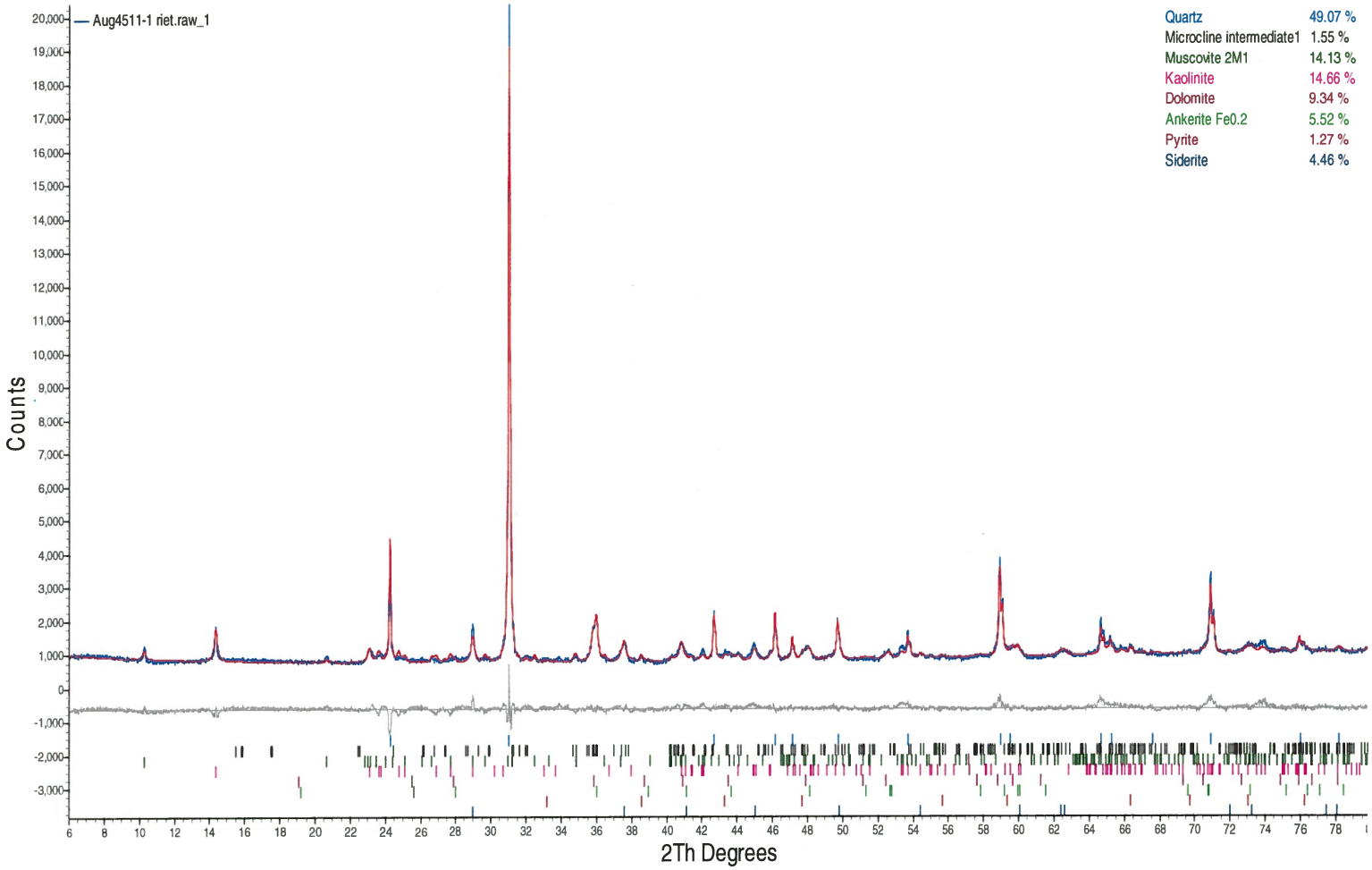
Mineral/Compound	KAM036824 AUG4511-01 (wt %)	KAM092488 AUG4511-02 (wt %)
Quartz	49.1	48.9
Microcline	1.6	22.5
Muscovite	14.1	14.5
Kaolinite	14.7	9.6
Dolomite	9.3	4.1
Ankerite	5.5	0.0
Pyrite	1.3	0.5
Siderite	4.5	-
TOTAL	100	100

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.
Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

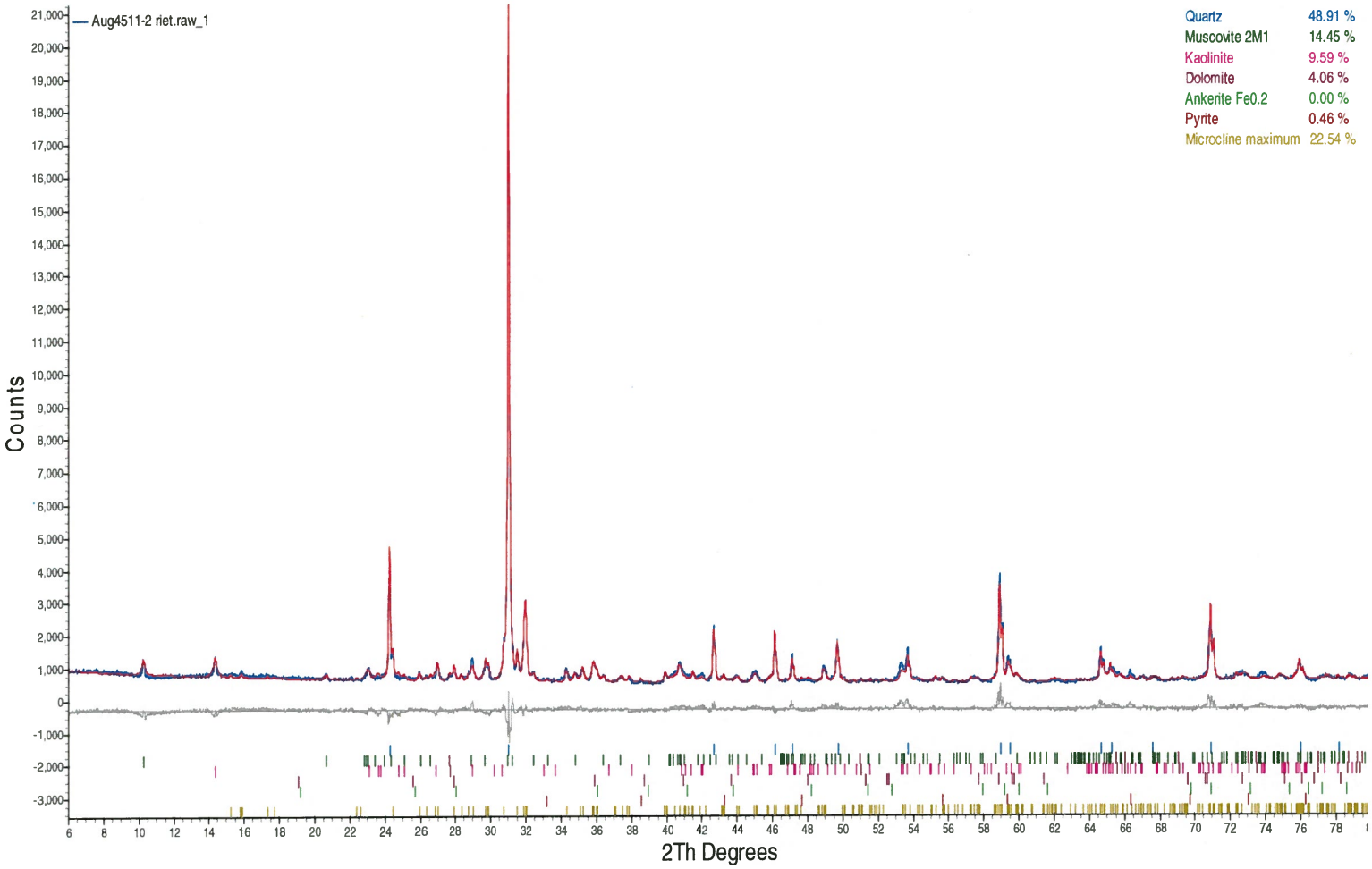
Mineral/Compound	Formula
Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Dolomite	$CaMg(CO_3)_2$
Ankerite	$CaFe(CO_3)_2$
Pyrite	FeS_2
Siderite	$FeCO_3$

SGS Canada Inc
14094-101B/MI4511-AUG15
10-Sep-15

KAM036824



KAM092488


Aug4511-2 riet.raw_1
Quartz 48.91 %
Muscovite 2M1 14.45 %
Kaolinite 9.59 %
Dolomite 4.06 %
Ankerite Fe0.2 0.00 %
Pyrite 0.46 %
Microcline maximum 22.54 %
Counts
2Th Degrees

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101B/MI4522-APR15*
Batch No.	*1416 Kaminak Coffee*
Sample Receipt:	*April 24, 2015*
Sample Analysis:	*April 29, 2015*
Reporting Date:	*May 1, 2015*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations:	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit:	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Quantitative XRD Results
4) XRD Pattern(s)

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Minerals Services Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada - Minerals Services - Lakefield: http://palcan.scc.ca/SpecsSearch/GLSearchForm.do.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

DISCLAIMER: This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

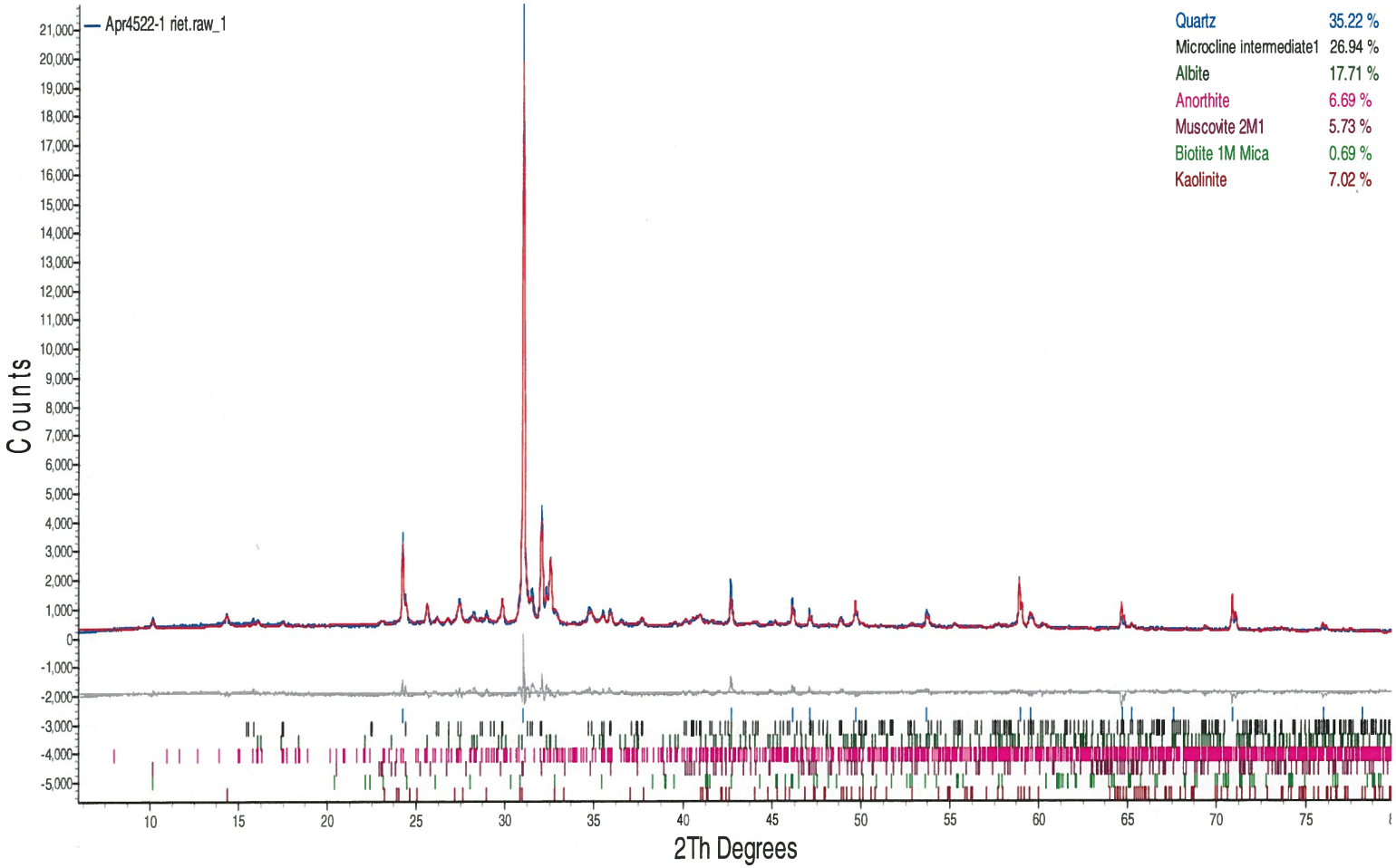
Quantitative X-ray Diffraction Results

Mineral/Compound	OKY Master APR4522-01 (wt %)	OKY Master (Sulphide) APR4522-02 (wt %)
Quartz	35.2	28.7
Microcline	26.9	29.0
Albite	17.7	22.2
Anorthite	6.7	9.8
Muscovite	5.7	4.6
Biotite	0.7	1.4
Kaolinite	7.0	4.4
TOTAL	100	100

Mineral/Compound	Formula
Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Albite	$NaAlSi_3O_8$
Anorthite	$CaAl_2Si_2O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$

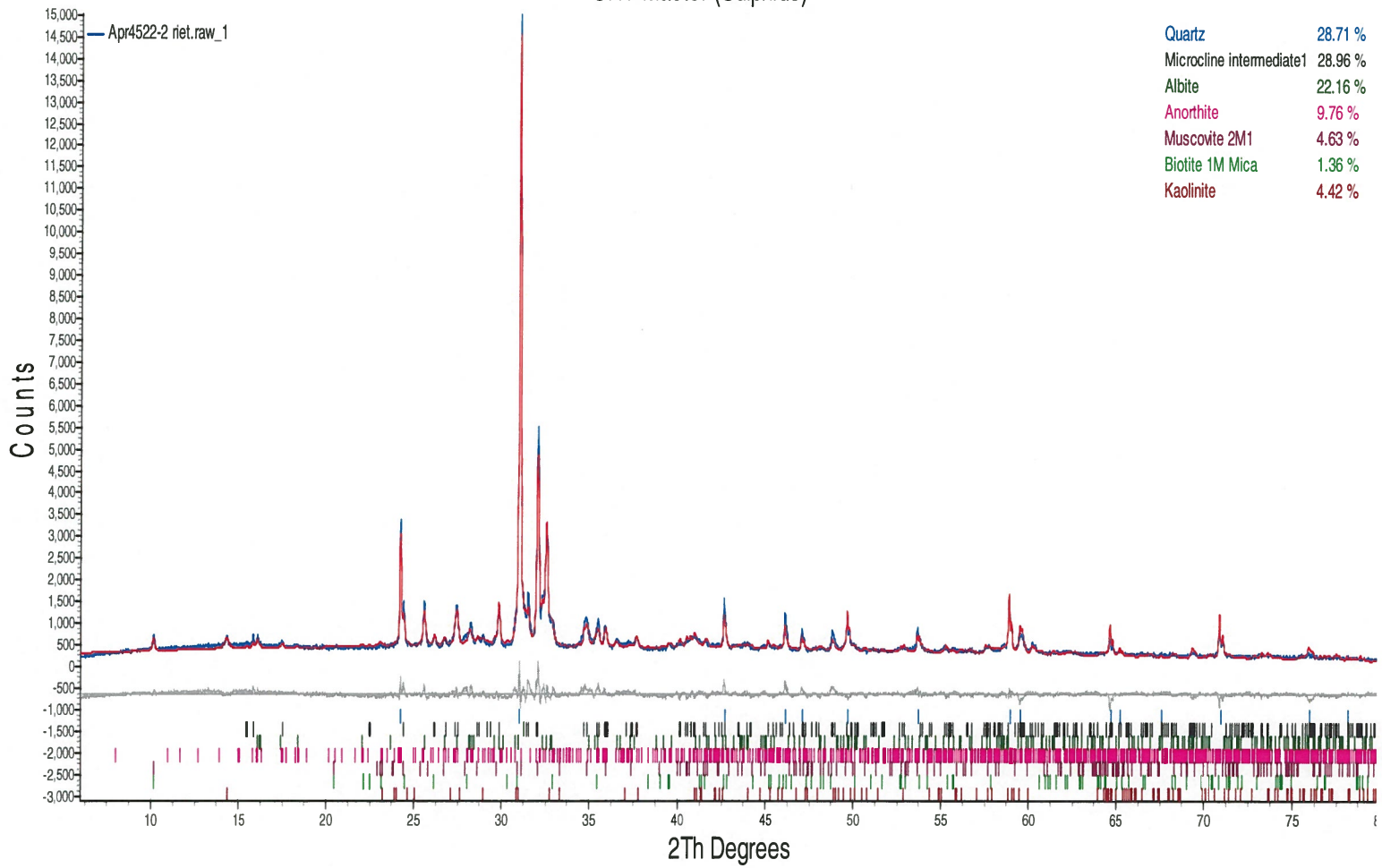
SGS Canada Inc
14094-101B/MI4522-APR15
05/01/2015

OKY Master



SGS Canada Inc
14094-101B/MI4522-APR15
05/01/2015

OKY Master (Sulphide)



Appendix D.1-2 Static Test Results for Waste Rock Kinetic Test Samples

Acid-Base Accounting Results

Kinetic Tests	Description	Lithology	Weathering Facies	Rinse pH	Paste pH	TIC	CaNP	Total C	Total S	S(SO4)	S(S-2)	Insoluble S	AP	Sobek NP	Siderite NP	Sobek NNP	Siderite NNP	Fizz Test
				s.u.	s.u.	%	kg $CaCO_3$/t	%	%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	
			Method Code	*Sobek*	*Sobek*	*CSB02V*	*Calc.*	*CSA06V*	*CSA06V*	*CSA07V*	*CSA08D*	*Calc.*	*Calc.*	*Sobek*	*Siderite Corr.*	*Calc.*	*Calc.*	*Sobek*
			Limit of Detection	*0.20*	*0.20*	*0.01*	*#N/A*	*0.005*	*0.005*	*0.01*	*0.01*	*#N/A*	*#N/A*	*0.5*	*0.5*	*#N/A*	*#N/A*	*#N/A*
Col 5, FB-GO	GO	Gneiss	Oxide	8.46	8.43	0.23	19.2	0.258	0.016	*<0.01*	0.01	0.006	0.3	22.7	26.5	22.4	26.2	Slight
Col 6, HC3, FB-GT	GT	Gneiss	Transition	8.00	8.59	0.48	40.0	0.488	0.083	*<0.01*	0.07	0.013	2.2	32.9	40.8	30.7	38.6	Slight
HC4, FB-GS	GS	Gneiss	Fresh	8.22	8.28	0.66	55.0	0.672	0.21	*<0.01*	0.18	0.03	5.6	51.7	56.9	46.1	51.3	Slight
HC8	KAM092488	Gneiss	Fresh		8.58	0.24	20.0	0.24	0.386	*<0.01*	0.38	<0.01	11.9	20.2		8.3		Slight
Col 3, FB-SO	SO	Schist	Oxide	8.35	8.25	0.93	77.5	0.958	0.031	*<0.01*	0.01	0.021	0.3	74.9	75.9	74.6	75.6	Slight
Col 4, HC1, FB-ST	ST	Schist	Transition	8.41	8.28	1.58	131.7	1.62	0.101	0.01	0.05	0.041	1.6	172.9	192.6	171.3	191.0	Moderate
HC2, FB-SS	SS	Schist	Fresh	8.49	8.40	2.09	174.2	2.13	0.421	*<0.01*	0.35	0.071	10.9	180.5	200.1	169.6	189.2	Moderate
HC7	KAM036824	Schist	Fresh		8.18	1.81	150.8	1.83	1.1	0.02	1.06	0.02	33.1	127.2		94.1		Moderate
Col 13, HC5, FB-GGT	OKY Master	Granite	Transition	7.12	7.49	0.01	0.8	0.02	0.035	*<0.01*	<0.01	0.035	<0.3	2.8	7.6	2.8	7.6	None
Col 14, HC6, FB-GGS	OKY Master (Fresh)	Granite	Fresh	8.59	8.48	0.11	9.2	0.122	0.045	*<0.01*	0.03	0.015	0.9	5.7	9.9	4.8	9.0	None

Notes:
Values in grey italics are below the analytical detection limit
CaNP = carbonate NP calculated from total inorganic carbon (TIC)
NNP = net neutralization potential, derived by subtracting AP from NP

Appendix D.1-2 Static Test Results for Waste Rock Kinetic Test Samples

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Description	Lithology	Weathering Facies	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Lu	Mg	Mn	Mo
				ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm
			Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
			Limit of Detection	*0.01*	*0.01*	*1*	*10*	*5*	*0.1*	*0.02*	*0.01*	*0.01*	*0.05*	*0.1*	*1*	*0.05*	*0.5*	*0.01*	*0.1*	*0.1*	*0.05*	*0.01*	*0.02*	*0.01*	*0.1*	*1*	*0.01*	*0.01*	*2*	*0.05*
Col 5, FB-GO	GO	Gneiss	Oxide	0.17	0.58	218	30	106	0.8	0.35	0.68	0.07	62.7	6.2	142	1.57	9.8	1.5	2.3	*<0.1*	0.32	0.15	*<0.02*	0.21	33.3	2	0.23	0.21	339	4.98
Col 6, HC3, FB-GT	GT	Gneiss	Transition	0.03	0.47	182	30	162	0.7	0.2	0.96	0.05	58.8	4.1	122	1.21	5.9	1.18	1.9	*<0.1*	0.28	0.24	*<0.02*	0.19	32.1	2	0.19	0.35	280	4.89
HC4, FB-GS	GS	Gneiss	Fresh	0.03	0.92	86	20	120	0.7	0.47	1.57	0.03	65.4	8	112	2.07	6.7	1.81	3.6	*<0.1*	0.22	0.07	*<0.02*	0.41	33.4	5	0.22	0.6	373	4.49
HC8	KAM092488	Gneiss	Fresh	0.06	0.34	248	50	63	0.5	0.06	0.47	0.07	36.3	1	100	0.36	2	0.6	0.9	*<0.1*	0.23	0.11	*<0.02*	0.18	22.5	2	0.11	0.19	102	5.42
Col 3, FB-SO	SO	Schist	Oxide	0.17	0.49	369	20	336	0.8	0.48	2.33	0.14	55.6	12.6	125	1.21	24.1	2.89	1.9	*<0.1*	0.14	0.44	0.03	0.16	27.3	2	0.24	0.48	530	3.84
Col 4, HC1, FB-ST	ST	Schist	Transition	0.05	1.52	67	30	542	0.7	0.25	4.86	0.07	38.7	15.1	190	3.7	16.1	2.57	5.8	*<0.1*	0.17	0.03	0.02	0.83	22.7	13	0.19	1.21	589	5.49
HC2, FB-SS	SS	Schist	Fresh	0.11	1.37	30	20	327	0.9	0.45	5.03	0.1	57.5	14.2	145	3.62	18	2.87	5.9	*<0.1*	0.08	0.12	0.04	0.68	28	10	0.23	1.44	660	3.25
HC7	KAM036824	Schist	Fresh	0.05	0.57	989	50	182	1.1	0.21	2.65	0.13	47.1	17	111	1.87	26.9	3.68	2.7	*<0.1*	*<0.05*	0.51	0.04	0.21	24.2	2	0.24	1.11	733	3.64
Col 13, HC5, FB-GGT	OKY Master	Granite	Transition	0.04	0.4	298	*<10*	54	0.4	0.21	0.05	0.05	46.7	1.6	132	3.25	7.6	0.87	1.9	*<0.1*	0.38	0.14	*<0.02*	0.16	25.1	6	0.2	0.06	384	6.68
Col 14, HC6, FB-GGS	OKY Master (Sulphide)	Granite	Fresh	0.03	0.38	59	*<10*	63	0.4	0.15	0.1	0.05	48	1.6	125	3	5.6	1.1	2.2	*<0.1*	0.43	0.08	*<0.02*	0.2	25.7	8	0.23	0.12	678	6.21

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.1-2 Static Test Results for Waste Rock Kinetic Test Samples

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Description	Lithology	Weathering Facies	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
				%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
			Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
			Limit of Detection	*0.01*	*0.05*	*0.5*	*0.005*	*0.2*	*0.2*	*0.01*	*0.05*	*0.1*	*1*	*0.3*	*0.5*	*0.05*	*0.02*	*0.05*	*0.1*	*0.01*	*0.02*	*0.05*	*1*	*0.1*	*0.05*	*0.1*	*1*	*0.5*
Col 5, FB-GO	GO	Gneiss	Oxide	0.02	0.1	9.7	0.03	10.8	18	0.01	12.1	3	*<1*	0.6	25	*<0.05*	0.49	0.1	35.2	*<0.01*	0.32	5.53	17	1.3	13	1.5	21	11.2
Col 6, HC3, FB-GT	GT	Gneiss	Transition	0.02	0.11	5.7	0.022	7.4	15.7	0.07	6.89	2	*<1*	0.6	38.1	*<0.05*	0.41	*<0.05*	30.6	*<0.01*	0.26	6.32	9	0.2	11	1.3	16	8.9
HC4, FB-GS	GS	Gneiss	Fresh	0.02	0.27	12.8	0.034	6	29.9	0.2	2.58	3.7	*<1*	0.7	55.3	*<0.05*	0.55	0.13	21.5	0.03	0.27	6.05	18	0.2	14.3	1.5	19	6.7
HC8	KAM092488	Gneiss	Fresh	0.01	0.09	5.7	0.006	6	12.5	0.35	2.18	0.4	2	*<0.3*	24.9	*<0.05*	0.19	0.09	36.1	*<0.01*	0.08	12.4	1	0.2	3.94	0.6	4	6.5
Col 3, FB-SO	SO	Schist	Oxide	0.01	*<0.05*	27.4	0.048	17	8.4	0.01	32.6	7	*<1*	0.4	56.9	*<0.05*	0.63	0.06	11.8	*<0.01*	0.44	2.55	32	0.4	15	1.6	41	4.5
Col 4, HC1, FB-ST	ST	Schist	Transition	0.04	0.73	49.6	0.048	9.3	52.2	0.09	1.86	5.7	*<1*	1.1	778	*<0.05*	0.41	0.07	15.1	0.11	0.48	2.71	42	1.4	11.9	1.3	43	4.8
HC2, FB-SS	SS	Schist	Fresh	0.03	0.29	53.9	0.063	15	43.1	0.43	2.59	6.8	*<1*	1.1	243	*<0.05*	0.61	*<0.05*	12.3	0.06	0.37	3.24	43	0.6	16.2	1.6	58	3
HC7	KAM036824	Schist	Fresh	0.02	0.07	43.1	0.048	42.5	13.3	1.09	6.4	8.6	3	0.4	70.9	*<0.05*	0.6	*<0.05*	11.7	*<0.01*	0.3	3.77	34	0.2	15.3	1.6	91	1.5
Col 13, HC5, FB-GGT	OKY Master	Granite	Transition	0.03	1.56	6.4	0.017	16.3	16.5	0.02	1.52	1.7	*<1*	0.7	7.6	*<0.05*	0.39	*<0.05*	30.3	0.02	0.24	7.64	6	0.1	11	1.3	29	8.3
Col 14, HC6, FB-GGS	OKY Master (Sulphide)	Granite	Fresh	0.04	2.38	5.8	0.019	8	22	0.04	0.51	2.1	*<1*	0.9	4	*<0.05*	0.41	*<0.05*	33.7	0.04	0.33	6.24	7	0.1	12.1	1.5	32	8.7

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 3 (SO)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1500	440	7.9	2529	#N/A	8.6	284	600	49	0.26	1.0	748	0.11	0.0088	0.028	0.050	0.000014	*< 0.000007*	0.032	0.000025	188	0.0032	0.0076
30-Jul-14	2	3	400	295	8.3	938	#N/A	2.5	203	240	7.5	0.36	*< 0.3*	209	0.0090	0.0065	0.018	0.019	*< 0.000007*	*< 0.000007*	0.023	*< 0.000003*	50	0.00088	0.00091
13-Aug-14	3	5	400	300	8.2	720	#N/A	3.4	208	129	2.6	0.32	*< 0.3*	164	0.0022	0.0060	0.014	0.024	*< 0.000007*	*< 0.000007*	0.024	*< 0.000003*	39	0.00074	0.00038
27-Aug-14	4	7	400	315	8.2	551	#N/A	8.0	187	91	*< 2*	0.40	*< 0.3*	133	0.0065	0.0052	0.015	0.022	*< 0.000007*	*< 0.000007*	0.028	*< 0.000003*	32	0.00063	0.00021
10-Sep-14	5	9	400	310	8.2	497	#N/A	3.8	181	65	0.50	0.43	*< 0.3*	118	0.0048	0.0049	0.016	0.024	*< 0.000007*	*< 0.000007*	0.023	*< 0.000003*	29	0.00065	0.00015
24-Sep-14	6	11	400	215	8.2	476	#N/A	4.7	198	57	0.30	0.36	*< 0.3*	133	0.0023	0.0049	0.011	0.032	*< 0.000007*	*< 0.000007*	0.021	*< 0.000003*	32	0.00074	0.00020
8-Oct-14	7	13	300	200	8.2	426	#N/A	4.2	159	48	*< 1*	0.42	*< 0.3*	129	0.0066	0.0043	0.015	0.031	*< 0.000007*	*< 0.000007*	0.019	*< 0.000003*	32	0.00072	0.00011
22-Oct-14	8	15	400	260	8.2	385	#N/A	6.1	158	42	*< 1*	0.44	*< 0.3*	126	0.0077	0.0043	0.013	0.034	*< 0.000007*	*< 0.000007*	0.021	0.000014	30	0.00076	0.000086
5-Nov-14	9	17	400	270	-	378	#N/A	#N/A	175	36	*< 1*	0.39	*< 0.3*	141	0.0050	0.0039	0.011	0.040	*< 0.000007*	*< 0.000007*	0.022	*< 0.000003*	33	0.00079	0.00011
19-Nov-14	10	19	400	260	8.1	351	#N/A	6.8	156	29	*< 0.2*	0.39	*< 0.3*	148	0.0049	0.0036	0.012	0.048	*< 0.000007*	*< 0.000007*	0.021	0.0000030	34	0.00073	0.000088
3-Dec-14	11	21	400	335	8.2	342	#N/A	2.7	161	27	*< 1*	0.35	*< 0.3*	161	0.0048	0.0036	0.011	0.051	*< 0.000007*	*< 0.000007*	0.020	0.0000040	39	0.00070	0.000074
17-Dec-14	12	23	400	280	8.2	362	#N/A	3.0	164	21	*< 0.2*	0.38	*< 0.3*	161	0.0052	0.0037	0.012	0.058	*< 0.000007*	*< 0.000007*	0.022	*< 0.000003*	37	0.00057	0.000067
31-Dec-14	13	25	400	280	8.4	353	#N/A	#N/A	215	20	*< 1*	0.37	*< 0.3*	154	0.0082	0.0035	0.012	0.057	*< 0.000007*	*< 0.000007*	0.020	*< 0.000003*	37	0.00091	0.00011
14-Jan-15	14	27	400	265	8.2	311	#N/A	3.4	145	21	*< 1*	0.44	*< 0.3*	145	0.0061	0.0040	0.014	0.051	*< 0.000007*	*< 0.000007*	0.020	0.0000050	34	0.00091	0.000073
28-Jan-15	15	29	400	275	8.2	334	#N/A	3.3	154	18	*< 1*	0.38	*< 0.3*	156	0.0087	0.0035	0.011	0.060	*< 0.000007*	0.0000090	0.017	0.000030	36	0.00086	0.000052
11-Feb-15	16	31	400	255	8.2	357	#N/A	3.2	164	21	*< 1*	0.41	*< 0.3*	163	0.0061	0.0040	0.011	0.062	*< 0.000007*	*< 0.000007*	0.022	0.0000080	39	0.00078	0.000066
25-Feb-15	17	33	400	235	8.2	343	#N/A	4.2	172	15	*< 1*	0.34	*< 0.3*	165	0.0024	0.0034	0.0071	0.066	*< 0.000007*	*< 0.000007*	0.020	*< 0.000003*	41	0.00076	0.000049
11-Mar-15	18	35	400	295	8.2	349	#N/A	2.9	180	17	*< 1*	0.39	*< 0.3*	169	0.0053	0.0035	0.0074	0.067	*< 0.000007*	*< 0.000007*	0.019	*< 0.000003*	42	0.00087	0.000074
25-Mar-15	19	37	400	260	8.1	366	#N/A	5.1	181	13	*< 1*	0.37	*< 0.3*	180	0.0051	0.0040	0.0082	0.077	*< 0.000007*	*< 0.000007*	0.018	*< 0.000003*	42	0.00090	0.000047
8-Apr-15	20	39	400	315	8.1	354	#N/A	5.0	187	13	*< 1*	0.37	*< 0.3*	172	0.0038	0.0045	0.012	0.077	*< 0.000007*	*< 0.000007*	0.019	*< 0.000003*	43	0.00063	0.000049
22-Apr-15	21	41	400	275	8.1	324	#N/A	5.4	166	14	*< 1*	0.42	*< 0.3*	161	0.0051	0.0039	0.0088	0.068	*< 0.000007*	*< 0.000007*	0.021	0.000028	39	0.00080	0.000032
6-May-15	22	43	400	265	8.1	318	#N/A	3.9	171	11	*< 1*	0.37	*< 0.3*	161	0.0054	0.0039	0.0083	0.075	*< 0.000007*	*< 0.000007*	0.019	*< 0.000003*	39	0.00060	0.000030
20-May-15	23	45	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	420	295	8.1	283	#N/A	4.7	135	11	*< 1*	0.46	*< 0.3*	135	0.0082	0.0034	0.0086	0.065	*< 0.000007*	*< 0.000007*	0.017	*< 0.000003*	33	0.00074	0.000026
17-Jun-15	25	49	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	420	280	8.1	304	#N/A	5.6	140	10	*< 1*	0.46	*< 0.3*	136	0.0044	0.0041	0.014	0.077	*< 0.000007*	*< 0.000007*	0.019	0.0000040	32	0.00082	0.000042
15-Jul-15	27	53	500	360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	360	280	8.2	269	#N/A	2.1	132	12	*< 1*	0.50	*< 0.3*	125	0.0065	0.0036	0.0098	0.070	*< 0.000007*	*< 0.000007*	0.018	*< 0.000003*	30	0.00084	0.000035
12-Aug-15	29	57	500	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	400	270	8.2	259	#N/A	2.0	131	10	*< 1*	0.46	*< 0.3*	125	0.0079	0.0038	0.011	0.079	*< 0.000007*	*< 0.000007*	0.017	0.0000060	30	0.00096	0.000038
9-Sep-15	31	61	500	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	400	340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	340	230	8.2	273	#N/A	3.3	138	8.0		0.48		123	0.0083	0.0041	0.012	0.077	*< 0.000007*	*< 0.000007*	0.015	0.0000030	29	0.00082	0.000026
21-Oct-15	34	67	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	450	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	420	305	8.4	264	#N/A	#N/A	149	7.0		0.52		125	0.0040	0.0037	0.0088	0.079	*< 0.000007*	*< 0.000007*	0.011	*< 0.000003*	30	0.00091	0.000023
2-Dec-15	37	73	500	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	460	405	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	405	380	8.3	263	#N/A	#N/A	119	7.0	-	0.48	-	123	0.0061	0.0035	0.0097	0.083	*< 0.000007*	*< 0.000007*	0.014	*< 0.000003*	29	0.00083	0.000051
6-Jan-16	40	78	400	330	8.3	255	#N/A	0.90	120	8.0	-	0.54	-	134	0.0057	0.0038	0.011	0.085	*< 0.000007*	*< 0.000007*	0.015	*< 0.000003*	32	0.00095	0.000031
20-Jan-16	41	80	400	260	8.3	255	#N/A	1.7	120	8.0	-	0.53	-	132	0.0054	0.0043	0.012	0.093	*< 0.000007*	*< 0.000007*	0.014	0.0000040	32	0.00099	0.00012
3-Feb-16	42	82	400	375	8.2	245	#N/A	2.0	119	7.0	-	0.37	-	122	0.0041	0.0040	0.0094	0.091	*< 0.000007*	*< 0.000007*	0.012	*< 0.000003*	30	0.00092	0.000023
17-Feb-16	43	84	400	285	8.2	262	#N/A	4.0	122	7.0	-	0.59	-	134	0.0018	0.0040	0.0097	0.096	*< 0.000007*	*< 0.000007*	0.012	*< 0.000003*	33	0.0011	0.000021
2-Mar-16	44	86	400	350	8.2	251	#N/A	1.3	117	7.0	-	0.56	-	126	0.0022	0.0043	0.012	0.094	*< 0.000007*	*< 0.000007*	0.011	*< 0.000003*	29	0.0010	0.000040

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 3 (SO)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1500	440	7.9	0.043	0.015	0.000090	0.020	68	0.052	0.34	0.0039	0.016	0.050	21	0.0081	5.0	0.000021	229	0.93	215	0.00019	0.00085	0.00054	0.025	0.0074	0.016	< 0.002
30-Jul-14	2	3	400	295	8.3	0.0079	2.7	0.000010	0.011	21	0.029	0.060	0.0046	0.0042	< 0.009	9.5	0.0034	4.8	< 0.000002	103	0.29	92	0.000096	0.000050	0.00039	0.013	0.00098	0.0030	< 0.002
13-Aug-14	3	5	400	300	8.2	0.0025	< 0.002	< 0.00001	0.011	16	0.011	0.020	0.0050	0.0021	< 0.009	7.9	0.0020	5.0	< 0.000002	46	0.23	49	0.000083	0.000020	0.00020	0.012	0.000020	0.0010	< 0.002
27-Aug-14	4	7	400	315	8.2	0.0014	< 0.002	0.000020	0.0089	13	0.0040	< 0.01	0.0049	0.0012	0.013	7.3	0.0013	4.9	< 0.000002	50	0.19	33	0.000082	0.00024	0.000070	0.0092	0.00019	< 0.001	< 0.002
10-Sep-14	5	9	400	310	8.2	0.0012	< 0.007	< 0.00001	0.0082	11	0.0021	< 0.01	0.0050	0.0010	< 0.003	6.5	0.0011	5.8	< 0.000002	56	0.20	27	0.000073	0.00017	< 0.00005	0.0074	0.00015	< 0.001	< 0.002
24-Sep-14	6	11	400	215	8.2	0.0015	< 0.002	0.000040	0.0091	13	0.0023	0.010	0.0034	0.0014	0.013	7.2	0.00045	5.0	0.000039	45	0.19	18	0.000080	0.000050	0.00033	0.0063	0.00011	0.0020	< 0.002
8-Oct-14	7	13	300	200	8.2	0.00098	< 0.007	0.00012	0.0090	12	0.0011	< 0.01	0.0046	0.00070	< 0.003	6.5	0.00080	5.1	< 0.000002	40	0.21	16	0.000077	0.000060	0.000090	0.0066	0.00014	< 0.001	< 0.002
22-Oct-14	8	15	400	260	8.2	0.0010	< 0.007	0.000030	0.0078	13	0.0017	< 0.01	0.0043	0.00070	< 0.003	7.4	0.00064	5.4	< 0.000002	30	0.19	15	0.000077	0.000060	0.00012	0.0058	0.00018	0.0010	< 0.002
5-Nov-14	9	17	400	270	-	0.00085	0.026	0.000060	0.0080	14	0.0016	< 0.01	0.0041	0.00060	< 0.003	6.3	0.00057	5.0	< 0.000002	24	0.24	12	0.000083	0.000030	0.00010	0.0058	0.000090	< 0.001	< 0.002
19-Nov-14	10	19	400	260	8.1	0.00096	< 0.007	< 0.00001	0.0082	15	0.00025	< 0.01	0.0037	0.00050	0.0060	6.6	0.00050	5.3	< 0.000002	17	0.26	9.4	0.00010	0.000070	0.00011	0.0058	0.00011	< 0.001	< 0.002
3-Dec-14	11	21	400	335	8.2	0.0011	< 0.007	0.000010	0.0074	15	0.0013	< 0.01	0.0032	0.00060	< 0.003	6.5	0.00043	5.0	< 0.000002	12	0.28	8.8	0.000089	0.000020	0.000070	0.0056	0.00010	< 0.001	< 0.002
17-Dec-14	12	23	400	280	8.2	0.00083	< 0.007	< 0.00001	0.0078	16	0.00018	< 0.01	0.0037	0.00050	< 0.003	7.3	0.00039	5.2	< 0.000002	9.2	0.29	7.7	0.000085	< 0.00001	0.000060	0.0058	0.00016	< 0.001	< 0.002
31-Dec-14	13	25	400	280	8.4	0.00082	< 0.007	0.00047	0.0071	15	0.0014	< 0.01	0.0042	0.00050	< 0.003	6.7	0.00035	5.1	0.0000020	6.3	0.28	7.2	0.000093	0.000070	0.000090	0.0056	0.00012	0.0020	< 0.002
14-Jan-15	14	27	400	265	8.2	0.0015	< 0.007	0.000050	0.0064	14	0.0012	< 0.01	0.0047	0.00050	< 0.003	6.7	0.00033	5.2	0.0000020	5.3	0.25	6.9	0.000078	0.000070	0.000090	0.0053	0.00014	0.0020	< 0.002
28-Jan-15	15	29	400	275	8.2	0.00071	< 0.007	0.000080	0.0057	16	0.00075	< 0.01	0.0041	0.00050	< 0.003	6.9	0.00043	4.7	< 0.000002	4.7	0.22	6.7	0.000083	0.00010	0.00012	0.0051	0.00022	0.0020	< 0.002
11-Feb-15	16	31	400	255	8.2	0.00067	< 0.007	0.000090	0.0067	16	0.00065	< 0.01	0.0036	0.00050	< 0.003	6.6	< 0.001	5.0	< 0.000002	3.6	0.27	6.4	0.000084	0.00039	< 0.00005	0.0053	0.00012	< 0.001	< 0.002
25-Feb-15	17	33	400	235	8.2	0.0013	< 0.007	0.000020	0.0068	16	0.00062	< 0.01	0.0026	0.00040	< 0.003	7.1	< 0.001	5.0	< 0.000002	3.0	0.27	5.4	0.000087	0.00013	< 0.00005	0.0052	0.000090	< 0.001	< 0.002
11-Mar-15	18	35	400	295	8.2	0.0016	< 0.007	0.000030	0.0068	16	0.00080	< 0.01	0.0028	0.00060	< 0.003	6.6	< 0.001	4.6	< 0.000002	2.6	0.29	5.3	0.000080	0.000020	< 0.00005	0.0051	0.00012	0.0020	< 0.002
25-Mar-15	19	37	400	260	8.1	0.0021	< 0.007	0.000010	0.0067	18	0.00060	< 0.01	0.0031	0.00060	< 0.003	7.7	< 0.001	5.7	0.0000020	2.7	0.31	5.5	0.000092	0.00068	0.000050	0.0058	0.00014	0.0010	< 0.002
8-Apr-15	20	39	400	315	8.1	0.0012	< 0.007	< 0.00001	0.0065	16	0.00039	< 0.01	0.0034	0.00040	< 0.003	7.2	< 0.001	5.8	< 0.000002	1.9	0.31	4.4	0.000080	0.00013	< 0.00005	0.0054	0.00011	< 0.001	< 0.002
22-Apr-15	21	41	400	275	8.1	0.0011	< 0.007	0.00027	0.0059	16	0.00075	< 0.01	0.0034	0.00040	< 0.003	7.1	0.00029	5.3	0.0000040	1.8	0.28	4.7	0.000086	0.00010	< 0.00005	0.0052	0.00013	0.0010	< 0.002
6-May-15	22	43	400	265	8.1	0.0015	< 0.007	< 0.00001	0.0060	15	0.00055	< 0.01	0.0031	0.00040	< 0.003	7.1	< 0.001	5.3	0.0000030	1.5	0.27	4.4	0.000071	0.000040	0.00012	0.0048	0.00018	0.0010	< 0.002
20-May-15	23	45	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	420	295	8.1	0.0020	< 0.007	0.000090	0.0048	13	0.00025	< 0.01	0.0034	0.00030	< 0.003	6.5	0.00015	4.9	0.0000020	1.1	0.24	4.5	0.000065	< 0.00001	< 0.00005	0.0044	0.00015	< 0.001	< 0.002
17-Jun-15	25	49	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	420	280	8.1	0.0044	< 0.007	0.000050	0.0052	14	0.0014	0.010	0.0041	0.00030	< 0.003	6.4	0.00029	5.2	< 0.000002	0.98	0.24	4.1	0.000074	0.00076	0.000080	0.0052	0.00012	0.0030	< 0.002
15-Jul-15	27	53	500	360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	360	280	8.2	0.00046	< 0.007	0.000060	0.0048	12	0.00022	< 0.01	0.0043	0.00020	< 0.003	5.9	0.00012	4.4	< 0.000002	0.83	0.22	3.8	0.000063	0.000050	< 0.00005	0.0047	0.00013	0.0010	< 0.002
12-Aug-15	29	57	500	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	400	270	8.2	0.0010	< 0.007	0.00010	0.0043	12	0.0012	< 0.01	0.012	0.00020	< 0.003	5.9	0.00018	4.7	0.000087	0.87	0.23	3.9	0.000081	0.000090	< 0.00005	0.0046	0.00016	0.0020	< 0.002
9-Sep-15	31	61	500	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	400	340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	340	230	8.2	0.0062	< 0.007	0.00066	0.0038	12	0.00053	0.020	0.0037	0.00030	< 0.003	5.8	0.00017	4.2	< 0.000002	0.66	0.20	3.5	0.000060	0.00030	< 0.00005	0.0047	0.00016	0.0010	< 0.002
21-Oct-15	34	67	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	450	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	420	305	8.4	0.00055	< 0.007	0.000060	0.0037	12	0.00024	< 0.01	0.0032	< 0.0001	< 0.003	6.0	0.00025	4.3	< 0.000002	0.59	0.20	3.1	0.000061	0.000030	0.000050	0.0035	0.000080	< 0.001	< 0.002
2-Dec-15	37	73	500	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	460	405	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	405	380	8.3	0.00098	< 0.007	0.00042	0.0033	12	0.00017	< 0.01	0.0040	0.00020	< 0.003	5.9	0.00013	4.2	< 0.000002	0.60	0.17	2.9	0.000043	0.00013	0.000060	0.0041	0.00013	< 0.001	< 0.002
6-Jan-16	40	78	400	330	8.3	0.0012	< 0.007	0.00048	0.0036	13	0.00057	< 0.01	0.0038	0.00020	< 0.003	6.6	0.00071	4.6	0.0000020	0.61	0.19	3.1	0.000023	0.00030	< 0.00005	0.0045	0.00010	< 0.001	< 0.002
20-Jan-16	41	80	400	260	8.3	0.00069	< 0.007	0.00019	0.0037	12	0.0062	< 0.01	0.0044	0.00030	< 0.003	6.2	0.00033	4.8	< 0.000002	0.57	0.22	3.1	0.00011	0.00010	< 0.00005	0.0050	0.00011	0.0020	< 0.002
3-Feb-16	42	82	400	375	8.2	0.00085	< 0.007	0.000080	0.0036	11	0.000040	< 0.01	0.0039	0.00020	< 0.003	6.0	0.00036	4.4	0.000011	0.56	0.22	3.0	0.000070	0.000040	< 0.00005	0.0043	0.00010	< 0.001	< 0.002
17-Feb-16	43	84	400	285	8.2	0.00045	< 0.007	0.000050	0.0036	13	0.00023	< 0.01	0.0040	0.00020	0.0050	6.3	0.000080	4.5	< 0.000002	0.61	0.21	3.0	0.000069	< 0.00001	< 0.00005	0.0044	0.000070	< 0.001	< 0.002
2-Mar-16	44	86	400	350	8.2	0.00024	< 0.007	0.000070	0.0036	13	0.00025	< 0.01	0.0041	0.00020	< 0.003	6.1	0.000080	4.5	< 0.000002	0.59	0.21	3.3	0.000076	0.000010	< 0.00005	0.0047	0.000070	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 3 (SO)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1500	440	7.9	2529	#N/A	0.38	12	26	2.2	0.011	0.044	33	0.0050	0.00039	0.0012	0.0022	0.00000062	0.00000031	0.0014	0.0000011	8.3	0.00014	0.00034
30-Jul-14	2	3	400	295	8.3	938	#N/A	0.036	3.0	3.5	0.11	0.0053	0.0044	3.1	0.00013	0.000096	0.00027	0.00028	0.00000010	0.00000010	0.00033	0.000000044	0.73	0.000013	0.000013
13-Aug-14	3	5	400	300	8.2	720	#N/A	0.051	3.1	1.9	0.039	0.0048	0.0045	2.5	0.000033	0.000090	0.00022	0.00036	0.00000011	0.00000011	0.00036	0.000000045	0.59	0.000011	0.0000057
27-Aug-14	4	7	400	315	8.2	551	#N/A	0.13	2.9	1.4	0.032	0.0063	0.0047	2.1	0.00010	0.000082	0.00023	0.00034	0.00000011	0.00000011	0.00045	0.000000047	0.50	0.0000099	0.0000032
10-Sep-14	5	9	400	310	8.2	497	#N/A	0.058	2.8	1.0	0.0078	0.0067	0.0047	1.8	0.000074	0.000076	0.00024	0.00038	0.00000011	0.00000011	0.00036	0.000000047	0.45	0.000010	0.0000023
24-Sep-14	6	11	400	215	8.2	476	#N/A	0.050	2.1	0.61	0.0032	0.0039	0.0032	1.4	0.000025	0.000053	0.00012	0.00034	0.000000075	0.000000075	0.00022	0.000000032	0.34	0.0000080	0.0000021
8-Oct-14	7	13	300	200	8.2	426	#N/A	0.042	1.6	0.48	0.010	0.0042	0.0030	1.3	0.000066	0.000043	0.00015	0.00031	0.000000070	0.000000070	0.00019	0.000000030	0.32	0.0000072	0.0000011
22-Oct-14	8	15	400	260	8.2	385	#N/A	0.080	2.1	0.55	0.013	0.0057	0.0039	1.6	0.00010	0.000056	0.00017	0.00044	0.000000091	0.000000091	0.00027	0.00000018	0.38	0.0000099	0.0000011
5-Nov-14	9	17	400	270		378	#N/A	#N/A	2.4	0.49	0.014	0.0053	0.0041	1.9	0.000068	0.000053	0.00015	0.00054	0.000000095	0.000000095	0.00029	0.000000041	0.44	0.000011	0.0000014
19-Nov-14	10	19	400	260	8.1	351	#N/A	0.088	2.0	0.38	0.0026	0.0051	0.0039	1.9	0.000064	0.000047	0.00015	0.00062	0.000000091	0.000000091	0.00028	0.000000039	0.44	0.0000095	0.0000011
3-Dec-14	11	21	400	335	8.2	342	#N/A	0.046	2.7	0.45	0.017	0.0059	0.0050	2.7	0.000080	0.000060	0.00018	0.00086	0.00000012	0.00000012	0.00033	0.000000067	0.65	0.000012	0.0000012
17-Dec-14	12	23	400	280	8.2	362	#N/A	0.042	2.3	0.29	0.0028	0.0053	0.0042	2.3	0.000073	0.000052	0.00016	0.00082	0.000000098	0.000000098	0.00030	0.000000042	0.52	0.0000080	0.00000094
31-Dec-14	13	25	400	280	8.4	353	#N/A	#N/A	3.0	0.28	0.014	0.0052	0.0042	2.2	0.00011	0.000049	0.00017	0.00080	0.000000098	0.000000098	0.00029	0.000000042	0.51	0.000013	0.0000015
14-Jan-15	14	27	400	265	8.2	311	#N/A	0.045	1.9	0.28	0.013	0.0058	0.0040	1.9	0.000081	0.000053	0.00018	0.00068	0.000000093	0.000000093	0.00026	0.000000066	0.45	0.000012	0.00000097
28-Jan-15	15	29	400	275	8.2	334	#N/A	0.045	2.1	0.25	0.014	0.0052	0.0041	2.1	0.00012	0.000048	0.00015	0.00082	0.000000096	0.00000012	0.00024	0.00000041	0.50	0.000012	0.00000072
11-Feb-15	16	31	400	255	8.2	357	#N/A	0.041	2.1	0.27	0.013	0.0052	0.0038	2.1	0.000078	0.000051	0.00014	0.00079	0.000000089	0.000000089	0.00027	0.00000010	0.50	0.0000099	0.00000084
25-Feb-15	17	33	400	235	8.2	343	#N/A	0.049	2.0	0.18	0.012	0.0040	0.0035	1.9	0.000028	0.000040	0.000083	0.00077	0.000000082	0.000000082	0.00023	0.000000035	0.48	0.0000089	0.00000058
11-Mar-15	18	35	400	295	8.2	349	#N/A	0.042	2.6	0.25	0.015	0.0058	0.0044	2.5	0.000078	0.000052	0.00011	0.00099	0.00000010	0.00000010	0.00027	0.000000044	0.62	0.000013	0.0000011
25-Mar-15	19	37	400	260	8.1	366	#N/A	0.066	2.4	0.17	0.013	0.0048	0.0039	2.3	0.000066	0.000052	0.00011	0.0010	0.000000091	0.000000091	0.00024	0.000000039	0.54	0.000012	0.00000061
8-Apr-15	20	39	400	315	8.1	354	#N/A	0.078	2.9	0.20	0.016	0.0058	0.0047	2.7	0.000060	0.000071	0.00018	0.0012	0.00000011	0.00000011	0.00030	0.000000047	0.68	0.0000099	0.00000077
22-Apr-15	21	41	400	275	8.1	324	#N/A	0.074	2.3	0.19	0.014	0.0058	0.0041	2.2	0.000070	0.000054	0.00012	0.00094	0.000000096	0.000000096	0.00029	0.00000039	0.54	0.000011	0.00000044
6-May-15	22	43	400	265	8.1	318	#N/A	0.052	2.3	0.15	0.013	0.0049	0.0040	2.1	0.000072	0.000052	0.00011	0.00099	0.000000093	0.000000093	0.00025	0.000000040	0.52	0.0000080	0.00000040
20-May-15	23	45	500	420																					
3-Jun-15	24	47	420	295	8.1	283	#N/A	0.035	0.99	0.081	0.0074	0.0034	0.0022	1.00	0.000060	0.000025	0.000063	0.00048	0.000000052	0.000000052	0.00012	0.000000022	0.24	0.0000055	0.00000019
17-Jun-15	25	49	500	420																					
1-Jul-15	26	51	420	280	8.1	304	#N/A	0.039	0.98	0.070	0.0070	0.0032	0.0021	0.95	0.000031	0.000029	0.000095	0.00054	0.000000049	0.000000049	0.00013	0.000000028	0.23	0.0000057	0.00000029
15-Jul-15	27	53	500	360																					
29-Jul-15	28	55	360	280	8.2	269	#N/A	0.015	0.92	0.084	0.0070	0.0035	0.0021	0.88	0.000046	0.000025	0.000069	0.00049	0.000000049	0.000000049	0.00012	0.000000021	0.21	0.0000059	0.00000025
12-Aug-15	29	57	500	400																					
26-Aug-15	30	59	400	270	8.2	259	#N/A	0.013	0.89	0.068	0.0068	0.0031	0.0020	0.84	0.000053	0.000026	0.000075	0.00053	0.000000047	0.000000047	0.00011	0.000000041	0.21	0.0000065	0.00000026
9-Sep-15	31	61	500	400																					
23-Sep-15	32	63	400	340																					
7-Oct-15	33	65	340	230	8.2	273	#N/A	0.013	0.53	0.031		0.0018		0.47	0.000032	0.000016	0.000045	0.00029	0.000000027	0.000000027	0.000058	0.000000012	0.11	0.0000031	0.000000100
21-Oct-15	34	67	500	450																					
4-Nov-15	35	69	450	420																					
18-Nov-15	36	71	420	305	8.4	264	#N/A		0.76	0.036		0.0026		0.64	0.000020	0.000019	0.000045	0.00040	0.000000036	0.000000036	0.000055	0.000000015	0.15	0.0000046	0.00000012
2-Dec-15	37	73	500	460																					
16-Dec-15	38	75	460	405																					
30-Dec-15	39	77	405	380	8.3	263	#N/A		0.76	0.044		0.0030		0.78	0.000039	0.000022	0.000061	0.00052	0.000000044	0.000000044	0.000087	0.000000019	0.19	0.0000053	0.00000032
6-Jan-16	40	78	400	330	8.3	255	#N/A	0.015	2.0	0.13		0.0089		2.2	0.000094	0.000063	0.00018	0.0014	0.00000012	0.00000012	0.00025	0.000000050	0.52	0.000016	0.00000051
20-Jan-16	41	80	400	260	8.3	255	#N/A	0.022	1.6	0.10		0.0069		1.7	0.000070	0.000056	0.00015	0.0012	0.000000091	0.000000091	0.00018	0.000000052	0.42	0.000013	0.0000016
3-Feb-16	42	82	400	375	8.2	245	#N/A	0.037	2.2	0.13		0.0069		2.3	0.000077	0.000075	0.00018	0.0017	0.00000013	0.00000013	0.00023	0.000000056	0.56	0.000017	0.00000043
17-Feb-16	43	84	400	285	8.2	262	#N/A	0.057	1.7	0.100		0.0084		1.9	0.000026	0.000057	0.00014	0.0014	0.000000100	0.000000100	0.00017	0.000000043	0.46	0.000015	0.00000030
2-Mar-16	44	86	400	350	8.2	251	#N/A	0.023	2.0	0.12		0.0098		2.2	0.000039	0.000075	0.00020	0.0016	0.00000012	0.00000012	0.00019	0.000000053	0.51	0.000018	0.00000070

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 3 (SO)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1500	440	7.9	0.0019	0.00066	0.0000040	0.00089	3.0	0.0023	0.015	0.00017	0.00070	0.0022	0.93	0.00036	0.22	0.00000092	10	0.041	9.5	0.0000082	0.000037	0.000024	0.0011	0.00032	0.00070	0.000088
30-Jul-14	2	3	400	295	8.3	0.00012	0.039	0.00000015	0.00017	0.30	0.00043	0.00089	0.000068	0.000062	0.00013	0.14	0.000051	0.071	0.000000030	1.5	0.0042	1.4	0.0000014	0.00000074	0.0000058	0.00020	0.000014	0.000044	0.000030
13-Aug-14	3	5	400	300	8.2	0.000037	0.000030	0.00000015	0.00017	0.24	0.00017	0.00030	0.000075	0.000032	0.00014	0.12	0.000029	0.075	0.000000030	0.69	0.0034	0.74	0.0000012	0.00000030	0.0000030	0.00017	0.00000030	0.000015	0.000030
27-Aug-14	4	7	400	315	8.2	0.000023	0.000032	0.00000032	0.00014	0.20	0.000063	0.00016	0.000077	0.000019	0.00020	0.12	0.000020	0.077	0.000000032	0.79	0.0029	0.52	0.0000013	0.0000038	0.0000011	0.00014	0.0000030	0.000016	0.000032
10-Sep-14	5	9	400	310	8.2	0.000019	0.00011	0.00000016	0.00013	0.17	0.000032	0.00016	0.000078	0.000016	0.000047	0.100	0.000017	0.089	0.000000031	0.87	0.0030	0.41	0.0000011	0.0000026	0.00000078	0.00011	0.0000023	0.000016	0.000031
24-Sep-14	6	11	400	215	8.2	0.000016	0.000022	0.00000043	0.000098	0.14	0.000025	0.00011	0.000037	0.000015	0.00014	0.078	0.0000048	0.053	0.00000042	0.48	0.0021	0.19	0.00000086	0.00000054	0.0000035	0.000068	0.0000012	0.000022	0.000022
8-Oct-14	7	13	300	200	8.2	0.0000098	0.000070	0.0000012	0.000090	0.12	0.000011	0.00010	0.000046	0.0000070	0.000030	0.065	0.0000080	0.051	0.000000020	0.40	0.0021	0.16	0.00000077	0.00000060	0.00000090	0.000066	0.0000014	0.000010	0.000020
22-Oct-14	8	15	400	260	8.2	0.000013	0.000091	0.00000039	0.00010	0.16	0.000022	0.00013	0.000056	0.0000091	0.000039	0.096	0.0000083	0.070	0.000000026	0.39	0.0025	0.20	0.0000010	0.00000078	0.0000016	0.000075	0.0000023	0.000013	0.000026
5-Nov-14	9	17	400	270		0.000011	0.00035	0.00000081	0.00011	0.19	0.000021	0.00014	0.000055	0.0000081	0.000041	0.085	0.0000077	0.068	0.000000027	0.32	0.0033	0.16	0.0000011	0.00000041	0.0000014	0.000078	0.0000012	0.000014	0.000027
19-Nov-14	10	19	400	260	8.1	0.000012	0.000091	0.00000013	0.00011	0.20	0.0000033	0.00013	0.000048	0.0000065	0.000078	0.085	0.0000065	0.069	0.000000026	0.22	0.0034	0.12	0.0000014	0.00000091	0.0000014	0.000075	0.0000014	0.000013	0.000026
3-Dec-14	11	21	400	335	8.2	0.000018	0.00012	0.00000017	0.00012	0.26	0.000022	0.00017	0.000054	0.000010	0.000050	0.11	0.0000072	0.083	0.000000034	0.20	0.0047	0.15	0.0000015	0.00000034	0.0000012	0.000094	0.0000017	0.000017	0.000034
17-Dec-14	12	23	400	280	8.2	0.000012	0.000098	0.00000014	0.00011	0.23	0.0000025	0.00014	0.000051	0.0000070	0.000042	0.10	0.0000055	0.073	0.000000028	0.13	0.0040	0.11	0.0000012	0.00000014	0.00000084	0.000081	0.0000022	0.000014	0.000028
31-Dec-14	13	25	400	280	8.4	0.000011	0.000098	0.0000066	0.000099	0.21	0.000019	0.00014	0.000058	0.0000070	0.000042	0.094	0.0000049	0.072	0.000000028	0.089	0.0039	0.10	0.0000013	0.00000098	0.0000013	0.000078	0.0000017	0.000028	0.000028
14-Jan-15	14	27	400	265	8.2	0.000020	0.000093	0.00000066	0.000085	0.19	0.000015	0.00013	0.000062	0.0000066	0.000040	0.089	0.0000044	0.069	0.000000027	0.070	0.0033	0.091	0.0000010	0.00000093	0.0000012	0.000070	0.0000019	0.000027	0.000027
28-Jan-15	15	29	400	275	8.2	0.0000098	0.000096	0.0000011	0.000079	0.22	0.000010	0.00014	0.000057	0.0000069	0.000041	0.094	0.0000059	0.065	0.000000028	0.064	0.0030	0.092	0.0000011	0.0000014	0.0000017	0.000071	0.0000030	0.000028	0.000028
11-Feb-15	16	31	400	255	8.2	0.0000085	0.000089	0.0000011	0.000085	0.20	0.0000083	0.00013	0.000046	0.0000064	0.000038	0.084	0.000013	0.064	0.000000026	0.046	0.0035	0.082	0.0000011	0.0000050	0.00000064	0.000068	0.0000015	0.000013	0.000026
25-Feb-15	17	33	400	235	8.2	0.000015	0.000082	0.00000024	0.000079	0.18	0.0000073	0.00012	0.000030	0.0000047	0.000035	0.083	0.000012	0.059	0.000000024	0.036	0.0032	0.063	0.0000010	0.0000015	0.00000059	0.000061	0.0000011	0.000012	0.000024
11-Mar-15	18	35	400	295	8.2	0.000023	0.00010	0.00000044	0.00010	0.23	0.000012	0.00015	0.000042	0.0000089	0.000044	0.098	0.000015	0.067	0.000000030	0.038	0.0042	0.078	0.0000012	0.00000030	0.00000074	0.000075	0.0000018	0.000030	0.000030
25-Mar-15	19	37	400	260	8.1	0.000027	0.000091	0.00000013	0.000087	0.24	0.0000078	0.00013	0.000041	0.0000078	0.000039	0.10	0.000013	0.075	0.000000026	0.035	0.0040	0.072	0.0000012	0.0000088	0.00000065	0.000075	0.0000018	0.000013	0.000026
8-Apr-15	20	39	400	315	8.1	0.000018	0.00011	0.00000016	0.00010	0.25	0.0000061	0.00016	0.000054	0.0000063	0.000047	0.11	0.000016	0.092	0.000000032	0.030	0.0049	0.069	0.0000013	0.0000020	0.00000079	0.000086	0.0000017	0.000016	0.000032
22-Apr-15	21	41	400	275	8.1	0.000015	0.000096	0.0000037	0.000081	0.21	0.000010	0.00014	0.000047	0.0000055	0.000041	0.097	0.0000040	0.073	0.000000055	0.024	0.0038	0.065	0.0000012	0.0000014	0.00000069	0.000071	0.0000018	0.000014	0.000028
6-May-15	22	43	400	265	8.1	0.000020	0.000093	0.00000013	0.000080	0.20	0.0000073	0.00013	0.000041	0.0000053	0.000040	0.095	0.000013	0.071	0.000000040	0.020	0.0035	0.058	0.00000094	0.00000053	0.0000016	0.000063	0.0000024	0.000013	0.000027
20-May-15	23	45	500	420																									
3-Jun-15	24	47	420	295	8.1	0.000015	0.000052	0.00000066	0.000035	0.094	0.0000018	0.000074	0.000025	0.0000022	0.000022	0.048	0.0000011	0.036	0.000000015	0.0080	0.0017	0.033	0.00000048	0.000000074	0.00000037	0.000032	0.0000011	0.0000074	0.000015
17-Jun-15	25	49	500	420																									
1-Jul-15	26	51	420	280	8.1	0.000031	0.000049	0.00000035	0.000036	0.095	0.0000097	0.000070	0.000029	0.0000021	0.000021	0.045	0.0000020	0.036	0.000000014	0.0069	0.0017	0.029	0.00000052	0.0000053	0.00000056	0.000036	0.00000084	0.000021	0.000014
15-Jul-15	27	53	500	360																									
29-Jul-15	28	55	360	280	8.2	0.0000032	0.000049	0.00000042	0.000034	0.084	0.0000015	0.000070	0.000030	0.0000014	0.000021	0.041	0.00000084	0.031	0.000000014	0.0058	0.0015	0.027	0.00000044	0.00000035	0.00000035	0.000033	0.00000091	0.0000070	0.000014
12-Aug-15	29	57	500	400																									
26-Aug-15	30	59	400	270	8.2	0.0000068	0.000047	0.00000068	0.000029	0.080	0.0000080	0.000068	0.000081	0.0000014	0.000020	0.040	0.0000012	0.031	0.00000059	0.0059	0.0015	0.026	0.00000055	0.00000061	0.00000034	0.000031	0.0000011	0.000014	0.000014
9-Sep-15	31	61	500	400																									
23-Sep-15	32	63	400	340																									
7-Oct-15	33	65	340	230	8.2	0.000024	0.000027	0.0000025	0.000015	0.046	0.0000020	0.000077	0.000014	0.0000012	0.000012	0.022	0.00000065	0.016	0.0000000077	0.0025	0.00076	0.013	0.00000023	0.0000012	0.00000019	0.000018	0.00000061	0.0000038	0.0000077
21-Oct-15	34	67	500	450																									
4-Nov-15	35	69	450	420																									
18-Nov-15	36	71	420	305	8.4	0.0000028	0.000036	0.00000031	0.000019	0.062	0.0000012	0.000051	0.000016	0.00000051	0.000015	0.031	0.0000013	0.022	0.000000010	0.0030	0.0010	0.016	0.00000031	0.00000015	0.00000025	0.000018	0.00000041	0.0000051	0.000010
2-Dec-15	37	73	500	460																									
16-Dec-15	38	75	460	405																									
30-Dec-15	39	77	405	380	8.3	0.0000062	0.000044	0.0000027	0.000021	0.076	0.0000011	0.000063	0.000025	0.0000013	0.000019	0.037	0.00000082	0.027	0.000000013	0.0038	0.0011	0.018	0.00000027	0.00000082	0.00000038	0.000026	0.00000082	0.0000063	0.000013
6-Jan-16	40	78	400	330	8.3	0.000020	0.00012	0.0000079	0.000060	0.22	0.0000094	0.00017	0.000063	0.0000033	0.000050	0.11	0.000012	0.075	0.000000033	0.010	0.0032	0.051	0.00000038	0.0000050	0.00000083	0.000074	0.0000017	0.000017	0.000033
20-Jan-16	41	80	400	260	8.3	0.0000090	0.000091	0.0000025	0.000048	0.16	0.000080	0.00013	0.000057	0.0000039	0.000039	0.080	0.0000043	0.063	0.000000026	0.0074	0.0029	0.040	0.0000014	0.0000013	0.00000065	0.000064	0.0000014	0.000026	0.000026
3-Feb-16	42	82	400	375	8.2	0.000016	0.00013	0.0000015	0.000068	0.21	0.00000075	0.00019	0.000073	0.0000038	0.000056	0.11	0.0000068	0.083	0.00000021	0.011	0.0041	0.056	0.0000013	0.00000075	0.00000094	0.000080	0.0000019	0.000019	0.000038
17-Feb-16	43	84	400	285	8.2	0.0000064	0.000100	0.00000071	0.000051	0.18	0.0000033	0.00014	0.000058	0.0000029	0.000071	0.089	0.0000011	0.065	0.000000029	0.0087	0.0030	0.043	0.00000098	0.00000014	0.00000071	0.000063	0.00000100	0.000014	0.000029
2-Mar-16	44	86	400	350	8.2	0.0000042	0.00012	0.0000012	0.000064	0.22	0.0000044	0.00018	0.000071	0.0000035	0.000053	0.11	0.0000014	0.079	0.000000035	0.010	0.0036	0.058	0.0000013	0.00000018	0.00000088	0.000083	0.0000012	0.000018	0.000035

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 4 (ST)

Date	Cycle	Weeks	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
	No.		Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1300	315	7.8	3419	#N/A	9.6	138	1704	24	0.27	0.40	1720	0.062	0.0032	0.021	0.071	*< 0.000007*	*< 0.000007*	0.038	0.000018	360	0.0017	0.0084
30-Jul-14	2	3	400	335	8.0	1594	#N/A	4.4	116	711	3.0	0.34	*< 0.3*	615	0.0057	0.0026	0.014	0.021	*< 0.000007*	*< 0.000007*	0.033	0.0000030	135	0.00029	0.0017
13-Aug-14	3	5	400	340	8.0	1176	#N/A	5.2	113	434	1.2	0.38	*< 0.3*	403	0.0022	0.0025	0.010	0.022	*< 0.000007*	*< 0.000007*	0.036	0.0000070	86	0.00022	0.00089
27-Aug-14	4	7	400	340	8.1	882	#N/A	7.3	125	333	0.60	0.41	*< 0.3*	304	0.0037	0.0023	0.0089	0.019	*< 0.000007*	*< 0.000007*	0.040	0.0000060	65	0.00015	0.00053
10-Sep-14	5	9	400	355	8.1	756	#N/A	6.7	126	237	0.20	0.49	*< 0.3*	285	0.0081	0.0020	0.0093	0.022	*< 0.000007*	*< 0.000007*	0.036	0.000018	71	0.00021	0.00037
24-Sep-14	6	11	400	255	8.2	671	#N/A	5.8	163	183	0.20	0.44	*< 0.3*	205	0.0017	0.0022	0.0092	0.026	*< 0.000007*	*< 0.000007*	0.036	0.0000060	43	0.00026	0.00045
8-Oct-14	7	13	300	225	8.1	673	#N/A	5.4	163	170	*< 1*	0.42	*< 0.3*	275	0.0059	0.0020	0.0098	0.027	*< 0.000007*	*< 0.000007*	0.036	*< 0.000003*	71	0.00021	0.00030
22-Oct-14	8	15	400	315	8.2	653	#N/A	7.7	188	142	*< 1*	0.43	*< 0.3*	217	0.0042	0.0021	0.0082	0.030	*< 0.000007*	*< 0.000007*	0.041	0.000052	45	0.00017	0.00027
5-Nov-14	9	17	400	320	-	561	#N/A	#N/A	170	119	*< 1*	0.48	*< 0.3*	166	0.0045	0.0021	0.0084	0.028	*< 0.000007*	*< 0.000007*	0.037	0.0000060	35	0.00024	0.00021
19-Nov-14	10	19	400	290	8.0	521	#N/A	7.1	154	118	*< 0.2*	0.57	*< 0.3*	153	0.0047	0.0022	0.0087	0.028	*< 0.000007*	*< 0.000007*	0.036	0.000047	31	0.00028	0.00018
3-Dec-14	11	21	400	350	8.2	481	#N/A	2.5	151	109	*< 0.2*	0.53	*< 0.3*	146	0.0056	0.0022	0.0073	0.029	*< 0.000007*	*< 0.000007*	0.032	0.000012	32	0.00032	0.00015
17-Dec-14	12	23	400	310	8.2	502	#N/A	3.0	141	99	*< 0.2*	0.66	*< 0.3*	143	0.0073	0.0023	0.0083	0.030	*< 0.000007*	*< 0.000007*	0.035	0.000012	29	0.00026	0.00013
31-Dec-14	13	25	400	300	8.3	475	#N/A	1.0	183	78	*< 1*	0.57	*< 0.3*	135	0.0076	0.0021	0.0069	0.030	*< 0.000007*	*< 0.000007*	0.030	0.000013	29	0.00023	0.00013
14-Jan-15	14	27	400	300	8.2	457	#N/A	2.9	155	81	*< 1*	0.56	*< 0.3*	146	0.0056	0.0022	0.0065	0.033	*< 0.000007*	*< 0.000007*	0.032	0.000017	32	0.00040	0.00011
28-Jan-15	15	29	400	295	8.1	461	#N/A	3.4	149	85	*< 1*	0.55	*< 0.3*	142	0.0069	0.0021	0.0069	0.030	*< 0.000007*	*< 0.000007*	0.026	0.0000070	29	0.00049	0.000089
11-Feb-15	16	31	400	270	8.2	454	#N/A	3.6	136	87	*< 1*	0.61	*< 0.3*	139	0.0070	0.0025	0.0078	0.030	*< 0.000007*	*< 0.000007*	0.032	0.000012	29	0.00045	0.000096
25-Feb-15	17	33	400	270	8.1	420	#N/A	4.2	147	65	*< 1*	0.50	*< 0.3*	144	0.0025	0.0019	0.0051	0.034	*< 0.000007*	*< 0.000007*	0.028	0.0000070	32	0.00047	0.000083
11-Mar-15	18	35	400	305	8.2	412	#N/A	3.1	149	69	*< 1*	0.57	*< 0.3*	150	0.0047	0.0019	0.0055	0.032	*< 0.000007*	*< 0.000007*	0.025	0.0000040	34	0.00050	0.000080
25-Mar-15	19	37	400	280	8.1	437	#N/A	4.8	158	67	*< 1*	0.53	*< 0.3*	177	0.0044	0.0022	0.0066	0.039	*< 0.000007*	*< 0.000007*	0.025	0.0000040	37	0.00062	0.000092
8-Apr-15	20	39	400	370	8.1	417	#N/A	5.7	164	60	*< 1*	0.51	*< 0.3*	167	0.0041	0.0025	0.0063	0.039	*< 0.000007*	*< 0.000007*	0.026	*< 0.000003*	38	0.00040	0.000087
22-Apr-15	21	41	400	260	8.1	380	#N/A	5.0	140	65	*< 1*	0.60	*< 0.3*	156	0.0054	0.0022	0.0061	0.033	*< 0.000007*	*< 0.000007*	0.027	0.000022	33	0.00051	0.000065
6-May-15	22	43	400	325	8.1	375	#N/A	4.3	140	57	*< 1*	0.61	*< 0.3*	157	0.0064	0.0022	0.0063	0.035	*< 0.000007*	*< 0.000007*	0.024	0.0000030	33	0.00044	0.000070
20-May-15	23	45	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	445	340	8.1	348	#N/A	4.4	124	47	*< 1*	0.58	*< 0.3*	146	0.0087	0.0017	0.0054	0.037	*< 0.000007*	*< 0.000007*	0.023	0.0000090	32	0.00054	0.000056
17-Jun-15	25	49	500	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	440	315	8.1	378	#N/A	5.7	124	55	*< 1*	0.55	*< 0.3*	145	0.0064	0.0018	0.0072	0.038	*< 0.000007*	*< 0.000007*	0.021	0.0000090	31	0.00063	0.000064
15-Jul-15	27	53	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	420	325	8.1	346	#N/A	3.6	121	56	*< 1*	0.56	*< 0.3*	146	0.0054	0.0017	0.0057	0.035	*< 0.000007*	*< 0.000007*	0.020	0.0000050	31	0.00061	0.000039
12-Aug-15	29	57	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	450	335	8.2	350	#N/A	2.2	120	60	*< 1*	0.53	*< 0.3*	147	0.0080	0.0017	0.0060	0.038	*< 0.000007*	*< 0.000007*	0.018	0.000010	32	0.00062	0.000055
9-Sep-15	31	61	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	445	395	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	395	305	8.1	378	#N/A	3.3	130	63		0.50		149	0.0073	0.0017	0.0058	0.035	*< 0.000007*	*< 0.000007*	0.015	0.0000040	32	0.00057	0.000037
21-Oct-15	34	67	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	450	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	440	350	8.3	368	#N/A	#N/A	139	64		0.48		158	0.0051	0.0014	0.0054	0.036	*< 0.000007*	*< 0.000007*	0.010	0.0000040	33	0.00061	0.000032
2-Dec-15	37	73	500	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	460	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	430	425	8.3	365	#N/A	#N/A	112	53	-	0.47	-	151	0.0051	0.0014	0.0049	0.036	*< 0.000007*	*< 0.000007*	0.013	*< 0.000003*	33	0.00059	0.000019
6-Jan-16	40	78	400	330	8.3	366	#N/A	1.1	114	60	-	0.42	-	168	0.0054	0.0016	0.0055	0.042	*< 0.000007*	*< 0.000007*	0.014	0.000056	36	0.00064	0.000025
20-Jan-16	41	80	400	310	8.2	366	#N/A	2.0	109	65	-	0.44	-	169	0.0045	0.0016	0.0064	0.042	*< 0.000007*	*< 0.000007*	0.012	0.000010	36	0.00073	0.000053
3-Feb-16	42	82	400	340	8.2	336	#N/A	2.1	111	52	-	0.44	-	146	0.0042	0.0016	0.0059	0.038	*< 0.000007*	*< 0.000007*	0.011	0.0000030	32	0.00066	0.000035
17-Feb-16	43	84	400	330	8.2	335	#N/A	3.8	119	42	-	0.50	-	155	0.0019	0.0016	0.0057	0.040	*< 0.000007*	*< 0.000007*	0.010	*< 0.000003*	34	0.00079	0.000034
2-Mar-16	44	86	400	360	8.3	318	#N/A	1.3	116	41	-	0.49	-	142	0.0027	0.0017	0.0072	0.038	*< 0.000007*	*< 0.000007*	0.010	0.0000080	30	0.00084	0.000066

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 4 (ST)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1300	315	7.8	0.056	0.017	0.00010	0.037	200	0.14	0.040	0.018	0.054	0.040	37	0.039	5.5	0.000035	187	7.1	632	0.000053	0.00036	0.00060	0.18	0.0045	0.016	< 0.002
30-Jul-14	2	3	400	335	8.0	0.0093	1.0	0.000020	0.020	68	0.084	< 0.01	0.019	0.023	0.012	22	0.011	5.2	< 0.000002	95	3.9	263	0.000038	< 0.00001	0.00051	0.074	0.00051	0.0030	< 0.002
13-Aug-14	3	5	400	340	8.0	0.0054	< 0.002	0.000010	0.019	46	0.046	< 0.01	0.023	0.013	< 0.009	18	0.0052	5.2	< 0.000002	46	3.6	164	0.000024	< 0.00001	0.00023	0.063	0.00013	0.0020	< 0.002
27-Aug-14	4	7	400	340	8.1	0.0032	< 0.002	0.000010	0.015	34	0.028	< 0.01	0.029	0.0067	< 0.009	17	0.0023	5.3	< 0.000002	50	3.3	115	0.000025	0.00021	0.000070	0.054	0.00027	< 0.001	< 0.002
10-Sep-14	5	9	400	355	8.1	0.0030	< 0.007	0.000020	0.014	26	0.017	< 0.01	0.034	0.0037	< 0.003	14	0.0014	6.0	< 0.000002	57	3.9	93	0.000018	0.00016	0.000080	0.048	0.00031	< 0.001	< 0.002
24-Sep-14	6	11	400	255	8.2	0.0029	< 0.002	0.000070	0.014	24	0.018	< 0.01	0.030	0.0039	< 0.009	14	0.00086	5.1	0.000016	47	3.1	60	0.000019	0.000040	0.00041	0.047	0.00029	0.0020	< 0.002
8-Oct-14	7	13	300	225	8.1	0.0025	< 0.007	0.000020	0.017	24	0.016	< 0.01	0.027	0.0032	< 0.003	14	0.00098	5.5	< 0.000002	52	4.3	59	0.000021	0.000040	0.00011	0.051	0.00029	< 0.001	< 0.002
22-Oct-14	8	15	400	315	8.2	0.0021	< 0.007	0.00059	0.015	25	0.018	< 0.01	0.027	0.0029	< 0.003	15	0.00084	6.1	< 0.000002	51	4.2	55	0.000020	0.000020	0.00014	0.055	0.00030	0.0010	< 0.002
5-Nov-14	9	17	400	320	-	0.0019	< 0.007	0.000050	0.013	20	0.011	< 0.01	0.030	0.0023	< 0.003	12	0.00070	5.3	< 0.000002	44	3.5	42	0.000020	0.0098	0.00012	0.047	0.00028	< 0.001	< 0.002
19-Nov-14	10	19	400	290	8.0	0.0018	< 0.007	0.00020	0.014	19	0.0064	< 0.01	0.038	0.0022	0.0050	11	0.00059	5.5	< 0.000002	44	3.5	40	0.000042	0.0018	0.000090	0.048	0.00033	< 0.001	< 0.002
3-Dec-14	11	21	400	350	8.2	0.0025	< 0.007	0.000040	0.011	16	0.0062	< 0.01	0.034	0.0020	< 0.003	11	0.00056	5.0	< 0.000002	39	3.4	36	0.000018	0.00098	0.000060	0.043	0.00034	0.0010	< 0.002
17-Dec-14	12	23	400	310	8.2	0.0019	< 0.007	< 0.00001	0.013	17	0.0019	< 0.01	0.038	0.0018	< 0.003	13	0.00055	5.1	< 0.000002	40	3.6	37	0.000013	0.00058	0.00014	0.046	0.00046	< 0.001	< 0.002
31-Dec-14	13	25	400	300	8.3	0.0014	< 0.007	0.000050	0.011	15	0.0037	< 0.01	0.032	0.0016	< 0.003	11	0.00055	5.2	0.0000020	33	3.4	29	0.000020	0.00048	0.00015	0.039	0.00040	< 0.001	< 0.002
14-Jan-15	14	27	400	300	8.2	0.0014	< 0.007	0.000020	0.011	17	0.0042	< 0.01	0.030	0.0017	< 0.003	11	0.00064	5.4	0.0000030	32	3.6	27	0.000014	0.00040	0.000080	0.040	0.00035	< 0.001	< 0.002
28-Jan-15	15	29	400	295	8.1	0.0013	< 0.007	0.000020	0.0097	17	0.0030	< 0.01	0.031	0.0013	< 0.003	12	0.00060	4.8	0.0000020	32	2.9	27	0.000014	0.00040	0.000080	0.045	0.00037	0.0010	< 0.002
11-Feb-15	16	31	400	270	8.2	0.0020	< 0.007	0.00018	0.011	16	0.0022	< 0.01	0.031	0.0015	< 0.003	12	< 0.001	4.9	0.0000020	27	3.7	30	0.000021	0.00055	0.000070	0.041	0.00039	0.0020	< 0.002
25-Feb-15	17	33	400	270	8.1	0.0016	< 0.007	0.000010	0.011	15	0.0021	< 0.01	0.024	0.0014	< 0.003	12	< 0.001	4.9	< 0.000002	21	3.7	22	0.000012	0.00038	< 0.00005	0.042	0.00031	< 0.001	< 0.002
11-Mar-15	18	35	400	305	8.2	0.0016	< 0.007	0.000040	0.012	16	0.0022	< 0.01	0.024	0.0014	< 0.003	11	< 0.001	4.5	0.0000040	16	3.8	23	< 0.000005	0.0058	0.00010	0.039	0.00032	0.0010	< 0.002
25-Mar-15	19	37	400	280	8.1	0.0016	< 0.007	< 0.00001	0.011	20	0.0029	< 0.01	0.027	0.0019	< 0.003	13	< 0.001	5.9	0.0000020	16	4.5	23	< 0.000005	0.00069	0.000090	0.041	0.00040	< 0.001	< 0.002
8-Apr-15	20	39	400	370	8.1	0.0013	< 0.007	< 0.00001	0.012	18	0.0025	< 0.01	0.020	0.0015	< 0.003	13	< 0.001	5.8	< 0.000002	9.3	4.7	20	< 0.000005	0.00039	< 0.00005	0.041	0.00031	< 0.001	< 0.002
22-Apr-15	21	41	400	260	8.1	0.0016	< 0.007	0.00020	0.011	18	0.0013	< 0.01	0.026	0.0013	< 0.003	13	0.00046	5.3	0.0000070	8.1	4.4	21	0.0000090	0.0047	0.00010	0.041	0.00042	0.0020	< 0.002
6-May-15	22	43	400	325	8.1	0.0017	< 0.007	0.000030	0.011	18	0.0013	< 0.01	0.026	0.0013	< 0.003	14	< 0.001	5.4	0.0000080	6.3	4.3	23	< 0.000005	0.00052	0.000090	0.038	0.00035	0.0010	< 0.002
20-May-15	23	45	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	445	340	8.1	0.00097	0.013	0.00012	0.0099	16	0.00086	< 0.01	0.023	0.0011	< 0.003	12	0.00035	5.1	0.0000080	3.4	4.2	18	< 0.000005	0.00067	0.000060	0.035	0.00038	0.0070	< 0.002
17-Jun-15	25	49	500	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	440	315	8.1	0.0017	< 0.007	< 0.00001	0.0100	17	0.0011	0.010	0.022	0.0011	< 0.003	12	0.00045	5.2	0.0000050	2.5	4.3	18	0.000011	0.00034	0.00017	0.036	0.00041	0.0030	< 0.002
15-Jul-15	27	53	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	420	325	8.1	0.00078	< 0.007	0.000060	0.011	16	0.00050	< 0.01	0.018	0.0010	< 0.003	11	0.00030	4.7	0.0000030	1.9	4.4	19	< 0.000005	0.00014	< 0.00005	0.036	0.00035	0.0010	< 0.002
12-Aug-15	29	57	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	450	335	8.2	0.0015	< 0.007	0.000080	0.0098	16	0.00094	0.010	0.022	0.00090	< 0.003	12	0.00036	5.0	0.000065	1.7	4.4	19	0.000012	0.00017	< 0.00005	0.036	0.00040	0.0010	< 0.002
9-Sep-15	31	61	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	445	395	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	395	305	8.1	0.0013	< 0.007	0.000060	0.0092	17	0.00034	0.030	0.013	0.0010	< 0.003	11	0.00038	4.4	< 0.000002	1.4	4.3	20	0.0000070	0.00085	< 0.00005	0.036	0.00030	0.0010	< 0.002
21-Oct-15	34	67	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	450	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	440	350	8.3	0.0011	< 0.007	0.000030	0.0090	18	0.00040	< 0.01	0.014	0.00080	< 0.003	13	0.00053	4.7	< 0.000002	1.4	4.6	23	0.000020	0.00012	< 0.00005	0.035	0.00030	< 0.001	< 0.002
2-Dec-15	37	73	500	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	460	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	430	425	8.3	0.0010	< 0.007	0.00033	0.0086	17	0.00021	< 0.01	0.013	0.00080	< 0.003	12	0.00033	4.5	< 0.000002	1.3	3.6	20	< 0.000005	0.00012	< 0.00005	0.036	0.00029	< 0.001	< 0.002
6-Jan-16	40	78	400	330	8.3	0.0020	< 0.007	0.00028	0.0097	19	0.00048	< 0.01	0.012	0.00090	< 0.003	13	0.0018	4.9	< 0.000002	1.5	4.4	23	< 0.000005	0.00037	< 0.00005	0.035	0.00030	< 0.001	< 0.002
20-Jan-16	41	80	400	310	8.2	0.0011	< 0.007	0.00012	0.010	19	0.0018	< 0.01	0.014	0.0010	< 0.003	13	0.00056	5.1	< 0.000002	1.5	5.1	23	0.000027	0.00013	< 0.00005	0.039	0.00034	0.0020	< 0.002
3-Feb-16	42	82	400	340	8.2	0.0012	< 0.007	0.000090	0.0097	16	0.00010	< 0.01	0.015	0.00090	< 0.003	12	0.00052	4.6	0.000015	1.4	4.6	19	0.0000080	0.00012	< 0.00005	0.034	0.00032	< 0.001	< 0.002
17-Feb-16	43	84	400	330	8.2	0.00079	< 0.007	0.000010	0.0091	17	0.00032	< 0.01	0.016	0.00090	< 0.003	13	0.00020	4.8	< 0.000002	1.5	4.3	16	0.000010	0.000050	< 0.00005	0.033	0.00029	< 0.001	< 0.002
2-Mar-16	44	86	400	360	8.3	0.00068	< 0.007	0.000040	0.0094	17	0.0015	< 0.01	0.016	0.00090	< 0.003	12	0.00018	4.8	< 0.000002	1.5	4.3	14	0.000013	0.000090	< 0.00005	0.031	0.00033	0.0020	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 4 (ST)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1300	315	7.8	3419	#N/A	0.30	4.4	54	0.76	0.0085	0.013	54	0.0019	0.00010	0.00067	0.0022	0.00000022	0.00000022	0.0012	0.00000057	11	0.000053	0.00027
30-Jul-14	2	3	400	335	8.0	1594	#N/A	0.073	1.9	12	0.050	0.0057	0.0050	10	0.000095	0.000044	0.00024	0.00035	0.00000012	0.00000012	0.00054	0.000000050	2.3	0.0000049	0.000028
13-Aug-14	3	5	400	340	8.0	1176	#N/A	0.088	1.9	7.4	0.020	0.0065	0.0051	6.9	0.000037	0.000043	0.00018	0.00038	0.00000012	0.00000012	0.00062	0.00000012	1.5	0.0000037	0.000015
27-Aug-14	4	7	400	340	8.1	882	#N/A	0.12	2.1	5.7	0.010	0.0070	0.0051	5.2	0.000063	0.000039	0.00015	0.00032	0.00000012	0.00000012	0.00068	0.00000010	1.1	0.0000026	0.0000090
10-Sep-14	5	9	400	355	8.1	756	#N/A	0.12	2.2	4.2	0.0036	0.0087	0.0053	5.1	0.00014	0.000036	0.00017	0.00039	0.00000012	0.00000012	0.00064	0.00000032	1.3	0.0000037	0.0000066
24-Sep-14	6	11	400	255	8.2	671	#N/A	0.074	2.1	2.3	0.0026	0.0056	0.0038	2.6	0.000022	0.000028	0.00012	0.00033	0.000000089	0.000000089	0.00046	0.000000077	0.55	0.0000033	0.0000057
8-Oct-14	7	13	300	225	8.1	673	#N/A	0.061	1.8	1.9	0.011	0.0047	0.0034	3.1	0.000066	0.000023	0.00011	0.00031	0.000000079	0.000000079	0.00041	0.000000034	0.80	0.0000024	0.0000033
22-Oct-14	8	15	400	315	8.2	653	#N/A	0.12	3.0	2.2	0.016	0.0068	0.0047	3.4	0.000066	0.000033	0.00013	0.00048	0.00000011	0.00000011	0.00064	0.00000082	0.71	0.0000027	0.0000042
5-Nov-14	9	17	400	320		561	#N/A	#N/A	2.7	1.9	0.016	0.0077	0.0048	2.7	0.000072	0.000034	0.00013	0.00044	0.00000011	0.00000011	0.00060	0.000000096	0.55	0.0000038	0.0000034
19-Nov-14	10	19	400	290	8.0	521	#N/A	0.10	2.2	1.7	0.0029	0.0083	0.0044	2.2	0.000068	0.000032	0.00013	0.00040	0.00000010	0.00000010	0.00052	0.00000068	0.45	0.0000041	0.0000026
3-Dec-14	11	21	400	350	8.2	481	#N/A	0.044	2.6	1.9	0.0035	0.0093	0.0053	2.6	0.000098	0.000039	0.00013	0.00050	0.00000012	0.00000012	0.00055	0.00000021	0.55	0.0000056	0.0000026
17-Dec-14	12	23	400	310	8.2	502	#N/A	0.047	2.2	1.5	0.0031	0.010	0.0047	2.2	0.00011	0.000036	0.00013	0.00047	0.00000011	0.00000011	0.00053	0.00000019	0.45	0.0000040	0.0000020
31-Dec-14	13	25	400	300	8.3	475	#N/A	0.015	2.7	1.2	0.015	0.0086	0.0045	2.0	0.00011	0.000032	0.00010	0.00045	0.00000011	0.00000011	0.00045	0.00000020	0.44	0.0000035	0.0000020
14-Jan-15	14	27	400	300	8.2	457	#N/A	0.044	2.3	1.2	0.015	0.0084	0.0045	2.2	0.000084	0.000033	0.000098	0.00049	0.00000011	0.00000011	0.00049	0.00000026	0.47	0.0000060	0.0000017
28-Jan-15	15	29	400	295	8.1	461	#N/A	0.051	2.2	1.3	0.015	0.0081	0.0044	2.1	0.00010	0.000031	0.00010	0.00045	0.00000010	0.00000010	0.00039	0.00000010	0.42	0.0000072	0.0000013
11-Feb-15	16	31	400	270	8.2	454	#N/A	0.049	1.8	1.2	0.014	0.0082	0.0041	1.9	0.000095	0.000034	0.00011	0.00041	0.000000095	0.000000095	0.00043	0.00000016	0.39	0.0000061	0.0000013
25-Feb-15	17	33	400	270	8.1	420	#N/A	0.056	2.0	0.88	0.014	0.0068	0.0041	1.9	0.000034	0.000026	0.000069	0.00046	0.000000095	0.000000095	0.00038	0.000000095	0.43	0.0000063	0.0000011
11-Mar-15	18	35	400	305	8.2	412	#N/A	0.047	2.3	1.1	0.015	0.0087	0.0046	2.3	0.000072	0.000029	0.000084	0.00049	0.00000011	0.00000011	0.00038	0.000000061	0.52	0.0000076	0.0000012
25-Mar-15	19	37	400	280	8.1	437	#N/A	0.067	2.2	0.94	0.014	0.0074	0.0042	2.5	0.000062	0.000031	0.000092	0.00055	0.000000098	0.000000098	0.00034	0.000000056	0.52	0.0000087	0.0000013
8-Apr-15	20	39	400	370	8.1	417	#N/A	0.10	3.0	1.1	0.019	0.0094	0.0056	3.1	0.000076	0.000046	0.00012	0.00071	0.00000013	0.00000013	0.00047	0.000000056	0.70	0.0000074	0.0000016
22-Apr-15	21	41	400	260	8.1	380	#N/A	0.065	1.8	0.85	0.013	0.0078	0.0039	2.0	0.000070	0.000029	0.000079	0.00043	0.000000091	0.000000091	0.00036	0.00000029	0.43	0.0000066	0.00000085
6-May-15	22	43	400	325	8.1	375	#N/A	0.070	2.3	0.93	0.016	0.0099	0.0049	2.6	0.00010	0.000036	0.00010	0.00057	0.00000011	0.00000011	0.00039	0.000000049	0.54	0.0000072	0.0000011
20-May-15	23	45	500	445																					
3-Jun-15	24	47	445	340	8.1	348	#N/A	0.037	1.1	0.40	0.0085	0.0049	0.0026	1.2	0.000074	0.000014	0.000046	0.00032	0.000000060	0.000000060	0.00019	0.000000077	0.28	0.0000046	0.00000048
17-Jun-15	25	49	500	440																					
1-Jul-15	26	51	440	315	8.1	378	#N/A	0.045	0.98	0.43	0.0079	0.0043	0.0024	1.1	0.000050	0.000014	0.000057	0.00030	0.000000055	0.000000055	0.00016	0.000000071	0.24	0.0000050	0.00000050
15-Jul-15	27	53	500	420																					
29-Jul-15	28	55	420	325	8.1	346	#N/A	0.029	0.98	0.46	0.0081	0.0046	0.0024	1.2	0.000044	0.000014	0.000046	0.00029	0.000000057	0.000000057	0.00016	0.000000041	0.26	0.0000050	0.00000032
12-Aug-15	29	57	500	450																					
26-Aug-15	30	59	450	335	8.2	350	#N/A	0.019	1.0	0.50	0.0084	0.0044	0.0025	1.2	0.000067	0.000014	0.000050	0.00032	0.000000059	0.000000059	0.00015	0.000000084	0.27	0.0000052	0.00000046
9-Sep-15	31	61	500	445																					
23-Sep-15	32	63	445	395																					
7-Oct-15	33	65	395	305	8.1	378	#N/A	0.017	0.66	0.32		0.0025		0.76	0.000037	0.0000086	0.000029	0.00018	0.000000036	0.000000036	0.000077	0.000000020	0.16	0.0000029	0.00000019
21-Oct-15	34	67	500	450																					
4-Nov-15	35	69	450	440																					
18-Nov-15	36	71	440	350	8.3	368	#N/A	#N/A	0.81	0.37		0.0028		0.92	0.000030	0.0000082	0.000032	0.00021	0.000000041	0.000000041	0.000060	0.000000023	0.19	0.0000036	0.00000019
2-Dec-15	37	73	500	460																					
16-Dec-15	38	75	460	430																					
30-Dec-15	39	77	430	425	8.3	365	#N/A	#N/A	0.79	0.38		0.0033		1.1	0.000036	0.0000099	0.000035	0.00026	0.000000050	0.000000050	0.000089	0.000000021	0.23	0.0000042	0.00000013
6-Jan-16	40	78	400	330	8.3	366	#N/A	0.018	1.9	0.99		0.0069		2.8	0.000089	0.000026	0.000091	0.00069	0.00000012	0.00000012	0.00023	0.00000092	0.59	0.000011	0.00000041
20-Jan-16	41	80	400	310	8.2	366	#N/A	0.030	1.7	1.0		0.0068		2.6	0.000070	0.000025	0.000099	0.00065	0.00000011	0.00000011	0.00019	0.00000016	0.56	0.000011	0.00000082
3-Feb-16	42	82	400	340	8.2	336	#N/A	0.036	1.9	0.88		0.0075		2.5	0.000071	0.000027	0.00010	0.00065	0.00000012	0.00000012	0.00019	0.000000051	0.54	0.000011	0.00000060
17-Feb-16	43	84	400	330	8.2	335	#N/A	0.063	2.0	0.69		0.0083		2.6	0.000031	0.000026	0.000094	0.00065	0.00000012	0.00000012	0.00017	0.000000050	0.56	0.000013	0.00000056
2-Mar-16	44	86	400	360	8.3	318	#N/A	0.024	2.1	0.74		0.0088		2.6	0.000049	0.000031	0.00013	0.00069	0.00000013	0.00000013	0.00018	0.00000014	0.53	0.000015	0.0000012

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 4 (ST)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1300	315	7.8	0.0017	0.00054	0.0000032	0.0012	6.3	0.0043	0.0013	0.00056	0.0017	0.0013	1.2	0.0012	0.17	0.0000011	5.9	0.22	20	0.0000017	0.000011	0.000019	0.0057	0.00014	0.00050	0.000063
30-Jul-14	2	3	400	335	8.0	0.00016	0.017	0.00000034	0.00034	1.1	0.0014	0.00017	0.00032	0.00039	0.00020	0.37	0.00018	0.088	0.000000034	1.6	0.065	4.4	0.00000064	0.00000017	0.0000085	0.0012	0.0000085	0.000050	0.000034
13-Aug-14	3	5	400	340	8.0	0.000092	0.000034	0.00000017	0.00032	0.78	0.00078	0.00017	0.00038	0.00022	0.00015	0.31	0.000088	0.088	0.000000034	0.78	0.062	2.8	0.00000041	0.00000017	0.0000039	0.0011	0.0000022	0.000034	0.000034
27-Aug-14	4	7	400	340	8.1	0.000055	0.000034	0.00000017	0.00026	0.58	0.00048	0.00017	0.00049	0.00011	0.00015	0.29	0.000038	0.089	0.000000034	0.86	0.055	2.0	0.00000043	0.0000036	0.0000012	0.00092	0.0000046	0.000017	0.000034
10-Sep-14	5	9	400	355	8.1	0.000053	0.00012	0.00000036	0.00024	0.46	0.00031	0.00018	0.00060	0.000066	0.000053	0.24	0.000025	0.11	0.000000036	1.0	0.069	1.7	0.00000032	0.0000028	0.0000014	0.00084	0.0000055	0.000018	0.000036
24-Sep-14	6	11	400	255	8.2	0.000037	0.000026	0.00000089	0.00018	0.30	0.00023	0.00013	0.00038	0.000050	0.00011	0.18	0.000011	0.065	0.00000020	0.60	0.040	0.77	0.00000024	0.00000051	0.0000052	0.00060	0.0000037	0.000026	0.000026
8-Oct-14	7	13	300	225	8.1	0.000028	0.000079	0.00000023	0.00019	0.27	0.00018	0.00011	0.00030	0.000036	0.000034	0.15	0.000011	0.062	0.000000023	0.58	0.048	0.67	0.00000024	0.00000045	0.0000012	0.00057	0.0000033	0.000011	0.000023
22-Oct-14	8	15	400	315	8.2	0.000032	0.00011	0.0000093	0.00023	0.40	0.00028	0.00016	0.00043	0.000046	0.000047	0.23	0.000013	0.096	0.000000032	0.81	0.067	0.86	0.00000032	0.00000032	0.0000022	0.00086	0.0000047	0.000016	0.000032
5-Nov-14	9	17	400	320		0.000031	0.00011	0.00000080	0.00021	0.31	0.00018	0.00016	0.00049	0.000037	0.000048	0.18	0.000011	0.085	0.000000032	0.70	0.056	0.66	0.00000032	0.00016	0.0000019	0.00075	0.0000045	0.000016	0.000032
19-Nov-14	10	19	400	290	8.0	0.000027	0.00010	0.0000029	0.00020	0.27	0.000093	0.00015	0.00055	0.000032	0.000073	0.17	0.0000086	0.079	0.000000029	0.64	0.051	0.58	0.00000061	0.000025	0.0000013	0.00070	0.0000048	0.000015	0.000029
3-Dec-14	11	21	400	350	8.2	0.000043	0.00012	0.00000070	0.00020	0.29	0.00011	0.00018	0.00059	0.000035	0.000053	0.19	0.0000098	0.087	0.000000035	0.68	0.060	0.62	0.00000032	0.000017	0.0000011	0.00075	0.0000060	0.000018	0.000035
17-Dec-14	12	23	400	310	8.2	0.000029	0.00011	0.00000016	0.00020	0.26	0.000030	0.00016	0.00059	0.000028	0.000047	0.19	0.0000085	0.080	0.000000031	0.63	0.056	0.58	0.00000020	0.0000090	0.0000022	0.00071	0.0000071	0.000016	0.000031
31-Dec-14	13	25	400	300	8.3	0.000021	0.00011	0.00000075	0.00016	0.23	0.000056	0.00015	0.00048	0.000024	0.000045	0.16	0.0000083	0.078	0.000000030	0.50	0.051	0.43	0.00000030	0.0000072	0.0000023	0.00059	0.0000060	0.000015	0.000030
14-Jan-15	14	27	400	300	8.2	0.000021	0.00011	0.00000030	0.00017	0.25	0.000063	0.00015	0.00045	0.000026	0.000045	0.17	0.0000096	0.081	0.000000045	0.49	0.054	0.40	0.00000021	0.0000060	0.0000012	0.00061	0.0000053	0.000015	0.000030
28-Jan-15	15	29	400	295	8.1	0.000020	0.00010	0.00000030	0.00014	0.25	0.000044	0.00015	0.00046	0.000019	0.000044	0.17	0.0000089	0.070	0.000000030	0.48	0.042	0.40	0.00000021	0.0000059	0.0000012	0.00066	0.0000055	0.000015	0.000030
11-Feb-15	16	31	400	270	8.2	0.000027	0.000095	0.0000024	0.00015	0.22	0.000029	0.00014	0.00041	0.000020	0.000041	0.16	0.000014	0.066	0.000000027	0.36	0.050	0.40	0.00000028	0.0000074	0.00000095	0.00055	0.0000053	0.000027	0.000027
25-Feb-15	17	33	400	270	8.1	0.000022	0.000095	0.00000014	0.00015	0.21	0.000028	0.00014	0.00032	0.000019	0.000041	0.16	0.000014	0.066	0.000000027	0.28	0.049	0.29	0.00000016	0.0000051	0.00000068	0.00056	0.0000042	0.000014	0.000027
11-Mar-15	18	35	400	305	8.2	0.000025	0.00011	0.00000061	0.00018	0.24	0.000033	0.00015	0.00036	0.000021	0.000046	0.17	0.000015	0.068	0.000000061	0.24	0.058	0.35	0.000000076	0.000089	0.0000015	0.00060	0.0000049	0.000015	0.000031
25-Mar-15	19	37	400	280	8.1	0.000023	0.000098	0.00000014	0.00016	0.29	0.000041	0.00014	0.00038	0.000027	0.000042	0.18	0.000014	0.083	0.000000028	0.22	0.062	0.32	0.000000070	0.0000097	0.0000013	0.00057	0.0000056	0.000014	0.000028
8-Apr-15	20	39	400	370	8.1	0.000025	0.00013	0.00000019	0.00022	0.33	0.000046	0.00019	0.00037	0.000028	0.000056	0.23	0.000019	0.11	0.000000037	0.17	0.088	0.37	0.000000093	0.0000072	0.00000093	0.00075	0.0000057	0.000019	0.000037
22-Apr-15	21	41	400	260	8.1	0.000021	0.000091	0.0000026	0.00015	0.23	0.000016	0.00013	0.00034	0.000017	0.000039	0.17	0.0000060	0.068	0.000000091	0.11	0.057	0.27	0.00000012	0.000061	0.0000013	0.00053	0.0000055	0.000026	0.000026
6-May-15	22	43	400	325	8.1	0.000027	0.00011	0.00000049	0.00018	0.29	0.000021	0.00016	0.00043	0.000021	0.000049	0.22	0.000016	0.088	0.00000013	0.10	0.069	0.37	0.000000081	0.0000085	0.0000015	0.00061	0.0000057	0.000016	0.000033
20-May-15	23	45	500	445																									
3-Jun-15	24	47	445	340	8.1	0.0000082	0.00011	0.0000010	0.000084	0.13	0.0000073	0.000085	0.00019	0.0000094	0.000026	0.11	0.0000030	0.043	0.000000068	0.029	0.036	0.15	0.000000043	0.0000057	0.00000051	0.00030	0.0000032	0.000060	0.000017
17-Jun-15	25	49	500	440																									
1-Jul-15	26	51	440	315	8.1	0.000013	0.000055	0.000000079	0.000078	0.13	0.0000084	0.000079	0.00017	0.0000087	0.000024	0.091	0.0000035	0.041	0.000000039	0.020	0.034	0.14	0.000000087	0.0000027	0.0000013	0.00029	0.0000032	0.000024	0.000016
15-Jul-15	27	53	500	420																									
29-Jul-15	28	55	420	325	8.1	0.0000063	0.000057	0.00000049	0.000088	0.13	0.0000041	0.000081	0.00015	0.0000081	0.000024	0.093	0.0000024	0.038	0.000000024	0.016	0.036	0.16	0.000000041	0.0000011	0.00000041	0.00029	0.0000028	0.0000081	0.000016
12-Aug-15	29	57	500	450																									
26-Aug-15	30	59	450	335	8.2	0.000013	0.000059	0.00000067	0.000082	0.14	0.0000079	0.000084	0.00018	0.0000075	0.000025	0.100	0.0000030	0.042	0.00000054	0.014	0.037	0.16	0.00000010	0.0000014	0.00000042	0.00030	0.0000034	0.0000084	0.000017
9-Sep-15	31	61	500	445																									
23-Sep-15	32	63	445	395																									
7-Oct-15	33	65	395	305	8.1	0.0000065	0.000036	0.00000031	0.000047	0.084	0.0000017	0.00015	0.000067	0.0000051	0.000015	0.057	0.0000019	0.023	0.000000010	0.0069	0.022	0.10	0.000000036	0.0000043	0.00000025	0.00018	0.0000015	0.0000051	0.000010
21-Oct-15	34	67	500	450																									
4-Nov-15	35	69	450	440																									
18-Nov-15	36	71	440	350	8.3	0.0000066	0.000041	0.00000018	0.000053	0.11	0.0000023	0.000058	0.000083	0.0000047	0.000018	0.077	0.0000031	0.027	0.000000012	0.0081	0.027	0.13	0.00000012	0.00000070	0.00000029	0.00020	0.0000018	0.0000058	0.000012
2-Dec-15	37	73	500	460																									
16-Dec-15	38	75	460	430																									
30-Dec-15	39	77	430	425	8.3	0.0000071	0.000050	0.0000023	0.000061	0.12	0.0000015	0.000071	0.000092	0.0000057	0.000021	0.084	0.0000023	0.032	0.000000014	0.0094	0.026	0.14	0.000000035	0.00000085	0.00000035	0.00025	0.0000021	0.0000071	0.000014
6-Jan-16	40	78	400	330	8.3	0.000033	0.00012	0.0000046	0.00016	0.31	0.0000079	0.00017	0.00020	0.000015	0.000050	0.22	0.000030	0.081	0.000000033	0.025	0.073	0.38	0.000000083	0.0000061	0.00000083	0.00057	0.0000050	0.000017	0.000033
20-Jan-16	41	80	400	310	8.2	0.000017	0.00011	0.0000019	0.00016	0.29	0.000028	0.00016	0.00022	0.000016	0.000047	0.21	0.0000087	0.079	0.000000031	0.023	0.079	0.35	0.00000042	0.0000020	0.00000078	0.00060	0.0000053	0.000031	0.000031
3-Feb-16	42	82	400	340	8.2	0.000020	0.00012	0.0000015	0.00017	0.28	0.0000017	0.00017	0.00025	0.000015	0.000051	0.21	0.0000088	0.078	0.00000026	0.023	0.079	0.32	0.00000014	0.0000020	0.00000085	0.00058	0.0000054	0.000017	0.000034
17-Feb-16	43	84	400	330	8.2	0.000013	0.00012	0.00000017	0.00015	0.28	0.0000053	0.00017	0.00026	0.000015	0.000050	0.21	0.0000033	0.079	0.000000033	0.024	0.071	0.26	0.00000017	0.00000083	0.00000083	0.00055	0.0000048	0.000017	0.000033
2-Mar-16	44	86	400	360	8.3	0.000012	0.00013	0.00000072	0.00017	0.30	0.000027	0.00018	0.00029	0.000016	0.000054	0.22	0.0000032	0.087	0.000000036	0.026	0.078	0.26	0.00000023	0.0000016	0.00000090	0.00056	0.0000059	0.000036	0.000036

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 5 (GO)

Date	Cycle	Weeks	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
	No.		Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1500	280	8.2	1228	#N/A	2.7	218	145	58	0.31	0.90	219	0.045	0.0049	0.045	0.073	0.000012	*< 0.000007*	0.059	*< 0.000003*	55	0.0028	0.0040
30-Jul-14	2	3	400	290	8.3	667	#N/A	#N/A	264	68	6.6	0.37	*< 0.3*	89	0.0061	0.0047	0.038	0.016	*< 0.000007*	*< 0.000007*	0.052	*< 0.000003*	22	0.0012	0.00060
13-Aug-14	3	5	400	305	8.3	525	#N/A	#N/A	226	32	1.6	0.42	*< 0.3*	69	0.0046	0.0040	0.032	0.031	*< 0.000007*	*< 0.000007*	0.055	*< 0.000003*	17	0.00058	0.00042
27-Aug-14	4	7	400	305	8.3	465	#N/A	#N/A	219	27	0.70	0.44	*< 0.3*	66	0.0078	0.0036	0.031	0.029	*< 0.000007*	*< 0.000007*	0.061	0.000012	16	0.00060	0.00028
10-Sep-14	5	9	400	265	8.3	445	#N/A	#N/A	213	17	0.40	0.46	*< 0.3*	61	0.0079	0.0034	0.033	0.032	*< 0.000007*	*< 0.000007*	0.052	0.000020	15	0.00057	0.00022
24-Sep-14	6	11	400	240	8.3	455	#N/A	4.1	232	17	0.30	0.39	*< 0.3*	72	0.0024	0.0035	0.025	0.040	*< 0.000007*	*< 0.000007*	0.052	*< 0.000003*	18	0.00064	0.00027
8-Oct-14	7	13	300	225	8.3	477	#N/A	4.1	212	12	*< 1*	0.35	*< 0.3*	84	0.0060	0.0031	0.021	0.048	*< 0.000007*	*< 0.000007*	0.054	0.0000040	21	0.00047	0.00017
22-Oct-14	8	15	400	290	8.3	492	#N/A	5.2	245	13	*< 1*	0.33	*< 0.3*	92	0.0067	0.0030	0.020	0.055	*< 0.000007*	*< 0.000007*	0.061	0.000023	23	0.00046	0.00015
5-Nov-14	9	17	400	275		463	#N/A	#N/A	245	10	*< 1*	0.35	*< 0.3*	89	0.0044	0.0030	0.019	0.056	*< 0.000007*	*< 0.000007*	0.060	0.0000050	22	0.00044	0.00014
19-Nov-14	10	19	400	275	8.3	437	#N/A	#N/A	202	11	*< 0.2*	0.35	*< 0.3*	93	0.0040	0.0029	0.018	0.060	*< 0.000007*	*< 0.000007*	0.057	0.000026	23	0.00041	0.00012
3-Dec-14	11	21	400	345	8.3	401	#N/A	#N/A	210	9.0	*< 0.2*	0.32	*< 0.3*	96	0.0038	0.0029	0.016	0.062	*< 0.000007*	*< 0.000007*	0.049	0.0000090	25	0.00039	0.00011
17-Dec-14	12	23	400	285	8.3	394	#N/A	2.7	193	8.0	*< 0.2*	0.34	*< 0.3*	96	0.0044	0.0028	0.016	0.065	*< 0.000007*	*< 0.000007*	0.046	0.0000030	24	0.00028	0.000099
31-Dec-14	13	25	400	295	8.4	398	#N/A	#N/A	240	5.0	*< 1*	0.31	*< 0.3*	103	0.0062	0.0026	0.015	0.066	*< 0.000007*	*< 0.000007*	0.045	0.000011	26	0.00057	0.000093
14-Jan-15	14	27	400	285	8.2	368	#N/A	2.7	188	8.0	*< 1*	0.31	*< 0.3*	108	0.0082	0.0029	0.014	0.075	*< 0.000007*	*< 0.000007*	0.046	0.000015	27	0.00038	0.000082
28-Jan-15	15	29	400	280	8.2	375	#N/A	3.5	186	8.0	*< 1*	0.29	*< 0.3*	113	0.0060	0.0026	0.013	0.076	*< 0.000007*	*< 0.000007*	0.035	0.0000080	27	0.00035	0.000069
11-Feb-15	16	31	400	275	8.2	374	#N/A	3.5	181	8.0	*< 1*	0.29	*< 0.3*	119	0.0064	0.0029	0.013	0.078	*< 0.000007*	*< 0.000007*	0.047	0.000011	30	0.00032	0.000082
25-Feb-15	17	33	400	255	8.2	348	#N/A	3.7	180	6.0	*< 1*	0.27	*< 0.3*	125	0.0022	0.0027	0.011	0.086	*< 0.000007*	*< 0.000007*	0.041	0.000018	32	0.00030	0.000072
11-Mar-15	18	35	400	265	8.2	352	#N/A	2.6	183	7.0	*< 1*	0.31	*< 0.3*	133	0.0049	0.0026	0.012	0.086	*< 0.000007*	*< 0.000007*	0.038	0.0000050	34	0.00036	0.000069
25-Mar-15	19	37	400	280	8.1	356	#N/A	4.1	183	7.0	*< 1*	0.28	*< 0.3*	152	0.0039	0.0028	0.012	0.096	*< 0.000007*	*< 0.000007*	0.036	0.0000040	38	0.00045	0.000072
8-Apr-15	20	39	400	350	8.1	336	#N/A	5.6	179	5.0	*< 1*	0.29	*< 0.3*	143	0.0062	0.0032	0.011	0.095	*< 0.000007*	*< 0.000007*	0.039	*< 0.000003*	37	0.00038	0.000067
22-Apr-15	21	41	400	270	8.1	288	#N/A	5.9	151	9.0	*< 1*	0.36	*< 0.3*	127	0.0043	0.0031	0.015	0.075	*< 0.000007*	*< 0.000007*	0.038	0.000027	32	0.00044	0.000057
6-May-15	22	43	400	290	8.1	278	#N/A	4.1	148	7.0	*< 1*	0.32	*< 0.3*	123	0.0051	0.0028	0.012	0.077	*< 0.000007*	*< 0.000007*	0.033	0.0000030	31	0.00059	0.000056
20-May-15	23	45	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	445	340	8.1	259	#N/A	4.7	123	7.0	*< 1*	0.40	*< 0.3*	118	0.0068	0.0026	0.015	0.071	*< 0.000007*	*< 0.000007*	0.034	0.0000080	31	0.00043	0.000047
17-Jun-15	25	49	500	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	440	335	8.1	267	#N/A	5.2	122	9.0	*< 1*	0.39	*< 0.3*	107	0.0051	0.0027	0.016	0.071	*< 0.000007*	*< 0.000007*	0.030	0.000010	27	0.00046	0.000054
15-Jul-15	27	53	500	380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	380	280	8.1	243	#N/A	3.2	118	10	*< 1*	0.41	*< 0.3*	109	0.0069	0.0024	0.014	0.066	*< 0.000007*	0.0000070	0.028	0.000013	28	0.00061	0.000051
12-Aug-15	29	57	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	425	305	8.2	240	#N/A	2.0	117	9.0	*< 1*	0.39	*< 0.3*	110	0.0066	0.0025	0.016	0.070	*< 0.000007*	*< 0.000007*	0.027	0.000015	28	0.00059	0.000050
9-Sep-15	31	61	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	420	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	345	305	8.1	260	#N/A	3.0	129	8.0		0.36		109	0.0073	0.0025	0.014	0.066	*< 0.000007*	*< 0.000007*	0.022	0.000022	28	0.00058	0.000037
21-Oct-15	34	67	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	480	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	435	335	8.3	255	#N/A	1.2	142	8.0		0.36		115	0.0038	0.0024	0.016	0.061	*< 0.000007*	*< 0.000007*	0.018	*< 0.000003*	28	0.00062	0.000046
2-Dec-15	37	73	500	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	475	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	425	410	8.3	256	#N/A	#N/A	114	8.0	-	0.33	-	113	0.0058	0.0022	0.012	0.070	*< 0.000007*	*< 0.000007*	0.021	*< 0.000003*	28	0.00062	0.000028
6-Jan-16	40	78	400	340	8.3	244	#N/A	1.0	110	8.0	-	0.33	-	117	0.0044	0.0023	0.014	0.074	*< 0.000007*	*< 0.000007*	0.022	0.0000030	30	0.00063	0.000018
20-Jan-16	41	80	400	280	8.2	239	#N/A	1.9	111	7.0	-	0.35	-	118	0.0049	0.0026	0.016	0.079	*< 0.000007*	*< 0.000007*	0.020	0.0000070	30	0.00068	0.000068
3-Feb-16	42	82	400	325	8.2	228	#N/A	2.3	107	6.0	-	0.36	-	104	0.0058	0.0025	0.016	0.076	*< 0.000007*	*< 0.000007*	0.018	*< 0.000003*	27	0.00058	0.000032
17-Feb-16	43	84	400	300	8.2	234	#N/A	3.5	109	6.0	-	0.37	-	111	0.0040	0.0024	0.017	0.077	*< 0.000007*	*< 0.000007*	0.018	0.0000060	29	0.00070	0.000037
2-Mar-16	44	86	400	330	8.2	231	#N/A	1.4	109	6.0	-	0.37	-	110	0.0021	0.0026	0.019	0.077	*< 0.000007*	*< 0.000007*	0.017	0.000010	28	0.00063	0.000041

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 5 (GO)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1500	280	8.2	0.029	0.024	0.000040	0.0080	20	0.056	0.19	0.037	0.0095	0.062	12	0.0068	5.8	*< 0.000002*	153	0.27	54	0.000048	0.00033	0.00057	0.17	0.0025	0.0070	*< 0.002*
30-Jul-14	2	3	400	290	8.3	0.0069	1.9	*< 0.00001*	0.0053	8.5	0.018	0.040	0.054	0.0046	0.018	7.8	0.0026	5.9	*< 0.000002*	100	0.12	29	0.000014	*< 0.00001*	0.00051	0.15	0.00027	*< 0.001*	*< 0.002*
13-Aug-14	3	5	400	305	8.3	0.0092	0.0020	0.000020	0.0048	6.4	0.0042	*< 0.01*	0.050	0.0026	0.021	6.6	0.00073	5.7	*< 0.000002*	46	0.092	13	0.000029	0.000050	0.00019	0.14	0.00012	*< 0.001*	*< 0.002*
27-Aug-14	4	7	400	305	8.3	0.0029	*< 0.002*	*< 0.00001*	0.0042	6.1	0.0020	*< 0.01*	0.054	0.0015	0.011	6.8	0.00034	5.9	*< 0.000002*	53	0.089	9.0	0.000026	0.00021	*< 0.00005*	0.13	0.00024	*< 0.001*	*< 0.002*
10-Sep-14	5	9	400	265	8.3	0.0024	*< 0.007*	0.000020	0.0037	5.4	0.00066	*< 0.01*	0.054	0.0010	0.012	6.1	0.00031	6.8	*< 0.000002*	74	0.086	8.1	0.000028	0.00011	0.000060	0.12	0.00025	*< 0.001*	*< 0.002*
24-Sep-14	6	11	400	240	8.3	0.0024	*< 0.002*	0.000020	0.0044	6.6	0.0013	0.010	0.043	0.0012	*< 0.009*	7.1	*< 0.00004*	5.9	0.0000090	52	0.099	5.9	0.000029	0.000080	0.00011	0.11	0.00019	0.0020	*< 0.002*
8-Oct-14	7	13	300	225	8.3	0.0018	*< 0.007*	*< 0.00001*	0.0056	7.6	0.00070	*< 0.01*	0.035	0.0011	*< 0.003*	7.0	0.00016	6.3	*< 0.000002*	73	0.12	5.2	0.000032	0.000020	0.00012	0.12	0.00018	*< 0.001*	*< 0.002*
22-Oct-14	8	15	400	290	8.3	0.0019	*< 0.007*	0.000020	0.0049	8.5	0.00089	*< 0.01*	0.032	0.00080	*< 0.003*	7.9	0.00024	7.1	*< 0.000002*	73	0.13	5.6	0.000036	0.000020	0.00018	0.13	0.00020	*< 0.001*	*< 0.002*
5-Nov-14	9	17	400	275		0.0017	*< 0.007*	0.000040	0.0049	8.4	0.0012	*< 0.01*	0.028	0.00070	*< 0.003*	6.7	0.00019	6.4	*< 0.000002*	68	0.14	4.1	0.000035	0.00013	0.00012	0.12	0.00017	*< 0.001*	*< 0.002*
19-Nov-14	10	19	400	275	8.3	0.0018	*< 0.007*	0.00022	0.0055	8.9	0.00020	*< 0.01*	0.027	0.00060	0.014	6.9	0.00013	6.9	*< 0.000002*	65	0.16	4.0	0.000042	0.000040	0.00021	0.12	0.00017	*< 0.001*	*< 0.002*
3-Dec-14	11	21	400	345	8.3	0.0015	*< 0.007*	0.000020	0.0046	8.5	0.00059	*< 0.01*	0.025	0.00060	0.0030	6.8	0.00014	6.1	*< 0.000002*	53	0.16	3.9	0.000035	0.000030	0.000090	0.11	0.00016	*< 0.001*	*< 0.002*
17-Dec-14	12	23	400	285	8.3	0.0014	*< 0.007*	*< 0.00001*	0.0046	9.0	0.00021	*< 0.01*	0.024	0.00060	0.0030	7.6	0.00020	6.0	*< 0.000002*	48	0.15	3.7	0.000031	0.000010	0.00010	0.11	0.00018	*< 0.001*	*< 0.002*
31-Dec-14	13	25	400	295	8.4	0.0011	*< 0.007*	0.00031	0.0045	9.1	0.00099	*< 0.01*	0.023	0.00050	0.0060	7.1	0.00014	6.7	*< 0.000002*	42	0.17	3.4	0.000034	0.000050	0.000070	0.098	0.00019	*< 0.001*	*< 0.002*
14-Jan-15	14	27	400	285	8.2	0.0019	*< 0.007*	0.000020	0.0045	9.9	0.00051	*< 0.01*	0.024	0.00050	0.0030	7.4	0.00016	6.6	0.0000020	36	0.17	3.0	0.000035	0.000060	0.00014	0.10	0.00016	0.0010	*< 0.002*
28-Jan-15	15	29	400	280	8.2	0.00090	*< 0.007*	0.000060	0.0039	11	0.0010	*< 0.01*	0.021	0.00040	0.0040	7.6	0.00025	5.7	*< 0.000002*	33	0.15	3.3	0.000031	0.000040	0.00012	0.10	0.00018	0.0020	*< 0.002*
11-Feb-15	16	31	400	275	8.2	0.0016	*< 0.007*	0.00015	0.0045	11	0.00065	*< 0.01*	0.019	0.00050	0.0040	7.5	*< 0.001*	6.2	*< 0.000002*	25	0.20	3.0	0.000035	0.00015	0.00015	0.099	0.00021	*< 0.001*	*< 0.002*
25-Feb-15	17	33	400	255	8.2	0.0012	*< 0.007*	0.00015	0.0046	11	0.0012	*< 0.01*	0.017	0.00040	0.0050	8.4	*< 0.001*	6.0	*< 0.000002*	20	0.20	2.6	0.000041	0.00010	0.000090	0.11	0.00014	0.0030	*< 0.002*
11-Mar-15	18	35	400	265	8.2	0.0011	*< 0.007*	*< 0.00001*	0.0046	12	0.00051	*< 0.01*	0.018	0.00050	*< 0.003*	8.0	*< 0.001*	5.3	*< 0.000002*	16	0.21	2.8	0.000025	0.000050	0.000080	0.100	0.00017	*< 0.001*	*< 0.002*
25-Mar-15	19	37	400	280	8.1	0.0025	*< 0.007*	0.000040	0.0045	14	0.00089	*< 0.01*	0.020	0.00050	*< 0.003*	9.0	*< 0.001*	7.3	*< 0.000002*	14	0.23	3.0	0.000038	0.00044	0.00012	0.096	0.00019	*< 0.001*	*< 0.002*
8-Apr-15	20	39	400	350	8.1	0.0011	*< 0.007*	*< 0.00001*	0.0046	12	0.00094	*< 0.01*	0.017	0.00040	*< 0.003*	8.3	*< 0.001*	7.2	*< 0.000002*	8.8	0.22	2.5	0.000026	0.00011	0.000060	0.095	0.00016	0.0010	*< 0.002*
22-Apr-15	21	41	400	270	8.1	0.0080	*< 0.007*	0.00036	0.0039	11	0.00027	*< 0.01*	0.024	0.00040	*< 0.003*	8.5	0.000090	6.3	0.0000050	7.5	0.18	3.2	0.000030	0.0067	*< 0.00005*	0.099	0.00017	0.0060	*< 0.002*
6-May-15	22	43	400	290	8.1	0.0012	*< 0.007*	*< 0.00001*	0.0038	11	0.00061	*< 0.01*	0.021	0.00040	*< 0.003*	8.2	*< 0.001*	6.1	0.0000040	5.5	0.18	2.9	0.000026	0.00019	0.00012	0.081	0.00021	0.0010	*< 0.002*
20-May-15	23	45	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	445	340	8.1	0.0022	*< 0.007*	0.000050	0.0032	10	0.00043	*< 0.01*	0.026	0.00030	*< 0.003*	7.9	0.000060	6.2	0.0000070	3.7	0.17	3.3	0.000015	0.0037	0.00011	0.085	0.00016	*< 0.001*	*< 0.002*
17-Jun-15	25	49	500	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	440	335	8.1	0.00085	*< 0.007*	*< 0.00001*	0.0030	9.5	0.00094	0.010	0.026	0.00030	0.0040	6.9	0.000070	6.0	0.0000020	2.7	0.17	3.1	0.000028	0.0016	0.00010	0.084	0.00016	*< 0.001*	*< 0.002*
15-Jul-15	27	53	500	380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	380	280	8.1	0.00092	*< 0.007*	0.000050	0.0030	9.6	0.00025	0.020	0.027	0.00030	*< 0.003*	6.9	*< 0.00004*	5.6	0.0000040	2.3	0.18	3.4	0.000020	0.0011	0.000080	0.089	0.00020	*< 0.001*	*< 0.002*
12-Aug-15	29	57	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	425	305	8.2	0.0011	*< 0.007*	0.00016	0.0027	9.6	0.00062	0.010	0.029	0.00020	*< 0.003*	7.0	0.000070	6.0	0.000040	2.3	0.17	3.6	0.000027	0.0012	*< 0.00005*	0.083	0.00016	*< 0.001*	*< 0.002*
9-Sep-15	31	61	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	420	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	345	305	8.1	0.0011	*< 0.007*	0.000020	0.0024	9.8	0.00027	0.020	0.021	0.00020	*< 0.003*	6.7	0.000050	5.1	*< 0.000002*	1.9	0.16	3.1	0.000022	0.00069	0.000060	0.084	0.00020	*< 0.001*	*< 0.002*
21-Oct-15	34	67	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	480	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	435	335	8.3	0.00072	*< 0.007*	0.00012	0.0023	11	0.00020	*< 0.01*	0.023	*< 0.0001*	*< 0.003*	7.5	0.00017	5.6	*< 0.000002*	1.9	0.16	3.2	0.000022	0.00047	*< 0.00005*	0.074	0.00014	*< 0.001*	*< 0.002*
2-Dec-15	37	73	500	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	475	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	425	410	8.3	0.0011	*< 0.007*	0.00035	0.0023	10	0.00019	*< 0.01*	0.022	0.00020	*< 0.003*	7.3	0.000070	5.4	*< 0.000002*	1.7	0.14	3.0	*< 0.000005*	0.00045	*< 0.00005*	0.082	0.00016	*< 0.001*	*< 0.002*
6-Jan-16	40	78	400	340	8.3	0.0012	*< 0.007*	0.000020	0.0023	10	0.00017	*< 0.01*	0.019	0.00020	0.0060	8.0	0.00025	5.8	0.0000020	1.9	0.15	2.9	*< 0.000005*	0.00051	*< 0.00005*	0.076	0.00014	*< 0.001*	*< 0.002*
20-Jan-16	41	80	400	280	8.2	0.00091	*< 0.007*	0.000040	0.0025	10	0.0021	*< 0.01*	0.023	0.00030	0.0050	7.6	0.000080	6.1	0.0000020	1.8	0.17	3.1	0.000042	0.00040	*< 0.00005*	0.090	0.00017	*< 0.001*	*< 0.002*
3-Feb-16	42	82	400	325	8.2	0.0011	*< 0.007*	0.000030	0.0024	9.2	*< 0.00001*	*< 0.01*	0.022	0.00020	*< 0.003*	7.4	0.00015	5.5	0.000013	1.7	0.16	2.7	0.000026	0.00031	*< 0.00005*	0.081	0.00016	*< 0.001*	*< 0.002*
17-Feb-16	43	84	400	300	8.2	0.00090	*< 0.007*	*< 0.00001*	0.0022	9.7	0.00014	*< 0.01*	0.024	0.00020	0.0060	7.5	*< 0.00004*	5.5	*< 0.000002*	1.8	0.15	2.4	0.000028	0.00030	*< 0.00005*	0.082	0.00016	*< 0.001*	*< 0.002*
2-Mar-16	44	86	400	330	8.2	0.00052	*< 0.007*	0.000030	0.0023	10	0.00050	*< 0.01*	0.024	0.00020	*< 0.003*	7.6	*< 0.00004*	5.7	*< 0.000002*	1.8	0.16	2.9	0.000026	0.00026	*< 0.00005*	0.082	0.00015	*< 0.001*	*< 0.002*

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 5 (GO)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1500	280	8.2	1228	#N/A	0.074	6.1	4.1	1.6	0.0087	0.025	6.1	0.0013	0.00014	0.0013	0.0020	0.00000034	0.00000020	0.0016	0.000000084	1.5	0.000078	0.00011
30-Jul-14	2	3	400	290	8.3	667	#N/A	#N/A	3.8	0.99	0.096	0.0054	0.0044	1.3	0.000088	0.000068	0.00055	0.00023	0.00000010	0.00000010	0.00076	0.000000044	0.32	0.000017	0.0000087
13-Aug-14	3	5	400	305	8.3	525	#N/A	#N/A	3.4	0.49	0.024	0.0064	0.0046	1.0	0.000070	0.000061	0.00049	0.00048	0.00000011	0.00000011	0.00084	0.000000046	0.26	0.0000088	0.0000064
27-Aug-14	4	7	400	305	8.3	465	#N/A	#N/A	3.3	0.41	0.011	0.0067	0.0046	1.0	0.00012	0.000055	0.00047	0.00044	0.00000011	0.00000011	0.00094	0.00000018	0.25	0.0000092	0.0000043
10-Sep-14	5	9	400	265	8.3	445	#N/A	#N/A	2.8	0.23	0.0053	0.0061	0.0040	0.80	0.00010	0.000045	0.00044	0.00043	0.000000093	0.000000093	0.00068	0.00000027	0.20	0.0000076	0.0000030
24-Sep-14	6	11	400	240	8.3	455	#N/A	0.049	2.8	0.20	0.0036	0.0047	0.0036	0.86	0.000029	0.000042	0.00030	0.00048	0.000000084	0.000000084	0.00063	0.000000036	0.22	0.0000077	0.0000032
8-Oct-14	7	13	300	225	8.3	477	#N/A	0.046	2.4	0.14	0.011	0.0039	0.0034	0.95	0.000068	0.000035	0.00024	0.00054	0.000000079	0.000000079	0.00060	0.000000045	0.24	0.0000053	0.0000019
22-Oct-14	8	15	400	290	8.3	492	#N/A	0.075	3.6	0.19	0.015	0.0048	0.0044	1.3	0.000097	0.000044	0.00029	0.00079	0.00000010	0.00000010	0.00088	0.00000033	0.33	0.0000066	0.0000021
5-Nov-14	9	17	400	275		463	#N/A	#N/A	3.4	0.14	0.014	0.0048	0.0041	1.2	0.000061	0.000041	0.00026	0.00077	0.000000096	0.000000096	0.00082	0.000000069	0.30	0.0000061	0.0000019
19-Nov-14	10	19	400	275	8.3	437	#N/A	#N/A	2.8	0.15	0.0028	0.0048	0.0041	1.3	0.000055	0.000040	0.00024	0.00083	0.000000096	0.000000096	0.00079	0.00000036	0.31	0.0000056	0.0000016
3-Dec-14	11	21	400	345	8.3	401	#N/A	#N/A	3.6	0.16	0.0035	0.0055	0.0052	1.7	0.000066	0.000050	0.00028	0.0011	0.00000012	0.00000012	0.00084	0.00000016	0.42	0.0000067	0.0000018
17-Dec-14	12	23	400	285	8.3	394	#N/A	0.038	2.8	0.11	0.0029	0.0048	0.0043	1.4	0.000063	0.000040	0.00023	0.00093	0.000000100	0.000000100	0.00065	0.000000043	0.34	0.0000040	0.0000014
31-Dec-14	13	25	400	295	8.4	398	#N/A	#N/A	3.5	0.074	0.015	0.0046	0.0044	1.5	0.000091	0.000038	0.00022	0.00097	0.00000010	0.00000010	0.00066	0.00000016	0.38	0.0000084	0.0000014
14-Jan-15	14	27	400	285	8.2	368	#N/A	0.038	2.7	0.11	0.014	0.0044	0.0043	1.5	0.00012	0.000041	0.00020	0.0011	0.000000100	0.000000100	0.00066	0.00000021	0.38	0.0000054	0.0000012
28-Jan-15	15	29	400	280	8.2	375	#N/A	0.049	2.6	0.11	0.014	0.0041	0.0042	1.6	0.000084	0.000036	0.00018	0.0011	0.000000098	0.000000098	0.00049	0.00000011	0.38	0.0000049	0.00000097
11-Feb-15	16	31	400	275	8.2	374	#N/A	0.048	2.5	0.11	0.014	0.0040	0.0041	1.6	0.000088	0.000040	0.00018	0.0011	0.000000096	0.000000096	0.00064	0.00000015	0.41	0.0000044	0.0000011
25-Feb-15	17	33	400	255	8.2	348	#N/A	0.047	2.3	0.077	0.013	0.0034	0.0038	1.6	0.000028	0.000034	0.00014	0.0011	0.000000089	0.000000089	0.00052	0.00000023	0.40	0.0000038	0.00000092
11-Mar-15	18	35	400	265	8.2	352	#N/A	0.034	2.4	0.093	0.013	0.0041	0.0040	1.8	0.000065	0.000034	0.00015	0.0011	0.000000093	0.000000093	0.00050	0.000000066	0.44	0.0000048	0.00000091
25-Mar-15	19	37	400	280	8.1	356	#N/A	0.057	2.6	0.098	0.014	0.0039	0.0042	2.1	0.000055	0.000039	0.00017	0.0013	0.000000098	0.000000098	0.00050	0.000000056	0.53	0.0000063	0.0000010
8-Apr-15	20	39	400	350	8.1	336	#N/A	0.098	3.1	0.088	0.018	0.0051	0.0053	2.5	0.00011	0.000056	0.00020	0.0017	0.00000012	0.00000012	0.00069	0.000000053	0.65	0.0000067	0.0000012
22-Apr-15	21	41	400	270	8.1	288	#N/A	0.079	2.0	0.12	0.014	0.0049	0.0041	1.7	0.000058	0.000042	0.00021	0.0010	0.000000095	0.000000095	0.00052	0.00000036	0.43	0.0000059	0.00000077
6-May-15	22	43	400	290	8.1	278	#N/A	0.060	2.1	0.10	0.015	0.0046	0.0044	1.8	0.000074	0.000041	0.00017	0.0011	0.00000010	0.00000010	0.00047	0.000000044	0.45	0.0000086	0.00000081
20-May-15	23	45	500	455																					
3-Jun-15	24	47	445	340	8.1	259	#N/A	0.040	1.0	0.060	0.0085	0.0034	0.0026	1.0	0.000058	0.000022	0.00013	0.00061	0.000000060	0.000000060	0.00029	0.000000068	0.26	0.0000037	0.00000040
17-Jun-15	25	49	500	440																					
1-Jul-15	26	51	440	335	8.1	267	#N/A	0.043	1.0	0.075	0.0084	0.0033	0.0025	0.90	0.000043	0.000023	0.00014	0.00060	0.000000059	0.000000059	0.00025	0.000000084	0.23	0.0000039	0.00000045
15-Jul-15	27	53	500	380																					
29-Jul-15	28	55	380	280	8.1	243	#N/A	0.022	0.83	0.070	0.0070	0.0029	0.0021	0.76	0.000048	0.000017	0.000099	0.00046	0.000000049	0.000000049	0.00019	0.000000091	0.19	0.0000043	0.00000036
12-Aug-15	29	57	500	425																					
26-Aug-15	30	59	425	305	8.2	240	#N/A	0.015	0.89	0.069	0.0076	0.0030	0.0023	0.84	0.000050	0.000019	0.00012	0.00054	0.000000053	0.000000053	0.00020	0.00000011	0.22	0.0000045	0.00000038
9-Sep-15	31	61	500	420																					
23-Sep-15	32	63	420	345																					
7-Oct-15	33	65	345	305	8.1	260	#N/A	0.015	0.66	0.041		0.0018		0.55	0.000037	0.000013	0.000073	0.00034	0.000000036	0.000000036	0.00011	0.00000011	0.14	0.0000029	0.00000019
21-Oct-15	34	67	500	480																					
4-Nov-15	35	69	480	435																					
18-Nov-15	36	71	435	335	8.3	255	#N/A	0.0064	0.79	0.045		0.0020		0.64	0.000021	0.000013	0.000087	0.00034	0.000000039	0.000000039	0.00010	0.000000017	0.16	0.0000035	0.00000026
2-Dec-15	37	73	500	475																					
16-Dec-15	38	75	475	425																					
30-Dec-15	39	77	425	410	8.3	256	#N/A	#N/A	0.78	0.055		0.0023		0.77	0.000040	0.000015	0.000084	0.00048	0.000000048	0.000000048	0.00014	0.000000021	0.19	0.0000042	0.00000019
6-Jan-16	40	78	400	340	8.3	244	#N/A	0.017	1.9	0.14		0.0056		2.0	0.000075	0.000039	0.00024	0.0013	0.00000012	0.00000012	0.00037	0.000000051	0.50	0.000011	0.00000031
20-Jan-16	41	80	400	280	8.2	239	#N/A	0.026	1.6	0.098		0.0049		1.7	0.000069	0.000036	0.00022	0.0011	0.000000098	0.000000098	0.00028	0.000000098	0.42	0.0000095	0.00000095
3-Feb-16	42	82	400	325	8.2	228	#N/A	0.037	1.7	0.098		0.0059		1.7	0.000094	0.000041	0.00026	0.0012	0.00000011	0.00000011	0.00029	0.000000049	0.43	0.0000094	0.00000052
17-Feb-16	43	84	400	300	8.2	234	#N/A	0.052	1.6	0.090		0.0056		1.7	0.000060	0.000036	0.00025	0.0012	0.00000011	0.00000011	0.00027	0.000000090	0.43	0.000011	0.00000056
2-Mar-16	44	86	400	330	8.2	231	#N/A	0.023	1.8	0.099		0.0061		1.8	0.000035	0.000043	0.00031	0.0013	0.00000012	0.00000012	0.00028	0.00000017	0.45	0.000010	0.00000068

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 5 (GO)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1500	280	8.2	0.00081	0.00067	0.0000011	0.00023	0.55	0.0016	0.0053	0.0010	0.00027	0.0017	0.33	0.00019	0.16	0.000000056	4.3	0.0077	1.5	0.0000013	0.0000092	0.000016	0.0047	0.000069	0.00020	0.000056
30-Jul-14	2	3	400	290	8.3	0.00010	0.027	0.00000015	0.000077	0.12	0.00027	0.00058	0.00078	0.000067	0.00026	0.11	0.000038	0.086	0.000000029	1.5	0.0017	0.42	0.00000020	0.00000015	0.0000074	0.0022	0.0000039	0.000015	0.000029
13-Aug-14	3	5	400	305	8.3	0.00014	0.000031	0.00000031	0.000073	0.097	0.000064	0.00015	0.00075	0.000040	0.00032	0.10	0.000011	0.086	0.000000031	0.70	0.0014	0.19	0.00000044	0.00000076	0.0000029	0.0021	0.0000018	0.000015	0.000031
27-Aug-14	4	7	400	305	8.3	0.000043	0.000031	0.00000015	0.000064	0.093	0.000031	0.00015	0.00082	0.000023	0.00017	0.10	0.0000052	0.090	0.000000031	0.81	0.0014	0.14	0.00000040	0.0000032	0.00000076	0.0019	0.0000037	0.000015	0.000031
10-Sep-14	5	9	400	265	8.3	0.000032	0.000093	0.00000027	0.000049	0.072	0.0000087	0.00013	0.00072	0.000013	0.00016	0.081	0.0000041	0.090	0.000000027	0.98	0.0011	0.11	0.00000037	0.0000015	0.00000080	0.0016	0.0000033	0.000013	0.000027
24-Sep-14	6	11	400	240	8.3	0.000029	0.000024	0.00000024	0.000053	0.079	0.000016	0.00012	0.00051	0.000014	0.00011	0.085	0.00000048	0.070	0.00000011	0.63	0.0012	0.070	0.00000035	0.00000096	0.0000013	0.0013	0.0000023	0.000024	0.000024
8-Oct-14	7	13	300	225	8.3	0.000021	0.000079	0.00000011	0.000063	0.085	0.0000079	0.00011	0.00039	0.000012	0.000034	0.079	0.0000018	0.071	0.000000023	0.82	0.0014	0.059	0.00000036	0.00000023	0.0000014	0.0014	0.0000020	0.000011	0.000023
22-Oct-14	8	15	400	290	8.3	0.000028	0.00010	0.00000029	0.000072	0.12	0.000013	0.00015	0.00046	0.000012	0.000044	0.11	0.0000035	0.10	0.000000029	1.1	0.0018	0.081	0.00000052	0.00000029	0.0000026	0.0019	0.0000029	0.000015	0.000029
5-Nov-14	9	17	400	275		0.000023	0.000096	0.00000055	0.000068	0.12	0.000017	0.00014	0.00039	0.0000096	0.000041	0.092	0.0000026	0.088	0.000000028	0.93	0.0020	0.056	0.00000048	0.0000018	0.0000017	0.0017	0.0000023	0.000014	0.000028
19-Nov-14	10	19	400	275	8.3	0.000024	0.000096	0.0000030	0.000075	0.12	0.0000028	0.00014	0.00037	0.0000083	0.00019	0.095	0.0000018	0.094	0.000000028	0.89	0.0021	0.055	0.00000058	0.00000055	0.0000029	0.0017	0.0000023	0.000014	0.000028
3-Dec-14	11	21	400	345	8.3	0.000026	0.00012	0.00000035	0.000079	0.15	0.000010	0.00017	0.00042	0.000010	0.000052	0.12	0.0000024	0.11	0.000000035	0.92	0.0027	0.067	0.00000060	0.00000052	0.0000016	0.0020	0.0000028	0.000017	0.000035
17-Dec-14	12	23	400	285	8.3	0.000020	0.000100	0.00000014	0.000066	0.13	0.0000030	0.00014	0.00034	0.0000086	0.000043	0.11	0.0000029	0.086	0.000000029	0.68	0.0021	0.053	0.00000044	0.00000014	0.0000014	0.0015	0.0000026	0.000014	0.000029
31-Dec-14	13	25	400	295	8.4	0.000016	0.00010	0.0000046	0.000066	0.13	0.000015	0.00015	0.00033	0.0000074	0.000089	0.11	0.0000021	0.099	0.000000030	0.61	0.0024	0.050	0.00000050	0.00000074	0.0000010	0.0015	0.0000028	0.000015	0.000030
14-Jan-15	14	27	400	285	8.2	0.000028	0.000100	0.00000029	0.000065	0.14	0.0000073	0.00014	0.00034	0.0000071	0.000043	0.10	0.0000023	0.094	0.000000029	0.52	0.0025	0.043	0.00000050	0.00000086	0.0000020	0.0014	0.0000023	0.000014	0.000029
28-Jan-15	15	29	400	280	8.2	0.000013	0.000098	0.00000084	0.000055	0.15	0.000014	0.00014	0.00030	0.0000056	0.000056	0.11	0.0000035	0.080	0.000000028	0.46	0.0021	0.046	0.00000043	0.00000056	0.0000017	0.0014	0.0000025	0.000028	0.000028
11-Feb-15	16	31	400	275	8.2	0.000021	0.000096	0.0000021	0.000062	0.15	0.0000089	0.00014	0.00026	0.0000069	0.000055	0.10	0.000014	0.085	0.000000028	0.35	0.0027	0.041	0.00000048	0.0000021	0.0000021	0.0014	0.0000029	0.000014	0.000028
25-Feb-15	17	33	400	255	8.2	0.000015	0.000089	0.0000019	0.000058	0.14	0.000015	0.00013	0.00022	0.0000051	0.000064	0.11	0.000013	0.077	0.000000026	0.26	0.0026	0.033	0.00000052	0.0000013	0.0000011	0.0014	0.0000018	0.000038	0.000026
11-Mar-15	18	35	400	265	8.2	0.000015	0.000093	0.00000013	0.000061	0.16	0.0000068	0.00013	0.00024	0.0000066	0.000040	0.11	0.000013	0.070	0.000000027	0.21	0.0028	0.037	0.00000033	0.00000066	0.0000011	0.0013	0.0000023	0.000013	0.000027
25-Mar-15	19	37	400	280	8.1	0.000036	0.000098	0.00000056	0.000063	0.19	0.000012	0.00014	0.00028	0.0000070	0.000042	0.13	0.000014	0.10	0.000000028	0.20	0.0032	0.042	0.00000053	0.0000062	0.0000017	0.0013	0.0000027	0.000014	0.000028
8-Apr-15	20	39	400	350	8.1	0.000020	0.00012	0.00000018	0.000080	0.21	0.000016	0.00018	0.00029	0.0000070	0.000053	0.15	0.000018	0.13	0.000000035	0.15	0.0038	0.044	0.00000046	0.0000019	0.0000011	0.0017	0.0000028	0.000018	0.000035
22-Apr-15	21	41	400	270	8.1	0.00011	0.000095	0.0000049	0.000052	0.15	0.0000036	0.00014	0.00032	0.0000054	0.000041	0.11	0.0000012	0.084	0.000000068	0.10	0.0025	0.043	0.00000041	0.000090	0.00000068	0.0013	0.0000023	0.000081	0.000027
6-May-15	22	43	400	290	8.1	0.000017	0.00010	0.00000015	0.000055	0.16	0.0000088	0.00015	0.00030	0.0000058	0.000044	0.12	0.000015	0.088	0.000000058	0.079	0.0026	0.042	0.00000038	0.0000028	0.0000017	0.0012	0.0000030	0.000015	0.000029
20-May-15	23	45	500	455																									
3-Jun-15	24	47	445	340	8.1	0.000019	0.000060	0.00000043	0.000027	0.086	0.0000037	0.000085	0.00022	0.0000026	0.000026	0.067	0.00000051	0.053	0.000000060	0.032	0.0015	0.028	0.00000013	0.000031	0.00000094	0.00072	0.0000014	0.0000085	0.000017
17-Jun-15	25	49	500	440																									
1-Jul-15	26	51	440	335	8.1	0.0000071	0.000059	0.000000084	0.000025	0.079	0.0000079	0.000084	0.00022	0.0000025	0.000034	0.057	0.00000059	0.050	0.000000017	0.022	0.0014	0.026	0.00000023	0.000013	0.00000084	0.00070	0.0000013	0.0000084	0.000017
15-Jul-15	27	53	500	380																									
29-Jul-15	28	55	380	280	8.1	0.0000064	0.000049	0.00000035	0.000021	0.067	0.0000018	0.00014	0.00019	0.0000021	0.000021	0.048	0.00000028	0.039	0.000000028	0.016	0.0012	0.024	0.00000014	0.0000078	0.00000056	0.00063	0.0000014	0.0000070	0.000014
12-Aug-15	29	57	500	425																									
26-Aug-15	30	59	425	305	8.2	0.0000086	0.000053	0.0000012	0.000021	0.073	0.0000047	0.000076	0.00022	0.0000015	0.000023	0.053	0.00000053	0.046	0.00000031	0.017	0.0013	0.027	0.00000021	0.0000093	0.00000038	0.00063	0.0000012	0.0000076	0.000015
9-Sep-15	31	61	500	420																									
23-Sep-15	32	63	420	345																									
7-Oct-15	33	65	345	305	8.1	0.0000056	0.000036	0.00000010	0.000012	0.050	0.0000014	0.00010	0.00011	0.0000010	0.000015	0.034	0.00000025	0.026	0.000000010	0.0096	0.00080	0.016	0.00000011	0.0000035	0.00000031	0.00043	0.0000010	0.0000051	0.000010
21-Oct-15	34	67	500	480																									
4-Nov-15	35	69	480	435																									
18-Nov-15	36	71	435	335	8.3	0.0000040	0.000039	0.00000067	0.000013	0.060	0.0000011	0.000056	0.00013	0.00000056	0.000017	0.042	0.00000095	0.031	0.000000011	0.011	0.00091	0.018	0.00000012	0.0000026	0.00000028	0.00042	0.00000078	0.0000056	0.000011
2-Dec-15	37	73	500	475																									
16-Dec-15	38	75	475	425																									
30-Dec-15	39	77	425	410	8.3	0.0000077	0.000048	0.0000024	0.000015	0.069	0.0000013	0.000068	0.00015	0.0000014	0.000021	0.050	0.00000048	0.037	0.000000014	0.012	0.00092	0.021	0.000000034	0.0000031	0.00000034	0.00056	0.0000011	0.0000068	0.000014
6-Jan-16	40	78	400	340	8.3	0.000020	0.00012	0.00000034	0.000040	0.18	0.0000029	0.00017	0.00033	0.0000034	0.00010	0.14	0.0000043	0.099	0.000000034	0.031	0.0026	0.049	0.000000085	0.0000087	0.00000085	0.0013	0.0000024	0.000017	0.000034
20-Jan-16	41	80	400	280	8.2	0.000013	0.000098	0.00000056	0.000035	0.15	0.000029	0.00014	0.00032	0.0000042	0.000070	0.11	0.0000011	0.085	0.000000028	0.025	0.0024	0.043	0.00000059	0.0000056	0.00000070	0.0013	0.0000024	0.000014	0.000028
3-Feb-16	42	82	400	325	8.2	0.000019	0.00011	0.00000049	0.000039	0.15	0.00000016	0.00016	0.00035	0.0000033	0.000049	0.12	0.0000024	0.090	0.00000021	0.027	0.0026	0.044	0.00000042	0.0000050	0.00000081	0.0013	0.0000026	0.000016	0.000033
17-Feb-16	43	84	400	300	8.2	0.000014	0.00011	0.00000015	0.000033	0.15	0.0000021	0.00015	0.00036	0.0000030	0.000090	0.11	0.00000060	0.082	0.000000030	0.027	0.0023	0.036	0.00000042	0.0000045	0.00000075	0.0012	0.0000024	0.000015	0.000030
2-Mar-16	44	86	400	330	8.2	0.0000086	0.00012	0.00000050	0.000038	0.17	0.0000083	0.00017	0.00039	0.0000033	0.000050	0.13	0.00000066	0.094	0.000000033	0.029	0.0026	0.048	0.00000043	0.0000043	0.00000083	0.0013	0.0000025	0.000017	0.000033

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 6 (GT)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/L	mg$CaCO_3$/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
30-Jul-14	1	1	1200	370	8.1	1431	#N/A	4.8	197	443	23	0.35	0.30	366	0.010	0.011	0.078	0.029	< 0.000007	0.000012	0.040	< 0.000003	83	0.00095	0.0015
13-Aug-14	2	3	400	300	8.2	776	#N/A	4.2	172	180	4.3	0.41	< 0.3	165	0.0039	0.012	0.084	0.022	< 0.000007	< 0.000007	0.036	< 0.000003	36	0.00033	0.00069
27-Aug-14	3	5	400	310	8.2	576	#N/A	4.9	174	120	< 2	0.45	< 0.3	135	0.0066	0.011	0.083	0.024	< 0.000007	< 0.000007	0.044	0.000010	30	0.000050	0.00035
10-Sep-14	4	7	400	310	8.3	492	#N/A	3.8	174	73	0.50	0.51	< 0.3	119	0.0067	0.0098	0.088	0.030	< 0.000007	< 0.000007	0.035	0.000022	27	0.00010	0.00024
24-Sep-14	5	9	400	240	8.2	449	#N/A	4.4	181	65	0.20	0.50	< 0.3	127	0.0039	0.010	0.074	0.038	< 0.000007	< 0.000007	0.033	< 0.000003	28	0.00012	0.00027
8-Oct-14	6	11	300	220	8.2	424	#N/A	6.5	158	43	< 1	0.46	< 0.3	140	0.0076	0.0093	0.069	0.041	< 0.000007	< 0.000007	0.035	0.000018	32	0.000080	0.00014
22-Oct-14	7	13	400	295	8.3	491	#N/A	5.6	245	45	< 1	0.48	< 0.3	138	0.0068	0.0091	0.069	0.044	< 0.000007	< 0.000007	0.036	0.000048	30	0.000033	0.00014
5-Nov-14	8	15	400	275		366	#N/A	#N/A	165	40	< 1	0.50	< 0.3	139	0.0067	0.0091	0.064	0.046	< 0.000007	< 0.000007	0.034	0.000017	29	0.000080	0.00012
19-Nov-14	9	17	400	270	8.3	368	#N/A	#N/A	204	33	< 0.2	0.50	< 0.3	153	0.0065	0.0088	0.062	0.054	< 0.000007	< 0.000007	0.035	0.00010	32	0.000050	0.000072
3-Dec-14	10	19	400	335	8.3	335	#N/A	2.9	155	30	< 0.2	0.45	< 0.3	151	0.0065	0.0086	0.058	0.056	< 0.000007	< 0.000007	0.028	0.000015	34	0.000060	0.000081
17-Dec-14	11	21	400	290	8.2	346	#N/A	2.9	150	27	< 1	0.54	< 0.3	156	0.0065	0.0091	0.061	0.053	< 0.000007	< 0.000007	0.029	0.0000080	35	< 0.00003	0.000065
31-Dec-14	12	23	400	290	8.2	333	#N/A	3.7	151	24	< 1	0.50	< 0.3	150	0.0090	0.0089	0.058	0.056	< 0.000007	< 0.000007	0.027	0.000015	33	< 0.00003	0.000083
14-Jan-15	13	25	400	275	8.2	351	#N/A	3.2	154	24	< 1	0.52	< 0.3	153	0.0069	0.0099	0.059	0.060	< 0.000007	< 0.000007	0.029	0.000018	33	0.000070	0.000070
28-Jan-15	14	27	400	285	8.2	347	#N/A	3.1	150	24	< 1	0.52	< 0.3	151	0.010	0.0090	0.055	0.059	< 0.000007	< 0.000007	0.022	0.000010	31	0.000090	0.000053
11-Feb-15	15	29	400	300	8.2	334	#N/A	4.2	157	26	< 1	0.52	< 0.3	151	0.0097	0.010	0.061	0.058	< 0.000007	< 0.000007	0.027	0.000015	33	0.000090	0.000058
25-Feb-15	16	31	400	275	8.2	335	#N/A	2.6	160	24	< 1	0.46	< 0.3	156	0.0040	0.0093	0.051	0.063	< 0.000007	< 0.000007	0.025	0.000019	35	0.00024	0.000058
11-Mar-15	17	33	400	300	8.3	355	#N/A	#N/A	184	20	< 1	0.53	< 0.3	148	0.0075	0.0096	0.051	0.058	< 0.000007	< 0.000007	0.021	0.000010	34	0.000090	0.000052
25-Mar-15	18	35	400	275	8.2	331	#N/A	3.8	151	21	< 1	0.50	< 0.3	154	0.0069	0.011	0.061	0.065	< 0.000007	< 0.000007	0.021	0.0000090	32	0.00014	0.000056
8-Apr-15	19	37	400	335	8.1	322	#N/A	4.3	153	25	< 1	0.50	< 0.3	146	0.0062	0.013	0.056	0.060	< 0.000007	< 0.000007	0.024	0.0000040	34	0.000070	0.000050
22-Apr-15	20	39	400	270	8.1	338	#N/A	5.2	165	25	< 1	0.47	< 0.3	164	0.0062	0.011	0.048	0.066	< 0.000007	< 0.000007	0.025	0.0000070	38	0.000080	0.000046
6-May-15	21	41	400	240	8.2	343	#N/A	4.4	170	23	< 1	0.39	< 0.3	163	0.0085	0.010	0.042	0.066	< 0.000007	< 0.000007	0.022	< 0.000003	37	< 0.00003	0.000039
20-May-15	22	43	500	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	23	45	435	315	8.1	307	#N/A	4.9	138	21	< 1	0.45	< 0.3	142	0.011	0.010	0.046	0.057	< 0.000007	< 0.000007	0.022	< 0.000003	33	0.000060	0.000037
17-Jun-15	24	47	500	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	25	49	435	315	8.1	319	#N/A	4.6	135	22	< 1	0.42	< 0.3	136	0.0081	0.011	0.053	0.059	< 0.000007	< 0.000007	0.017	0.0000060	31	0.000080	0.000052
15-Jul-15	26	51	500	375	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	27	53	375	270	8.1	298	#N/A	3.0	133	27	< 1	0.42	< 0.3	135	0.0087	0.010	0.045	0.054	< 0.000007	< 0.000007	0.018	0.0000070	31	0.000080	0.000035
12-Aug-15	28	55	500	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	29	57	430	270	8.2	299	#N/A	1.9	133	26	< 1	0.41	< 0.3	135	0.010	0.010	0.048	0.056	< 0.000007	< 0.000007	0.016	0.0000060	31	0.00010	0.000045
9-Sep-15	30	59	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	31	61	425	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	32	63	335	245	8.2	321	#N/A	3.2	148	23		0.39		137	0.0085	0.011	0.045	0.049	< 0.000007	< 0.000007	0.013	0.0000090	31	0.00013	0.000029
21-Oct-15	33	65	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	34	67	485	375	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	35	69	375	280	8.4	310	#N/A	#N/A	159	21		0.35		140	0.0086	0.0099	0.051	0.044	< 0.000007	< 0.000007	0.0098	0.0000090	32	0.00010	0.00045
2-Dec-15	36	71	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	37	73	455	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	38	75	410	350	8.4	316	#N/A	#N/A	130	22	-	0.32	-	143	0.0075	0.0094	0.039	0.051	< 0.000007	< 0.000007	0.012	< 0.000003	33	0.00010	0.000019
6-Jan-16	39	76	400	355	8.3	315	#N/A	#N/A	131	28	-	0.29	-	156	0.0065	0.0097	0.043	0.058	< 0.000007	< 0.000007	0.013	0.000026	36	0.000070	< 0.000004
20-Jan-16	40	78	400	255	8.3	321	#N/A	1.6	132	32	-	0.33	-	157	0.0059	0.012	0.052	0.059	< 0.000007	< 0.000007	0.012	0.0000060	36	0.000080	0.000042
3-Feb-16	41	80	400	310	8.3	292	#N/A	1.9	128	20	-	0.32	-	142	0.0067	0.011	0.052	0.053	< 0.000007	< 0.000007	0.011	0.0000060	32	0.000070	0.000033
17-Feb-16	42	82	400	285	8.3	318	#N/A	3.2	142	18	-	0.34	-	160	0.0064	0.012	0.055	0.072	< 0.000007	< 0.000007	0.012	0.0000030	37	0.00012	0.000028
2-Mar-16	43	84	400	335	8.3	296	#N/A	1.1	131	14	-	0.35	-	146	0.0044	0.011	0.060	0.061	< 0.000007	< 0.000007	0.010	0.000013	32	0.00012	0.000027

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 6 (GT)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
30-Jul-14	1	1	1200	370	8.1	0.016	0.31	0.000070	0.011	39	0.070	0.41	0.054	0.0086	0.051	24	0.0065	4.6	0.000084	146	0.42	169	0.00021	0.00051	0.00059	0.44	0.00038	0.0030	< 0.002
13-Aug-14	2	3	400	300	8.2	0.0059	< 0.002	0.000070	0.0073	18	0.026	< 0.01	0.065	0.0072	0.024	14	0.0022	4.5	< 0.000002	43	0.21	67	0.00015	0.000030	0.00019	0.41	0.000050	0.0010	< 0.002
27-Aug-14	3	5	400	310	8.2	0.0027	< 0.002	0.000040	0.0060	15	0.010	< 0.01	0.068	0.0039	0.026	13	0.0012	4.6	< 0.000002	51	0.18	40	0.00014	0.00019	0.000050	0.33	0.00014	0.0010	< 0.002
10-Sep-14	4	7	400	310	8.3	0.0020	< 0.007	0.000030	0.0053	13	0.0070	< 0.01	0.064	0.0014	0.020	11	0.00076	5.5	< 0.000002	53	0.19	29	0.00016	0.000060	0.000050	0.28	0.00017	< 0.001	< 0.002
24-Sep-14	5	9	400	240	8.2	0.0020	< 0.002	0.000030	0.0060	14	0.0052	< 0.01	0.057	0.0017	0.013	12	0.00034	4.5	0.0000070	42	0.18	19	0.00016	0.00012	0.00033	0.25	0.00015	0.0030	< 0.002
8-Oct-14	6	11	300	220	8.2	0.0015	< 0.007	0.000080	0.0066	15	0.0028	< 0.01	0.050	0.00090	0.015	11	0.00034	4.6	< 0.000002	32	0.22	17	0.00016	0.000040	0.00010	0.25	0.00015	< 0.001	< 0.002
22-Oct-14	7	13	400	295	8.3	0.0012	< 0.007	0.00019	0.0051	15	0.0046	< 0.01	0.050	0.00080	0.015	12	0.00029	5.1	< 0.000002	26	0.20	16	0.00016	< 0.00001	0.00011	0.25	0.00014	< 0.001	< 0.002
5-Nov-14	8	15	400	275		0.0013	< 0.007	0.000060	0.0051	16	0.0036	< 0.01	0.048	0.00070	0.011	10	0.00024	4.7	< 0.000002	17	0.24	13	0.00015	0.000060	0.00013	0.25	0.00013	< 0.001	< 0.002
19-Nov-14	9	17	400	270	8.3	0.0011	< 0.007	0.00013	0.0057	18	0.00018	< 0.01	0.042	0.00060	0.014	11	0.00020	4.9	< 0.000002	13	0.25	12	0.00023	0.000030	0.000090	0.26	0.00014	0.0020	< 0.002
3-Dec-14	10	19	400	335	8.3	0.0015	< 0.007	< 0.00001	0.0046	16	0.0018	< 0.01	0.038	0.00070	0.0090	10	0.00019	4.5	< 0.000002	8.9	0.26	10	0.00016	0.000020	0.000090	0.23	0.00014	0.0010	< 0.002
17-Dec-14	11	21	400	290	8.2	0.0011	< 0.007	< 0.00001	0.0048	17	0.00010	< 0.01	0.040	0.00060	0.0040	12	0.00018	4.5	< 0.000002	7.6	0.26	10	0.00015	< 0.00001	0.000080	0.24	0.00016	< 0.001	< 0.002
31-Dec-14	12	23	400	290	8.2	0.0010	< 0.007	< 0.00001	0.0044	17	0.0014	< 0.01	0.038	0.00060	0.013	11	0.00016	4.8	< 0.000002	5.9	0.26	8.9	0.00015	0.000080	0.00011	0.24	0.00015	< 0.001	< 0.002
14-Jan-15	13	25	400	275	8.2	0.00083	< 0.007	0.000030	0.0045	17	0.0013	< 0.01	0.040	0.00060	0.0030	11	0.00016	4.8	0.0000020	4.9	0.26	8.3	0.00015	0.000050	0.000090	0.25	0.00015	0.0010	< 0.002
28-Jan-15	14	27	400	285	8.2	0.00063	< 0.007	0.00012	0.0037	18	0.0011	< 0.01	0.036	0.00040	< 0.003	11	0.00018	4.3	< 0.000002	4.5	0.20	8.1	0.00014	0.000060	0.00012	0.25	0.00022	0.0020	< 0.002
11-Feb-15	15	29	400	300	8.2	0.0012	< 0.007	< 0.00001	0.0043	17	0.00069	0.010	0.034	0.00050	0.0060	11	< 0.001	4.4	< 0.000002	3.8	0.26	8.7	0.00014	0.00018	0.00010	0.25	0.00018	< 0.001	< 0.002
25-Feb-15	16	31	400	275	8.2	0.0011	< 0.007	0.000030	0.0044	17	0.00075	< 0.01	0.031	0.00050	< 0.003	11	< 0.001	4.7	< 0.000002	3.4	0.26	7.9	0.00017	0.00013	0.000060	0.27	0.00011	0.0010	< 0.002
11-Mar-15	17	33	400	300	8.3	0.0023	< 0.007	< 0.00001	0.0041	16	0.00048	< 0.01	0.031	0.00050	0.0080	10	< 0.001	3.9	< 0.000002	2.7	0.25	7.8	0.00015	0.000020	0.000060	0.25	0.00017	0.0020	< 0.002
25-Mar-15	18	35	400	275	8.2	0.0011	< 0.007	0.000010	0.0040	18	0.00044	< 0.01	0.036	0.00050	0.0070	11	< 0.001	4.8	< 0.000002	3.1	0.26	8.3	0.00016	0.00018	0.00011	0.25	0.00021	< 0.001	< 0.002
8-Apr-15	19	37	400	335	8.1	0.00062	< 0.007	< 0.00001	0.0040	15	0.00025	< 0.01	0.028	0.00040	0.011	11	< 0.001	5.0	< 0.000002	2.2	0.25	7.7	0.00015	0.000060	0.000070	0.25	0.00014	< 0.001	< 0.002
22-Apr-15	20	39	400	270	8.1	0.0019	< 0.007	0.00021	0.0042	17	0.00046	< 0.01	0.025	0.00050	0.0090	11	0.00017	4.9	0.0000030	2.2	0.28	7.6	0.00017	0.00041	0.000070	0.25	0.00016	< 0.001	< 0.002
6-May-15	21	41	400	240	8.2	0.0012	< 0.007	< 0.00001	0.0043	17	0.00073	< 0.01	0.022	0.00050	0.0050	11	< 0.001	4.8	0.0000030	2.0	0.27	8.0	0.00015	< 0.00001	0.000060	0.24	0.00021	0.0010	< 0.002
20-May-15	22	43	500	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	23	45	435	315	8.1	0.0013	< 0.007	0.00013	0.0037	15	0.00030	< 0.01	0.023	0.00040	0.010	10	0.00014	4.6	0.0000020	1.5	0.24	7.7	0.00012	0.000030	0.000070	0.24	0.00017	< 0.001	< 0.002
17-Jun-15	24	47	500	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	25	49	435	315	8.1	0.00060	< 0.007	< 0.00001	0.0034	15	0.00079	0.010	0.021	0.00030	0.012	9.1	0.00014	4.6	< 0.000002	1.3	0.23	7.5	0.00015	0.000080	0.000070	0.25	0.00016	0.0010	< 0.002
15-Jul-15	26	51	500	375	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	27	53	375	270	8.1	0.00091	< 0.007	0.000070	0.0035	14	0.00017	0.010	0.020	0.00030	0.0040	9.1	0.00010	4.1	< 0.000002	1.2	0.24	8.7	0.00014	0.000050	< 0.00005	0.27	0.00017	0.0010	< 0.002
12-Aug-15	28	55	500	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	29	57	430	270	8.2	0.00058	< 0.007	0.000060	0.0032	14	0.00056	< 0.01	0.023	0.00030	0.0060	8.7	0.00013	4.3	0.000026	1.2	0.24	8.5	0.00013	0.000020	< 0.00005	0.25	0.00018	< 0.001	< 0.002
9-Sep-15	30	59	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	31	61	425	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	32	63	335	245	8.2	0.00058	< 0.007	< 0.00001	0.0028	15	0.00016	< 0.01	0.015	0.00030	0.0050	8.4	0.00010	3.9	< 0.000002	1.1	0.22	7.7	0.000096	0.00013	< 0.00005	0.23	0.00017	0.0020	< 0.002
21-Oct-15	33	65	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	34	67	485	375	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	35	69	375	280	8.4	0.0014	0.017	0.00028	0.0026	15	0.0078	< 0.01	0.018	0.00080	0.0070	8.8	0.00027	4.1	0.000012	1.1	0.23	8.7	0.00012	0.000060	< 0.00005	0.21	0.00016	0.0010	< 0.002
2-Dec-15	36	71	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	37	73	455	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	38	75	410	350	8.4	0.00070	< 0.007	0.00028	0.0025	15	0.00010	< 0.01	0.016	0.00020	0.0090	8.2	0.00011	4.0	< 0.000002	1.0	0.19	7.4	0.000095	0.00011	< 0.00005	0.24	0.00014	< 0.001	< 0.002
6-Jan-16	39	76	400	355	8.3	0.0010	< 0.007	0.00011	0.0027	16	0.000080	< 0.01	0.014	0.00020	0.0070	9.1	0.00032	4.5	0.0000020	1.1	0.22	9.3	0.000085	0.00032	< 0.00005	0.25	0.00011	< 0.001	< 0.002
20-Jan-16	40	78	400	255	8.3	0.00054	< 0.007	0.000050	0.0028	16	0.0011	< 0.01	0.018	0.00030	0.0060	8.9	0.00014	4.7	< 0.000002	1.1	0.26	9.6	0.00013	0.000030	< 0.00005	0.31	0.00014	< 0.001	< 0.002
3-Feb-16	41	80	400	310	8.3	0.00065	< 0.007	0.000030	0.0027	15	< 0.00001	< 0.01	0.015	0.00030	0.0080	8.8	0.00021	4.4	0.000014	1.0	0.24	7.9	0.00014	0.000040	< 0.00005	0.24	0.00014	< 0.001	< 0.002
17-Feb-16	42	82	400	285	8.3	0.00074	< 0.007	< 0.00001	0.0030	17	0.00014	< 0.01	0.017	0.00030	0.010	9.3	0.000070	4.5	< 0.000002	1.2	0.25	6.9	0.00016	0.000080	< 0.00005	0.28	0.00014	< 0.001	< 0.002
2-Mar-16	43	84	400	335	8.3	0.00036	< 0.007	0.00017	0.0026	16	0.00013	< 0.01	0.017	0.00020	0.0040	8.8	0.000070	4.5	< 0.000002	1.1	0.23	6.4	0.00014	0.000020	< 0.00005	0.22	0.00012	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 6 (GT)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
30-Jul-14	1	1	1200	370	8.1	1431	#N/A	0.18	7.3	16	0.85	0.013	0.011	14	0.00037	0.00041	0.0029	0.0011	0.00000026	0.00000044	0.0015	0.00000011	3.1	0.000035	0.000054
13-Aug-14	2	3	400	300	8.2	776	#N/A	0.062	2.6	2.7	0.065	0.0062	0.0045	2.5	0.000059	0.00017	0.0013	0.00033	0.00000011	0.00000011	0.00054	0.000000045	0.54	0.0000050	0.000010
27-Aug-14	3	5	400	310	8.2	576	#N/A	0.076	2.7	1.9	0.031	0.0070	0.0047	2.1	0.00010	0.00016	0.0013	0.00037	0.00000011	0.00000011	0.00068	0.00000016	0.46	0.00000078	0.0000054
10-Sep-14	4	7	400	310	8.3	492	#N/A	0.058	2.7	1.1	0.0078	0.0079	0.0047	1.8	0.00010	0.00015	0.0014	0.00047	0.00000011	0.00000011	0.00053	0.00000034	0.41	0.0000016	0.0000037
24-Sep-14	5	9	400	240	8.2	449	#N/A	0.052	2.2	0.78	0.0024	0.0060	0.0036	1.5	0.000047	0.00012	0.00089	0.00045	0.000000084	0.000000084	0.00040	0.000000036	0.33	0.0000014	0.0000032
8-Oct-14	6	11	300	220	8.2	424	#N/A	0.072	1.7	0.47	0.011	0.0051	0.0033	1.5	0.000084	0.00010	0.00076	0.00045	0.000000077	0.000000077	0.00039	0.00000020	0.35	0.00000088	0.0000015
22-Oct-14	7	13	400	295	8.3	491	#N/A	0.082	3.6	0.66	0.015	0.0071	0.0044	2.0	0.00010	0.00013	0.0010	0.00064	0.00000010	0.00000010	0.00053	0.00000071	0.44	0.00000049	0.0000020
5-Nov-14	8	15	400	275		366	#N/A	#N/A	2.3	0.55	0.014	0.0069	0.0041	1.9	0.000092	0.00013	0.00087	0.00064	0.000000096	0.000000096	0.00046	0.00000023	0.40	0.0000011	0.0000017
19-Nov-14	9	17	400	270	8.3	368	#N/A	#N/A	2.7	0.45	0.0027	0.0068	0.0041	2.1	0.000088	0.00012	0.00083	0.00072	0.000000095	0.000000095	0.00047	0.0000014	0.43	0.00000068	0.00000097
3-Dec-14	10	19	400	335	8.3	335	#N/A	0.049	2.6	0.50	0.0034	0.0075	0.0050	2.5	0.00011	0.00014	0.00097	0.00093	0.00000012	0.00000012	0.00046	0.00000025	0.56	0.0000010	0.0000014
17-Dec-14	11	21	400	290	8.2	346	#N/A	0.042	2.2	0.39	0.015	0.0078	0.0044	2.3	0.000094	0.00013	0.00088	0.00077	0.00000010	0.00000010	0.00042	0.00000012	0.50	0.00000044	0.00000094
31-Dec-14	12	23	400	290	8.2	333	#N/A	0.054	2.2	0.35	0.015	0.0073	0.0044	2.2	0.00013	0.00013	0.00084	0.00082	0.00000010	0.00000010	0.00039	0.00000022	0.48	0.00000044	0.0000012
14-Jan-15	13	25	400	275	8.2	351	#N/A	0.044	2.1	0.33	0.014	0.0072	0.0041	2.1	0.000095	0.00014	0.00082	0.00082	0.000000096	0.000000096	0.00039	0.00000025	0.46	0.00000096	0.00000096
28-Jan-15	14	27	400	285	8.2	347	#N/A	0.045	2.1	0.34	0.014	0.0074	0.0043	2.2	0.00014	0.00013	0.00078	0.00084	0.000000100	0.000000100	0.00031	0.00000014	0.44	0.0000013	0.00000076
11-Feb-15	15	29	400	300	8.2	334	#N/A	0.063	2.4	0.39	0.015	0.0078	0.0045	2.3	0.00015	0.00016	0.00091	0.00087	0.00000011	0.00000011	0.00040	0.00000023	0.49	0.0000014	0.00000087
25-Feb-15	16	31	400	275	8.2	335	#N/A	0.035	2.2	0.33	0.014	0.0063	0.0041	2.1	0.000055	0.00013	0.00070	0.00086	0.000000096	0.000000096	0.00034	0.00000026	0.49	0.0000033	0.00000080
11-Mar-15	17	33	400	300	8.3	355	#N/A	#N/A	2.8	0.30	0.015	0.0080	0.0045	2.2	0.00011	0.00014	0.00077	0.00087	0.00000011	0.00000011	0.00032	0.00000015	0.50	0.0000014	0.00000078
25-Mar-15	18	35	400	275	8.2	331	#N/A	0.052	2.1	0.29	0.014	0.0069	0.0041	2.1	0.000095	0.00015	0.00084	0.00089	0.000000096	0.000000096	0.00029	0.00000012	0.44	0.0000019	0.00000077
8-Apr-15	19	37	400	335	8.1	322	#N/A	0.072	2.6	0.42	0.017	0.0084	0.0050	2.4	0.00010	0.00022	0.00093	0.00100	0.00000012	0.00000012	0.00041	0.000000067	0.56	0.0000012	0.00000084
22-Apr-15	20	39	400	270	8.1	338	#N/A	0.070	2.2	0.34	0.014	0.0063	0.0041	2.2	0.000084	0.00015	0.00065	0.00090	0.000000095	0.000000095	0.00034	0.000000095	0.51	0.0000011	0.00000062
6-May-15	21	41	400	240	8.2	343	#N/A	0.053	2.0	0.28	0.012	0.0047	0.0036	2.0	0.00010	0.00012	0.00050	0.00079	0.000000084	0.000000084	0.00026	0.000000036	0.44	0.00000036	0.00000047
20-May-15	22	43	500	435																					
3-Jun-15	23	45	435	315	8.1	307	#N/A	0.039	1.1	0.17	0.0079	0.0035	0.0024	1.1	0.000083	0.000080	0.00036	0.00045	0.000000055	0.000000055	0.00017	0.000000024	0.26	0.00000047	0.00000029
17-Jun-15	24	47	500	435																					
1-Jul-15	25	49	435	315	8.1	319	#N/A	0.036	1.1	0.17	0.0079	0.0033	0.0024	1.1	0.000064	0.000087	0.00042	0.00046	0.000000055	0.000000055	0.00013	0.000000047	0.24	0.00000063	0.00000041
15-Jul-15	26	51	500	375																					
29-Jul-15	27	53	375	270	8.1	298	#N/A	0.020	0.90	0.18	0.0068	0.0028	0.0020	0.91	0.000059	0.000070	0.00030	0.00037	0.000000047	0.000000047	0.00012	0.000000047	0.21	0.00000054	0.00000024
12-Aug-15	28	55	500	430																					
26-Aug-15	29	57	430	270	8.2	299	#N/A	0.013	0.90	0.18	0.0068	0.0028	0.0020	0.91	0.000070	0.000070	0.00032	0.00038	0.000000047	0.000000047	0.00011	0.000000041	0.21	0.00000068	0.00000030
9-Sep-15	30	59	500	425																					
23-Sep-15	31	61	425	335																					
7-Oct-15	32	63	335	245	8.2	321	#N/A	0.013	0.60	0.094	0.00	0.0016	0.00	0.56	0.000035	0.000045	0.00018	0.00020	0.000000029	0.000000029	0.000054	0.000000037	0.13	0.00000053	0.00000012
21-Oct-15	33	65	500	485																					
4-Nov-15	34	67	485	375																					
18-Nov-15	35	69	375	280	8.4	310	#N/A	#N/A	0.74	0.098	0.00	0.0016	0.00	0.65	0.000040	0.000046	0.00024	0.00021	0.000000033	0.000000033	0.000046	0.000000042	0.15	0.00000047	0.0000021
2-Dec-15	36	71	500	455																					
16-Dec-15	37	73	455	410																					
30-Dec-15	38	75	410	350	8.4	316	#N/A	#N/A	0.76	0.13	0.00	0.0019	0.00	0.83	0.000044	0.000055	0.00023	0.00030	0.000000041	0.000000041	0.000072	0.000000018	0.19	0.00000058	0.00000011
6-Jan-16	39	76	400	355	8.3	315	#N/A	#N/A	0.77	0.17	0.00	0.0017	0.00	0.92	0.000038	0.000057	0.00026	0.00034	0.000000041	0.000000041	0.000077	0.00000015	0.21	0.00000041	0.000000024
20-Jan-16	40	78	400	255	8.3	321	#N/A	0.0067	0.56	0.14	0.00	0.0014	0.00	0.67	0.000025	0.000049	0.00022	0.00025	0.000000030	0.000000030	0.000051	0.000000026	0.15	0.00000034	0.00000018
3-Feb-16	41	80	400	310	8.3	292	#N/A	0.030	2.0	0.31	0.00	0.0050	0.00	2.2	0.00010	0.00017	0.00081	0.00082	0.00000011	0.00000011	0.00017	0.000000093	0.50	0.0000011	0.00000051
17-Feb-16	42	82	400	285	8.3	318	#N/A	0.046	2.0	0.26	0.00	0.0048	0.00	2.3	0.000091	0.00017	0.00078	0.0010	0.000000100	0.000000100	0.00017	0.000000043	0.52	0.0000017	0.00000040
2-Mar-16	43	84	400	335	8.3	296	#N/A	0.018	2.2	0.23	0.00	0.0059	0.00	2.4	0.000074	0.00019	0.0010	0.0010	0.00000012	0.00000012	0.00017	0.00000022	0.54	0.0000020	0.00000045

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 6 (GT)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
30-Jul-14	1	1	1200	370	8.1	0.00060	0.011	0.0000026	0.00041	1.4	0.0026	0.015	0.0020	0.00032	0.0019	0.88	0.00024	0.17	0.0000031	5.4	0.016	6.3	0.0000077	0.000019	0.000022	0.016	0.000014	0.00011	0.000074
13-Aug-14	2	3	400	300	8.2	0.000088	0.000030	0.0000011	0.00011	0.28	0.00039	0.00015	0.00097	0.00011	0.00036	0.21	0.000033	0.068	0.000000030	0.65	0.0032	1.0	0.0000023	0.00000045	0.0000029	0.0062	0.00000075	0.000015	0.000030
27-Aug-14	3	5	400	310	8.2	0.000042	0.000031	0.00000062	0.000093	0.23	0.00016	0.00016	0.0011	0.000060	0.00040	0.20	0.000019	0.071	0.000000031	0.78	0.0028	0.63	0.0000021	0.0000029	0.00000078	0.0051	0.0000022	0.000016	0.000031
10-Sep-14	4	7	400	310	8.3	0.000031	0.00011	0.00000047	0.000082	0.20	0.00011	0.00016	0.00100	0.000022	0.00031	0.17	0.000012	0.085	0.000000031	0.82	0.0029	0.44	0.0000024	0.00000093	0.00000078	0.0043	0.0000026	0.000016	0.000031
24-Sep-14	5	9	400	240	8.2	0.000024	0.000024	0.00000036	0.000072	0.17	0.000062	0.00012	0.00068	0.000020	0.00016	0.14	0.0000041	0.054	0.000000084	0.51	0.0021	0.23	0.0000020	0.0000014	0.0000040	0.0030	0.0000018	0.000036	0.000024
8-Oct-14	6	11	300	220	8.2	0.000016	0.000077	0.00000088	0.000073	0.16	0.000030	0.00011	0.00055	0.0000099	0.00017	0.12	0.0000037	0.051	0.000000022	0.36	0.0025	0.18	0.0000018	0.00000044	0.0000011	0.0028	0.0000017	0.000011	0.000022
22-Oct-14	7	13	400	295	8.3	0.000018	0.00010	0.0000028	0.000075	0.23	0.000068	0.00015	0.00074	0.000012	0.00022	0.17	0.0000043	0.075	0.000000030	0.39	0.0030	0.23	0.0000023	0.00000015	0.0000016	0.0037	0.0000021	0.000015	0.000030
5-Nov-14	8	15	400	275		0.000018	0.000096	0.00000083	0.000070	0.22	0.000049	0.00014	0.00066	0.0000096	0.00015	0.14	0.0000033	0.064	0.000000028	0.24	0.0032	0.17	0.0000021	0.00000083	0.0000018	0.0034	0.0000018	0.000014	0.000028
19-Nov-14	9	17	400	270	8.3	0.000015	0.000095	0.0000018	0.000077	0.24	0.0000024	0.00014	0.00057	0.0000081	0.00019	0.15	0.0000027	0.066	0.000000027	0.17	0.0034	0.16	0.0000032	0.00000041	0.0000012	0.0035	0.0000019	0.000027	0.000027
3-Dec-14	10	19	400	335	8.3	0.000026	0.00012	0.00000017	0.000077	0.27	0.000029	0.00017	0.00063	0.000012	0.00015	0.17	0.0000032	0.075	0.000000034	0.15	0.0043	0.17	0.0000026	0.00000034	0.0000015	0.0038	0.0000023	0.000017	0.000034
17-Dec-14	11	21	400	290	8.2	0.000016	0.00010	0.00000015	0.000069	0.25	0.0000015	0.00015	0.00057	0.0000087	0.000058	0.17	0.0000026	0.065	0.000000029	0.11	0.0038	0.15	0.0000022	0.00000015	0.0000012	0.0035	0.0000023	0.000015	0.000029
31-Dec-14	12	23	400	290	8.2	0.000015	0.00010	0.00000015	0.000063	0.24	0.000020	0.00015	0.00055	0.0000087	0.00019	0.15	0.0000023	0.069	0.000000029	0.085	0.0037	0.13	0.0000022	0.0000012	0.0000016	0.0035	0.0000022	0.000015	0.000029
14-Jan-15	13	25	400	275	8.2	0.000011	0.000096	0.00000041	0.000062	0.24	0.000018	0.00014	0.00055	0.0000083	0.000041	0.15	0.0000022	0.065	0.000000028	0.067	0.0036	0.11	0.0000021	0.00000069	0.0000012	0.0034	0.0000021	0.000014	0.000028
28-Jan-15	14	27	400	285	8.2	0.0000090	0.000100	0.0000017	0.000053	0.25	0.000016	0.00014	0.00051	0.0000057	0.000043	0.15	0.0000026	0.061	0.000000029	0.064	0.0029	0.12	0.0000020	0.00000086	0.0000017	0.0036	0.0000031	0.000029	0.000029
11-Feb-15	15	29	400	300	8.2	0.000018	0.00011	0.00000015	0.000064	0.26	0.000010	0.00015	0.00051	0.0000075	0.000090	0.16	0.000015	0.066	0.000000030	0.057	0.0038	0.13	0.0000021	0.0000027	0.0000015	0.0037	0.0000027	0.000015	0.000030
25-Feb-15	16	31	400	275	8.2	0.000015	0.000096	0.00000041	0.000060	0.23	0.000010	0.00014	0.00043	0.0000069	0.000041	0.16	0.000014	0.065	0.000000028	0.046	0.0036	0.11	0.0000023	0.0000018	0.00000083	0.0037	0.0000015	0.000014	0.000028
11-Mar-15	17	33	400	300	8.3	0.000034	0.00011	0.00000015	0.000062	0.23	0.0000072	0.00015	0.00047	0.0000075	0.00012	0.15	0.000015	0.058	0.000000030	0.040	0.0037	0.12	0.0000023	0.00000030	0.00000090	0.0038	0.0000026	0.000030	0.000030
25-Mar-15	18	35	400	275	8.2	0.000015	0.000096	0.00000014	0.000054	0.24	0.0000061	0.00014	0.00049	0.0000069	0.000096	0.15	0.000014	0.066	0.000000028	0.042	0.0035	0.11	0.0000022	0.0000025	0.0000015	0.0035	0.0000029	0.000014	0.000028
8-Apr-15	19	37	400	335	8.1	0.000010	0.00012	0.00000017	0.000067	0.25	0.0000042	0.00017	0.00047	0.0000067	0.00018	0.18	0.000017	0.084	0.000000034	0.037	0.0042	0.13	0.0000025	0.0000010	0.0000012	0.0043	0.0000023	0.000017	0.000034
22-Apr-15	20	39	400	270	8.1	0.000025	0.000095	0.0000028	0.000057	0.23	0.0000062	0.00014	0.00034	0.0000068	0.00012	0.15	0.0000023	0.066	0.000000041	0.030	0.0037	0.10	0.0000023	0.0000055	0.00000095	0.0034	0.0000022	0.000014	0.000027
6-May-15	21	41	400	240	8.2	0.000014	0.000084	0.00000012	0.000051	0.21	0.0000088	0.00012	0.00027	0.0000060	0.000060	0.13	0.000012	0.058	0.000000036	0.024	0.0032	0.096	0.0000018	0.00000012	0.00000072	0.0029	0.0000025	0.000012	0.000024
20-May-15	22	43	500	435																									
3-Jun-15	23	45	435	315	8.1	0.000010	0.000055	0.0000010	0.000029	0.12	0.0000024	0.000079	0.00018	0.0000032	0.000079	0.079	0.0000011	0.036	0.000000016	0.012	0.0019	0.061	0.00000098	0.00000024	0.00000055	0.0019	0.0000013	0.0000079	0.000016
17-Jun-15	24	47	500	435																									
1-Jul-15	25	49	435	315	8.1	0.0000047	0.000055	0.000000079	0.000027	0.11	0.0000062	0.000079	0.00017	0.0000024	0.000095	0.072	0.0000011	0.036	0.000000016	0.010	0.0018	0.059	0.0000012	0.00000063	0.00000055	0.0019	0.0000013	0.0000079	0.000016
15-Jul-15	26	51	500	375																									
29-Jul-15	27	53	375	270	8.1	0.0000061	0.000047	0.00000047	0.000024	0.097	0.0000011	0.000068	0.00014	0.0000020	0.000027	0.061	0.00000068	0.028	0.000000014	0.0078	0.0016	0.059	0.00000092	0.00000034	0.00000034	0.0018	0.0000011	0.0000068	0.000014
12-Aug-15	28	55	500	430																									
26-Aug-15	29	57	430	270	8.2	0.0000039	0.000047	0.00000041	0.000021	0.096	0.0000038	0.000068	0.00015	0.0000020	0.000041	0.059	0.00000088	0.029	0.00000018	0.0080	0.0016	0.057	0.00000088	0.00000014	0.00000034	0.0017	0.0000012	0.0000068	0.000014
9-Sep-15	30	59	500	425																									
23-Sep-15	31	61	425	335																									
7-Oct-15	32	63	335	245	8.2	0.0000024	0.000029	0.000000041	0.000011	0.060	0.00000065	0.000041	0.000060	0.0000012	0.000020	0.034	0.00000041	0.016	0.0000000082	0.0043	0.00088	0.031	0.00000039	0.00000053	0.00000020	0.00095	0.00000069	0.0000082	0.0000082
21-Oct-15	33	65	500	485																									
4-Nov-15	34	67	485	375																									
18-Nov-15	35	69	375	280	8.4	0.0000066	0.000079	0.0000013	0.000012	0.069	0.000037	0.000047	0.000082	0.0000037	0.000033	0.041	0.0000013	0.019	0.000000056	0.0051	0.0011	0.041	0.00000056	0.00000028	0.00000023	0.00096	0.00000075	0.0000047	0.0000093
2-Dec-15	36	71	500	455																									
16-Dec-15	37	73	455	410																									
30-Dec-15	38	75	410	350	8.4	0.0000041	0.000041	0.0000016	0.000014	0.087	0.00000058	0.000058	0.000094	0.0000012	0.000053	0.048	0.00000064	0.024	0.000000012	0.0060	0.0011	0.043	0.00000055	0.00000064	0.00000029	0.0014	0.00000082	0.0000058	0.000012
6-Jan-16	39	76	400	355	8.3	0.0000059	0.000041	0.00000065	0.000016	0.096	0.00000047	0.000059	0.000083	0.0000012	0.000041	0.054	0.0000019	0.027	0.000000012	0.0062	0.0013	0.055	0.00000050	0.0000019	0.00000030	0.0015	0.00000065	0.0000059	0.000012
20-Jan-16	40	78	400	255	8.3	0.0000023	0.000030	0.00000021	0.000012	0.070	0.0000045	0.000043	0.000075	0.0000013	0.000026	0.038	0.00000060	0.020	0.0000000085	0.0046	0.0011	0.041	0.00000057	0.00000013	0.00000021	0.0013	0.00000060	0.0000043	0.0000085
3-Feb-16	41	80	400	310	8.3	0.000010	0.00011	0.00000047	0.000042	0.23	0.00000016	0.00016	0.00023	0.0000047	0.00012	0.14	0.0000033	0.068	0.00000022	0.016	0.0036	0.12	0.0000021	0.00000062	0.00000078	0.0038	0.0000022	0.000016	0.000031
17-Feb-16	42	82	400	285	8.3	0.000011	0.000100	0.00000014	0.000043	0.24	0.0000020	0.00014	0.00025	0.0000043	0.00014	0.13	0.00000100	0.064	0.000000029	0.017	0.0035	0.098	0.0000023	0.0000011	0.00000071	0.0039	0.0000020	0.000014	0.000029
2-Mar-16	43	84	400	335	8.3	0.0000060	0.00012	0.0000028	0.000044	0.26	0.0000022	0.00017	0.00028	0.0000034	0.000067	0.15	0.0000012	0.075	0.000000034	0.019	0.0039	0.11	0.0000023	0.00000034	0.00000084	0.0038	0.0000020	0.000017	0.000034

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 13 (OKY Master)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/L	mg$CaCO_3$/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-May-15	1	1	2000	415	7.0	1431	#N/A	9.4	80	333	36	#N/A	*< 0.3*	272	0.012	0.0046	0.057	0.031	0.000037	*< 0.000007*	0.12	0.000062	77	0.000060	0.020
3-Jun-15	2	3	400	360	7.7	301	#N/A	6.8	83	67	6.0	0.18	*< 0.3*	29	0.0050	0.0069	0.20	0.0034	0.0000090	*< 0.000007*	0.16	*< 0.000003*	8.2	0.000060	0.0025
17-Jun-15	3	5	300	260	7.7	282	#N/A	5.2	85	45	*< 1*	0.18	*< 0.3*	30	0.0042	0.0071	0.23	0.0034	0.000010	*< 0.000007*	0.14	0.0000040	8.5	0.000040	0.0026
1-Jul-15	4	7	300	280	7.8	300	#N/A	6.6	78	52	8.0	0.20	*< 0.3*	31	0.0050	0.0066	0.14	0.0033	0.0000090	*< 0.000007*	0.16	0.000012	8.5	0.000080	0.0028
15-Jul-15	5	9	300	265	7.8	293	#N/A	5.8	70	66	4.0	0.20	*< 0.3*	32	0.0043	0.0064	0.10	0.0038	*< 0.000007*	*< 0.000007*	0.16	0.0000040	8.8	0.000060	0.0034
29-Jul-15	6	11	300	250	7.7	307	#N/A	3.5	57	87	2.0	0.20	*< 0.3*	35	0.0049	0.0060	0.081	0.0036	0.0000070	*< 0.000007*	0.13	0.000010	10	0.00011	0.0032
12-Aug-15	7	13	300	295	7.7	301	#N/A	3.8	51	90	*< 1*	0.19	*< 0.3*	36	0.0044	0.0060	0.086	0.0037	*< 0.000007*	0.0000090	0.13	0.000011	10	0.00024	0.0033
26-Aug-15	8	15	300	250	7.6	262	#N/A	3.8	40	81	*< 1*	0.22	*< 0.3*	29	0.0043	0.0066	0.096	0.0028	*< 0.000007*	*< 0.000007*	0.13	0.000012	8.2	*< 0.00003*	0.0023
9-Sep-15	9	17	300	235	7.5	230	#N/A	3.9	31	69	*< 1*	0.25	*< 0.3*	24	0.0038	0.0071	0.11	0.0023	*< 0.000007*	*< 0.000007*	0.12	0.0000030	6.8	0.000050	0.0018
23-Sep-15	10	19	300	250	7.5	197	#N/A	3.0	23	63	*< 1*	0.25	-	19	0.0039	0.0076	0.12	0.0018	*< 0.000007*	*< 0.000007*	0.12	*< 0.000003*	5.5	0.00017	0.0013
7-Oct-15	11	21	300	230	7.5	181	#N/A	3.1	22	55	*< 1*	0.27	-	15	0.0047	0.0077	0.10	0.0014	*< 0.000007*	*< 0.000007*	0.089	0.0000040	4.3	0.000030	0.0011
21-Oct-15	12	23	350	275	7.8	164	#N/A	1.5	24	41	*< 1*	0.28	-	14	0.0075	0.0069	0.11	0.0016	*< 0.000007*	*< 0.000007*	0.070	0.0000050	3.9	0.00020	0.00095
4-Nov-15	13	25	300	230	7.4	152	#N/A	2.3	17	39	*< 1*	0.26	-	15	0.0073	0.0076	0.12	0.0015	*< 0.000007*	*< 0.000007*	0.091	0.0000070	4.2	0.000070	0.0013
18-Nov-15	14	27	300	245	7.6	146	#N/A	1.4	22	42	*< 1*	0.26	-	13	0.0025	0.0070	0.11	0.0011	*< 0.000007*	*< 0.000007*	0.068	*< 0.000003*	3.6	*< 0.00003*	0.0012
2-Dec-15	15	29	300	240	7.3	137	#N/A	3.6	17	39	*< 1*	0.29	-	13	0.0052	0.0077	0.13	0.0015	*< 0.000007*	*< 0.000007*	0.063	0.000010	3.6	0.00028	0.00098
16-Dec-15	16	31	300	235	7.6	129	#N/A	4.1	18	39	*< 1*	0.24	-	13	0.0039	0.0073	0.11	0.0014	*< 0.000007*	*< 0.000007*	0.066	0.0000070	3.6	0.000060	0.0012
30-Dec-15	17	33	300	385	7.5	126	#N/A	2.8	16	31	*< 1*	0.28	-	13	0.0039	0.0073	0.12	0.0014	*< 0.000007*	*< 0.000007*	0.070	0.0000040	3.5	0.000040	0.0011
13-Jan-16	18	35	300	290	7.4	118	#N/A	2.8	17	31	*< 1*	0.26	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	19	37	300	300	7.5	120	#N/A	3.7	21	32	*< 1*	0.29	-	12	0.020	0.0069	0.10	0.0016	*< 0.000007*	*< 0.000007*	0.057	0.0000080	3.3	*< 0.00003*	0.00095
10-Feb-16	20	39	300	275	7.5	119	#N/A	3.4	23	30	*< 1*	0.26	-	13	0.0033	0.0073	0.11	0.0013	*< 0.000007*	*< 0.000007*	0.047	0.0000050	3.6	*< 0.00003*	0.0011
24-Feb-16	21	41	300	300	7.5	119	#N/A	3.4	22	28	*< 1*	0.26	-	12	0.0022	0.0073	0.11	0.0013	*< 0.000007*	*< 0.000007*	0.050	0.0000060	3.3	*< 0.00003*	0.0011
9-Mar-16	22	43	300	335	7.5	119	#N/A	3.0	22	23															

Calculated Loading Rates for Col 13 (OKY Master)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
20-May-15	1	1	2000	415	7.0	1431	#N/A	0.39	3.3	14	1.5	#N/A	0.012	11	0.00048	0.00019	0.0023	0.0013	0.0000015	0.00000029	0.0049	0.0000026	3.2	0.0000025	0.00081
3-Jun-15	2	3	400	360	7.7	301	#N/A	0.12	1.5	1.2	0.11	0.0032	0.0054	0.52	0.000090	0.00012	0.0036	0.000062	0.00000016	0.00000013	0.0028	0.000000054	0.15	0.0000011	0.000045
17-Jun-15	3	5	300	260	7.7	282	#N/A	0.067	1.1	0.59	0.013	0.0023	0.0039	0.39	0.000055	0.000092	0.0029	0.000044	0.00000013	0.000000091	0.0018	0.000000052	0.11	0.00000052	0.000034
1-Jul-15	4	7	300	280	7.8	300	#N/A	0.093	1.1	0.73	0.11	0.0028	0.0042	0.43	0.000070	0.000092	0.0020	0.000046	0.00000013	0.000000098	0.0022	0.00000017	0.12	0.0000011	0.000040
15-Jul-15	5	9	300	265	7.8	293	#N/A	0.077	0.92	0.87	0.053	0.0027	0.0040	0.43	0.000057	0.000085	0.0014	0.000050	0.000000093	0.000000093	0.0021	0.000000053	0.12	0.00000080	0.000045
29-Jul-15	6	11	300	250	7.7	307	#N/A	0.044	0.71	1.1	0.025	0.0025	0.0038	0.44	0.000061	0.000075	0.0010	0.000045	0.000000088	0.000000088	0.0017	0.00000013	0.13	0.0000014	0.000040
12-Aug-15	7	13	300	295	7.7	301	#N/A	0.056	0.75	1.3	0.015	0.0028	0.0044	0.53	0.000065	0.000089	0.0013	0.000054	0.00000010	0.00000013	0.0018	0.00000016	0.15	0.0000035	0.000049
26-Aug-15	8	15	300	250	7.6	262	#N/A	0.048	0.50	1.0	0.013	0.0028	0.0038	0.36	0.000054	0.000083	0.0012	0.000035	0.000000088	0.000000088	0.0016	0.00000015	0.10	0.00000038	0.000029
9-Sep-15	9	17	300	235	7.5	230	#N/A	0.045	0.36	0.81	0.012	0.0029	0.0035	0.28	0.000045	0.000083	0.0013	0.000027	0.000000082	0.000000082	0.0015	0.000000035	0.080	0.00000059	0.000022
23-Sep-15	10	19	300	250	7.5	197	#N/A	0.037	0.29	0.79	0.013	0.0031	0.00	0.24	0.000049	0.000095	0.0015	0.000023	0.000000088	0.000000088	0.0015	0.000000038	0.068	0.0000021	0.000017
7-Oct-15	11	21	300	230	7.5	181	#N/A	0.035	0.25	0.63	0.012	0.0031	0.00	0.17	0.000054	0.000089	0.0012	0.000016	0.000000081	0.000000081	0.0010	0.000000046	0.049	0.00000035	0.000012
21-Oct-15	12	23	350	275	7.8	164	#N/A	0.020	0.32	0.56	0.014	0.0039	0.00	0.19	0.00010	0.000095	0.0015	0.000022	0.000000096	0.000000096	0.00096	0.000000069	0.054	0.0000028	0.000013
4-Nov-15	13	25	300	230	7.4	152	#N/A	0.027	0.20	0.45	0.012	0.0030	0.00	0.17	0.000084	0.000087	0.0013	0.000018	0.000000081	0.000000081	0.0010	0.000000081	0.049	0.00000081	0.000015
18-Nov-15	14	27	300	245	7.6	146	#N/A	0.018	0.27	0.51	0.012	0.0032	0.00	0.16	0.000031	0.000086	0.0014	0.000014	0.000000086	0.000000086	0.00083	0.000000037	0.044	0.00000037	0.000015
2-Dec-15	15	29	300	240	7.3	137	#N/A	0.043	0.21	0.47	0.012	0.0035	0.00	0.16	0.000062	0.000092	0.0015	0.000017	0.000000084	0.000000084	0.00075	0.00000012	0.043	0.0000034	0.000012
16-Dec-15	16	31	300	235	7.6	129	#N/A	0.048	0.21	0.46	0.012	0.0028	0.00	0.15	0.000046	0.000086	0.0013	0.000017	0.000000082	0.000000082	0.00077	0.000000082	0.042	0.00000071	0.000014
30-Dec-15	17	33	300	385	7.5	126	#N/A	0.054	0.31	0.60	0.019	0.0054	0.00	0.24	0.000075	0.00014	0.0022	0.000028	0.00000013	0.00000013	0.0014	0.000000077	0.068	0.00000077	0.000021
13-Jan-16	18	35	300	290	7.4	118	#N/A	0.041	0.24	0.45	0.015	0.0038	0.00												
27-Jan-16	19	37	300	300	7.5	120	#N/A	0.056	0.31	0.48	0.015	0.0044	0.00	0.18	0.00030	0.00010	0.0016	0.000024	0.00000011	0.00000011	0.00086	0.00000012	0.050	0.00000045	0.000014
10-Feb-16	20	39	300	275	7.5	119	#N/A	0.047	0.31	0.41	0.014	0.0036	0.00	0.17	0.000045	0.00010	0.0016	0.000018	0.000000096	0.000000096	0.00065	0.000000069	0.050	0.00000041	0.000015
24-Feb-16	21	41	300	300	7.5	119	#N/A	0.051	0.33	0.42	0.015	0.0039	0.00	0.18	0.000033	0.00011	0.0017	0.000019	0.00000011	0.00000011	0.00075	0.000000090	0.050	0.00000045	0.000016
9-Mar-16	22	43	300	335	7.5	119	#N/A	0.050	0.36	0.39															

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 13 (OKY Master)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-May-15	1	1	2000	415	7.0	0.0011	0.056	0.00014	0.023	19	2.3	0.050	0.0011	0.0042	0.023	31	0.0020	14	0.000056	120	0.36	125	0.00024	0.000070	0.00020	0.0030	0.00010	0.049	*< 0.002*
3-Jun-15	2	3	400	360	7.7	0.0013	*< 0.007*	0.000070	0.0096	2.1	0.54	0.030	0.0015	0.00080	0.0080	12	*< 0.001*	14	0.000032	42	0.036	22	0.000070	0.00011	0.00017	0.0029	0.00013	0.0070	*< 0.002*
17-Jun-15	3	5	300	260	7.7	0.00059	*< 0.007*	*< 0.00001*	0.0085	2.1	0.66	*< 0.01*	0.0023	0.00070	0.0060	12	0.00021	15	0.000010	40	0.038	26	0.000078	0.000090	0.00021	0.0037	0.00011	0.0060	*< 0.002*
1-Jul-15	4	7	300	280	7.8	0.00077	*< 0.007*	*< 0.00001*	0.0093	2.3	0.79	0.020	0.0022	0.00080	*< 0.003*	11	0.00020	15	0.000017	39	0.041	26	0.000074	0.00015	0.00022	0.0037	0.00013	0.0060	*< 0.002*
15-Jul-15	5	9	300	265	7.8	0.0034	*< 0.007*	0.000060	0.0099	2.5	1.0	*< 0.01*	0.0022	0.00090	*< 0.003*	11	0.00019	15	0.000017	41	0.045	29	0.000082	0.00044	0.00025	0.0038	0.00012	0.0070	*< 0.002*
29-Jul-15	6	11	300	250	7.7	0.00059	*< 0.007*	0.000020	0.011	2.5	1.1	0.010	0.0023	0.00080	*< 0.003*	12	0.00014	14	0.000010	37	0.046	30	0.000069	0.000060	*< 0.00005*	0.0035	0.00011	0.0050	*< 0.002*
12-Aug-15	7	13	300	295	7.7	0.00055	*< 0.007*	0.000010	0.0095	2.6	1.1	*< 0.01*	0.0025	0.00090	0.0030	12	0.00013	15	0.000012	36	0.047	27	0.000087	0.000090	*< 0.00005*	0.0026	0.00010	0.0050	*< 0.002*
26-Aug-15	8	15	300	250	7.6	0.00090	*< 0.007*	0.00010	0.0091	1.9	0.90	0.010	0.0022	0.00060	0.0040	10	0.00013	15	0.0000090	31	0.037	24	0.000065	0.00013	*< 0.00005*	0.0021	0.00012	0.0040	*< 0.002*
9-Sep-15	9	17	300	235	7.5	0.00093	*< 0.007*	0.000040	0.0071	1.7	0.75	*< 0.01*	0.0038	0.00060	*< 0.003*	10	0.00010	14	0.0000080	28	0.029	27	0.000066	0.00015	*< 0.00005*	0.0015	0.00014	0.0030	*< 0.002*
23-Sep-15	10	19	300	250	7.5	0.00092	*< 0.007*	0.000020	0.0065	1.3	0.60	*< 0.01*	0.0021	0.00040	*< 0.003*	8.6	0.000090	15	0.000086	24	0.024	21	0.000042	0.00010	0.00015	0.0011	0.00010	0.0030	*< 0.002*
7-Oct-15	11	21	300	230	7.5	0.00061	*< 0.007*	0.000020	0.0057	1.1	0.51	*< 0.01*	0.0037	0.00040	*< 0.003*	7.5	0.000050	13	0.000010	20	0.019	18	0.000059	0.00016	*< 0.00005*	0.0012	0.000090	0.0020	*< 0.002*
21-Oct-15	12	23	350	275	7.8	0.0014	*< 0.007*	0.000030	0.0047	0.97	0.45	*< 0.01*	0.0034	0.00040	0.0050	7.3	*< 0.00004*	14	0.0000060	17	0.016	15	0.000066	0.00016	0.000070	0.00087	0.00018	0.0020	*< 0.002*
4-Nov-15	13	25	300	230	7.4	0.00065	*< 0.007*	*< 0.00001*	0.0057	1.1	0.53	*< 0.01*	0.0040	0.00040	*< 0.003*	6.9	0.000070	14	0.0000020	18	0.019	17	0.000067	0.00016	0.00013	0.0012	0.00030	0.0030	*< 0.002*
18-Nov-15	14	27	300	245	7.6	0.00096	*< 0.007*	0.000070	0.0052	0.95	0.46	*< 0.01*	0.0039	0.00040	*< 0.003*	7.2	0.00011	14	*< 0.000002*	17	0.017	15	0.000052	0.000090	*< 0.00005*	0.0011	0.00010	0.0030	*< 0.002*
2-Dec-15	15	29	300	240	7.3	0.0013	*< 0.007*	0.000060	0.0050	0.98	0.45	*< 0.01*	0.0046	0.00030	0.0030	7.6	0.000090	14	0.0000020	18	0.016	15	0.000037	0.00018	*< 0.00005*	0.0010	0.00014	0.0040	*< 0.002*
16-Dec-15	16	31	300	235	7.6	0.00043	*< 0.007*	0.00017	0.0054	0.95	0.49	*< 0.01*	0.0043	0.00040	*< 0.003*	7.2	0.000060	15	*< 0.000002*	16	0.017	13	0.000075	0.000080	*< 0.00005*	0.0016	0.00012	0.0030	*< 0.002*
30-Dec-15	17	33	300	385	7.5	0.00061	*< 0.007*	0.00015	0.0058	0.94	0.49	0.010	0.0039	0.00040	0.0040	7.0	*< 0.00004*	14	0.0000030	16	0.016	12	0.000051	0.000040	0.000090	0.0012	0.00012	0.0030	*< 0.002*
13-Jan-16	18	35	300	290	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	19	37	300	300	7.5	0.00056	*< 0.007*	0.000030	0.0047	0.84	0.46	*< 0.01*	0.0021	0.00030	0.0060	6.7	*< 0.00004*	15	0.0000020	14	0.015	11	0.000046	0.00014	*< 0.00005*	0.00084	0.00012	0.0030	*< 0.002*
10-Feb-16	20	39	300	275	7.5	0.0026	*< 0.007*	0.00013	0.0050	0.85	0.48	*< 0.01*	0.0023	0.00030	0.0030	6.6	0.00017	16	*< 0.000002*	13	0.016	10	0.000043	0.00011	*< 0.00005*	0.00080	0.00012	0.0040	*< 0.002*
24-Feb-16	21	41	300	300	7.5	0.00054	*< 0.007*	0.000040	0.0051	0.86	0.49	0.020	0.0022	0.00040	0.0070	6.8	0.000040	16	0.0000020	12	0.015	9.6	0.000041	0.000050	0.000060	0.00089	0.000080	0.0050	*< 0.002*
9-Mar-16	22	43	300	335	7.5																								

Calculated Loading Rates for Col 13 (OKY Master)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
20-May-15	1	1	2000	415	7.0	0.000046	0.0023	0.0000058	0.00097	0.80	0.096	0.0021	0.000045	0.00017	0.00095	1.3	0.000083	0.60	0.0000023	5.0	0.015	5.2	0.000010	0.0000029	0.0000083	0.00012	0.0000042	0.0020	0.000083
3-Jun-15	2	3	400	360	7.7	0.000023	0.00013	0.0000013	0.00017	0.037	0.0097	0.00054	0.000028	0.000014	0.00014	0.21	0.000018	0.25	0.00000058	0.76	0.00065	0.39	0.0000013	0.0000020	0.0000031	0.000052	0.0000023	0.00013	0.000036
17-Jun-15	3	5	300	260	7.7	0.0000077	0.000091	0.00000013	0.00011	0.027	0.0086	0.00013	0.000030	0.0000091	0.000078	0.15	0.0000027	0.19	0.00000013	0.52	0.00049	0.34	0.0000010	0.0000012	0.0000027	0.000048	0.0000014	0.000078	0.000026
1-Jul-15	4	7	300	280	7.8	0.000011	0.000098	0.00000014	0.00013	0.032	0.011	0.00028	0.000031	0.000011	0.000042	0.16	0.0000028	0.21	0.00000024	0.55	0.00058	0.36	0.0000010	0.0000021	0.0000031	0.000052	0.0000018	0.000084	0.000028
15-Jul-15	5	9	300	265	7.8	0.000045	0.000093	0.00000080	0.00013	0.034	0.014	0.00013	0.000029	0.000012	0.000040	0.14	0.0000025	0.20	0.00000023	0.54	0.00059	0.38	0.0000011	0.0000058	0.0000033	0.000050	0.0000016	0.000093	0.000027
29-Jul-15	6	11	300	250	7.7	0.0000074	0.000088	0.00000025	0.00013	0.031	0.014	0.00013	0.000029	0.000010	0.000038	0.15	0.0000018	0.18	0.00000013	0.46	0.00057	0.38	0.00000086	0.00000075	0.00000063	0.000044	0.0000014	0.000063	0.000025
12-Aug-15	7	13	300	295	7.7	0.0000081	0.00010	0.00000015	0.00014	0.038	0.017	0.00015	0.000037	0.000013	0.000044	0.18	0.0000019	0.22	0.00000018	0.53	0.00069	0.40	0.0000013	0.0000013	0.00000074	0.000038	0.0000015	0.000074	0.000030
26-Aug-15	8	15	300	250	7.6	0.000011	0.000088	0.0000013	0.00011	0.024	0.011	0.00013	0.000028	0.0000075	0.000050	0.13	0.0000016	0.18	0.00000011	0.39	0.00046	0.29	0.00000081	0.0000016	0.00000063	0.000027	0.0000015	0.000050	0.000025
9-Sep-15	9	17	300	235	7.5	0.000011	0.000082	0.00000047	0.000083	0.020	0.0089	0.00012	0.000044	0.0000071	0.000035	0.12	0.0000012	0.16	0.000000094	0.32	0.00034	0.32	0.00000078	0.0000018	0.00000059	0.000018	0.0000016	0.000035	0.000024
23-Sep-15	10	19	300	250	7.5	0.000012	0.000088	0.00000025	0.000081	0.016	0.0075	0.00013	0.000026	0.0000050	0.000038	0.11	0.0000011	0.19	0.0000011	0.30	0.00030	0.27	0.00000053	0.0000013	0.0000019	0.000014	0.0000013	0.000038	0.000025
7-Oct-15	11	21	300	230	7.5	0.0000070	0.000081	0.00000023	0.000066	0.012	0.0058	0.00012	0.000043	0.0000046	0.000035	0.087	0.00000058	0.15	0.00000012	0.23	0.00022	0.21	0.00000068	0.0000018	0.00000058	0.000014	0.0000010	0.000023	0.000023
21-Oct-15	12	23	350	275	7.8	0.000019	0.000096	0.00000041	0.000064	0.013	0.0061	0.00014	0.000047	0.0000055	0.000069	0.100	0.00000055	0.19	0.000000083	0.24	0.00022	0.21	0.00000091	0.0000022	0.00000096	0.000012	0.0000025	0.000028	0.000028
4-Nov-15	13	25	300	230	7.4	0.0000075	0.000081	0.00000012	0.000065	0.013	0.0061	0.00012	0.000046	0.0000046	0.000035	0.079	0.00000081	0.16	0.000000023	0.21	0.00022	0.19	0.00000077	0.0000018	0.0000015	0.000014	0.0000035	0.000035	0.000023
18-Nov-15	14	27	300	245	7.6	0.000012	0.000086	0.00000086	0.000063	0.012	0.0056	0.00012	0.000047	0.0000049	0.000037	0.088	0.0000013	0.17	0.000000025	0.20	0.00020	0.18	0.00000064	0.0000011	0.00000061	0.000013	0.0000012	0.000037	0.000025
2-Dec-15	15	29	300	240	7.3	0.000015	0.000084	0.00000072	0.000060	0.012	0.0054	0.00012	0.000055	0.0000036	0.000036	0.091	0.0000011	0.17	0.000000024	0.21	0.00020	0.18	0.00000044	0.0000022	0.00000060	0.000012	0.0000017	0.000048	0.000024
16-Dec-15	16	31	300	235	7.6	0.0000051	0.000082	0.0000020	0.000063	0.011	0.0057	0.00012	0.000051	0.0000047	0.000035	0.084	0.00000071	0.18	0.000000024	0.18	0.00020	0.15	0.00000088	0.00000094	0.00000059	0.000018	0.0000014	0.000035	0.000024
30-Dec-15	17	33	300	385	7.5	0.000012	0.00013	0.0000029	0.00011	0.018	0.0094	0.00019	0.000075	0.0000077	0.000077	0.13	0.00000077	0.27	0.000000058	0.30	0.00031	0.22	0.00000098	0.00000077	0.0000017	0.000023	0.0000023	0.000058	0.000039
13-Jan-16	18	35	300	290	7.4																								
27-Jan-16	19	37	300	300	7.5	0.0000084	0.00011	0.00000045	0.000071	0.013	0.0070	0.00015	0.000031	0.0000045	0.000090	0.10	0.00000060	0.23	0.000000030	0.20	0.00023	0.16	0.00000069	0.0000021	0.00000075	0.000013	0.0000018	0.000045	0.000030
10-Feb-16	20	39	300	275	7.5	0.000036	0.000096	0.0000018	0.000069	0.012	0.0066	0.00014	0.000032	0.0000041	0.000041	0.091	0.0000023	0.22	0.000000028	0.18	0.00021	0.14	0.00000059	0.0000015	0.00000069	0.000011	0.0000017	0.000055	0.000028
24-Feb-16	21	41	300	300	7.5	0.0000081	0.00011	0.00000060	0.000077	0.013	0.0073	0.00030	0.000033	0.0000060	0.00011	0.10	0.00000060	0.24	0.000000030	0.18	0.00023	0.14	0.00000062	0.00000075	0.00000090	0.000013	0.0000012	0.000075	0.000030
9-Mar-16	22	43	300	335	7.5																								

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 14 (OKY Master (Fresh))

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/L	mg$CaCO_3$/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-May-15	1	1	2000	575	8.0	782	#N/A	7.5	210	431	48	#N/A	*< 0.3*	569	0.0057	0.0062	0.050	0.043	*< 0.000007*	*< 0.000007*	0.048	0.000034	174	0.000050	0.0068
3-Jun-15	2	3	400	395	8.1	556	#N/A	6.0	200	78	9.0	0.80	*< 0.3*	119	0.0070	0.0085	0.057	0.022	*< 0.000007*	*< 0.000007*	0.075	0.000014	35	0.000060	0.0014
17-Jun-15	3	5	300	270	8.1	582	#N/A	5.4	193	79	*< 1*	0.70	*< 0.3*	140	0.0044	0.0085	0.048	0.027	*< 0.000007*	*< 0.000007*	0.074	0.000019	43	0.000050	0.0016
1-Jul-15	4	7	300	230	8.1	666	#N/A	6.1	187	126	7.0	0.70	*< 0.3*	159	0.0068	0.0076	0.041	0.032	*< 0.000007*	*< 0.000007*	0.084	0.000013	48	0.000040	0.0022
15-Jul-15	5	9	300	300	8.1	701	#N/A	6.0	192	175	*< 1*	0.65	*< 0.3*	188	0.0065	0.0071	0.034	0.041	*< 0.000007*	*< 0.000007*	0.092	0.000018	54	0.000090	0.0030
29-Jul-15	6	11	300	240	8.1	700	#N/A	5.1	181	173	*< 1*	0.66	*< 0.3*	202	0.0057	0.0065	0.025	0.037	0.0000070	*< 0.000007*	0.073	*< 0.000003*	61	0.00012	0.0027
12-Aug-15	7	13	300	335	8.1	665	#N/A	5.2	179	159	*< 1*	0.65	*< 0.3*	201	0.0055	0.0066	0.025	0.035	*< 0.000007*	*< 0.000007*	0.076	0.000025	59	0.000090	0.0029
26-Aug-15	8	15	300	280	8.1	572	#N/A	3.5	152	133	*< 1*	0.87	*< 0.3*	166	0.0077	0.0068	0.032	0.027	*< 0.000007*	*< 0.000007*	0.074	0.000019	50	*< 0.00003*	0.0015
9-Sep-15	9	17	300	285	8.1	354	#N/A	2.0	118	57	-	1.2	-	115	0.13	0.0072	0.031	0.019	*< 0.000007*	*< 0.000007*	0.059	0.000016	35	0.00015	0.00098
23-Sep-15	10	19	300	290	8.2	353	#N/A	1.4	134	53	-	1.2	-	113	0.0042	0.0062	0.033	0.014	*< 0.000007*	*< 0.000007*	0.045	0.0000090	34	0.000050	0.00081
7-Oct-15	11	21	300	280	8.2	342	#N/A	2.0	115	48	-	1.3	-	126	0.0076	0.0066	0.032	0.019	*< 0.000007*	*< 0.000007*	0.045	0.000012	38	0.00020	0.0010
21-Oct-15	12	23	300	290	8.3	333	#N/A	3.5	109	48	-	1.3	-	125	0.0059	0.0066	0.032	0.020	*< 0.000007*	*< 0.000007*	0.049	0.0000080	38	0.000050	0.00092
4-Nov-15	13	25	300	285	8.2	340	#N/A	1.4	109	40	-	1.3	-	131	0.0038	0.0066	0.032	0.021	*< 0.000007*	*< 0.000007*	0.050	0.000012	39	0.000040	0.0010
18-Nov-15	14	27	300	295	8.2	315	#N/A	1.2	107	45	-	1.3	-	121	0.0050	0.0061	0.026	0.018	0.0000080	*< 0.000007*	0.041	0.0000070	37	*< 0.00003*	0.00083
2-Dec-15	15	29	300	260	8.1	308	#N/A	3.0	105	46	-	1.4	-	114	0.0074	0.0061	0.030	0.020	*< 0.000007*	*< 0.000007*	0.043	0.000016	34	*< 0.00003*	0.00079
16-Dec-15	16	31	300	290	8.3	333	#N/A	3.5	109	48	-	1.3	-	125	0.0059	0.0066	0.032	0.020	*< 0.000007*	*< 0.000007*	0.049	0.0000080	38	0.000050	0.00092
30-Dec-15	17	33	300	285	8.2	340	#N/A	1.4	109	40	-	1.3	-	131	0.0038	0.0066	0.032	0.021	*< 0.000007*	*< 0.000007*	0.050	0.000012	39	0.000040	0.0010
13-Jan-16	18	35	300	295	8.2	315	#N/A	1.2	107	45	-	1.3	-	121	0.0050	0.0061	0.026	0.018	0.0000080	*< 0.000007*	0.041	0.0000070	37	*< 0.00003*	0.00083
27-Jan-16	19	37	300	260	8.1	308	#N/A	3.0	105	46	-	1.4	-	114	0.0074	0.0061	0.030	0.020	*< 0.000007*	*< 0.000007*	0.043	0.000016	34	*< 0.00003*	0.00079
10-Feb-16	20	39	300	280	8.2	300	#N/A	2.4	103	42	-	1.5	-	112	0.0057	0.0067	0.034	0.020	*< 0.000007*	*< 0.000007*	0.033	0.0000080	34	*< 0.00003*	0.00083
24-Feb-16	21	41	300	290	8.1	301	#N/A	2.2	100	42	-	1.5	-	119	0.0042	0.0065	0.034	0.020	*< 0.000007*	*< 0.000007*	0.036	0.000010	36	0.000050	0.00075
9-Mar-16	22	43	301	265	8.1	291	#N/A	2.3	97	40															

Calculated Loading Rates for Col 14 (OKY Master (Fresh))

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
20-May-15	1	1	2000	575	8.0	782	#N/A	0.43	12	25	2.8	#N/A	0.017	33	0.00033	0.00036	0.0029	0.0025	0.00000040	0.00000040	0.0028	0.0000020	10	0.0000029	0.00039
3-Jun-15	2	3	400	395	8.1	556	#N/A	0.12	3.9	1.5	0.18	0.016	0.0059	2.4	0.00014	0.00017	0.0011	0.00044	0.00000014	0.00000014	0.0015	0.00000028	0.70	0.0000012	0.000028
17-Jun-15	3	5	300	270	8.1	582	#N/A	0.073	2.6	1.1	0.014	0.0095	0.0041	1.9	0.000059	0.00011	0.00065	0.00037	0.000000095	0.000000095	0.00099	0.00000026	0.58	0.00000068	0.000022
1-Jul-15	4	7	300	230	8.1	666	#N/A	0.070	2.1	1.4	0.081	0.0081	0.0035	1.8	0.000078	0.000087	0.00047	0.00037	0.000000081	0.000000081	0.00096	0.00000015	0.55	0.00000046	0.000025
15-Jul-15	5	9	300	300	8.1	701	#N/A	0.090	2.9	2.6	0.015	0.0098	0.0045	2.8	0.000098	0.00011	0.00051	0.00061	0.00000011	0.00000011	0.0014	0.00000027	0.81	0.0000014	0.000045
29-Jul-15	6	11	300	240	8.1	700	#N/A	0.061	2.2	2.1	0.012	0.0079	0.0036	2.4	0.000068	0.000078	0.00030	0.00044	0.000000084	0.000000084	0.00087	0.000000036	0.73	0.0000014	0.000033
12-Aug-15	7	13	300	335	8.1	665	#N/A	0.087	3.0	2.7	0.017	0.011	0.0050	3.4	0.000092	0.00011	0.00042	0.00059	0.00000012	0.00000012	0.0013	0.00000042	0.99	0.0000015	0.000048
26-Aug-15	8	15	300	280	8.1	572	#N/A	0.049	2.1	1.9	0.014	0.012	0.0042	2.3	0.00011	0.000095	0.00044	0.00038	0.000000098	0.000000098	0.0010	0.00000027	0.70	0.00000042	0.000021
9-Sep-15	9	17	300	285	8.1	354	#N/A	0.028	1.7	0.81		0.017	0.00	1.6	0.0019	0.00010	0.00044	0.00027	0.000000100	0.000000100	0.00084	0.00000023	0.50	0.0000021	0.000014
23-Sep-15	10	19	300	290	8.2	353	#N/A	0.020	1.9	0.77		0.018	0.00	1.6	0.000061	0.000090	0.00047	0.00020	0.00000010	0.00000010	0.00065	0.00000013	0.49	0.00000073	0.000012
7-Oct-15	11	21	300	280	8.2	342	#N/A	0.028	1.6	0.67		0.018	0.00	1.8	0.00011	0.000092	0.00045	0.00026	0.000000098	0.000000098	0.00063	0.00000017	0.53	0.0000028	0.000014
21-Oct-15	12	23	300	290	8.3	333	#N/A	0.050	1.6	0.70		0.019	0.00	1.8	0.000086	0.000096	0.00046	0.00029	0.00000010	0.00000010	0.00070	0.00000012	0.55	0.00000073	0.000013
4-Nov-15	13	25	300	285	8.2	340	#N/A	0.019	1.6	0.57		0.018	0.00	1.9	0.000054	0.000094	0.00045	0.00030	0.000000100	0.000000100	0.00071	0.00000017	0.56	0.00000057	0.000014
18-Nov-15	14	27	300	295	8.2	315	#N/A	0.018	1.6	0.66		0.019	0.00	1.8	0.000074	0.000090	0.00038	0.00027	0.00000012	0.00000010	0.00060	0.00000010	0.54	0.00000044	0.000012
2-Dec-15	15	29	300	260	8.1	308	#N/A	0.039	1.4	0.60		0.018	0.00	1.5	0.000096	0.000079	0.00039	0.00026	0.000000091	0.000000091	0.00056	0.00000021	0.45	0.00000039	0.000010
16-Dec-15	16	31	300	290	8.3	333	#N/A	0.050	1.6	0.70		0.019	0.00	1.8	0.000086	0.000096	0.00046	0.00029	0.00000010	0.00000010	0.00070	0.00000012	0.55	0.00000073	0.000013
30-Dec-15	17	33	300	285	8.2	340	#N/A	0.019	1.6	0.57		0.018	0.00	1.9	0.000054	0.000094	0.00045	0.00030	0.000000100	0.000000100	0.00071	0.00000017	0.56	0.00000057	0.000014
13-Jan-16	18	35	300	295	8.2	315	#N/A	0.018	1.6	0.66		0.019	0.00	1.8	0.000074	0.000090	0.00038	0.00027	0.00000012	0.00000010	0.00060	0.00000010	0.54	0.00000044	0.000012
27-Jan-16	19	37	300	260	8.1	308	#N/A	0.039	1.4	0.60		0.018	0.00	1.5	0.000096	0.000079	0.00039	0.00026	0.000000091	0.000000091	0.00056	0.00000021	0.45	0.00000039	0.000010
10-Feb-16	20	39	300	280	8.2	300	#N/A	0.033	1.4	0.59		0.021	0.00	1.6	0.000080	0.000094	0.00047	0.00027	0.000000098	0.000000098	0.00046	0.00000011	0.47	0.00000042	0.000012
24-Feb-16	21	41	300	290	8.1	301	#N/A	0.031	1.4	0.61		0.021	0.00	1.7	0.000061	0.000094	0.00049	0.00028	0.00000010	0.00000010	0.00052	0.00000015	0.52	0.00000073	0.000011
9-Mar-16	22	43	301	265	8.1	291	#N/A	0.030	1.3	0.53															

Note:
Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 14 (OKY Master (Fresh))

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-May-15	1	1	2000	575	8.0	0.0021	*< 0.007*	0.000040	0.058	33	1.5	0.010	0.024	0.0024	0.025	31	*< 0.001*	6.9	0.000068	107	0.46	165	0.00014	*< 0.00001*	0.00015	0.40	0.00043	0.0020	*< 0.002*
3-Jun-15	2	3	400	395	8.1	0.0012	*< 0.007*	0.000060	0.037	7.4	0.47	*< 0.01*	0.038	0.00080	0.0070	17	*< 0.001*	6.7	0.000046	58	0.097	32	0.000075	0.000030	0.00012	0.084	0.00050	0.0010	*< 0.002*
17-Jun-15	3	5	300	270	8.1	0.0013	*< 0.007*	0.000010	0.033	8.1	0.64	*< 0.01*	0.036	0.00080	0.0090	18	0.00014	7.5	0.000010	53	0.11	44	0.000098	0.00011	0.00017	0.13	0.00042	0.0020	*< 0.002*
1-Jul-15	4	7	300	230	8.1	0.00081	*< 0.007*	0.000010	0.035	9.7	0.86	0.030	0.033	0.00090	0.0050	18	0.00011	7.6	0.000016	53	0.14	47	0.000094	0.00010	0.00012	0.21	0.00040	0.0010	*< 0.002*
15-Jul-15	5	9	300	300	8.1	0.0015	*< 0.007*	0.000060	0.037	13	1.3	*< 0.01*	0.028	0.0011	*< 0.003*	18	0.000080	8.0	0.0000050	57	0.17	56	0.00012	0.00022	0.00018	0.34	0.00042	0.0020	*< 0.002*
29-Jul-15	6	11	300	240	8.1	0.00092	*< 0.007*	0.000030	0.038	12	1.3	*< 0.01*	0.026	0.00090	*< 0.003*	19	0.000070	7.4	0.000034	50	0.18	59	0.00011	0.000060	0.000060	0.33	0.00039	0.0020	*< 0.002*
12-Aug-15	7	13	300	335	8.1	0.00045	*< 0.007*	0.000020	0.030	13	1.4	*< 0.01*	0.025	0.00090	0.0030	21	0.000070	8.0	0.000013	50	0.17	54	0.00011	0.000040	0.000090	0.26	0.00037	0.0020	*< 0.002*
26-Aug-15	8	15	300	280	8.1	0.0011	*< 0.007*	0.00015	0.027	9.7	1.0	*< 0.01*	0.027	0.00050	0.0040	17	0.000070	7.3	0.0000060	40	0.14	41	0.000096	0.00019	*< 0.00005*	0.21	0.00040	0.0020	*< 0.002*
9-Sep-15	9	17	300	285	8.1	0.0012	*< 0.007*	0.000010	0.016	6.7	0.72	*< 0.01*	0.026	0.00030	0.0030	12	0.000060	6.5	0.0000030	18	0.090	24	0.000082	0.00018	*< 0.00005*	0.083	0.00044	0.0040	*< 0.002*
23-Sep-15	10	19	300	290	8.2	0.00043	*< 0.007*	0.000030	0.014	7.1	0.73	*< 0.01*	0.020	*< 0.0001*	*< 0.003*	14	0.00017	6.6	*< 0.000002*	16	0.091	19	0.000059	0.000050	*< 0.00005*	0.055	0.00035	*< 0.001*	*< 0.002*
7-Oct-15	11	21	300	280	8.2	0.00057	*< 0.007*	0.00017	0.014	7.7	0.80	*< 0.01*	0.020	0.00030	*< 0.003*	14	0.000050	6.5	0.0000020	16	0.095	19	0.000060	0.000080	*< 0.00005*	0.070	0.00042	0.0020	*< 0.002*
21-Oct-15	12	23	300	290	8.3	0.00052	*< 0.007*	0.00038	0.014	7.4	0.82	*< 0.01*	0.018	0.00030	0.0060	14	0.000070	7.0	*< 0.000002*	14	0.096	17	0.000081	0.00011	0.000080	0.068	0.00035	0.0010	*< 0.002*
4-Nov-15	13	25	300	285	8.2	0.00067	*< 0.007*	0.00013	0.015	8.0	0.93	0.010	0.010	0.00040	0.0030	14	*< 0.00004*	6.8	*< 0.000002*	14	0.10	16	0.000065	*< 0.00001*	*< 0.00005*	0.047	0.00033	0.0020	*< 0.002*
18-Nov-15	14	27	300	295	8.2	0.00046	*< 0.007*	0.00025	0.014	7.3	0.83	*< 0.01*	0.012	0.00020	0.0030	14	0.00020	6.9	0.000012	12	0.086	15	0.000042	0.00018	*< 0.00005*	0.057	0.00032	0.0010	*< 0.002*
2-Dec-15	15	29	300	260	8.1	0.00047	*< 0.007*	0.000040	0.012	6.8	0.78	*< 0.01*	0.012	0.00020	0.0040	13	*< 0.00004*	6.7	0.0000020	10	0.092	15	0.000075	0.00011	0.000090	0.062	0.00035	0.0010	*< 0.002*
16-Dec-15	16	31	300	290	8.3	0.00052	*< 0.007*	0.00038	0.014	7.4	0.82	*< 0.01*	0.018	0.00030	0.0060	14	0.000070	7.0	*< 0.000002*	14	0.096	17	0.000081	0.00011	0.000080	0.068	0.00035	0.0010	*< 0.002*
30-Dec-15	17	33	300	285	8.2	0.00067	*< 0.007*	0.00013	0.015	8.0	0.93	0.010	0.010	0.00040	0.0030	14	*< 0.00004*	6.8	*< 0.000002*	14	0.10	16	0.000065	*< 0.00001*	*< 0.00005*	0.047	0.00033	0.0020	*< 0.002*
13-Jan-16	18	35	300	295	8.2	0.00046	*< 0.007*	0.00025	0.014	7.3	0.83	*< 0.01*	0.012	0.00020	0.0030	14	0.00020	6.9	0.000012	12	0.086	15	0.000042	0.00018	*< 0.00005*	0.057	0.00032	0.0010	*< 0.002*
27-Jan-16	19	37	300	260	8.1	0.00047	*< 0.007*	0.000040	0.012	6.8	0.78	*< 0.01*	0.012	0.00020	0.0040	13	*< 0.00004*	6.7	0.0000020	10	0.092	15	0.000075	0.00011	0.000090	0.062	0.00035	0.0010	*< 0.002*
10-Feb-16	20	39	300	280	8.2	0.0018	*< 0.007*	0.00014	0.012	6.8	0.80	*< 0.01*	0.012	0.00020	0.0060	13	0.000060	6.6	*< 0.000002*	9.6	0.090	15	0.000070	0.000080	*< 0.00005*	0.055	0.00037	0.0020	*< 0.002*
24-Feb-16	21	41	300	290	8.1	0.00019	*< 0.007*	0.000050	0.012	7.2	0.81	0.020	0.011	0.00020	0.0080	13	*< 0.00004*	7.1	*< 0.000002*	8.3	0.089	13	0.000073	0.000020	*< 0.00005*	0.056	0.00034	0.0010	*< 0.002*
9-Mar-16	22	43	301	265	8.1																								

Calculated Loading Rates for Col 14 (OKY Master (Fresh))

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
20-May-15	1	1	2000	575	8.0	0.00012	0.00040	0.0000023	0.0033	1.9	0.089	0.00058	0.0014	0.00014	0.0014	1.8	0.000058	0.40	0.0000039	6.2	0.027	9.5	0.0000082	0.00000058	0.0000086	0.023	0.000025	0.00012	0.00012
3-Jun-15	2	3	400	395	8.1	0.000024	0.00014	0.0000012	0.00073	0.15	0.0093	0.00020	0.00075	0.000016	0.00014	0.34	0.000020	0.13	0.00000091	1.1	0.0019	0.63	0.0000015	0.00000059	0.0000024	0.0017	0.0000099	0.000020	0.000040
17-Jun-15	3	5	300	270	8.1	0.000018	0.000095	0.00000014	0.00045	0.11	0.0087	0.00014	0.00048	0.000011	0.00012	0.24	0.0000019	0.10	0.00000014	0.71	0.0015	0.59	0.0000013	0.0000015	0.0000023	0.0017	0.0000057	0.000027	0.000027
1-Jul-15	4	7	300	230	8.1	0.0000093	0.000081	0.00000012	0.00040	0.11	0.0099	0.00035	0.00038	0.000010	0.000058	0.21	0.0000013	0.087	0.00000018	0.61	0.0016	0.54	0.0000011	0.0000012	0.0000014	0.0024	0.0000046	0.000012	0.000023
15-Jul-15	5	9	300	300	8.1	0.000023	0.00011	0.00000090	0.00055	0.19	0.020	0.00015	0.00042	0.000017	0.000045	0.27	0.0000012	0.12	0.000000075	0.86	0.0025	0.83	0.0000018	0.0000033	0.0000027	0.0051	0.0000063	0.000030	0.000030
29-Jul-15	6	11	300	240	8.1	0.000011	0.000084	0.00000036	0.00045	0.15	0.016	0.00012	0.00031	0.000011	0.000036	0.23	0.00000084	0.089	0.00000041	0.60	0.0021	0.71	0.0000013	0.00000072	0.00000072	0.0040	0.0000047	0.000024	0.000024
12-Aug-15	7	13	300	335	8.1	0.0000075	0.00012	0.00000034	0.00051	0.22	0.024	0.00017	0.00042	0.000015	0.000050	0.36	0.0000012	0.13	0.00000022	0.83	0.0029	0.90	0.0000019	0.00000067	0.0000015	0.0043	0.0000062	0.000034	0.000034
26-Aug-15	8	15	300	280	8.1	0.000016	0.000098	0.0000021	0.00037	0.14	0.014	0.00014	0.00038	0.0000070	0.000056	0.24	0.00000098	0.10	0.000000084	0.55	0.0019	0.58	0.0000013	0.0000027	0.00000070	0.0029	0.0000056	0.000028	0.000028
9-Sep-15	9	17	300	285	8.1	0.000018	0.000100	0.00000014	0.00022	0.096	0.010	0.00014	0.00037	0.0000043	0.000043	0.18	0.00000086	0.092	0.000000043	0.26	0.0013	0.34	0.0000012	0.0000026	0.00000071	0.0012	0.0000063	0.000057	0.000029
23-Sep-15	10	19	300	290	8.2	0.0000062	0.00010	0.00000044	0.00020	0.10	0.011	0.00015	0.00029	0.0000015	0.000044	0.20	0.0000025	0.096	0.000000029	0.23	0.0013	0.28	0.00000086	0.00000073	0.00000073	0.00080	0.0000051	0.000015	0.000029
7-Oct-15	11	21	300	280	8.2	0.0000080	0.000098	0.0000024	0.00019	0.11	0.011	0.00014	0.00028	0.0000042	0.000042	0.20	0.00000070	0.091	0.000000028	0.23	0.0013	0.26	0.00000084	0.0000011	0.00000070	0.00098	0.0000059	0.000028	0.000028
21-Oct-15	12	23	300	290	8.3	0.0000075	0.00010	0.0000055	0.00021	0.11	0.012	0.00015	0.00025	0.0000044	0.000087	0.20	0.0000010	0.10	0.000000029	0.20	0.0014	0.24	0.0000012	0.0000016	0.0000012	0.00099	0.0000051	0.000015	0.000029
4-Nov-15	13	25	300	285	8.2	0.0000095	0.000100	0.0000019	0.00022	0.11	0.013	0.00014	0.00015	0.0000057	0.000043	0.20	0.00000057	0.097	0.000000029	0.20	0.0015	0.23	0.00000093	0.00000014	0.00000071	0.00067	0.0000047	0.000029	0.000029
18-Nov-15	14	27	300	295	8.2	0.0000068	0.00010	0.0000037	0.00020	0.11	0.012	0.00015	0.00018	0.0000030	0.000044	0.20	0.0000030	0.10	0.00000018	0.17	0.0013	0.22	0.00000062	0.0000027	0.00000074	0.00085	0.0000047	0.000015	0.000030
2-Dec-15	15	29	300	260	8.1	0.0000061	0.000091	0.00000052	0.00016	0.088	0.010	0.00013	0.00016	0.0000026	0.000052	0.17	0.00000052	0.087	0.000000026	0.13	0.0012	0.20	0.00000098	0.0000014	0.0000012	0.00081	0.0000046	0.000013	0.000026
16-Dec-15	16	31	300	290	8.3	0.0000075	0.00010	0.0000055	0.00021	0.11	0.012	0.00015	0.00025	0.0000044	0.000087	0.20	0.0000010	0.10	0.000000029	0.20	0.0014	0.24	0.0000012	0.0000016	0.0000012	0.00099	0.0000051	0.000015	0.000029
30-Dec-15	17	33	300	285	8.2	0.0000095	0.000100	0.0000019	0.00022	0.11	0.013	0.00014	0.00015	0.0000057	0.000043	0.20	0.00000057	0.097	0.000000029	0.20	0.0015	0.23	0.00000093	0.00000014	0.00000071	0.00067	0.0000047	0.000029	0.000029
13-Jan-16	18	35	300	295	8.2	0.0000068	0.00010	0.0000037	0.00020	0.11	0.012	0.00015	0.00018	0.0000030	0.000044	0.20	0.0000030	0.10	0.00000018	0.17	0.0013	0.22	0.00000062	0.0000027	0.00000074	0.00085	0.0000047	0.000015	0.000030
27-Jan-16	19	37	300	260	8.1	0.0000061	0.000091	0.00000052	0.00016	0.088	0.010	0.00013	0.00016	0.0000026	0.000052	0.17	0.00000052	0.087	0.000000026	0.13	0.0012	0.20	0.00000098	0.0000014	0.0000012	0.00081	0.0000046	0.000013	0.000026
10-Feb-16	20	39	300	280	8.2	0.000026	0.000098	0.0000020	0.00017	0.096	0.011	0.00014	0.00016	0.0000028	0.000084	0.18	0.00000084	0.092	0.000000028	0.13	0.0013	0.21	0.00000098	0.0000011	0.00000070	0.00077	0.0000052	0.000028	0.000028
24-Feb-16	21	41	300	290	8.1	0.0000028	0.00010	0.00000073	0.00017	0.10	0.012	0.00029	0.00016	0.0000029	0.00012	0.19	0.00000058	0.10	0.000000029	0.12	0.0013	0.19	0.0000011	0.00000029	0.00000073	0.00081	0.0000049	0.000015	0.000029
9-Mar-16	22	43	301	265	8.1																								

Note:
Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC1 (ST)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	345	7.7	484	#N/A	6.4	54	136	2.2	0.38	*< 0.3*	137	0.018	0.0011	0.011	0.036	*< 0.000007*	*< 0.000007*	0.020	*< 0.000003*	31	0.00015	0.00048	0.0064
2-Jul-14	1	500	500	7.7	295	#N/A	8.1	53	77	0.50	0.23	*< 0.3*	107	0.018	0.0013	0.0086	0.025	*< 0.000007*	*< 0.000007*	0.014	*< 0.000003*	24	0.00019	0.00064	0.0026
9-Jul-14	2	500	485	7.9	192	#N/A	2.5	48	39	*< 0.2*	0.18	*< 0.3*	59	0.023	0.00060	0.0071	0.032	*< 0.000007*	*< 0.000007*	0.012	*< 0.000003*	14	0.000040	0.00010	0.0010
16-Jul-14	3	500	485	7.8	146	#N/A	2.4	46	19	*< 0.2*	0.13	*< 0.3*	47	0.023	0.0011	0.0062	0.032	*< 0.000007*	*< 0.000007*	0.0080	0.0000030	11	0.00021	0.00046	0.00081
23-Jul-14	4	500	485	7.8	108	#N/A	2.3	39	11	*< 0.2*	0.10	*< 0.3*	40	0.027	0.00050	0.0048	0.042	*< 0.000007*	*< 0.000007*	0.0066	*< 0.000003*	9.8	*< 0.00003*	0.00017	0.0014
30-Jul-14	5	500	480	8.1	79	#N/A	1.6	37	6.0	*< 0.2*	*< 0.06*	*< 0.3*	30	0.034	0.00060	0.0051	0.034	*< 0.000007*	*< 0.000007*	0.0043	*< 0.000003*	7.8	0.00020	0.00030	0.0015
6-Aug-14	6	500	485	7.8	76	#N/A	2.1	30	5.0	*< 0.2*	*< 0.06*	*< 0.3*	29	0.038	0.00030	0.0034	0.036	*< 0.000007*	*< 0.000007*	0.0068	*< 0.000003*	7.6	0.000030	0.000032	0.00037
13-Aug-14	7	500	490	8.2	109	#N/A	2.2	43	9.0	*< 0.2*	0.10	*< 0.3*	42	0.057	0.00040	0.0053	0.061	*< 0.000007*	*< 0.000007*	0.0067	*< 0.000003*	10	0.00026	0.000056	0.00053
20-Aug-14	8	500	485	7.9	85	#N/A	1.8	36	8.0	*< 0.2*	0.060	*< 0.3*	36	0.044	*< 0.0002*	0.0048	0.049	*< 0.000007*	*< 0.000007*	0.0048	*< 0.000003*	9.2	0.000090	0.000057	0.00091
27-Aug-14	9	500	500	8.1	117	#N/A	3.9	49	9.0	*< 0.2*	0.11	*< 0.3*	44	0.036	0.00040	0.0049	0.053	*< 0.000007*	*< 0.000007*	0.011	*< 0.000003*	11	0.00010	0.000035	0.00038
3-Sep-14	10	500	490	7.8	101	#N/A	4.4	42	9.0	*< 0.2*	0.090	*< 0.3*	53	0.030	0.0011	0.0060	0.052	*< 0.000007*	*< 0.000007*	0.0076	0.0000030	15	*< 0.00003*	0.000032	0.00072
10-Sep-14	11	500	500	8.2	98	#N/A	3.0	41	5.0	*< 0.2*	0.080	*< 0.3*	44	0.039	0.00040	0.0041	0.051	*< 0.000007*	*< 0.000007*	0.0064	*< 0.000003*	13	0.00010	0.000025	0.00037
17-Sep-14	12	500	475	8.0	77	#N/A	7.3	37	4.0	*< 0.2*	*< 0.06*	*< 0.3*	28	0.037	0.00020	0.0031	0.044	*< 0.000007*	*< 0.000007*	0.0062	*< 0.000003*	7.5	0.000070	0.000017	0.00025
24-Sep-14	13	500	485	8.2	75	#N/A	3.1	36	5.0	*< 0.2*	*< 0.06*	*< 0.3*	30	0.029	*< 0.0002*	0.0028	0.040	*< 0.000007*	*< 0.000007*	0.0035	*< 0.000003*	7.8	*< 0.00003*	0.00011	0.00044
1-Oct-14	14	500	485	7.8	72	#N/A	9.4	37	3.0	*< 0.2*	*< 0.06*	*< 0.3*	30	0.034	*< 0.0002*	0.0025	0.040	*< 0.000007*	*< 0.000007*	0.0030	0.000044	8.0	*< 0.00003*	0.00	*< 0.00002*
8-Oct-14	15	500	480	8.1	87	#N/A	2.7	35	4.0	*< 0.2*	0.060	*< 0.3*	44	0.036	0.00030	0.0036	0.052	*< 0.000007*	*< 0.000007*	0.024	*< 0.000003*	13	0.000070	0.000025	0.00031
15-Oct-14	16	500	485	7.7	94	#N/A	5.8	38	5.0	*< 0.2*	0.060	*< 0.3*	48	0.028	0.00040	0.0037	0.047	*< 0.000007*	*< 0.000007*	0.0057	0.000011	14	0.000040	0.000018	0.00034
22-Oct-14	17	500	490	8.1	92	#N/A	4.1	41	5.0	*< 0.2*	0.060	*< 0.3*	37	0.024	0.00040	0.0035	0.050	*< 0.000007*	*< 0.000007*	0.016	0.0000030	9.5	0.000040	0.000019	0.00032
29-Oct-14	18	500	495	7.8	89	#N/A	8.9	43	3.0	*< 0.2*	*< 0.06*	*< 0.3*	35	0.024	0.00040	0.0036	0.047	*< 0.000007*	*< 0.000007*	0.015	*< 0.000003*	9.3	0.00012	0.000018	0.00024
5-Nov-14	19	500	490	7.9	81	#N/A	#N/A	46	2.0	*< 0.2*	*< 0.06*	*< 0.3*	32	0.024	0.00030	0.0030	0.046	*< 0.000007*	*< 0.000007*	0.0060	0.000016	8.5	0.000060	0.000023	0.00054
12-Nov-14	20	500	485	7.6	88	#N/A	6.6	34	3.0	*< 0.2*	0.070	*< 0.3*	37	0.047	0.00040	0.0037	0.052	*< 0.000007*	*< 0.000007*	0.0058	0.0000030	9.9	0.00019	0.000031	0.00045
19-Nov-14	21	500	485	7.7	89	#N/A	6.7	35	2.0	*< 0.2*	0.060	*< 0.3*	36	0.027	0.00040	0.0033	0.058	*< 0.000007*	*< 0.000007*	0.0032	0.0000080	9.3	0.000060	0.000023	0.00047
26-Nov-14	22	500	490	8.1	88	#N/A	1.9	39	3.0	*< 0.2*	0.060	*< 0.3*	37	0.028	0.00040	0.0036	0.054	*< 0.000007*	*< 0.000007*	0.0023	*< 0.000003*	9.9	0.000050	0.000018	0.00029
3-Dec-14	23	500	475	8.0	75	#N/A	2.9	37	*< 2*	*< 0.2*	*< 0.06*	*< 0.3*	35	0.027	0.00040	0.0039	0.056	*< 0.000007*	*< 0.000007*	0.0049	*< 0.000003*	9.4	0.000050	0.000016	0.00031
10-Dec-14	24	500	495	7.9	63	#N/A	4.6	34	*< 2*	*< 0.2*	*< 0.06*	*< 0.3*	27	0.023	*< 0.0002*	0.0024	0.044	*< 0.000007*	*< 0.000007*	0.0029	*< 0.000003*	7.5	0.000060	0.000010	0.00030
17-Dec-14	25	500	495	7.7	74	#N/A	4.4	35	3.0	*< 0.2*	*< 0.06*	*< 0.3*	31	0.031	0.00020	0.0029	0.053	*< 0.000007*	*< 0.000007*	0.0022	*< 0.000003*	8.4	*< 0.00003*	0.000013	0.00040
24-Dec-14	26	500	495	7.7	75	#N/A	3.6	35	*< 2*	*< 0.2*	*< 0.06*	*< 0.3*	32	0.031	0.00030	0.0031	0.058	*< 0.000007*	*< 0.000007*	0.0063	*< 0.000003*	8.8	*< 0.00003*	0.000012	0.00022
31-Dec-14	27	500	495	7.9	88	#N/A	1.3	37	2.0	*< 0.2*	*< 0.06*	*< 0.3*	38	0.026	0.00080	0.0063	0.063	*< 0.000007*	*< 0.000007*	0.0028	*< 0.000003*	11	*< 0.00003*	0.0000060	0.00022
7-Jan-15	28	500	485	7.5	71	#N/A	3.1	34	2.0	*< 1*	*< 0.06*	*< 0.3*	33	0.026	0.00030	0.0025	0.048	*< 0.000007*	*< 0.000007*	0.0047	*< 0.000003*	9.1	0.000060	0.000015	0.00036
14-Jan-15	29	500	495	7.9	77	#N/A	2.4	38	3.0	*< 1*	*< 0.06*	*< 0.3*	39	0.022	0.00030	0.0030	0.051	*< 0.000007*	*< 0.000007*	0.0040	0.0000050	11	0.000060	0.000010	0.00038
21-Jan-15	30	500	485	7.8	83	#N/A	4.7	43	2.0	*< 1*	*< 0.06*	*< 0.3*	35	0.026	0.00040	0.0030	0.063	*< 0.000007*	*< 0.000007*	0.0037	*< 0.000003*	9.3	0.000080	0.000015	0.00064
28-Jan-15	31	500	495	7.8	75	#N/A	1.7	37	2.0	*< 1*	*< 0.06*	*< 0.3*	33	0.026	0.00030	0.0026	0.054	*< 0.000007*	*< 0.000007*	0.0044	0.0000040	9.0	0.00010	0.0000090	0.00021
4-Feb-15	32	500	490	7.8	77	#N/A	2.6	36	2.0	*< 1*	*< 0.06*	*< 0.3*	32	0.022	0.00030	0.0027	0.055	*< 0.000007*	*< 0.000007*	0.0051	0.0000030	8.7	0.00020	0.0000070	0.00067
11-Feb-15	33	500	490	8.0	74	#N/A	2.0	37	3.0	*< 1*	*< 0.06*	*< 0.3*	32	0.025	0.00040	0.0026	0.051	*< 0.000007*	*< 0.000007*	0.0039	*< 0.000003*	8.8	0.000050	0.000012	0.00067
18-Feb-15	34	500	485	7.8	73	#N/A	2.3	36	2.0	1.0	0.070	*< 0.3*	33	0.026	0.00050	0.0027	0.051	*< 0.000007*	*< 0.000007*	0.0029	*< 0.000003*	9.1	0.000040	0.000016	0.00042
25-Feb-15	35	500	490	7.8	76	#N/A	3.1	38	*< 2*	*< 1*	*< 0.06*	*< 0.3*	32	0.022	0.00040	0.0025	0.057	*< 0.000007*	*< 0.000007*	0.0015	0.0000060	9.0	0.000080	0.000017	0.0011
4-Mar-15	36	500	480	7.7	62	#N/A	2.1	31	*< 2*	*< 1*	*< 0.06*	*< 0.3*	30	0.020	0.00020	0.0018	0.047	*< 0.000007*	*< 0.000007*	0.0027	*< 0.000003*	9.1	0.00011	0.0000070	0.00048
11-Mar-15	37	500	480	8.0	64	#N/A	1.6	34	2.0	*< 1*	0.080	*< 0.3*	28	0.021	0.00030	0.0021	0.048	*< 0.000007*	*< 0.000007*	0.0053	*< 0.000003*	7.9	0.000090	0.0000060	0.00080
18-Mar-15	38	500	500	7.8	65	#N/A	2.6	33	2.0	*< 1*	*< 0.06*	*< 0.3*	31	0.021	0.00030	0.0017	0.047	0.000014	*< 0.000007*	0.0022	*< 0.000003*	9.5	0.00010	0.000013	0.0011
25-Mar-15	39	500	485	7.8	65	#N/A	2.9	34	*< 2*	*< 1*	*< 0.06*	*< 0.3*	29	0.026	0.00030	0.0024	0.055	*< 0.000007*	*< 0.000007*	0.0052	*< 0.000003*	8.3	0.00013	0.0000040	0.0020
1-Apr-15	40	500	500	7.7	66	#N/A	3.7	36	2.0	*< 1*	*< 0.06*	*< 0.3*	25	0.023	0.00030	0.0016	0.061	0.000012	*< 0.000007*	0.0027	*< 0.000003*	6.8	0.000060	*< 0.000004*	0.00037
8-Apr-15	41	500	490	7.9	71	#N/A	2.8	38	2.0	*< 1*	*< 0.06*	*< 0.3*	30	0.022	0.00040	0.0022	0.056	*< 0.000007*	*< 0.000007*	0.0050	*< 0.000003*	8.6	0.000060	0.000016	0.00098
15-Apr-15	42	500	485	7.7	61	#N/A	3.8	34	*< 2*	*< 1*	*< 0.06*	*< 0.3*	26	0.022	0.00030	0.0018	0.050	*< 0.000007*	*< 0.000007*	0.0065	*< 0.000003*	7.6	0.000060	*< 0.000004*	0.00097
22-Apr-15	43	500	490	7.6	60	#N/A	3.1	34	3.0	*< 1*	*< 0.06*	*< 0.3*	26	0.019	0.00020	0.0015	0.046	*< 0.000007*	*< 0.000007*	0.0089	*< 0.000003*	7.5	0.000040	0.0000060	0.0011
29-Apr-15	44	500	490	7.8	80	#N/A	2.1	39	3.0	*< 1*	*< 0.06*	*< 0.3*	40	0.026	0.00040	0.0029	0.068	*< 0.000007*	*< 0.000007*	0.0036	0.0000050	12	0.000090	0.000020	0.00054
6-May-15	45	500	500	8.0	73	#N/A	2.4	39	*< 2*	*< 1*	*< 0.06*	*< 0.3*	32	0.026	0.00030	0.0064	0.055	*< 0.000007*	*< 0.000007*	0.0045	*< 0.000003*	9.2	*< 0.00003*	0.000017	0.00033
13-May-15	46	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	475	470	8.2	161	#N/A	2.8	76	6.0	*< 1*	0.060	*< 0.3*	75	0.0097	0.00060	0.0024	0.16	*< 0.000007*	*< 0.000007*	0.0041	*< 0.000003*	22	0.00016	0.000022	0.00034
10-Jun-15	50	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	470	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	460	465	8.1	166	#N/A	3.6	76	4.0	*< 1*	*< 0.06*	*< 0.3*	66	0.016	0.00050	0.0028	0.14	*< 0.000007*	*< 0.000007*	0.014	0.0000030	19	0.00020	0.000037	0.00035
8-Jul-15	54	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	480	470	8.1	161	#N/A	1.9	78	5.0	*< 1*	*< 0.06*	*< 0.3*	70	0.015	0.00050	0.0025	0.14	*< 0.000007*	*< 0.000007*	0.0074	0.0000030	20	0.00021	0.000028	0.00022
5-Aug-15	58	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	480	470	8.0	158	#N/A	2.0	76	5.0	*< 1*	*< 0.06*	*< 0.3*	70	0.0090	0.00060	0.0028	0.15	*< 0.000007*	*< 0.000007*	0.0062	0.0000080	20	0.00017	0.000025	0.00046
2-Sep-15	62	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	490	470	8.1	163	#N/A	2.1	77	5.0				73	0.010	0.00060	0.0028	0.16	*< 0.000007*	*< 0.000007*	0.0072	0.0000040	21	0.00020	0.000025	0.00025
30-Sep-15	66	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	480	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	460	450	8.1	149	#N/A	1.6	75	5.0				70	0.0099	0.00050	0.0026	0.14	*< 0.000007*	*< 0.000007*	0.0066	0.000035	20	0.00024	0.000036	0.0016
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	470	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	460	460	8.0	138	#N/A	1.1	74	4.0				58	0.019	0.00040	0.0020	0.13	*< 0.000007*	*< 0.000007*	0.0033	*< 0.000003*	17	0.00023	0.000080	0.00062
25-Nov-15	74	500	485	8.0	69	#N/A	0.40	40	2.0				33	0.031	0.00030	0.0025	0.062	*< 0.000007*	*< 0.000007*	0.0032	*< 0.000003*	10	0.00016	0.00018	0.00078
2-Dec-15	75	500	495	8.0	68	#N/A	1.4	35	2.0				30	0.029	0.00030	0.0023	0.062	*< 0.000007*	*< 0.000007*	0.0028	0.0000070	8.7	0.000050	0.000014	0.00056
9-Dec-15	76	500	505	8.1	67	#N/A	2.4	34	2.0				28	0.030	0.00040	0.0031	0.062	0.000010	*< 0.000007*	0.0090	0.000013	8.4	0.00010	0.0000040	0.00035
16-Dec-15	77	500	495	7.9	63	#N/A	1.7	30	2.0				30	0.051	*< 0.0002*	0.0022	0.063	*< 0.000007*	*< 0.000007*	0.0020	0.0000040	8.9	0.00020	0.000016	0.00042
23-Dec-15	78	500	500	7.9	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	485	7.9	62	#N/A	1.3	31	3.0				28	0.026	*< 0.0002*	0.0015	0.059	*< 0.000007*	*< 0.000007*	0.0024	0.0000040	8.5	0.00010	*< 0.000004*	0.00022
6-Jan-16	80	500	495	7.9	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	495	7.8	68	#N/A	1.5	32	3.0				29	0.022	0.00020	0.0018	0.061	*< 0.000007*	*< 0.000007*	0.0050	*< 0.000003*	8.5	0.000080	*< 0.000004*	0.00024
20-Jan-16	82	500	495	7.9	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	490	7.9	73	#N/A	2.5	35	2.0				32	0.026	*< 0.0002*	0.0022	0.073	*< 0.000007*	*< 0.000007*	*< 0.002*	0.0000030	9.2	0.000080	0.000018	0.00020
3-Feb-16	84	500	490	7.9	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.8	70	#N/A	2.3	34	2.0				30	0.025	0.00020	0.0022	0.076	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	9.1	0.000090	0.0000080	0.00075
17-Feb-16	86	500	500	7.8	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.8	69	#N/A	2.3	32	*< 2*				31	0.028	0.00020	0.0020	0.070	*< 0.000007*	*< 0.000007*	*< 0.002*	0.0000030	9.0	0.000030	*< 0.000004*	0.00015

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC1 (ST)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	345	7.7	0.0090	0.000010	0.0085	15	0.011	0.020	0.015	0.0053	0.025	9.5	0.0035	2.8	< 0.000002	35	1.1	55	0.000026	0.00013	0.00018	0.012	0.00073	0.0020	< 0.002
2-Jul-14	1	500	500	7.7	< 0.002	< 0.00001	0.0067	12	0.016	< 0.01	0.0096	0.0042	< 0.009	7.7	0.0013	2.4	< 0.000002	21	1.1	35	0.000021	0.0072	0.00020	0.018	0.00048	0.0010	< 0.002
9-Jul-14	2	500	485	7.9	0.0060	< 0.00001	0.0044	6.0	0.0098	< 0.01	0.0062	0.0019	< 0.009	5.8	0.00032	2.0	< 0.000002	8.8	0.82	14	0.000013	0.0033	0.00015	0.0081	0.00048	< 0.001	< 0.002
16-Jul-14	3	500	485	7.8	0.011	< 0.00001	0.0034	4.8	0.0065	< 0.01	0.0075	0.0012	< 0.009	4.5	0.00018	1.5	0.0000060	5.6	0.75	7.5	0.000018	0.00024	0.000090	0.011	0.00037	< 0.001	< 0.002
23-Jul-14	4	500	485	7.8	0.0020	0.000020	0.0026	3.8	0.0078	< 0.01	0.0032	0.00070	< 0.009	3.9	0.00011	1.3	0.0000040	3.4	0.66	5.2	0.0000090	0.0032	0.000080	0.0050	0.00033	< 0.001	< 0.002
30-Jul-14	5	500	480	8.1	0.0050	< 0.00001	0.0019	2.6	0.0066	< 0.01	0.0052	0.00040	0.015	2.7	0.000090	0.84	< 0.000002	1.8	0.51	2.9	0.000011	0.00021	0.00023	0.0071	0.00029	< 0.001	< 0.002
6-Aug-14	6	500	485	7.8	0.0080	0.000030	0.0015	2.5	0.0057	< 0.01	0.0019	< 0.0001	0.011	2.8	0.00012	0.86	< 0.000002	1.5	0.53	2.6	0.0000070	0.00011	0.00026	0.0036	0.00081	0.0020	< 0.002
13-Aug-14	7	500	490	8.2	0.018	0.000020	0.0027	4.1	0.0062	< 0.01	0.0034	0.00030	0.010	4.4	0.00012	1.5	< 0.000002	2.7	0.77	4.3	0.000010	0.0012	0.00082	0.0058	0.00034	< 0.001	< 0.002
20-Aug-14	8	500	485	7.9	0.0060	0.000040	0.0019	3.2	0.0064	< 0.01	0.0024	0.00030	< 0.009	3.4	0.00031	1.1	< 0.000002	1.5	0.66	2.9	0.0000060	0.0020	0.00037	0.0048	0.00037	< 0.001	< 0.002
27-Aug-14	9	500	500	8.1	0.0060	< 0.00001	0.0026	4.1	0.0076	< 0.01	0.0039	0.00030	< 0.009	4.4	0.00011	1.5	< 0.000002	2.1	0.87	3.6	0.000016	0.0014	0.00032	0.0064	0.00039	< 0.001	< 0.002
3-Sep-14	10	500	490	7.8	< 0.007	0.000040	0.0024	3.7	0.0060	< 0.01	0.0031	0.00030	0.0050	4.6	0.00028	1.5	0.000013	1.6	0.94	4.0	0.000018	0.00019	0.000060	0.0053	0.00039	< 0.001	< 0.002
10-Sep-14	11	500	500	8.2	0.010	< 0.00001	0.0019	2.9	0.0060	< 0.01	0.0025	0.00020	< 0.003	3.6	0.000090	1.3	< 0.000002	1.2	0.81	2.3	0.000015	0.0015	0.00032	0.0045	0.00031	< 0.001	< 0.002
17-Sep-14	12	500	475	8.0	< 0.007	< 0.00001	0.0014	2.4	0.0052	< 0.01	0.0017	0.00010	< 0.003	2.9	0.00010	0.82	< 0.000002	0.69	0.66	2.1	< 0.000005	0.000090	0.00017	0.0033	0.00027	< 0.001	< 0.002
24-Sep-14	13	500	485	8.2	< 0.002	0.000010	0.0015	2.5	0.0045	< 0.01	0.0017	0.00020	< 0.009	2.8	< 0.00004	0.82	0.0000050	0.70	0.58	1.6	< 0.000005	0.00010	< 0.00005	0.0034	0.00024	< 0.001	< 0.002
1-Oct-14	14	500	485	7.8	0.040	0.000040	0.0013	2.5	0.011	< 0.01	0.0021	0.00010	< 0.009	2.9	< 0.00004	0.88	< 0.000002	0.58	0.63	2.0	< 0.000005	0.000060	0.00030	0.0033	0.00025	< 0.002	< 0.002
8-Oct-14	15	500	480	8.1	0.010	0.000020	0.0018	2.7	0.0056	< 0.01	0.0034	0.00020	< 0.003	3.4	< 0.00004	1.0	< 0.000002	0.66	0.79	2.4	0.000017	0.00048	0.00041	0.0042	0.00036	< 0.001	< 0.002
15-Oct-14	16	500	485	7.7	< 0.007	< 0.00001	0.0021	3.2	0.0047	< 0.01	0.0022	0.00020	< 0.003	3.8	0.000070	1.1	< 0.000002	0.75	0.89	2.4	0.000010	0.0014	0.00010	0.0046	0.00028	< 0.001	< 0.002
22-Oct-14	17	500	490	8.1	0.010	0.000010	0.0019	3.3	0.0054	< 0.01	0.0022	0.00020	< 0.003	4.0	0.000070	1.1	< 0.000002	0.68	0.89	2.2	0.000022	0.00019	0.000080	0.0047	0.00026	< 0.001	< 0.002
29-Oct-14	18	500	495	7.8	< 0.007	< 0.00001	0.0018	3.0	0.0042	< 0.01	0.0019	0.00010	< 0.003	3.4	0.000060	1.0	< 0.000002	0.53	0.84	1.8	0.000014	0.00096	< 0.00005	0.0041	0.00027	< 0.001	< 0.002
5-Nov-14	19	500	490	7.9	< 0.007	0.00030	0.0015	2.7	0.0039	< 0.01	0.0024	0.00020	< 0.003	3.0	< 0.00004	0.93	< 0.000002	0.46	0.78	1.7	0.000022	0.00026	0.00013	0.0039	0.00023	< 0.001	< 0.002
12-Nov-14	20	500	485	7.6	0.017	0.000040	0.0016	3.0	0.0049	< 0.01	0.0027	0.00020	< 0.003	3.3	0.000070	1.1	< 0.000002	0.53	0.90	1.8	0.000013	0.0010	0.00076	0.0044	0.00034	< 0.001	< 0.002
19-Nov-14	21	500	485	7.7	< 0.007	0.00013	0.0016	3.0	0.0052	< 0.01	0.0017	0.00020	< 0.003	3.3	0.000080	0.93	0.0000020	0.43	0.91	1.6	0.000025	0.00054	0.000050	0.0041	0.00027	0.0020	< 0.002
26-Nov-14	22	500	490	8.1	< 0.007	< 0.00001	0.0018	3.1	0.0042	< 0.01	0.0019	< 0.0001	0.010	3.4	0.00022	1.1	< 0.000002	0.41	0.89	1.5	0.000014	0.00013	0.00011	0.0043	0.00030	< 0.001	< 0.002
3-Dec-14	23	500	475	8.0	< 0.007	< 0.00001	0.0016	2.8	0.0049	0.010	0.0016	0.00010	< 0.003	3.1	0.000070	0.81	< 0.000002	0.33	0.75	1.4	0.000016	0.00097	0.00010	0.0041	0.00032	< 0.001	< 0.002
10-Dec-14	24	500	495	7.9	< 0.007	< 0.00001	0.0011	2.0	0.0039	< 0.01	0.0013	< 0.0001	< 0.003	2.3	0.000060	0.60	< 0.000002	0.21	0.65	1.1	0.000013	0.00058	< 0.00005	0.0028	0.00019	< 0.001	< 0.002
17-Dec-14	25	500	495	7.7	< 0.007	< 0.00001	0.0014	2.6	0.0045	< 0.01	0.0012	< 0.0001	< 0.003	3.1	0.000050	0.86	< 0.000002	0.28	0.79	1.2	0.000011	0.00085	0.00040	0.0034	0.00028	0.0010	< 0.002
24-Dec-14	26	500	495	7.7	< 0.007	< 0.00001	0.0015	2.5	0.0039	< 0.01	0.0014	0.00010	< 0.003	2.8	0.00016	0.78	< 0.000002	0.27	0.78	1.3	0.0000090	0.00074	0.00010	0.0034	0.00029	< 0.001	< 0.002
31-Dec-14	27	500	495	7.9	< 0.007	< 0.00001	0.0017	3.0	0.0043	< 0.01	0.0020	0.00010	< 0.003	3.5	0.00023	1.2	< 0.000002	0.31	0.96	1.8	0.000021	0.00053	0.000060	0.0045	0.00029	< 0.001	< 0.002
7-Jan-15	28	500	485	7.5	< 0.007	0.000020	0.0013	2.5	0.0038	< 0.01	0.0019	0.00010	< 0.003	2.8	0.00012	0.71	< 0.000002	0.21	0.75	0.90	0.000039	0.00036	0.000050	0.0032	0.00023	< 0.001	< 0.002
14-Jan-15	29	500	495	7.9	< 0.007	0.000020	0.0012	2.5	0.0036	< 0.01	0.0021	0.00010	< 0.003	2.9	0.00011	1.0	0.0000020	0.21	0.86	1.0	0.000028	0.00063	< 0.00005	0.0033	0.00022	< 0.001	< 0.002
21-Jan-15	30	500	485	7.8	< 0.007	0.000030	0.0016	2.8	0.0039	< 0.01	0.0023	0.00010	< 0.003	3.2	0.00010	0.88	0.0000020	0.24	0.93	1.0	0.000017	0.00068	0.000080	0.0043	0.00030	< 0.001	< 0.002
28-Jan-15	31	500	495	7.8	< 0.007	< 0.00001	0.0011	2.7	0.0037	< 0.01	0.0065	< 0.0001	< 0.003	3.1	0.00014	0.89	0.0000040	0.20	0.68	1.6	0.0000090	0.00025	0.00011	0.0032	0.00024	< 0.001	< 0.002
4-Feb-15	32	500	490	7.8	< 0.007	0.000030	0.0014	2.6	0.0038	< 0.01	0.0013	0.00010	< 0.003	2.9	0.000060	0.84	< 0.000002	0.18	0.78	1.3	0.0000090	0.00051	< 0.00005	0.0032	0.00025	0.0010	< 0.002
11-Feb-15	33	500	490	8.0	< 0.007	0.000010	0.0012	2.3	0.0033	< 0.01	0.0017	0.00010	< 0.003	2.8	< 0.001	0.77	< 0.000002	0.16	0.77	1.1	0.000013	0.0010	0.000090	0.0029	0.00025	< 0.001	< 0.002
18-Feb-15	34	500	485	7.8	< 0.007	< 0.00001	0.0014	2.6	0.0036	0.010	0.0011	0.00010	< 0.003	3.0	< 0.001	0.81	0.0000030	0.18	0.92	1.1	0.000012	0.00059	0.000070	0.0033	0.00027	< 0.001	< 0.002
25-Feb-15	35	500	490	7.8	< 0.007	0.000020	0.0012	2.4	0.0031	< 0.01	0.0013	0.00010	< 0.003	3.1	< 0.001	0.83	< 0.000002	0.14	0.81	0.60	0.000014	0.00050	0.00013	0.0036	0.00023	< 0.001	< 0.002
4-Mar-15	36	500	480	7.7	< 0.007	0.000020	0.0010	1.7	0.0035	< 0.01	0.00091	< 0.0001	< 0.003	2.2	< 0.001	0.65	< 0.000002	0.11	0.56	1.0	< 0.000005	0.00058	0.000080	0.0026	0.00021	< 0.001	< 0.002
11-Mar-15	37	500	480	8.0	< 0.007	0.000050	0.0011	2.0	0.0036	< 0.01	0.00084	< 0.0001	< 0.003	2.2	< 0.001	0.55	0.0000070	0.080	0.61	0.10	0.0000070	0.00065	< 0.00005	0.0024	0.00019	0.0010	< 0.002
18-Mar-15	38	500	500	7.8	0.013	0.000010	0.00098	1.8	0.0038	< 0.01	0.00085	0.00010	< 0.003	2.5	< 0.001	0.57	< 0.000002	0.10	0.67	1.0	< 0.000005	0.00083	0.00020	0.0023	0.00018	< 0.001	< 0.002
25-Mar-15	39	500	485	7.8	< 0.007	0.000030	0.00084	2.1	0.0036	< 0.01	0.0022	0.00020	< 0.003	2.6	< 0.001	0.65	0.0000020	0.18	0.65	1.0	< 0.000005	0.00083	0.000090	0.0027	0.00031	< 0.001	< 0.002
1-Apr-15	40	500	500	7.7	< 0.007	< 0.00001	0.00080	1.8	0.011	< 0.01	0.00072	0.00010	< 0.003	2.6	< 0.001	0.44	< 0.000002	0.79	0.67	0.50	0.000010	0.00056	< 0.00005	0.0033	0.00017	< 0.001	< 0.002
8-Apr-15	41	500	490	7.9	< 0.007	< 0.00001	0.0011	2.0	0.0031	< 0.01	0.0013	< 0.0001	< 0.003	2.8	< 0.001	0.74	< 0.000002	0.11	0.75	0.60	< 0.000005	0.00075	< 0.00005	0.0027	0.00022	< 0.001	< 0.002
15-Apr-15	42	500	485	7.7	0.010	< 0.00001	0.00098	1.8	0.0030	< 0.01	0.0012	< 0.0001	< 0.003	2.4	< 0.001	0.58	0.0000040	0.13	0.66	0.90	< 0.000005	0.0010	< 0.00005	0.0023	0.00026	< 0.001	< 0.002
22-Apr-15	43	500	490	7.6	< 0.007	0.000020	0.00088	1.7	0.0032	< 0.01	0.00077	< 0.0001	< 0.003	2.3	< 0.001	0.55	0.000011	0.070	0.62	0.60	0.000017	0.00095	0.000090	0.0020	0.00019	< 0.001	< 0.002
29-Apr-15	44	500	490	7.8	< 0.007	0.00010	0.0013	2.5	0.0033	< 0.01	0.0013	0.00010	< 0.003	3.5	< 0.001	0.83	< 0.000002	0.12	0.84	1.1	0.0000080	0.00071	< 0.00005	0.0033	0.00025	< 0.001	< 0.002
6-May-15	45	500	500	8.0	< 0.007	< 0.00001	0.0012	2.2	0.0032	< 0.01	0.0015	0.00010	< 0.003	3.0	< 0.001	0.79	< 0.000002	0.14	0.74	0.90	< 0.000005	0.00057	0.00012	0.0033	0.00025	0.0010	< 0.002
13-May-15	46	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	475	470	8.2	< 0.007	< 0.00001	0.0026	5.0	0.0045	< 0.01	0.0024	0.00020	< 0.003	5.6	0.00011	1.9	< 0.000002	0.21	1.8	2.5	0.000021	0.0012	0.000070	0.0070	0.00019	< 0.001	< 0.002
10-Jun-15	50	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	470	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	460	465	8.1	0.011	< 0.00001	0.0024	4.7	0.0048	0.010	0.0020	0.00030	< 0.003	4.8	0.00039	1.6	0.0000040	0.22	1.7	3.3	0.000017	0.0010	0.00025	0.0067	0.00022	0.0010	< 0.002
8-Jul-15	54	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	480	470	8.1	< 0.007	< 0.00001	0.0027	5.1	0.0039	< 0.01	0.0025	0.00030	< 0.003	5.1	0.00013	1.7	< 0.000002	0.23	1.8	2.5	0.0000050	0.00079	0.00019	0.0070	0.00026	< 0.001	< 0.002
5-Aug-15	58	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	480	470	8.0	< 0.007	0.00011	0.0026	4.7	0.0037	< 0.01	0.0028	0.00020	< 0.003	5.0	0.00013	1.8	< 0.000002	0.21	1.8	2.2	0.000014	0.00095	0.000070	0.0065	0.00028	< 0.001	< 0.002
2-Sep-15	62	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	490	470	8.1	< 0.007	< 0.00001	0.0025	5.2	0.0028	< 0.01	0.0031	0.00030	< 0.003	5.4	0.00015	1.8	< 0.000002	0.22	1.8	2.5	0.000017	0.0013	0.00013	0.0061	0.00023	< 0.001	< 0.002
30-Sep-15	66	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	480	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	460	450	8.1	< 0.007	0.000080	0.0024	4.9	0.0038	< 0.01	0.0018	0.00020	< 0.003	5.2	0.00052	1.6	0.00010	0.40	1.6	2.5	0.000020	0.0013	0.00012	0.0057	0.00018	0.0010	< 0.002
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	470	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	460	460	8.0	0.0080	0.000020	0.0017	4.0	0.0050	< 0.01	0.0030	< 0.0001	< 0.003	4.5	0.00024	1.2	0.0000013	0.20	1.3	1.4	0.000075	0.0012	0.00048	0.0049	0.00021	0.0020	< 0.002
25-Nov-15	74	500	485	8.0	< 0.007	0.00023	0.00100	1.8	0.0027	< 0.01	0.0013	0.00010	0.020	2.8	0.00084	0.65	0.00047	0.14	0.67	0.90	0.000080	0.00038	0.000090	0.0023	0.00030	< 0.001	< 0.002
2-Dec-15	75	500	495	8.0	< 0.007	0.00038	0.00094	2.0	0.0035	< 0.01	0.0013	< 0.0001	< 0.003	2.9	0.00023	0.70	0.0000020	0.11	0.64	0.80	< 0.000005	0.00042	0.00010	0.0025	0.00023	0.0010	< 0.002
9-Dec-15	76	500	505	8.1	< 0.007	< 0.00001	0.00098	1.8	0.0029	< 0.01	0.00094	< 0.0001	< 0.003	2.6	0.00033	0.62	0.0000090	0.090	0.64	0.70	0.000020	0.00041	0.00010	0.0023	0.00026	< 0.001	< 0.002
16-Dec-15	77	500	495	7.9	0.015	0.00012	0.00096	1.8	0.0032	< 0.01	0.00061	0.00010	0.0040	2.8	< 0.00004	0.71	< 0.000002	0.10	0.64	0.50	0.000014	0.00035	0.00041	0.0022	0.00027	< 0.001	< 0.002
23-Dec-15	78	500	500	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	485	7.9	< 0.007	< 0.00001	0.00086	1.7	0.0032	0.010	0.00052	< 0.0001	< 0.003	2.4	0.000050	0.56	0.0000030	0.11	0.59	1.1	< 0.000005	0.00024	0.00016	0.0020	0.00025	< 0.001	< 0.002
6-Jan-16	80	500	495	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	495	7.8	< 0.007	< 0.00001	0.00090	1.8	0.0036	< 0.01	0.0015	< 0.0001	< 0.003	2.7	0.00024	0.63	< 0.000002	0.070	0.63	0.40	< 0.000005	0.00028	< 0.00005	0.0026	0.00017	< 0.001	< 0.002
20-Jan-16	82	500	495	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	490	7.9	< 0.007	< 0.00001	0.0011	2.1	0.0033	< 0.01	0.00063	< 0.0001	< 0.003	3.0	< 0.00004	0.70	< 0.000002	0.080	0.75	0.50	0.000011	0.00042	0.00016	0.0029	0.00020	< 0.001	< 0.002
3-Feb-16	84	500	490	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.8	< 0.007	< 0.00001	0.00086	1.9	0.0038	< 0.01	0.00058	< 0.0001	< 0.003	2.6	0.000090	0.60	< 0.000002	0.11	0.68	1.1	0.0000090	0.00045	0.00010	0.0019	0.00018	< 0.001	< 0.002
17-Feb-16	86	500	500	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.8	< 0.007	< 0.00001	0.00097	2.0	0.0033	< 0.01	0.00096	< 0.0001	< 0.003	2.9	0.00017	0.45	0.000014	0.080	0.71	0.80	< 0.000005	0.00026	0.00010	0.0020	0.00019	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC1 (ST)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	345	7.7	484	#N/A	2.2	19	47	0.76	0.13	0.10	47	0.0062	0.00038	0.0038	0.012	0.0000024	0.0000024	0.0067	0.0000010	11	0.000052	0.00016	0.0022
2-Jul-14	1	500	500	7.7	295	#N/A	4.1	26	39	0.25	0.12	0.15	54	0.0090	0.00065	0.0043	0.012	0.0000035	0.0000035	0.0071	0.0000015	12	0.000095	0.00032	0.0013
9-Jul-14	2	500	485	7.9	192	#N/A	1.2	23	19	0.097	0.087	0.15	28	0.011	0.00029	0.0034	0.015	0.0000034	0.0000034	0.0059	0.0000015	6.6	0.000019	0.000050	0.00050
16-Jul-14	3	500	485	7.8	146	#N/A	1.1	22	9.2	0.097	0.063	0.15	23	0.011	0.00053	0.0030	0.015	0.0000034	0.0000034	0.0039	0.0000015	5.4	0.00010	0.00022	0.00039
23-Jul-14	4	500	485	7.8	108	#N/A	1.1	19	5.3	0.097	0.049	0.15	19	0.013	0.00024	0.0023	0.020	0.0000034	0.0000034	0.0032	0.0000015	4.7	0.000015	0.000083	0.00067
30-Jul-14	5	500	480	8.1	79	#N/A	0.76	18	2.9	0.096	0.029	0.14	14	0.016	0.00029	0.0024	0.016	0.0000034	0.0000034	0.0021	0.0000014	3.7	0.000096	0.00014	0.00072
6-Aug-14	6	500	485	7.8	76	#N/A	1.0	15	2.4	0.097	0.029	0.15	14	0.019	0.00015	0.0016	0.018	0.0000034	0.0000034	0.0033	0.0000015	3.7	0.000015	0.000016	0.00018
13-Aug-14	7	500	490	8.2	109	#N/A	1.1	21	4.4	0.098	0.049	0.15	21	0.028	0.00020	0.0026	0.030	0.0000034	0.0000034	0.0033	0.0000015	4.9	0.00013	0.000027	0.00026
20-Aug-14	8	500	485	7.9	85	#N/A	0.85	17	3.9	0.097	0.029	0.15	17	0.021	0.000097	0.0023	0.024	0.0000034	0.0000034	0.0023	0.0000015	4.4	0.000044	0.000028	0.00044
27-Aug-14	9	500	500	8.1	117	#N/A	1.9	24	4.5	0.10	0.055	0.15	22	0.018	0.00020	0.0025	0.027	0.0000035	0.0000035	0.0055	0.0000015	5.5	0.000050	0.000018	0.00019
3-Sep-14	10	500	490	7.8	101	#N/A	2.2	21	4.4	0.098	0.044	0.15	26	0.015	0.00054	0.0029	0.025	0.0000034	0.0000034	0.0037	0.0000015	7.4	0.000015	0.000016	0.00035
10-Sep-14	11	500	500	8.2	98	#N/A	1.5	21	2.5	0.10	0.040	0.15	22	0.019	0.00020	0.0021	0.026	0.0000035	0.0000035	0.0032	0.0000015	6.3	0.000050	0.000013	0.00019
17-Sep-14	12	500	475	8.0	77	#N/A	3.4	17	1.9	0.095	0.029	0.14	13	0.018	0.000095	0.0015	0.021	0.0000033	0.0000033	0.0029	0.0000014	3.6	0.000033	0.0000081	0.00012
24-Sep-14	13	500	485	8.2	75	#N/A	1.5	18	2.4	0.097	0.029	0.15	14	0.014	0.000097	0.0014	0.019	0.0000034	0.0000034	0.0017	0.0000015	3.8	0.000015	0.000053	0.00021
1-Oct-14	14	500	485	7.8	72	#N/A	4.6	18	1.5	0.097	0.029	0.15	15	0.016	0.000097	0.0012	0.019	0.0000034	0.0000034	0.0015	0.000021	3.9	0.000015	0.00	0.0000097
8-Oct-14	15	500	480	8.1	87	#N/A	1.3	17	1.9	0.096	0.029	0.14	21	0.017	0.00014	0.0017	0.025	0.0000034	0.0000034	0.011	0.0000014	6.2	0.000034	0.000012	0.00015
15-Oct-14	16	500	485	7.7	94	#N/A	2.8	18	2.4	0.097	0.029	0.15	23	0.013	0.00019	0.0018	0.023	0.0000034	0.0000034	0.0028	0.0000053	6.8	0.000019	0.0000087	0.00016
22-Oct-14	17	500	490	8.1	92	#N/A	2.0	20	2.5	0.098	0.029	0.15	18	0.012	0.00020	0.0017	0.024	0.0000034	0.0000034	0.0076	0.0000015	4.6	0.000020	0.0000093	0.00016
29-Oct-14	18	500	495	7.8	89	#N/A	4.4	21	1.5	0.099	0.030	0.15	17	0.012	0.00020	0.0018	0.023	0.0000035	0.0000035	0.0073	0.0000015	4.6	0.000059	0.0000089	0.00012
5-Nov-14	19	500	490	7.9	81	#N/A	#N/A	23	0.98	0.098	0.029	0.15	16	0.012	0.00015	0.0015	0.022	0.0000034	0.0000034	0.0029	0.0000078	4.1	0.000029	0.000011	0.00026
12-Nov-14	20	500	485	7.6	88	#N/A	3.2	17	1.5	0.097	0.034	0.15	18	0.023	0.00019	0.0018	0.025	0.0000034	0.0000034	0.0028	0.0000015	4.8	0.000092	0.000015	0.00022
19-Nov-14	21	500	485	7.7	89	#N/A	3.2	17	0.97	0.097	0.029	0.15	17	0.013	0.00019	0.0016	0.028	0.0000034	0.0000034	0.0016	0.0000039	4.5	0.000029	0.000011	0.00023
26-Nov-14	22	500	490	8.1	88	#N/A	0.95	19	1.5	0.098	0.029	0.15	18	0.014	0.00020	0.0018	0.027	0.0000034	0.0000034	0.0011	0.0000015	4.8	0.000025	0.0000088	0.00014
3-Dec-14	23	500	475	8.0	75	#N/A	1.4	17	0.95	0.095	0.029	0.14	16	0.013	0.00019	0.0019	0.027	0.0000033	0.0000033	0.0023	0.0000014	4.4	0.000024	0.0000076	0.00015
10-Dec-14	24	500	495	7.9	63	#N/A	2.3	17	0.99	0.099	0.030	0.15	13	0.011	0.000099	0.0012	0.022	0.0000035	0.0000035	0.0014	0.0000015	3.7	0.000030	0.0000050	0.00015
17-Dec-14	25	500	495	7.7	74	#N/A	2.2	17	1.5	0.099	0.030	0.15	16	0.015	0.000099	0.0014	0.026	0.0000035	0.0000035	0.0011	0.0000015	4.1	0.000015	0.0000064	0.00020
24-Dec-14	26	500	495	7.7	75	#N/A	1.8	17	0.99	0.099	0.030	0.15	16	0.015	0.00015	0.0015	0.029	0.0000035	0.0000035	0.0031	0.0000015	4.4	0.000015	0.0000059	0.00011
31-Dec-14	27	500	495	7.9	88	#N/A	0.65	18	0.99	0.099	0.030	0.15	19	0.013	0.00040	0.0031	0.031	0.0000035	0.0000035	0.0014	0.0000015	5.2	0.000015	0.0000030	0.00011
7-Jan-15	28	500	485	7.5	71	#N/A	1.5	16	0.97	0.49	0.029	0.15	16	0.013	0.00015	0.0012	0.023	0.0000034	0.0000034	0.0023	0.0000015	4.4	0.000029	0.0000073	0.00017
14-Jan-15	29	500	495	7.9	77	#N/A	1.2	19	1.5	0.50	0.030	0.15	19	0.011	0.00015	0.0015	0.025	0.0000035	0.0000035	0.0020	0.0000025	5.5	0.000030	0.0000050	0.00019
21-Jan-15	30	500	485	7.8	83	#N/A	2.3	21	0.97	0.49	0.029	0.15	17	0.013	0.00019	0.0015	0.031	0.0000034	0.0000034	0.0018	0.0000015	4.5	0.000039	0.0000073	0.00031
28-Jan-15	31	500	495	7.8	75	#N/A	0.83	18	0.99	0.50	0.030	0.15	16	0.013	0.00015	0.0013	0.027	0.0000035	0.0000035	0.0022	0.0000020	4.5	0.000050	0.0000045	0.00010
4-Feb-15	32	500	490	7.8	77	#N/A	1.3	18	0.98	0.49	0.029	0.15	16	0.011	0.00015	0.0013	0.027	0.0000034	0.0000034	0.0025	0.0000015	4.2	0.000098	0.0000034	0.00033
11-Feb-15	33	500	490	8.0	74	#N/A	0.96	18	1.5	0.49	0.029	0.15	15	0.012	0.00020	0.0013	0.025	0.0000034	0.0000034	0.0019	0.0000015	4.3	0.000025	0.0000059	0.00033
18-Feb-15	34	500	485	7.8	73	#N/A	1.1	18	0.97	0.49	0.034	0.15	16	0.012	0.00024	0.0013	0.024	0.0000034	0.0000034	0.0014	0.0000015	4.4	0.000019	0.0000078	0.00020
25-Feb-15	35	500	490	7.8	76	#N/A	1.5	19	0.98	0.49	0.029	0.15	16	0.011	0.00020	0.0012	0.028	0.0000034	0.0000034	0.00074	0.0000029	4.4	0.000039	0.0000083	0.00054
4-Mar-15	36	500	480	7.7	62	#N/A	1.0	15	0.96	0.48	0.029	0.14	14	0.0094	0.000096	0.00086	0.022	0.0000034	0.0000034	0.0013	0.0000014	4.4	0.000053	0.0000034	0.00023
11-Mar-15	37	500	480	8.0	64	#N/A	0.74	16	0.96	0.48	0.038	0.14	13	0.010	0.00014	0.0010	0.023	0.0000034	0.0000034	0.0025	0.0000014	3.8	0.000043	0.0000029	0.00038
18-Mar-15	38	500	500	7.8	65	#N/A	1.3	17	1.0	0.50	0.030	0.15	16	0.011	0.00015	0.00085	0.023	0.0000070	0.0000035	0.0011	0.0000015	4.7	0.000050	0.0000065	0.00053
25-Mar-15	39	500	485	7.8	65	#N/A	1.4	17	0.97	0.49	0.029	0.15	14	0.013	0.00015	0.0012	0.027	0.0000034	0.0000034	0.0025	0.0000015	4.0	0.000063	0.0000019	0.00095
1-Apr-15	40	500	500	7.7	66	#N/A	1.9	18	1.0	0.50	0.030	0.15	12	0.011	0.00015	0.00080	0.030	0.0000060	0.0000035	0.0014	0.0000015	3.4	0.000030	0.0000020	0.00019
8-Apr-15	41	500	490	7.9	71	#N/A	1.4	18	0.98	0.49	0.029	0.15	15	0.011	0.00020	0.0011	0.027	0.0000034	0.0000034	0.0025	0.0000015	4.2	0.000029	0.0000078	0.00048
15-Apr-15	42	500	485	7.7	61	#N/A	1.8	16	0.97	0.49	0.029	0.15	13	0.011	0.00015	0.00087	0.024	0.0000034	0.0000034	0.0032	0.0000015	3.7	0.000029	0.0000019	0.00047
22-Apr-15	43	500	490	7.6	60	#N/A	1.5	16	1.5	0.49	0.029	0.15	13	0.0091	0.000098	0.00074	0.023	0.0000034	0.0000034	0.0044	0.0000015	3.7	0.000020	0.0000029	0.00054
29-Apr-15	44	500	490	7.8	80	#N/A	1.0	19	1.5	0.49	0.029	0.15	20	0.013	0.00020	0.0014	0.034	0.0000034	0.0000034	0.0018	0.0000025	5.8	0.000044	0.0000098	0.00026
6-May-15	45	500	500	8.0	73	#N/A	1.2	20	1.0	0.50	0.030	0.15	16	0.013	0.00015	0.0032	0.027	0.0000035	0.0000035	0.0023	0.0000015	4.6	0.000015	0.0000085	0.00017
13-May-15	46	500	490																						
20-May-15	47	490	480																						
27-May-15	48	480	475																						
3-Jun-15	49	475	470	8.2	161	#N/A	1.3	8.9	0.71	0.12	0.0071	0.035	8.9	0.0011	0.000071	0.00028	0.019	0.00000082	0.00000082	0.00048	0.00000035	2.6	0.000019	0.0000026	0.000040
10-Jun-15	50	500	480																						
17-Jun-15	51	480	470																						
24-Jun-15	52	470	460																						
1-Jul-15	53	460	465	8.1	166	#N/A	1.7	8.8	0.47	0.12	0.0070	0.035	7.7	0.0018	0.000058	0.00033	0.016	0.00000081	0.00000081	0.0017	0.00000035	2.2	0.000023	0.0000043	0.000041
8-Jul-15	54	500	490																						
15-Jul-15	55	490	480																						
22-Jul-15	56	480	480																						
29-Jul-15	57	480	470	8.1	161	#N/A	0.91	9.1	0.59	0.12	0.0071	0.035	8.2	0.0017	0.000059	0.00029	0.017	0.00000082	0.00000082	0.00087	0.00000035	2.3	0.000025	0.0000033	0.000026
5-Aug-15	58	500	495																						
12-Aug-15	59	495	490																						
19-Aug-15	60	490	480																						
26-Aug-15	61	480	470	8.0	158	#N/A	0.92	9.0	0.59	0.12	0.0071	0.035	8.2	0.0011	0.000071	0.00033	0.018	0.00000082	0.00000082	0.00073	0.00000094	2.4	0.000020	0.0000029	0.000054
2-Sep-15	62	500	495																						
9-Sep-15	63	495	490																						
16-Sep-15	64	490	490																						
23-Sep-15	65	490	470	8.1	163	#N/A	1.0	9.0	0.59	0.00	0.00	0.00	8.6	0.0012	0.000071	0.00033	0.019	0.00000082	0.00000082	0.00085	0.00000047	2.5	0.000024	0.0000029	0.000029
30-Sep-15	66	500	500																						
7-Oct-15	67	500	480																						
14-Oct-15	68	480	460																						
21-Oct-15	69	460	450	8.1	149	#N/A	0.70	8.5	0.56	0.00	0.00	0.00	7.9	0.0011	0.000056	0.00029	0.016	0.00000079	0.00000079	0.00074	0.0000039	2.2	0.000027	0.0000041	0.00018
28-Oct-15	70	500	490																						
4-Nov-15	71	490	470																						
11-Nov-15	72	470	460																						
18-Nov-15	73	460	460	8.0	138	#N/A	0.52	8.5	0.46	0.00	0.00	0.00	6.7	0.0022	0.000046	0.00023	0.015	0.00000081	0.00000081	0.00038	0.00000035	1.9	0.000026	0.0000092	0.000071
25-Nov-15	74	500	485	8.0	69	#N/A	0.20	19	0.97	0.00	0.00	0.00	16	0.015	0.00015	0.0012	0.030	0.0000034	0.0000034	0.0016	0.0000015	4.9	0.000078	0.000087	0.00038
2-Dec-15	75	500	495	8.0	68	#N/A	0.68	17	0.99	0.00	0.00	0.00	15	0.014	0.00015	0.0011	0.031	0.0000035	0.0000035	0.0014	0.0000035	4.3	0.000025	0.0000069	0.00028
9-Dec-15	76	500	505	8.1	67	#N/A	1.2	17	1.0	0.00	0.00	0.00	14	0.015	0.00020	0.0016	0.031	0.0000051	0.0000035	0.0045	0.0000066	4.2	0.000051	0.0000020	0.00018
16-Dec-15	77	500	495	7.9	63	#N/A	0.85	15	0.99	0.00	0.00	0.00	15	0.025	0.000099	0.0011	0.031	0.0000035	0.0000035	0.00099	0.0000020	4.4	0.000099	0.0000079	0.00021
23-Dec-15	78	500	500	7.9	71	-	0.75	15	1.2	0.00	0.00	0.00	14	0.019	0.000098	0.00091	0.030	0.0000034	0.0000034	0.0011	0.0000020	4.3	0.000074	0.0000049	0.00016
30-Dec-15	79	500	485	7.9	62	#N/A	0.65	15	1.5	0.00	0.00	0.00	14	0.013	0.000097	0.00073	0.029	0.0000034	0.0000034	0.0012	0.0000019	4.1	0.000049	0.0000019	0.00011
6-Jan-16	80	500	495	7.9	70	-	0.69	15	1.5	0.00	0.00	0.00	14	0.012	0.000098	0.00081	0.029	0.0000034	0.0000034	0.0018	0.0000017	4.2	0.000044	0.0000020	0.00011
13-Jan-16	81	500	495	7.8	68	#N/A	0.74	16	1.5	0.00	0.00	0.00	14	0.011	0.000099	0.00089	0.030	0.0000035	0.0000035	0.0025	0.0000015	4.2	0.000040	0.0000020	0.00012
20-Jan-16	82	500	495	7.9	80	-	0.97	17	1.2	0.00	0.00	0.00	15	0.012	0.000099	0.00098	0.033	0.0000034	0.0000034	0.0017	0.0000015	4.4	0.000039	0.0000054	0.00011
27-Jan-16	83	500	490	7.9	73	#N/A	1.2	17	0.98	0.00	0.00	0.00	15	0.012	0.000098	0.0011	0.036	0.0000034	0.0000034	0.00098	0.0000015	4.5	0.000039	0.0000088	0.000098
3-Feb-16	84	500	490	7.9	74	-	1.2	17	0.99	0.00	0.00	0.00	15	0.012	0.000099	0.0011	0.037	0.0000035	0.0000035	0.00099	0.0000015	4.5	0.000042	0.0000064	0.00024
10-Feb-16	85	500	500	7.8	70	#N/A	1.1	17	1.0	0.00	0.00	0.00	15	0.013	0.00010	0.0011	0.038	0.0000035	0.0000035	0.0010	0.0000015	4.5	0.000045	0.0000040	0.00038
17-Feb-16	86	500	500	7.8	73	-	1.1	17	1.0	0.00	0.00	0.00	15	0.013	0.00010	0.0011	0.037	0.0000035	0.0000035	0.0010	0.0000015	4.5	0.000030	0.0000030	0.00023
24-Feb-16	87	500	500	7.8	69	#N/A	1.1	16	1.0	0.00	0.00	0.00	15	0.014	0.00010	0.0010	0.035	0.0000035	0.0000035	0.0010	0.0000015	4.5	0.000015	0.0000020	0.000075

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC1 (ST)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	345	7.7	0.0031	0.0000035	0.0029	5.1	0.0038	0.0069	0.0050	0.0018	0.0086	3.3	0.0012	0.96	0.00000069	12	0.37	19	0.0000090	0.000045	0.000062	0.0042	0.00025	0.00069	0.00069
2-Jul-14	1	500	500	7.7	0.0010	0.0000050	0.0033	5.8	0.0081	0.0050	0.0048	0.0021	0.0045	3.9	0.00064	1.2	0.0000010	10	0.57	18	0.000011	0.0036	0.00010	0.0089	0.00024	0.00050	0.0010
9-Jul-14	2	500	485	7.9	0.0029	0.0000049	0.0022	2.9	0.0048	0.0049	0.0030	0.00092	0.0044	2.8	0.00016	0.98	0.00000097	4.3	0.40	6.7	0.0000063	0.0016	0.000073	0.0039	0.00023	0.00049	0.00097
16-Jul-14	3	500	485	7.8	0.0053	0.0000049	0.0017	2.3	0.0032	0.0049	0.0037	0.00058	0.0044	2.2	0.000087	0.72	0.0000029	2.7	0.36	3.6	0.0000087	0.00012	0.000044	0.0054	0.00018	0.00049	0.00097
23-Jul-14	4	500	485	7.8	0.00097	0.0000097	0.0013	1.8	0.0038	0.0049	0.0015	0.00034	0.0044	1.9	0.000053	0.61	0.0000019	1.7	0.32	2.5	0.0000044	0.0016	0.000039	0.0024	0.00016	0.00049	0.00097
30-Jul-14	5	500	480	8.1	0.0024	0.0000048	0.00089	1.2	0.0032	0.0048	0.0025	0.00019	0.0072	1.3	0.000043	0.40	0.00000096	0.85	0.25	1.4	0.0000053	0.00010	0.00011	0.0034	0.00014	0.00048	0.00096
6-Aug-14	6	500	485	7.8	0.0039	0.000015	0.00075	1.2	0.0028	0.0049	0.00091	0.000049	0.0053	1.4	0.000058	0.42	0.00000097	0.74	0.26	1.3	0.0000034	0.000053	0.00013	0.0018	0.00039	0.00097	0.00097
13-Aug-14	7	500	490	8.2	0.0088	0.0000098	0.0013	2.0	0.0030	0.0049	0.0017	0.00015	0.0049	2.1	0.000059	0.71	0.00000098	1.3	0.38	2.1	0.0000049	0.00060	0.00040	0.0029	0.00017	0.00049	0.00098
20-Aug-14	8	500	485	7.9	0.0029	0.000019	0.00092	1.5	0.0031	0.0049	0.0011	0.00015	0.0044	1.6	0.00015	0.52	0.00000097	0.72	0.32	1.4	0.0000029	0.00097	0.00018	0.0023	0.00018	0.00049	0.00097
27-Aug-14	9	500	500	8.1	0.0030	0.0000050	0.0013	2.1	0.0038	0.0050	0.0019	0.00015	0.0045	2.2	0.000055	0.73	0.0000010	1.1	0.43	1.8	0.0000080	0.00069	0.00016	0.0032	0.00020	0.00050	0.0010
3-Sep-14	10	500	490	7.8	0.0034	0.000020	0.0012	1.8	0.0029	0.0049	0.0015	0.00015	0.0025	2.2	0.00014	0.74	0.0000064	0.78	0.46	2.0	0.0000088	0.000093	0.000029	0.0026	0.00019	0.00049	0.00098
10-Sep-14	11	500	500	8.2	0.0050	0.0000050	0.00093	1.5	0.0030	0.0050	0.0013	0.00010	0.0015	1.8	0.000045	0.65	0.0000010	0.59	0.41	1.2	0.0000075	0.00073	0.00016	0.0023	0.00016	0.00050	0.0010
17-Sep-14	12	500	475	8.0	0.0033	0.0000048	0.00066	1.1	0.0025	0.0048	0.00081	0.000048	0.0014	1.4	0.000048	0.39	0.00000095	0.33	0.31	1.00	0.0000024	0.000043	0.000081	0.0016	0.00013	0.00048	0.00095
24-Sep-14	13	500	485	8.2	0.00097	0.0000049	0.00072	1.2	0.0022	0.0049	0.00081	0.000097	0.0044	1.4	0.000019	0.40	0.0000024	0.34	0.28	0.75	0.0000024	0.000049	0.000024	0.0017	0.00012	0.00049	0.00097
1-Oct-14	14	500	485	7.8	0.019	0.000019	0.00065	1.2	0.0053	0.0049	0.0010	0.000049	0.0044	1.4	0.000019	0.43	0.00000097	0.28	0.30	0.96	0.0000024	0.000029	0.00015	0.0016	0.00012	0.00097	0.00097
8-Oct-14	15	500	480	8.1	0.0048	0.0000096	0.00088	1.3	0.0027	0.0048	0.0016	0.000096	0.0014	1.6	0.000019	0.48	0.00000096	0.32	0.38	1.2	0.0000082	0.00023	0.00020	0.0020	0.00017	0.00048	0.00096
15-Oct-14	16	500	485	7.7	0.0034	0.0000049	0.0010	1.5	0.0023	0.0049	0.0011	0.000097	0.0015	1.9	0.000034	0.53	0.00000097	0.36	0.43	1.2	0.0000049	0.00066	0.000049	0.0022	0.00014	0.00049	0.00097
22-Oct-14	17	500	490	8.1	0.0049	0.0000049	0.00092	1.6	0.0027	0.0049	0.0011	0.000098	0.0015	2.0	0.000034	0.52	0.00000098	0.33	0.43	1.1	0.000011	0.000093	0.000039	0.0023	0.00013	0.00049	0.00098
29-Oct-14	18	500	495	7.8	0.0035	0.0000050	0.00089	1.5	0.0021	0.0050	0.00093	0.000050	0.0015	1.7	0.000030	0.51	0.00000099	0.26	0.41	0.89	0.0000069	0.00048	0.000025	0.0020	0.00013	0.00050	0.00099
5-Nov-14	19	500	490	7.9	0.0034	0.00015	0.00071	1.3	0.0019	0.0049	0.0012	0.000098	0.0015	1.5	0.000020	0.46	0.00000098	0.23	0.38	0.83	0.000011	0.00013	0.000064	0.0019	0.00011	0.00049	0.00098
12-Nov-14	20	500	485	7.6	0.0082	0.000019	0.00076	1.5	0.0024	0.0049	0.0013	0.000097	0.0015	1.6	0.000034	0.51	0.00000097	0.26	0.43	0.87	0.0000063	0.00050	0.00037	0.0021	0.00016	0.00049	0.00097
19-Nov-14	21	500	485	7.7	0.0034	0.000063	0.00077	1.4	0.0025	0.0049	0.00084	0.000097	0.0015	1.6	0.000039	0.45	0.00000097	0.21	0.44	0.78	0.000012	0.00026	0.000024	0.0020	0.00013	0.00097	0.00097
26-Nov-14	22	500	490	8.1	0.0034	0.0000049	0.00089	1.5	0.0021	0.0049	0.00092	0.000049	0.0049	1.7	0.00011	0.56	0.00000098	0.20	0.44	0.74	0.0000069	0.000064	0.000054	0.0021	0.00015	0.00049	0.00098
3-Dec-14	23	500	475	8.0	0.0033	0.0000048	0.00077	1.3	0.0023	0.0048	0.00076	0.000048	0.0014	1.5	0.000033	0.38	0.00000095	0.16	0.36	0.67	0.0000076	0.00046	0.000048	0.0019	0.00015	0.00048	0.00095
10-Dec-14	24	500	495	7.9	0.0035	0.0000050	0.00052	1.00	0.0019	0.0050	0.00063	0.000050	0.0015	1.1	0.000030	0.30	0.00000099	0.10	0.32	0.54	0.0000064	0.00029	0.000025	0.0014	0.000094	0.00050	0.00099
17-Dec-14	25	500	495	7.7	0.0035	0.0000050	0.00071	1.3	0.0022	0.0050	0.00058	0.000050	0.0015	1.5	0.000025	0.43	0.00000099	0.14	0.39	0.59	0.0000054	0.00042	0.00020	0.0017	0.00014	0.00050	0.00099
24-Dec-14	26	500	495	7.7	0.0035	0.0000050	0.00072	1.2	0.0019	0.0050	0.00069	0.000050	0.0015	1.4	0.000079	0.39	0.00000099	0.13	0.39	0.64	0.0000045	0.00037	0.000050	0.0017	0.00014	0.00050	0.00099
31-Dec-14	27	500	495	7.9	0.0035	0.0000050	0.00085	1.5	0.0021	0.0050	0.00098	0.000050	0.0015	1.7	0.00011	0.59	0.00000099	0.15	0.47	0.89	0.000010	0.00026	0.000030	0.0022	0.00014	0.00050	0.00099
7-Jan-15	28	500	485	7.5	0.0034	0.0000097	0.00061	1.2	0.0018	0.0049	0.00090	0.000049	0.0015	1.3	0.000058	0.34	0.00000097	0.10	0.37	0.44	0.000019	0.00017	0.000024	0.0015	0.00011	0.00049	0.00097
14-Jan-15	29	500	495	7.9	0.0035	0.0000099	0.00061	1.3	0.0018	0.0050	0.0011	0.000050	0.0015	1.4	0.000054	0.50	0.00000099	0.10	0.42	0.50	0.000014	0.00031	0.000025	0.0016	0.00011	0.00050	0.00099
21-Jan-15	30	500	485	7.8	0.0034	0.000015	0.00078	1.3	0.0019	0.0049	0.0011	0.000049	0.0015	1.6	0.000049	0.43	0.00000097	0.12	0.45	0.49	0.0000082	0.00033	0.000039	0.0021	0.00015	0.00049	0.00097
28-Jan-15	31	500	495	7.8	0.0035	0.0000050	0.00052	1.3	0.0018	0.0050	0.0032	0.000050	0.0015	1.5	0.000069	0.44	0.0000020	0.099	0.34	0.79	0.0000045	0.00012	0.000054	0.0016	0.00012	0.00050	0.00099
4-Feb-15	32	500	490	7.8	0.0034	0.000015	0.00070	1.3	0.0019	0.0049	0.00066	0.000049	0.0015	1.4	0.000029	0.41	0.00000098	0.088	0.38	0.64	0.0000044	0.00025	0.000025	0.0016	0.00012	0.00049	0.00098
11-Feb-15	33	500	490	8.0	0.0034	0.0000049	0.00057	1.1	0.0016	0.0049	0.00083	0.000049	0.0015	1.4	0.00049	0.38	0.00000098	0.078	0.38	0.54	0.0000064	0.00049	0.000044	0.0014	0.00012	0.00049	0.00098
18-Feb-15	34	500	485	7.8	0.0034	0.0000049	0.00067	1.2	0.0017	0.0049	0.00053	0.000049	0.0015	1.5	0.00049	0.39	0.0000015	0.087	0.45	0.53	0.0000058	0.00029	0.000034	0.0016	0.00013	0.00049	0.00097
25-Feb-15	35	500	490	7.8	0.0034	0.0000098	0.00061	1.2	0.0015	0.0049	0.00061	0.000049	0.0015	1.5	0.00049	0.41	0.00000098	0.069	0.40	0.29	0.0000069	0.00025	0.000064	0.0018	0.00011	0.00049	0.00098
4-Mar-15	36	500	480	7.7	0.0034	0.0000096	0.00048	0.83	0.0017	0.0048	0.00044	0.000048	0.0014	1.0	0.00048	0.31	0.00000096	0.053	0.27	0.48	0.0000024	0.00028	0.000038	0.0013	0.00010	0.00048	0.00096
11-Mar-15	37	500	480	8.0	0.0034	0.000024	0.00050	0.95	0.0017	0.0048	0.00040	0.000048	0.0014	1.1	0.00048	0.26	0.0000034	0.038	0.29	0.048	0.0000034	0.00031	0.000024	0.0012	0.000091	0.00048	0.00096
18-Mar-15	38	500	500	7.8	0.0065	0.0000050	0.00049	0.91	0.0019	0.0050	0.00043	0.000050	0.0015	1.2	0.00050	0.29	0.0000010	0.050	0.33	0.50	0.0000025	0.00042	0.00010	0.0012	0.000090	0.00050	0.0010
25-Mar-15	39	500	485	7.8	0.0034	0.000015	0.00041	1.0	0.0017	0.0049	0.0010	0.000097	0.0015	1.2	0.00049	0.32	0.00000097	0.087	0.31	0.49	0.0000024	0.00040	0.000044	0.0013	0.00015	0.00049	0.00097
1-Apr-15	40	500	500	7.7	0.0035	0.0000050	0.00040	0.92	0.0057	0.0050	0.00036	0.000050	0.0015	1.3	0.00050	0.22	0.0000010	0.40	0.33	0.25	0.0000050	0.00028	0.000025	0.0016	0.000085	0.00050	0.0010
8-Apr-15	41	500	490	7.9	0.0034	0.0000049	0.00053	0.98	0.0015	0.0049	0.00064	0.000049	0.0015	1.4	0.00049	0.36	0.00000098	0.054	0.37	0.29	0.0000025	0.00037	0.000025	0.0013	0.00011	0.00049	0.00098
15-Apr-15	42	500	485	7.7	0.0049	0.0000049	0.00048	0.89	0.0014	0.0049	0.00059	0.000049	0.0015	1.2	0.00049	0.28	0.0000019	0.063	0.32	0.44	0.0000024	0.00050	0.000024	0.0011	0.00013	0.00049	0.00097
22-Apr-15	43	500	490	7.6	0.0034	0.0000098	0.00043	0.83	0.0016	0.0049	0.00038	0.000049	0.0015	1.1	0.00049	0.27	0.0000054	0.034	0.30	0.29	0.0000083	0.00047	0.000044	0.00100	0.000093	0.00049	0.00098
29-Apr-15	44	500	490	7.8	0.0034	0.000049	0.00063	1.2	0.0016	0.0049	0.00065	0.000049	0.0015	1.7	0.00049	0.41	0.00000098	0.059	0.41	0.54	0.0000039	0.00035	0.000025	0.0016	0.00012	0.00049	0.00098
6-May-15	45	500	500	8.0	0.0035	0.0000050	0.00060	1.1	0.0016	0.0050	0.00077	0.000050	0.0015	1.5	0.00050	0.40	0.0000010	0.070	0.37	0.45	0.0000025	0.00029	0.000060	0.0017	0.00013	0.00050	0.0010
13-May-15	46	500	490																								
20-May-15	47	490	480																								
27-May-15	48	480	475																								
3-Jun-15	49	475	470	8.2	0.00082	0.0000012	0.00031	0.59	0.00053	0.0012	0.00028	0.000024	0.00035	0.65	0.000013	0.22	0.00000024	0.025	0.22	0.29	0.0000025	0.00014	0.0000082	0.00082	0.000022	0.00012	0.00024
10-Jun-15	50	500	480																								
17-Jun-15	51	480	470																								
24-Jun-15	52	470	460																								
1-Jul-15	53	460	465	8.1	0.0013	0.0000012	0.00028	0.55	0.00055	0.0012	0.00023	0.000035	0.00035	0.56	0.000045	0.19	0.00000047	0.026	0.19	0.38	0.0000020	0.00012	0.000029	0.00078	0.000026	0.00012	0.00023
8-Jul-15	54	500	490																								
15-Jul-15	55	490	480																								
22-Jul-15	56	480	480																								
29-Jul-15	57	480	470	8.1	0.00082	0.0000012	0.00032	0.60	0.00046	0.0012	0.00029	0.000035	0.00035	0.60	0.000015	0.20	0.00000024	0.027	0.21	0.29	0.00000059	0.000093	0.000022	0.00082	0.000031	0.00012	0.00024
5-Aug-15	58	500	495																								
12-Aug-15	59	495	490																								
19-Aug-15	60	490	480																								
26-Aug-15	61	480	470	8.0	0.00082	0.000013	0.00031	0.56	0.00043	0.0012	0.00032	0.000024	0.00035	0.59	0.000015	0.21	0.00000024	0.025	0.21	0.26	0.0000016	0.00011	0.0000082	0.00076	0.000033	0.00012	0.00024
2-Sep-15	62	500	495																								
9-Sep-15	63	495	490																								
16-Sep-15	64	490	490																								
23-Sep-15	65	490	470	8.1	0.00082	0.0000012	0.00029	0.61	0.00033	0.0012	0.00036	0.000035	0.00035	0.63	0.000018	0.22	0.00000024	0.026	0.21	0.29	0.0000020	0.00016	0.000015	0.00072	0.000027	0.00012	0.00024
30-Sep-15	66	500	500																								
7-Oct-15	67	500	480																								
14-Oct-15	68	480	460																								
21-Oct-15	69	460	450	8.1	0.00079	0.0000090	0.00027	0.55	0.00042	0.0011	0.00020	0.000023	0.00034	0.59	0.000059	0.18	0.000012	0.045	0.18	0.28	0.0000023	0.00015	0.000014	0.00064	0.000020	0.00011	0.00023
28-Oct-15	70	500	490																								
4-Nov-15	71	490	470																								
11-Nov-15	72	470	460																								
18-Nov-15	73	460	460	8.0	0.00092	0.0000023	0.00020	0.45	0.00058	0.0012	0.00035	0.000012	0.00035	0.52	0.000028	0.14	0.0000015	0.023	0.15	0.16	0.0000086	0.00013	0.000055	0.00056	0.000024	0.00023	0.00023
25-Nov-15	74	500	485	8.0	0.0034	0.00011	0.00048	0.89	0.0013	0.0049	0.00063	0.000049	0.0097	1.3	0.00041	0.32	0.00023	0.068	0.32	0.44	0.000039	0.00018	0.000044	0.0011	0.00015	0.00049	0.00097
2-Dec-15	75	500	495	8.0	0.0035	0.00019	0.00047	0.98	0.0017	0.0050	0.00063	0.000050	0.0015	1.5	0.00011	0.35	0.00000099	0.054	0.32	0.40	0.0000025	0.00021	0.000050	0.0012	0.00011	0.00050	0.00099
9-Dec-15	76	500	505	8.1	0.0035	0.0000051	0.00049	0.91	0.0014	0.0051	0.00047	0.000051	0.0015	1.3	0.00017	0.31	0.0000045	0.045	0.32	0.35	0.000010	0.00021	0.000051	0.0012	0.00013	0.00051	0.0010
16-Dec-15	77	500	495	7.9	0.0074	0.000059	0.00047	0.89	0.0016	0.0050	0.00030	0.000050	0.0020	1.4	0.000020	0.35	0.00000099	0.050	0.32	0.25	0.0000069	0.00017	0.00020	0.0011	0.00013	0.00050	0.00099
23-Dec-15	78	500	500	7.9	0.0054	0.000032	0.00045	0.87	0.0016	0.0049	0.00028	0.000049	0.0017	1.3	0.000022	0.31	0.0000012	0.051	0.30	0.39	0.0000047	0.00014	0.00014	0.0010	0.00013	0.00049	0.00098
30-Dec-15	79	500	485	7.9	0.0034	0.0000049	0.00042	0.84	0.0016	0.0049	0.00025	0.000049	0.0015	1.2	0.000024	0.27	0.0000015	0.053	0.28	0.53	0.0000024	0.00012	0.000078	0.00098	0.00012	0.00049	0.00097
6-Jan-16	80	500	495	7.9	0.0034	0.0000049	0.00043	0.87	0.0017	0.0049	0.00050	0.000049	0.0015	1.2	0.000072	0.29	0.0000012	0.044	0.30	0.37	0.0000025	0.00013	0.000051	0.0011	0.00010	0.00049	0.00098
13-Jan-16	81	500	495	7.8	0.0035	0.0000050	0.00044	0.89	0.0018	0.0050	0.00075	0.000050	0.0015	1.3	0.00012	0.31	0.00000099	0.035	0.31	0.20	0.0000025	0.00014	0.000025	0.0013	0.000084	0.00050	0.00099
20-Jan-16	82	500	495	7.9	0.0034	0.0000049	0.00048	0.96	0.0017	0.0049	0.00053	0.000049	0.0015	1.4	0.000069	0.33	0.00000099	0.037	0.34	0.22	0.0000039	0.00017	0.000052	0.0014	0.000091	0.00049	0.00099
27-Jan-16	83	500	490	7.9	0.0034	0.0000049	0.00051	1.0	0.0016	0.0049	0.00031	0.000049	0.0015	1.5	0.000020	0.34	0.00000098	0.039	0.37	0.25	0.0000054	0.00021	0.000078	0.0014	0.000098	0.00049	0.00098
3-Feb-16	84	500	490	7.9	0.0035	0.0000050	0.00047	0.97	0.0018	0.0050	0.00030	0.000050	0.0015	1.4	0.000032	0.32	0.00000099	0.047	0.35	0.40	0.0000049	0.00022	0.000064	0.0012	0.000094	0.00050	0.00099
10-Feb-16	85	500	500	7.8	0.0035	0.0000050	0.00043	0.93	0.0019	0.0050	0.00029	0.000050	0.0015	1.3	0.000045	0.30	0.0000010	0.055	0.34	0.55	0.0000045	0.00023	0.000050	0.00095	0.000090	0.00050	0.0010
17-Feb-16	86	500	500	7.8	0.0035	0.0000050	0.00046	0.95	0.0018	0.0050	0.00039	0.000050	0.0015	1.4	0.000065	0.26	0.0000040	0.048	0.35	0.48	0.0000035	0.00018	0.000050	0.00098	0.000093	0.00050	0.0010
24-Feb-16	87	500	500	7.8	0.0035	0.0000050	0.00048	0.98	0.0017	0.0050	0.00048	0.000050	0.0015	1.5	0.000085	0.23	0.0000070	0.040	0.35	0.40	0.0000025	0.00013	0.000050	0.0010	0.000095	0.00050	0.0010

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC2 (SS)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	330	8.0	464	#N/A	6.8	88	101	3.3	0.59	< 0.3	126	0.038	0.032	0.064	0.034	0.0000080	< 0.000007	0.019	0.0000090	24	0.00021	0.00044	0.0060
2-Jul-14	1	500	485	8.0	255	#N/A	8.2	74	49	0.80	0.29	< 0.3	83	0.036	0.028	0.063	0.043	< 0.000007	< 0.000007	0.012	< 0.000003	16	0.000040	0.00031	0.0017
9-Jul-14	2	500	490	8.0	220	#N/A	2.4	77	27	< 0.2	0.28	< 0.3	72	0.043	0.031	0.048	0.068	< 0.000007	< 0.000007	0.013	0.0000030	14	< 0.00003	0.00013	0.00092
16-Jul-14	3	500	480	8.0	177	#N/A	2.4	69	12	< 0.2	0.20	< 0.3	64	0.043	0.025	0.036	0.063	< 0.000007	< 0.000007	0.0085	< 0.000003	13	0.00019	0.00046	0.00073
23-Jul-14	4	500	500	8.0	118	#N/A	2.1	50	7.0	< 0.2	0.10	< 0.3	50	0.069	0.015	0.025	0.081	< 0.000007	< 0.000007	0.0059	0.0000030	11	< 0.00003	0.00016	0.0010
30-Jul-14	5	500	485	8.1	160	#N/A	1.9	77	9.0	< 0.2	0.18	< 0.3	66	0.051	0.025	0.034	0.074	< 0.000007	< 0.000007	0.0079	< 0.000003	13	0.00020	0.00020	0.0015
6-Aug-14	6	500	480	8.0	142	#N/A	2.6	64	5.0	< 0.2	0.15	< 0.3	60	0.050	0.021	0.028	0.069	< 0.000007	< 0.000007	0.0070	< 0.000003	12	< 0.00003	0.000088	0.00035
13-Aug-14	7	500	490	8.0	125	#N/A	2.4	58	7.0	< 0.2	0.11	< 0.3	55	0.045	0.018	0.020	0.082	< 0.000007	< 0.000007	0.0060	< 0.000003	12	0.000050	0.000084	0.00035
20-Aug-14	8	500	490	8.0	103	#N/A	1.9	48	6.0	< 0.2	0.070	< 0.3	48	0.057	0.012	0.016	0.074	< 0.000007	< 0.000007	0.0046	< 0.000003	11	< 0.00003	0.000084	0.00038
27-Aug-14	9	500	495	8.0	130	#N/A	4.5	58	5.0	< 0.2	0.10	< 0.3	56	0.045	0.017	0.020	0.080	< 0.000007	< 0.000007	0.010	< 0.000003	12	< 0.00003	0.000068	0.00027
3-Sep-14	10	500	490	7.9	121	#N/A	4.6	54	7.0	< 0.2	0.070	< 0.3	68	0.060	0.018	0.022	0.098	< 0.000007	< 0.000007	0.0052	< 0.000003	18	< 0.00003	0.000066	0.00033
10-Sep-14	11	500	500	8.0	111	#N/A	3.3	50	5.0	< 0.2	0.060	< 0.3	54	0.057	0.014	0.015	0.081	< 0.000007	< 0.000007	0.0062	0.000021	14	< 0.00003	0.000050	0.00029
17-Sep-14	12	500	495	7.9	112	#N/A	8.3	53	6.0	< 0.2	0.060	< 0.3	47	0.058	0.016	0.014	0.076	< 0.000007	< 0.000007	0.0047	< 0.000003	11	0.000040	0.000059	0.00041
24-Sep-14	13	500	480	8.0	95	#N/A	3.7	45	8.0	< 0.2	< 0.06	< 0.3	42	0.048	0.015	0.010	0.068	< 0.000007	< 0.000007	0.0036	0.0000060	9.6	< 0.00003	0.00014	0.00018
1-Oct-14	14	500	470	7.9	96	#N/A	6.7	48	6.0	< 0.2	< 0.06	< 0.3	42	0.052	0.020	0.0097	0.061	< 0.000007	< 0.000007	0.0027	0.0000030	9.8	< 0.00003	0.00	< 0.00002
8-Oct-14	15	500	490	7.9	90	#N/A	3.0	37	4.0	< 0.2	< 0.06	< 0.3	46	0.048	0.012	0.0099	0.059	< 0.000007	< 0.000007	0.016	< 0.000003	13	< 0.00003	0.000040	0.00019
15-Oct-14	16	500	495	7.9	110	#N/A	5.4	43	7.0	< 0.2	< 0.06	< 0.3	57	0.051	0.016	0.012	0.077	< 0.000007	< 0.000007	0.0051	< 0.000003	16	< 0.00003	0.000055	0.00026
22-Oct-14	17	500	505	8.0	102	#N/A	5.0	46	5.0	< 0.2	< 0.06	< 0.3	44	0.049	0.016	0.012	0.071	< 0.000007	< 0.000007	0.011	0.0000050	10	0.00015	0.000058	0.00037
29-Oct-14	18	500	490	7.9	84	#N/A	8.4	39	3.0	< 0.2	< 0.06	< 0.3	37	0.037	0.011	0.0079	0.053	< 0.000007	< 0.000007	0.0075	< 0.000003	9.2	0.000040	0.000040	0.00037
5-Nov-14	19	500	485	7.7	85	#N/A	#N/A	48	3.0	< 0.2	< 0.06	< 0.3	37	0.053	0.011	0.0093	0.062	< 0.000007	< 0.000007	0.0035	0.000019	8.8	< 0.00003	0.000045	0.00052
12-Nov-14	20	500	495	7.6	89	#N/A	6.7	34	2.0	< 0.2	< 0.06	< 0.3	41	0.058	0.012	0.011	0.066	< 0.000007	< 0.000007	0.0048	< 0.000003	10	0.000050	0.000054	0.00043
19-Nov-14	21	500	475	7.6	93	#N/A	6.5	34	2.0	< 0.2	< 0.06	< 0.3	40	0.052	0.013	0.010	0.070	< 0.000007	< 0.000007	0.0027	0.000013	9.8	< 0.00003	0.000052	0.00057
26-Nov-14	22	500	500	7.9	78	#N/A	1.8	35	2.0	< 0.2	< 0.06	< 0.3	35	0.051	0.010	0.0090	0.059	< 0.000007	< 0.000007	0.0021	< 0.000003	8.5	< 0.00003	0.000042	0.00014
3-Dec-14	23	500	495	7.8	71	#N/A	3.0	34	< 2	< 0.2	< 0.06	< 0.3	36	0.047	0.0089	0.0088	0.061	< 0.000007	< 0.000007	0.0032	< 0.000003	9.5	< 0.00003	0.000034	0.00023
10-Dec-14	24	500	495	7.9	71	#N/A	5.1	37	2.0	< 0.2	< 0.06	< 0.3	34	0.051	0.0087	0.0079	0.061	< 0.000007	< 0.000007	0.0023	0.0000030	8.7	< 0.00003	0.000030	0.00035
17-Dec-14	25	500	500	8.0	91	#N/A	3.9	42	3.0	< 0.2	< 0.06	< 0.3	41	0.075	0.012	0.010	0.077	< 0.000007	< 0.000007	0.0023	0.0000030	10	< 0.00003	0.000076	0.00026
24-Dec-14	26	500	495	7.9	87	#N/A	3.3	42	< 2	< 0.2	< 0.06	< 0.3	39	0.057	0.012	0.0092	0.079	< 0.000007	< 0.000007	0.0017	0.0000040	9.9	< 0.00003	0.000048	0.00024
31-Dec-14	27	500	495	7.9	88	#N/A	1.3	30	3.0	< 0.2	< 0.06	< 0.3	41	0.046	0.012	0.0094	0.074	< 0.000007	< 0.000007	0.0016	0.0000030	11	< 0.00003	0.000040	0.00018
7-Jan-15	28	500	500	7.8	68	#N/A	2.7	34	2.0	< 1	< 0.06	< 0.3	33	0.040	0.0073	0.0059	0.056	< 0.000007	< 0.000007	0.0028	< 0.000003	9.0	< 0.00003	0.000038	0.00027
14-Jan-15	29	500	480	7.8	68	#N/A	2.7	34	2.0	< 1	< 0.06	< 0.3	32	0.037	0.0081	0.0057	0.057	< 0.000007	< 0.000007	0.0028	0.0000070	8.5	< 0.00003	0.000035	0.00019
21-Jan-15	30	500	485	8.0	75	#N/A	4.3	42	2.0	< 1	< 0.06	< 0.3	34	0.052	0.0096	0.0076	0.064	< 0.000007	< 0.000007	0.0020	< 0.000003	8.9	< 0.00003	0.000037	0.00031
28-Jan-15	31	500	495	7.9	76	#N/A	1.7	36	2.0	< 1	< 0.06	< 0.3	36	0.050	0.0082	0.0068	0.066	< 0.000007	< 0.000007	0.0032	0.000025	9.0	< 0.00003	0.000035	0.00021
4-Feb-15	32	500	495	7.9	72	#N/A	2.3	34	< 2	< 1	< 0.06	< 0.3	32	0.041	0.0079	0.0063	0.061	< 0.000007	< 0.000007	0.0027	0.0000040	8.0	0.00	0.000028	0.00032
11-Feb-15	33	500	490	7.9	76	#N/A	2.1	36	3.0	< 1	< 0.06	< 0.3	34	0.045	0.0094	0.0066	0.065	< 0.000007	< 0.000007	0.0029	0.0000070	8.6	< 0.00003	0.000039	0.000030
18-Feb-15	34	500	485	7.9	67	#N/A	2.2	35	2.0	< 1	< 0.06	< 0.3	32	0.043	0.0077	0.0058	0.057	< 0.000007	< 0.000007	0.0026	< 0.000003	8.6	< 0.00003	0.000040	0.00036
25-Feb-15	35	500	480	7.9	80	#N/A	3.0	40	< 2	< 1	< 0.06	< 0.3	37	0.033	0.0086	0.0053	0.062	< 0.000007	< 0.000007	0.00090	0.0000050	9.7	0.000030	0.000045	0.00049
4-Mar-15	36	500	490	7.8	68	#N/A	2.0	34	2.0	< 1	< 0.06	< 0.3	33	0.035	0.0070	0.0047	0.054	< 0.000007	< 0.000007	0.0014	< 0.000003	9.4	0.000060	0.000036	0.00019
11-Mar-15	37	500	490	7.9	73	#N/A	1.7	38	< 2	< 1	< 0.06	< 0.3	33	0.029	0.0073	0.0048	0.063	< 0.000007	< 0.000007	0.0024	< 0.000003	9.0	0.000050	0.000037	0.00061
18-Mar-15	38	500	490	7.9	68	#N/A	2.5	37	2.0	< 1	< 0.06	< 0.3	33	0.028	0.0066	0.0038	0.056	< 0.000007	< 0.000007	0.0014	< 0.000003	9.3	< 0.00003	0.000040	0.00031
25-Mar-15	39	500	485	7.8	73	#N/A	3.0	37	< 2	< 1	< 0.06	< 0.3	34	0.029	0.0091	0.0050	0.071	< 0.000007	< 0.000007	0.0040	0.0000040	8.9	0.000080	0.000045	0.00044
1-Apr-15	40	500	490	7.8	64	#N/A	3.7	36	< 2	< 1	< 0.06	< 0.3	24	0.028	0.0064	0.0034	0.062	0.000013	< 0.000007	0.0018	< 0.000003	6.3	< 0.00003	0.000021	0.00088
8-Apr-15	41	500	485	7.8	78	#N/A	2.8	41	< 2	< 1	< 0.06	< 0.3	35	0.032	0.011	0.0051	0.068	< 0.000007	< 0.000007	0.0022	< 0.000003	9.5	< 0.00003	0.000054	0.00074
15-Apr-15	42	500	495	7.8	66	#N/A	3.9	37	< 2	< 1	< 0.06	< 0.3	30	0.029	0.0067	0.0043	0.055	< 0.000007	< 0.000007	0.0042	< 0.000003	8.0	< 0.00003	0.000012	0.00099
22-Apr-15	43	500	485	7.8	53	#N/A	3.4	31	3.0	< 1	< 0.06	< 0.3	25	0.026	0.0043	0.0034	0.047	< 0.000007	< 0.000007	0.0047	< 0.000003	7.0	0.000060	0.000028	0.00082
29-Apr-15	44	500	490	7.9	80	#N/A	2.2	42	< 2	< 1	< 0.06	< 0.3	40	0.047	0.0082	0.0055	0.083	< 0.000007	< 0.000007	0.0030	< 0.000003	11	0.000040	0.000054	0.00048
6-May-15	45	500	495	7.9	73	#N/A	2.8	41	< 2	< 1	< 0.06	< 0.3	34	0.040	0.0074	0.0067	0.067	< 0.000007	< 0.000007	0.0015	< 0.000003	9.1	< 0.00003	0.000048	0.00041
13-May-15	46	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	505	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	480	490	8.1	181	#N/A	4.0	87	5.0	< 1	< 0.06	< 0.3	88	0.014	0.017	0.0047	0.21	< 0.000007	< 0.000007	0.0042	< 0.000003	23	< 0.00003	0.00015	0.00069
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	485	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	480	480	8.0	192	#N/A	4.5	89	4.0	< 1	< 0.06	< 0.3	83	0.012	0.018	0.0051	0.19	< 0.000007	< 0.000007	0.0067	< 0.000003	22	< 0.00003	0.00018	0.00032
8-Jul-15	54	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	485	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	480	470	8.1	176	#N/A	2.7	89	4.0	< 1	< 0.06	< 0.3	83	0.016	0.014	0.0045	0.16	0.0000090	< 0.000007	0.0056	0.0000070	22	< 0.00003	0.00016	0.00035
5-Aug-15	58	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	495	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	480	470	8.0	172	#N/A	1.9	87	4.0	< 1	< 0.06	< 0.3	83	0.016	0.014	0.0037	0.19	< 0.000007	< 0.000007	0.0050	< 0.000003	22	< 0.00003	0.00020	0.00040
2-Sep-15	62	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	470	460	8.1	167	#N/A	2.4	81	4.0				81	0.013	0.013	0.0043	0.18	< 0.000007	< 0.000007	0.0059	< 0.000003	22	< 0.00003	0.00015	0.00045
30-Sep-15	66	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	485	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	475	455	8.1	155	#N/A	1.3	81	4.0				78	0.012	0.012	0.0031	0.17	< 0.000007	< 0.000007	0.0043	0.0000050	20	< 0.00003	0.00016	0.00080
28-Oct-15	70	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	485	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	470	450	8.1	172	#N/A	1.2	97	4.0				79	0.011	0.011	0.0032	0.20	< 0.000007	< 0.000007	0.0024	< 0.000003	21	0.000030	0.00018	0.0011
25-Nov-15	74	500	500	8.1	92	#N/A	0.80	52	2.0				46	0.059	0.0066	0.0041	0.092	< 0.000007	< 0.000007	0.0027	0.0000090	13	0.00011	0.00011	0.00058
2-Dec-15	75	500	490	8.0	85	#N/A	1.6	44	2.0				41	0.056	0.0058	0.0041	0.087	< 0.000007	< 0.000007	0.0024	< 0.000003	11	0.000060	0.000067	0.00044
9-Dec-15	76	500	500	8.1	76	#N/A	2.5	40	2.0				35	0.045	0.0049	0.0039	0.079	0.000031	0.000031	0.0053	0.000017	9.8	0.000060	0.000059	0.00027
16-Dec-15	77	500	495	8.0	76	#N/A	2.0	38	2.0				40	0.048	0.0053	0.0043	0.089	0.000013	< 0.000007	0.0023	0.0000050	11	0.000070	0.000064	0.00037
23-Dec-15	78	500	485	8.2	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	495	7.9	70	#N/A	1.3	34	3.0				34	0.035	0.0039	0.0027	0.069	< 0.000007	< 0.000007	0.0020	< 0.000003	9.2	0.000070	0.000036	0.00020
6-Jan-16	80	500	490	7.8	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	490	7.8	75	#N/A	1.5	36	2.0				35	0.033	0.0042	0.0029	0.073	< 0.000007	< 0.000007	0.0020	< 0.000003	9.5	< 0.00003	0.000025	0.00034
20-Jan-16	82	500	490	8.0	77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	495	7.9	78	#N/A	2.7	38	2.0				37	0.036	0.0044	0.0028	0.087	< 0.000007	< 0.000007	< 0.002	0.0000050	10	< 0.00003	0.000054	0.00031
3-Feb-16	84	500	490	8.0	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.9	78	#N/A	2.2	39	2.0				36	0.031	0.0040	0.0028	0.086	< 0.000007	< 0.000007	< 0.002	< 0.000003	10.0	< 0.00003	0.000046	0.00014
17-Feb-16	86	500	490	7.8	66	-	-	-	< 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.8	74	#N/A	2.1	35	< 2				35	0.037	0.0036	0.0024	0.079	< 0.000007	< 0.000007	< 0.002	< 0.000003	9.5	< 0.00003	0.000039	0.00013

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC2 (SS)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	330	8.0	0.0080	0.000020	0.010	16	0.0097	< 0.01	0.0068	0.014	0.020	21	0.0012	2.2	0.0000090	34	1.1	37	0.000044	0.00011	0.00022	0.023	0.0024	0.0040	< 0.002
2-Jul-14	1	500	485	8.0	< 0.002	< 0.00001	0.0057	11	0.010	< 0.01	0.0040	0.0084	< 0.009	12	0.00049	1.7	< 0.000002	12	1.1	17	0.000019	0.00034	0.000060	0.024	0.0014	< 0.001	< 0.002
9-Jul-14	2	500	490	8.0	< 0.002	< 0.00001	0.0049	8.9	0.0091	< 0.01	0.0024	0.0041	< 0.009	9.9	0.00011	1.8	< 0.000002	7.4	1.0	9.6	0.000014	0.00018	0.000090	0.018	0.0013	0.0010	< 0.002
16-Jul-14	3	500	480	8.0	0.0080	< 0.00001	0.0038	7.8	0.0072	< 0.01	0.0022	0.0025	< 0.009	7.7	0.000050	1.5	0.0000040	3.5	1.00	5.3	0.000018	0.000050	0.000090	0.015	0.0010	< 0.001	< 0.002
23-Jul-14	4	500	500	8.0	0.0050	0.000040	0.0022	5.6	0.010	< 0.01	0.00087	0.0011	< 0.009	4.8	0.000080	1.0	0.0000020	1.5	0.74	3.5	0.0000080	0.00024	0.00036	0.0097	0.00071	< 0.001	< 0.002
30-Jul-14	5	500	485	8.1	0.0020	< 0.00001	0.0039	7.9	0.0089	< 0.01	0.0016	0.0019	0.0090	7.3	0.000060	1.5	< 0.000002	1.8	1.1	4.3	0.000016	< 0.00001	0.00021	0.013	0.00099	< 0.001	< 0.002
6-Aug-14	6	500	480	8.0	< 0.002	< 0.00001	0.0030	7.2	0.0078	< 0.01	0.00053	0.0010	< 0.009	6.9	< 0.00004	1.5	< 0.000002	1.0	1.0	3.3	0.000010	0.000030	0.000060	0.012	0.0012	< 0.001	< 0.002
13-Aug-14	7	500	490	8.0	< 0.002	< 0.00001	0.0024	6.3	0.0092	< 0.01	0.00059	0.0010	< 0.009	5.4	0.000040	1.2	< 0.000002	0.68	0.87	2.8	0.0000070	0.00021	0.000060	0.010	0.00057	< 0.001	< 0.002
20-Aug-14	8	500	490	8.0	< 0.002	< 0.00001	0.0017	5.1	0.011	< 0.01	0.00041	0.00070	< 0.009	3.9	0.000050	0.90	< 0.000002	0.42	0.75	2.2	0.0000060	0.00013	0.000090	0.0093	0.00064	0.0010	< 0.002
27-Aug-14	9	500	495	8.0	< 0.002	< 0.00001	0.0022	6.1	0.011	< 0.01	0.00046	0.0010	0.010	5.0	0.000060	1.2	< 0.000002	0.47	0.90	2.6	0.0000010	0.00011	< 0.00005	0.011	0.00071	< 0.001	< 0.002
3-Sep-14	10	500	490	7.9	< 0.007	0.000010	0.0019	5.8	0.012	< 0.01	0.00034	0.00090	0.0060	4.8	0.00020	1.3	0.000017	0.39	1.0	3.7	0.0000012	0.000020	< 0.00005	0.012	0.00079	< 0.001	< 0.002
10-Sep-14	11	500	500	8.0	< 0.007	0.000010	0.0015	4.5	0.011	< 0.01	0.00027	0.00070	< 0.003	3.6	0.000060	1.0	< 0.000002	0.28	0.85	2.3	0.0000012	0.00015	0.00011	0.0096	0.00061	< 0.001	< 0.002
17-Sep-14	12	500	495	7.9	< 0.007	0.000020	0.0015	4.9	0.010	< 0.01	0.00028	0.00080	< 0.003	3.7	0.00014	0.89	< 0.000002	0.27	0.94	3.1	< 0.000005	0.000040	0.00019	0.010	0.00055	< 0.001	< 0.002
24-Sep-14	13	500	480	8.0	< 0.002	0.000020	0.0013	4.3	0.010	< 0.01	0.00032	0.00020	< 0.009	2.9	< 0.00004	0.73	0.0000040	0.27	0.66	2.1	< 0.000005	0.000020	< 0.00005	0.0088	0.00044	< 0.001	< 0.002
1-Oct-14	14	500	470	7.9	0.026	< 0.00001	0.0012	4.4	0.015	< 0.01	0.0010	< 0.0001	< 0.009	3.0	< 0.00004	0.80	< 0.000002	0.19	0.70	2.6	< 0.000005	0.000070	0.00034	0.0088	0.00046	< 0.002	< 0.002
8-Oct-14	15	500	490	7.9	< 0.007	0.000040	0.0011	3.5	0.010	< 0.01	0.00045	0.00050	< 0.003	2.4	< 0.00004	0.60	< 0.000002	0.16	0.65	2.5	0.0000080	0.000080	< 0.00005	0.0078	0.00045	< 0.001	< 0.002
15-Oct-14	16	500	495	7.9	< 0.007	0.000010	0.0015	4.5	0.012	< 0.01	0.00032	0.00070	< 0.003	3.2	0.000050	0.82	< 0.000002	0.22	0.84	2.8	0.0000090	0.00010	< 0.00005	0.0094	0.00046	< 0.001	< 0.002
22-Oct-14	17	500	505	8.0	< 0.007	0.000050	0.0012	4.3	0.012	< 0.01	0.00030	0.00080	< 0.003	3.3	0.000050	0.79	< 0.000002	0.21	0.78	2.5	0.0000010	0.000040	0.00026	0.0092	0.00045	< 0.001	< 0.002
29-Oct-14	18	500	490	7.9	< 0.007	0.000010	0.00092	3.3	0.010	< 0.01	0.00024	0.00050	< 0.003	2.0	< 0.00004	0.55	< 0.000002	0.14	0.60	1.7	0.0000010	0.000090	0.000090	0.0064	0.00030	< 0.001	< 0.002
5-Nov-14	19	500	485	7.7	< 0.007	0.000040	0.00089	3.5	0.0099	< 0.01	0.00042	0.00040	< 0.003	2.1	< 0.00004	0.61	< 0.000002	0.16	0.63	1.8	0.0000023	0.000040	0.00019	0.0069	0.00039	< 0.001	< 0.002
12-Nov-14	20	500	495	7.6	< 0.007	0.000020	0.00096	3.7	0.012	< 0.01	0.00069	0.00060	< 0.003	2.3	0.000040	0.65	< 0.000002	0.19	0.70	1.8	0.0000080	0.00014	0.00020	0.0074	0.00044	< 0.001	< 0.002
19-Nov-14	21	500	475	7.6	< 0.007	0.000030	0.0010	3.7	0.012	< 0.01	0.00082	0.00060	< 0.003	2.3	0.000060	0.64	< 0.000002	0.16	0.72	1.7	0.000032	0.00019	< 0.00005	0.0071	0.00042	0.0020	< 0.002
26-Nov-14	22	500	500	7.9	< 0.007	< 0.00001	0.00092	3.3	0.010	< 0.01	0.00034	0.00040	0.0080	2.0	< 0.00004	0.57	< 0.000002	0.13	0.59	1.4	0.0000080	0.000050	0.00017	0.0066	0.00039	0.0020	< 0.002
3-Dec-14	23	500	495	7.8	< 0.007	0.000020	0.00078	2.9	0.011	< 0.01	0.00025	0.00040	< 0.003	1.6	0.000050	0.47	< 0.000002	0.12	0.50	1.3	0.0000070	0.000050	0.000080	0.0062	0.00042	< 0.001	< 0.002
10-Dec-14	24	500	495	7.9	< 0.007	< 0.00001	0.00077	2.8	0.011	< 0.01	0.00029	0.00030	< 0.003	1.7	< 0.00004	0.46	< 0.000002	0.12	0.56	1.4	0.0000070	0.00010	0.000060	0.0057	0.00034	< 0.001	< 0.002
17-Dec-14	25	500	500	8.0	0.0070	0.000020	0.0012	3.7	0.014	< 0.01	0.00023	0.00060	< 0.003	2.5	< 0.00004	0.74	< 0.000002	0.13	0.74	1.5	0.0000070	0.00017	0.00067	0.0075	0.00046	< 0.001	< 0.002
24-Dec-14	26	500	495	7.9	< 0.007	0.000010	0.0010	3.5	0.013	< 0.01	0.00013	0.00050	< 0.003	2.0	< 0.00004	0.59	< 0.000002	0.14	0.68	1.5	0.0000070	0.000030	< 0.00005	0.0071	0.00043	< 0.001	< 0.002
31-Dec-14	27	500	495	7.9	< 0.007	< 0.00001	0.00097	3.5	0.012	< 0.01	0.00026	0.00050	< 0.003	2.1	< 0.00004	0.68	< 0.000002	0.13	0.69	1.5	0.0000090	0.000050	0.00016	0.0073	0.00038	< 0.001	< 0.002
7-Jan-15	28	500	500	7.8	< 0.007	0.000030	0.00067	2.5	0.011	< 0.01	0.00025	0.00040	< 0.003	1.4	< 0.00004	0.39	< 0.000002	0.090	0.51	0.80	0.0000026	0.000040	0.00012	0.0051	0.00032	< 0.001	< 0.002
14-Jan-15	29	500	480	7.8	< 0.007	0.000010	0.00059	2.6	0.011	< 0.01	0.00086	0.00040	< 0.003	1.4	0.000070	0.42	< 0.000002	0.090	0.52	0.80	0.000017	0.000060	0.000070	0.0046	0.00028	< 0.001	< 0.002
21-Jan-15	30	500	485	8.0	< 0.007	0.000040	0.00080	2.9	0.012	< 0.01	0.00031	0.00040	< 0.003	1.7	0.000040	0.48	< 0.000002	0.11	0.57	0.90	0.0000050	0.000040	0.000090	0.0059	0.00043	< 0.001	< 0.002
28-Jan-15	31	500	495	7.9	< 0.007	< 0.00001	0.00063	3.2	0.012	< 0.01	0.0011	0.00040	< 0.003	1.8	0.000090	0.53	< 0.000002	0.11	0.49	1.5	0.000028	0.000080	0.00011	0.0054	0.00032	< 0.001	< 0.002
4-Feb-15	32	500	495	7.9	< 0.007	0.000020	0.00077	2.8	0.010	< 0.01	0.00039	0.00040	< 0.003	1.6	< 0.00004	0.47	< 0.000002	0.10	0.57	1.2	0.0000050	0.00014	0.000080	0.0048	0.00032	< 0.001	< 0.002
11-Feb-15	33	500	490	7.9	< 0.007	0.000030	0.00076	3.0	0.012	< 0.01	0.00053	0.00040	< 0.003	1.7	< 0.001	0.47	< 0.000002	0.10	0.59	1.0	0.000028	0.00042	0.000070	0.0054	0.00035	< 0.001	< 0.002
18-Feb-15	34	500	485	7.9	< 0.007	< 0.00001	0.00078	2.6	0.011	< 0.01	0.00016	0.00040	< 0.003	1.5	< 0.001	0.44	0.0000020	0.090	0.59	1.0	0.0000060	0.000050	0.000060	0.0051	0.00033	< 0.001	< 0.002
25-Feb-15	35	500	480	7.9	< 0.007	0.00048	0.00077	3.0	0.012	< 0.01	0.00018	0.00050	< 0.003	2.0	< 0.001	0.53	< 0.000002	0.10	0.63	0.90	0.000010	0.00017	< 0.00005	0.0057	0.00028	< 0.001	< 0.002
4-Mar-15	36	500	490	7.8	< 0.007	0.000010	0.00071	2.4	0.011	< 0.01	0.000080	0.00050	< 0.003	1.4	< 0.001	0.48	< 0.000002	0.080	0.48	1.2	< 0.000005	0.000060	0.00010	0.0051	0.00029	< 0.001	< 0.002
11-Mar-15	37	500	490	7.9	< 0.007	0.000060	0.00074	2.7	0.012	< 0.01	0.00014	0.00040	< 0.003	1.5	< 0.001	0.40	< 0.000002	0.080	0.55	0.20	< 0.000005	0.00011	< 0.00005	0.0048	0.00030	< 0.001	< 0.002
18-Mar-15	38	500	490	7.9	< 0.007	0.000010	0.00067	2.4	0.012	< 0.01	0.00011	0.00040	< 0.003	1.5	< 0.001	0.38	< 0.000002	0.070	0.54	0.90	< 0.000005	0.000070	0.000060	0.0046	0.00024	< 0.001	< 0.002
25-Mar-15	39	500	485	7.8	< 0.007	< 0.00001	0.00072	3.0	0.013	< 0.01	0.00035	0.00060	< 0.003	1.6	< 0.001	0.45	< 0.000002	0.16	0.58	1.0	< 0.000005	0.00054	0.000090	0.0062	0.00034	< 0.001	< 0.002
1-Apr-15	40	500	490	7.8	< 0.007	0.000040	0.00048	2.1	0.019	< 0.01	0.000080	0.00040	< 0.003	1.2	< 0.001	0.24	< 0.000002	0.72	0.47	0.30	< 0.000005	0.00015	0.000080	0.0053	0.00020	< 0.001	< 0.002
8-Apr-15	41	500	485	7.8	< 0.007	< 0.00001	0.00076	2.8	0.012	< 0.01	0.00026	0.00050	< 0.003	1.8	< 0.001	0.54	< 0.000002	0.080	0.62	0.60	< 0.000005	0.00030	0.00011	0.0052	0.00031	< 0.001	< 0.002
15-Apr-15	42	500	495	7.8	< 0.007	< 0.00001	0.00063	2.5	0.011	< 0.01	0.00026	0.00040	< 0.003	1.4	< 0.001	0.39	0.0000020	0.090	0.53	0.80	< 0.000005	0.00026	< 0.00005	0.0044	0.00026	< 0.001	< 0.002
22-Apr-15	43	500	485	7.8	< 0.007	0.000030	0.00044	1.7	0.011	< 0.01	0.00012	0.00030	< 0.003	0.93	< 0.001	0.29	0.0000040	0.050	0.37	0.40	0.0000090	0.00032	0.000070	0.0029	0.00020	< 0.001	< 0.002
29-Apr-15	44	500	490	7.9	< 0.007	0.00013	0.00083	3.0	0.015	< 0.01	0.00021	0.00040	< 0.003	1.9	< 0.001	0.48	< 0.000002	0.10	0.60	1.3	< 0.000005	0.000080	0.000090	0.0060	0.00032	< 0.001	< 0.002
6-May-15	45	500	495	7.9	< 0.007	0.000020	0.00074	2.7	0.013	< 0.01	0.00010	0.00040	< 0.003	1.6	< 0.001	0.47	0.0000020	0.080	0.53	0.80	< 0.000005	0.00063	0.000050	0.0051	0.00030	0.0030	< 0.002
13-May-15	46	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	505	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	480	490	8.1	< 0.007	< 0.00001	0.0017	7.1	0.032	< 0.01	0.00034	0.0017	< 0.003	3.6	< 0.00004	1.2	< 0.000002	0.18	1.5	2.6	0.0000050	0.000090	0.000080	0.012	0.00025	< 0.001	< 0.002
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	485	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	480	480	8.0	< 0.007	< 0.00001	0.0016	7.0	0.031	0.010	0.00028	0.0019	< 0.003	3.0	0.000090	1.1	< 0.000002	0.22	1.5	2.2	0.000011	0.00020	< 0.00005	0.013	0.00024	0.0010	< 0.002
8-Jul-15	54	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	485	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	480	470	8.1	< 0.007	0.000020	0.0016	7.1	0.032	< 0.01	0.00044	0.0017	< 0.003	3.0	< 0.00004	0.99	< 0.000002	0.20	1.5	2.1	< 0.000005	0.000050	0.00013	0.011	0.00025	0.0010	< 0.002
5-Aug-15	58	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	495	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	480	470	8.0	< 0.007	0.00013	0.0015	7.2	0.038	0.010	0.00077	0.0019	< 0.003	3.1	0.000050	1.0	0.0000020	0.19	1.5	2.6	0.0000080	0.00012	< 0.00005	0.011	0.00027	0.0020	< 0.002
2-Sep-15	62	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	470	460	8.1	< 0.007	< 0.00001	0.0014	6.6	0.028	< 0.01	0.0011	0.0017	< 0.003	2.9	0.000060	1.0	< 0.000002	0.26	1.3	2.1	0.0000080	0.000030	< 0.00005	0.010	0.00022	< 0.001	< 0.002
30-Sep-15	66	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	485	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	475	455	8.1	< 0.007	0.000050	0.0013	6.6	0.030	< 0.01	0.00024	0.0016	< 0.003	2.9	0.00020	0.89	0.000040	0.27	1.2	2.0	0.000011	0.00016	0.000050	0.0096	0.00018	< 0.001	< 0.002
28-Oct-15	70	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	485	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	470	450	8.1	0.040	0.000040	0.0012	6.7	0.030	< 0.01	0.0015	0.0015	< 0.003	2.9	0.00011	0.91	0.0000030	0.19	1.3	1.2	0.000029	0.00013	0.00013	0.011	0.00017	0.0020	< 0.002
25-Nov-15	74	500	500	8.1	0.0070	0.000090	0.00092	3.5	0.017	< 0.01	0.00037	0.00060	0.0070	2.1	0.00050	0.56	0.00028	0.12	0.71	1.0	0.0000013	< 0.00001	0.00047	0.0059	0.00030	< 0.001	< 0.002
2-Dec-15	75	500	490	8.0	0.0090	0.000080	0.00082	3.5	0.015	< 0.01	0.00039	0.00060	< 0.003	1.9	0.000040	0.57	< 0.000002	0.11	0.63	0.90	< 0.000005	0.000080	0.00049	0.0056	0.00029	< 0.001	< 0.002
9-Dec-15	76	500	500	8.1	< 0.007	0.000030	0.00073	2.7	0.013	< 0.01	0.00033	0.00050	0.0080	1.6	0.000090	0.43	0.000017	0.090	0.56	0.80	0.0000035	0.00014	0.00017	0.0050	0.00028	< 0.001	< 0.002
16-Dec-15	77	500	495	8.0	< 0.007	0.00017	0.00079	3.2	0.016	< 0.01	0.00018	0.00050	0.0040	1.9	< 0.00004	0.50	0.0000040	0.10	0.61	0.80	0.0000070	0.00016	< 0.00005	0.0054	0.00028	< 0.001	< 0.002
23-Dec-15	78	500	485	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	495	7.9	< 0.007	< 0.00001	0.00065	2.6	0.013	0.010	0.00014	0.00040	< 0.003	1.4	< 0.00004	0.35	0.0000030	0.12	0.52	1.1	< 0.000005	< 0.00001	0.00015	0.0041	0.00020	< 0.001	< 0.002
6-Jan-16	80	500	490	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	490	7.8	< 0.007	< 0.00001	0.00061	2.7	0.013	< 0.01	0.00044	0.00040	< 0.003	1.5	0.00015	0.40	0.0000020	0.060	0.50	0.40	< 0.000005	0.000060	0.00025	0.0041	0.00019	< 0.001	< 0.002
20-Jan-16	82	500	490	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	495	7.9	< 0.007	< 0.00001	0.00066	2.8	0.015	< 0.01	0.000070	0.00050	< 0.003	1.6	< 0.00004	0.43	< 0.000002	0.070	0.55	0.40	< 0.000005	0.00011	0.00014	0.0049	0.00019	0.0010	< 0.002
3-Feb-16	84	500	490	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.9	< 0.007	< 0.00001	0.00064	2.6	0.015	< 0.01	0.000090	0.00040	< 0.003	1.4	0.000090	0.37	< 0.000002	0.090	0.54	1.3	< 0.000005	0.000030	< 0.00005	0.0040	0.00017	< 0.001	< 0.002
17-Feb-16	86	500	490	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.8	< 0.007	< 0.00001	0.00064	2.8	0.014	< 0.01	0.00011	0.00040	< 0.003	1.5	< 0.00004	0.14	0.0000030	0.040	0.52	0.80	< 0.000005	0.000020	< 0.00005	0.0037	0.00018	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for HC2 (SS)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	330	8.0	464	#N/A	2.2	29	33	1.1	0.19	0.099	42	0.013	0.011	0.021	0.011	0.0000026	0.0000023	0.0062	0.0000030	7.9	0.000069	0.00014	0.0020
2-Jul-14	1	500	485	8.0	255	#N/A	4.0	36	24	0.39	0.14	0.15	40	0.017	0.013	0.031	0.021	0.0000034	0.0000034	0.0058	0.0000015	7.8	0.000019	0.00015	0.00080
9-Jul-14	2	500	490	8.0	220	#N/A	1.2	37	13	0.098	0.14	0.15	35	0.021	0.015	0.023	0.033	0.0000034	0.0000034	0.0061	0.0000015	7.0	0.000015	0.000064	0.00045
16-Jul-14	3	500	480	8.0	177	#N/A	1.1	33	5.8	0.096	0.096	0.14	31	0.020	0.012	0.017	0.030	0.0000034	0.0000034	0.0041	0.0000014	6.2	0.000091	0.00022	0.00035
23-Jul-14	4	500	500	8.0	118	#N/A	1.1	25	3.5	0.10	0.050	0.15	25	0.035	0.0076	0.013	0.040	0.0000035	0.0000035	0.0030	0.0000015	5.5	0.000015	0.000082	0.00051
30-Jul-14	5	500	485	8.1	160	#N/A	0.90	37	4.4	0.097	0.087	0.15	32	0.025	0.012	0.016	0.036	0.0000034	0.0000034	0.0038	0.0000015	6.4	0.000097	0.000097	0.00071
6-Aug-14	6	500	480	8.0	142	#N/A	1.3	31	2.4	0.096	0.072	0.14	29	0.024	0.010	0.014	0.033	0.0000034	0.0000034	0.0034	0.0000014	5.8	0.000014	0.000042	0.00017
13-Aug-14	7	500	490	8.0	125	#N/A	1.2	28	3.4	0.098	0.054	0.15	27	0.022	0.0088	0.0100	0.040	0.0000034	0.0000034	0.0029	0.0000015	5.7	0.000025	0.000041	0.00017
20-Aug-14	8	500	490	8.0	103	#N/A	0.94	24	2.9	0.098	0.034	0.15	23	0.028	0.0057	0.0078	0.036	0.0000034	0.0000034	0.0023	0.0000015	5.2	0.000015	0.000041	0.00019
27-Aug-14	9	500	495	8.0	130	#N/A	2.2	29	2.5	0.099	0.050	0.15	28	0.022	0.0084	0.0099	0.040	0.0000035	0.0000035	0.0050	0.0000015	6.0	0.000015	0.000034	0.00013
3-Sep-14	10	500	490	7.9	121	#N/A	2.3	26	3.4	0.098	0.034	0.15	33	0.029	0.0088	0.011	0.048	0.0000034	0.0000034	0.0025	0.0000015	8.6	0.000015	0.000032	0.00016
10-Sep-14	11	500	500	8.0	111	#N/A	1.7	25	2.5	0.10	0.030	0.15	27	0.029	0.0072	0.0077	0.041	0.0000035	0.0000035	0.0031	0.000011	7.1	0.000015	0.000025	0.00015
17-Sep-14	12	500	495	7.9	112	#N/A	4.1	26	3.0	0.099	0.030	0.15	23	0.028	0.0077	0.0070	0.038	0.0000035	0.0000035	0.0023	0.0000015	5.3	0.000020	0.000029	0.00020
24-Sep-14	13	500	480	8.0	95	#N/A	1.8	21	3.8	0.096	0.029	0.14	20	0.023	0.0072	0.0049	0.033	0.0000034	0.0000034	0.0017	0.0000029	4.6	0.000014	0.000068	0.000086
1-Oct-14	14	500	470	7.9	96	#N/A	3.1	23	2.8	0.094	0.028	0.14	20	0.024	0.0093	0.0046	0.029	0.0000033	0.0000033	0.0013	0.0000014	4.6	0.000014	0.00	0.0000094
8-Oct-14	15	500	490	7.9	90	#N/A	1.5	18	2.0	0.098	0.029	0.15	23	0.024	0.0059	0.0049	0.029	0.0000034	0.0000034	0.0076	0.0000015	6.3	0.000015	0.000020	0.000093
15-Oct-14	16	500	495	7.9	110	#N/A	2.7	21	3.5	0.099	0.030	0.15	28	0.025	0.0081	0.0060	0.038	0.0000035	0.0000035	0.0025	0.0000015	7.7	0.000015	0.000027	0.00013
22-Oct-14	17	500	505	8.0	102	#N/A	2.5	23	2.5	0.10	0.030	0.15	22	0.025	0.0079	0.0060	0.036	0.0000035	0.0000035	0.0055	0.0000025	5.3	0.000076	0.000029	0.00019
29-Oct-14	18	500	490	7.9	84	#N/A	4.1	19	1.5	0.098	0.029	0.15	18	0.018	0.0054	0.0039	0.026	0.0000034	0.0000034	0.0037	0.0000015	4.5	0.000020	0.000020	0.00018
5-Nov-14	19	500	485	7.7	85	#N/A	#N/A	23	1.5	0.097	0.029	0.15	18	0.025	0.0055	0.0045	0.030	0.0000034	0.0000034	0.0017	0.0000092	4.3	0.000015	0.000022	0.00025
12-Nov-14	20	500	495	7.6	89	#N/A	3.3	17	0.99	0.099	0.030	0.15	20	0.029	0.0061	0.0054	0.033	0.0000035	0.0000035	0.0024	0.0000015	5.0	0.000025	0.000027	0.00021
19-Nov-14	21	500	475	7.6	93	#N/A	3.1	16	0.95	0.095	0.029	0.14	19	0.025	0.0060	0.0048	0.033	0.0000033	0.0000033	0.0013	0.0000062	4.6	0.000014	0.000025	0.00027
26-Nov-14	22	500	500	7.9	78	#N/A	0.91	18	1.0	0.10	0.030	0.15	17	0.025	0.0051	0.0045	0.030	0.0000035	0.0000035	0.0011	0.0000015	4.2	0.000015	0.000021	0.000070
3-Dec-14	23	500	495	7.8	71	#N/A	1.5	17	0.99	0.099	0.030	0.15	18	0.023	0.0044	0.0044	0.030	0.0000035	0.0000035	0.0016	0.0000015	4.7	0.000015	0.000017	0.00011
10-Dec-14	24	500	495	7.9	71	#N/A	2.5	18	0.99	0.099	0.030	0.15	17	0.025	0.0043	0.0039	0.030	0.0000035	0.0000035	0.0011	0.0000015	4.3	0.000015	0.000015	0.00017
17-Dec-14	25	500	500	8.0	91	#N/A	2.0	21	1.5	0.10	0.030	0.15	20	0.037	0.0060	0.0052	0.039	0.0000035	0.0000035	0.0012	0.0000015	5.1	0.000015	0.000038	0.00013
24-Dec-14	26	500	495	7.9	87	#N/A	1.6	21	0.99	0.099	0.030	0.15	19	0.028	0.0057	0.0046	0.039	0.0000035	0.0000035	0.00084	0.0000020	4.9	0.000015	0.000024	0.00012
31-Dec-14	27	500	495	7.9	88	#N/A	0.66	15	1.5	0.099	0.030	0.15	20	0.023	0.0058	0.0047	0.036	0.0000035	0.0000035	0.00079	0.0000015	5.2	0.000015	0.000020	0.000089
7-Jan-15	28	500	500	7.8	68	#N/A	1.3	17	1.0	0.50	0.030	0.15	16	0.020	0.0037	0.0030	0.028	0.0000035	0.0000035	0.0014	0.0000015	4.5	0.000015	0.000019	0.00014
14-Jan-15	29	500	480	7.8	68	#N/A	1.3	16	0.96	0.48	0.029	0.14	15	0.018	0.0039	0.0027	0.027	0.0000034	0.0000034	0.0013	0.0000034	4.1	0.000014	0.000017	0.000091
21-Jan-15	30	500	485	8.0	75	#N/A	2.1	20	0.97	0.49	0.029	0.15	16	0.025	0.0047	0.0037	0.031	0.0000034	0.0000034	0.00097	0.0000015	4.3	0.000015	0.000018	0.00015
28-Jan-15	31	500	495	7.9	76	#N/A	0.82	18	0.99	0.50	0.030	0.15	18	0.025	0.0041	0.0034	0.032	0.0000035	0.0000035	0.0016	0.000012	4.5	0.000015	0.000017	0.00010
4-Feb-15	32	500	495	7.9	72	#N/A	1.1	17	0.99	0.50	0.030	0.15	16	0.020	0.0039	0.0031	0.030	0.0000035	0.0000035	0.0013	0.0000020	4.0	0.00	0.000014	0.00016
11-Feb-15	33	500	490	7.9	76	#N/A	1.0	18	1.5	0.49	0.029	0.15	17	0.022	0.0046	0.0032	0.032	0.0000034	0.0000034	0.0014	0.0000034	4.2	0.000015	0.000019	0.000015
18-Feb-15	34	500	485	7.9	67	#N/A	1.0	17	0.97	0.49	0.029	0.15	16	0.021	0.0037	0.0028	0.028	0.0000034	0.0000034	0.0013	0.0000015	4.2	0.000015	0.000019	0.00017
25-Feb-15	35	500	480	7.9	80	#N/A	1.4	19	0.96	0.48	0.029	0.14	18	0.016	0.0041	0.0025	0.030	0.0000034	0.0000034	0.00043	0.0000024	4.7	0.000014	0.000022	0.00024
4-Mar-15	36	500	490	7.8	68	#N/A	0.98	17	0.98	0.49	0.029	0.15	16	0.017	0.0034	0.0023	0.027	0.0000034	0.0000034	0.00069	0.0000015	4.6	0.000029	0.000018	0.000093
11-Mar-15	37	500	490	7.9	73	#N/A	0.85	18	0.98	0.49	0.029	0.15	16	0.014	0.0036	0.0024	0.031	0.0000034	0.0000034	0.0012	0.0000015	4.4	0.000025	0.000018	0.00030
18-Mar-15	38	500	490	7.9	68	#N/A	1.2	18	0.98	0.49	0.029	0.15	16	0.014	0.0032	0.0019	0.027	0.0000034	0.0000034	0.00069	0.0000015	4.6	0.000015	0.000020	0.00015
25-Mar-15	39	500	485	7.8	73	#N/A	1.5	18	0.97	0.49	0.029	0.15	17	0.014	0.0044	0.0024	0.034	0.0000034	0.0000034	0.0019	0.0000019	4.3	0.000039	0.000022	0.00021
1-Apr-15	40	500	490	7.8	64	#N/A	1.8	18	0.98	0.49	0.029	0.15	12	0.014	0.0031	0.0017	0.030	0.0000064	0.0000034	0.00088	0.0000015	3.1	0.000015	0.000010	0.00043
8-Apr-15	41	500	485	7.8	78	#N/A	1.3	20	0.97	0.49	0.029	0.15	17	0.016	0.0052	0.0025	0.033	0.0000034	0.0000034	0.0011	0.0000015	4.6	0.000015	0.000026	0.00036
15-Apr-15	42	500	495	7.8	66	#N/A	1.9	18	0.99	0.50	0.030	0.15	15	0.014	0.0033	0.0021	0.027	0.0000035	0.0000035	0.0021	0.0000015	4.0	0.000015	0.0000059	0.00049
22-Apr-15	43	500	485	7.8	53	#N/A	1.7	15	1.5	0.49	0.029	0.15	12	0.013	0.0021	0.0016	0.023	0.0000034	0.0000034	0.0023	0.0000015	3.4	0.000029	0.000014	0.00040
29-Apr-15	44	500	490	7.9	80	#N/A	1.1	21	0.98	0.49	0.029	0.15	20	0.023	0.0040	0.0027	0.041	0.0000034	0.0000034	0.0015	0.0000015	5.5	0.000020	0.000026	0.00024
6-May-15	45	500	495	7.9	73	#N/A	1.4	20	0.99	0.50	0.030	0.15	17	0.020	0.0037	0.0033	0.033	0.0000035	0.0000035	0.00074	0.0000015	4.5	0.000015	0.000024	0.00020
13-May-15	46	500	505																						
20-May-15	47	505	480																						
27-May-15	48	480	480																						
3-Jun-15	49	480	490	8.1	181	#N/A	0.49	11	0.61	0.12	0.0074	0.037	11	0.0017	0.0021	0.00058	0.025	0.00000086	0.00000086	0.00051	0.00000037	2.9	0.0000037	0.000018	0.000085
10-Jun-15	50	500	490																						
17-Jun-15	51	490	485																						
24-Jun-15	52	485	480																						
1-Jul-15	53	480	480	8.0	192	#N/A	0.54	11	0.48	0.12	0.0072	0.036	9.9	0.0015	0.0021	0.00061	0.022	0.00000084	0.00000084	0.00080	0.00000036	2.6	0.0000036	0.000021	0.000038
8-Jul-15	54	500	485																						
15-Jul-15	55	485	480																						
22-Jul-15	56	480	480																						
29-Jul-15	57	480	470	8.1	176	#N/A	0.31	10	0.47	0.12	0.0071	0.035	9.8	0.0018	0.0016	0.00053	0.019	0.0000011	0.00000082	0.00066	0.00000082	2.5	0.0000035	0.000019	0.000041
5-Aug-15	58	500	500																						
12-Aug-15	59	500	495																						
19-Aug-15	60	495	480																						
26-Aug-15	61	480	470	8.0	172	#N/A	0.23	10	0.47	0.12	0.0071	0.035	9.8	0.0019	0.0016	0.00043	0.022	0.00000082	0.00000082	0.00059	0.00000035	2.5	0.0000035	0.000023	0.000047
2-Sep-15	62	500	490																						
9-Sep-15	63	490	480																						
16-Sep-15	64	480	470																						
23-Sep-15	65	470	460	8.1	167	#N/A	0.27	9.3	0.46				9.3	0.0014	0.0015	0.00049	0.020	0.00000081	0.00000081	0.00068	0.00000035	2.5	0.0000035	0.000018	0.000052
30-Sep-15	66	500	495																						
7-Oct-15	67	495	485																						
14-Oct-15	68	485	475																						
21-Oct-15	69	475	455	8.1	155	#N/A	0.15	9.2	0.46				8.9	0.0014	0.0014	0.00035	0.019	0.00000080	0.00000080	0.00049	0.00000057	2.3	0.0000034	0.000018	0.000091
28-Oct-15	70	500	495																						
4-Nov-15	71	495	485																						
11-Nov-15	72	485	470																						
18-Nov-15	73	470	450	8.1	172	#N/A	0.14	11	0.45				8.9	0.0012	0.0012	0.00036	0.023	0.00000079	0.00000079	0.00027	0.00000034	2.3	0.0000034	0.000020	0.00012
25-Nov-15	74	500	500	8.1	92	#N/A	0.41	26	1.0				23	0.030	0.0033	0.0021	0.046	0.0000035	0.0000035	0.0014	0.0000045	6.4	0.000055	0.000055	0.00029
2-Dec-15	75	500	490	8.0	85	#N/A	0.78	21	0.98				20	0.028	0.0028	0.0020	0.042	0.0000034	0.0000034	0.0012	0.0000015	5.3	0.000029	0.000033	0.00022
9-Dec-15	76	500	500	8.1	76	#N/A	1.2	20	1.0				18	0.022	0.0025	0.0020	0.039	0.000016	0.000016	0.0027	0.0000085	4.9	0.000030	0.000030	0.00014
16-Dec-15	77	500	495	8.0	76	#N/A	0.97	19	0.99				20	0.024	0.0026	0.0021	0.044	0.0000064	0.0000035	0.0011	0.0000025	5.4	0.000035	0.000032	0.00018
23-Dec-15	78	500	485	8.2	65	#N/A	0.79	18	1.2				18	0.021	0.0023	0.0017	0.039	0.0000050	0.0000035	0.0011	0.0000020	5.0	0.000035	0.000025	0.00014
30-Dec-15	79	500	495	7.9	70	#N/A	0.62	17	1.5				17	0.018	0.0019	0.0013	0.034	0.0000035	0.0000035	0.00099	0.0000015	4.6	0.000035	0.000018	0.000099
6-Jan-16	80	500	490	7.8	67	#N/A	0.68	17	1.2				17	0.017	0.0020	0.0014	0.035	0.0000034	0.0000034	0.00099	0.0000015	4.6	0.000025	0.000015	0.00013
13-Jan-16	81	500	490	7.8	75	#N/A	0.74	17	0.98				17	0.016	0.0021	0.0014	0.036	0.0000034	0.0000034	0.00098	0.0000015	4.7	0.000015	0.000012	0.00017
20-Jan-16	82	500	490	8.0	77	#N/A	1.0	18	0.99				18	0.017	0.0021	0.0014	0.039	0.0000034	0.0000034	0.00099	0.0000020	4.8	0.000015	0.000019	0.00016
27-Jan-16	83	500	495	7.9	78	#N/A	1.3	19	0.99				18	0.018	0.0022	0.0014	0.043	0.0000035	0.0000035	0.00099	0.0000025	5.0	0.000015	0.000027	0.00015
3-Feb-16	84	500	490	8.0	85	#N/A	1.2	19	1.00				18	0.017	0.0021	0.0014	0.043	0.0000035	0.0000035	0.00100	0.0000020	5.0	0.000015	0.000025	0.00011
10-Feb-16	85	500	500	7.9	78	#N/A	1.1	19	1.0				18	0.016	0.0020	0.0014	0.043	0.0000035	0.0000035	0.0010	0.0000015	5.0	0.000015	0.000023	0.000070
17-Feb-16	86	500	490	7.8	66	#N/A	1.1	19	0.98				18	0.017	0.0019	0.0013	0.041	0.0000035	0.0000035	0.0010	0.0000015	4.9	0.000015	0.000021	0.000068
24-Feb-16	87	500	500	7.8	74	#N/A	1.1	18	1.0				18	0.018	0.0018	0.0012	0.040	0.0000035	0.0000035	0.0010	0.0000015	4.8	0.000015	0.000020	0.000065

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for HC2 (SS)

Date	**Cycle**	**Volume** (mL)		**pH**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	330	8.0	0.0026	0.0000066	0.0034	5.3	0.0032	0.0033	0.0022	0.0046	0.0066	7.0	0.00040	0.72	0.0000030	11	0.35	12	0.000015	0.000036	0.000073	0.0075	0.00078	0.0013	0.00066
2-Jul-14	1	500	485	8.0	0.00097	0.0000049	0.0028	5.1	0.0049	0.0049	0.0019	0.0041	0.0044	5.6	0.00024	0.82	0.00000097	6.0	0.51	8.4	0.0000092	0.00016	0.000029	0.012	0.00070	0.00049	0.00097
9-Jul-14	2	500	490	8.0	0.00098	0.0000049	0.0024	4.4	0.0045	0.0049	0.0012	0.0020	0.0044	4.9	0.000054	0.90	0.00000098	3.6	0.51	4.7	0.0000069	0.000088	0.000044	0.0087	0.00064	0.00049	0.00098
16-Jul-14	3	500	480	8.0	0.0038	0.0000048	0.0018	3.8	0.0035	0.0048	0.0011	0.0012	0.0043	3.7	0.000024	0.70	0.0000019	1.7	0.48	2.5	0.0000086	0.000024	0.000043	0.0074	0.00050	0.00048	0.00096
23-Jul-14	4	500	500	8.0	0.0025	0.000020	0.0011	2.8	0.0052	0.0050	0.00044	0.00055	0.0045	2.4	0.000040	0.51	0.0000010	0.74	0.37	1.7	0.0000040	0.00012	0.00018	0.0049	0.00036	0.00050	0.0010
30-Jul-14	5	500	485	8.1	0.00097	0.0000049	0.0019	3.8	0.0043	0.0049	0.00078	0.00092	0.0044	3.6	0.000029	0.74	0.00000097	0.86	0.52	2.1	0.0000078	0.0000049	0.00010	0.0063	0.00048	0.00049	0.00097
6-Aug-14	6	500	480	8.0	0.00096	0.0000048	0.0014	3.5	0.0037	0.0048	0.00025	0.00048	0.0043	3.3	0.000019	0.70	0.00000096	0.50	0.48	1.6	0.0000048	0.000014	0.000029	0.0055	0.00056	0.00048	0.00096
13-Aug-14	7	500	490	8.0	0.00098	0.0000049	0.0012	3.1	0.0045	0.0049	0.00029	0.00049	0.0044	2.6	0.000020	0.56	0.00000098	0.33	0.42	1.3	0.0000034	0.00010	0.000029	0.0050	0.00028	0.00049	0.00098
20-Aug-14	8	500	490	8.0	0.00098	0.0000049	0.00082	2.5	0.0054	0.0049	0.00020	0.00034	0.0044	1.9	0.000025	0.44	0.00000098	0.21	0.37	1.1	0.0000029	0.000064	0.000044	0.0046	0.00031	0.00049	0.00098
27-Aug-14	9	500	495	8.0	0.00099	0.0000050	0.0011	3.0	0.0055	0.0050	0.00023	0.00050	0.0050	2.5	0.000030	0.58	0.00000099	0.23	0.45	1.3	0.0000050	0.000054	0.000025	0.0054	0.00035	0.00050	0.00099
3-Sep-14	10	500	490	7.9	0.0034	0.0000049	0.00093	2.8	0.0059	0.0049	0.00017	0.00044	0.0029	2.3	0.000098	0.62	0.0000083	0.19	0.51	1.8	0.0000059	0.0000098	0.000025	0.0056	0.00039	0.00049	0.00098
10-Sep-14	11	500	500	8.0	0.0035	0.0000050	0.00073	2.2	0.0056	0.0050	0.00014	0.00035	0.0015	1.8	0.000030	0.50	0.0000010	0.14	0.43	1.2	0.0000060	0.000075	0.000055	0.0048	0.00031	0.00050	0.0010
17-Sep-14	12	500	495	7.9	0.0035	0.0000099	0.00074	2.4	0.0051	0.0050	0.00014	0.00040	0.0015	1.8	0.000069	0.44	0.00000099	0.13	0.47	1.5	0.0000025	0.000020	0.000094	0.0050	0.00027	0.00050	0.00099
24-Sep-14	13	500	480	8.0	0.00096	0.0000096	0.00063	2.0	0.0049	0.0048	0.00015	0.000096	0.0043	1.4	0.000019	0.35	0.0000019	0.13	0.31	0.99	0.0000024	0.0000096	0.000024	0.0042	0.00021	0.00048	0.00096
1-Oct-14	14	500	470	7.9	0.012	0.0000047	0.00054	2.0	0.0069	0.0047	0.00047	0.000047	0.0042	1.4	0.000019	0.38	0.00000094	0.089	0.33	1.2	0.0000024	0.000033	0.00016	0.0041	0.00022	0.00094	0.00094
8-Oct-14	15	500	490	7.9	0.0034	0.000020	0.00053	1.7	0.0050	0.0049	0.00022	0.00025	0.0015	1.2	0.000020	0.29	0.00000098	0.078	0.32	1.2	0.0000039	0.000039	0.000025	0.0038	0.00022	0.00049	0.00098
15-Oct-14	16	500	495	7.9	0.0035	0.0000050	0.00073	2.2	0.0060	0.0050	0.00016	0.00035	0.0015	1.6	0.000025	0.41	0.00000099	0.11	0.42	1.4	0.0000045	0.000050	0.000025	0.0046	0.00023	0.00050	0.00099
22-Oct-14	17	500	505	8.0	0.0035	0.000025	0.00060	2.2	0.0062	0.0051	0.00015	0.00040	0.0015	1.7	0.000025	0.40	0.0000010	0.11	0.39	1.3	0.0000051	0.000020	0.00013	0.0046	0.00023	0.00051	0.0010
29-Oct-14	18	500	490	7.9	0.0034	0.0000049	0.00045	1.6	0.0050	0.0049	0.00012	0.00025	0.0015	1.00	0.000020	0.27	0.00000098	0.069	0.29	0.83	0.0000049	0.000044	0.000044	0.0031	0.00015	0.00049	0.00098
5-Nov-14	19	500	485	7.7	0.0034	0.000019	0.00043	1.7	0.0048	0.0049	0.00020	0.00019	0.0015	1.0	0.000019	0.30	0.00000097	0.078	0.31	0.87	0.000011	0.000019	0.000092	0.0033	0.00019	0.00049	0.00097
12-Nov-14	20	500	495	7.6	0.0035	0.0000099	0.00048	1.8	0.0058	0.0050	0.00034	0.00030	0.0015	1.1	0.000020	0.32	0.00000099	0.094	0.35	0.89	0.0000040	0.000069	0.000099	0.0037	0.00022	0.00050	0.00099
19-Nov-14	21	500	475	7.6	0.0033	0.000014	0.00048	1.8	0.0055	0.0048	0.00039	0.00029	0.0014	1.1	0.000029	0.30	0.00000095	0.076	0.34	0.81	0.000015	0.000090	0.000024	0.0034	0.00020	0.00095	0.00095
26-Nov-14	22	500	500	7.9	0.0035	0.0000050	0.00046	1.6	0.0052	0.0050	0.00017	0.00020	0.0040	0.98	0.000020	0.29	0.0000010	0.065	0.30	0.70	0.0000040	0.000025	0.000085	0.0033	0.00020	0.0010	0.0010
3-Dec-14	23	500	495	7.8	0.0035	0.0000099	0.00039	1.4	0.0054	0.0050	0.00012	0.00020	0.0015	0.81	0.000025	0.23	0.00000099	0.059	0.25	0.64	0.0000035	0.000025	0.000040	0.0031	0.00021	0.00050	0.00099
10-Dec-14	24	500	495	7.9	0.0035	0.0000050	0.00038	1.4	0.0054	0.0050	0.00014	0.00015	0.0015	0.82	0.000020	0.23	0.00000099	0.059	0.28	0.69	0.0000035	0.000050	0.000030	0.0028	0.00017	0.00050	0.00099
17-Dec-14	25	500	500	8.0	0.0035	0.000010	0.00058	1.9	0.0070	0.0050	0.00012	0.00030	0.0015	1.2	0.000020	0.37	0.0000010	0.065	0.37	0.75	0.0000035	0.000085	0.00034	0.0037	0.00023	0.00050	0.0010
24-Dec-14	26	500	495	7.9	0.0035	0.0000050	0.00051	1.7	0.0066	0.0050	0.000064	0.00025	0.0015	0.99	0.000020	0.29	0.00000099	0.069	0.34	0.74	0.0000035	0.000015	0.000025	0.0035	0.00021	0.00050	0.00099
31-Dec-14	27	500	495	7.9	0.0035	0.0000050	0.00048	1.7	0.0061	0.0050	0.00013	0.00025	0.0015	1.0	0.000020	0.34	0.00000099	0.064	0.34	0.74	0.0000045	0.000025	0.000079	0.0036	0.00019	0.00050	0.00099
7-Jan-15	28	500	500	7.8	0.0035	0.000015	0.00033	1.3	0.0055	0.0050	0.00013	0.00020	0.0015	0.70	0.000020	0.20	0.0000010	0.045	0.25	0.40	0.000013	0.000020	0.000060	0.0026	0.00016	0.00050	0.0010
14-Jan-15	29	500	480	7.8	0.0034	0.0000048	0.00029	1.2	0.0052	0.0048	0.00041	0.00019	0.0014	0.67	0.000034	0.20	0.00000096	0.043	0.25	0.38	0.0000082	0.000029	0.000034	0.0022	0.00013	0.00048	0.00096
21-Jan-15	30	500	485	8.0	0.0034	0.000019	0.00039	1.4	0.0056	0.0049	0.00015	0.00019	0.0015	0.81	0.000019	0.23	0.00000097	0.053	0.27	0.44	0.0000024	0.000019	0.000044	0.0029	0.00021	0.00049	0.00097
28-Jan-15	31	500	495	7.9	0.0035	0.0000050	0.00031	1.6	0.0059	0.0050	0.00056	0.00020	0.0015	0.87	0.000045	0.26	0.00000099	0.054	0.24	0.74	0.000014	0.000040	0.000054	0.0027	0.00016	0.00050	0.00099
4-Feb-15	32	500	495	7.9	0.0035	0.0000099	0.00038	1.4	0.0051	0.0050	0.00019	0.00020	0.0015	0.78	0.000020	0.23	0.00000099	0.050	0.28	0.59	0.0000025	0.000069	0.000040	0.0024	0.00016	0.00050	0.00099
11-Feb-15	33	500	490	7.9	0.0034	0.000015	0.00037	1.5	0.0056	0.0049	0.00026	0.00020	0.0015	0.81	0.00049	0.23	0.00000098	0.049	0.29	0.49	0.000014	0.00021	0.000034	0.0026	0.00017	0.00049	0.00098
18-Feb-15	34	500	485	7.9	0.0034	0.0000049	0.00038	1.3	0.0053	0.0049	0.000078	0.00019	0.0015	0.74	0.00049	0.21	0.00000097	0.044	0.29	0.49	0.0000029	0.000024	0.000029	0.0025	0.00016	0.00049	0.00097
25-Feb-15	35	500	480	7.9	0.0034	0.00023	0.00037	1.4	0.0056	0.0048	0.000086	0.00024	0.0014	0.96	0.00048	0.25	0.00000096	0.048	0.30	0.43	0.0000048	0.000082	0.000024	0.0027	0.00013	0.00048	0.00096
4-Mar-15	36	500	490	7.8	0.0034	0.0000049	0.00035	1.2	0.0052	0.0049	0.000039	0.00025	0.0015	0.67	0.00049	0.24	0.00000098	0.039	0.23	0.59	0.0000025	0.000029	0.000049	0.0025	0.00014	0.00049	0.00098
11-Mar-15	37	500	490	7.9	0.0034	0.000029	0.00036	1.3	0.0059	0.0049	0.000069	0.00020	0.0015	0.73	0.00049	0.20	0.00000098	0.039	0.27	0.098	0.0000025	0.000054	0.000025	0.0023	0.00015	0.00049	0.00098
18-Mar-15	38	500	490	7.9	0.0034	0.0000049	0.00033	1.2	0.0060	0.0049	0.000054	0.00020	0.0015	0.72	0.00049	0.19	0.00000098	0.034	0.26	0.44	0.0000025	0.000034	0.000029	0.0022	0.00012	0.00049	0.00098
25-Mar-15	39	500	485	7.8	0.0034	0.0000049	0.00035	1.4	0.0063	0.0049	0.00017	0.00029	0.0015	0.79	0.00049	0.22	0.00000097	0.078	0.28	0.49	0.0000024	0.00026	0.000044	0.0030	0.00016	0.00049	0.00097
1-Apr-15	40	500	490	7.8	0.0034	0.000020	0.00024	1.0	0.0093	0.0049	0.000039	0.00020	0.0015	0.60	0.00049	0.12	0.00000098	0.35	0.23	0.15	0.0000025	0.000074	0.000039	0.0026	0.000098	0.00049	0.00098
8-Apr-15	41	500	485	7.8	0.0034	0.0000049	0.00037	1.3	0.0059	0.0049	0.00013	0.00024	0.0015	0.85	0.00049	0.26	0.00000097	0.039	0.30	0.29	0.0000024	0.00015	0.000053	0.0025	0.00015	0.00049	0.00097
15-Apr-15	42	500	495	7.8	0.0035	0.0000050	0.00031	1.2	0.0053	0.0050	0.00013	0.00020	0.0015	0.70	0.00050	0.19	0.00000099	0.045	0.26	0.40	0.0000025	0.00013	0.000025	0.0022	0.00013	0.00050	0.00099
22-Apr-15	43	500	485	7.8	0.0034	0.000015	0.00021	0.83	0.0053	0.0049	0.000058	0.00015	0.0015	0.45	0.00049	0.14	0.0000019	0.024	0.18	0.19	0.0000044	0.00016	0.000034	0.0014	0.000097	0.00049	0.00097
29-Apr-15	44	500	490	7.9	0.0034	0.000064	0.00040	1.5	0.0073	0.0049	0.00010	0.00020	0.0015	0.91	0.00049	0.24	0.00000098	0.049	0.29	0.64	0.0000025	0.000039	0.000044	0.0030	0.00016	0.00049	0.00098
6-May-15	45	500	495	7.9	0.0035	0.0000099	0.00037	1.3	0.0064	0.0050	0.000050	0.00020	0.0015	0.81	0.00050	0.23	0.00000099	0.040	0.26	0.40	0.0000025	0.00031	0.000025	0.0025	0.00015	0.0015	0.00099
13-May-15	46	500	505																								
20-May-15	47	505	480																								
27-May-15	48	480	480																								
3-Jun-15	49	480	490	8.1	0.00086	0.0000012	0.00021	0.87	0.0039	0.0012	0.000042	0.00021	0.00037	0.44	0.0000049	0.14	0.00000025	0.022	0.19	0.32	0.00000061	0.000011	0.0000098	0.0014	0.000031	0.00012	0.00025
10-Jun-15	50	500	490																								
17-Jun-15	51	490	485																								
24-Jun-15	52	485	480																								
1-Jul-15	53	480	480	8.0	0.00084	0.0000012	0.00019	0.84	0.0038	0.0012	0.000034	0.00023	0.00036	0.36	0.000011	0.14	0.00000024	0.026	0.18	0.26	0.0000013	0.000024	0.0000060	0.0016	0.000029	0.00012	0.00024
8-Jul-15	54	500	485																								
15-Jul-15	55	485	480																								
22-Jul-15	56	480	480																								
29-Jul-15	57	480	470	8.1	0.00082	0.0000024	0.00018	0.84	0.0037	0.0012	0.000052	0.00020	0.00035	0.35	0.0000047	0.12	0.00000024	0.024	0.18	0.25	0.00000059	0.0000059	0.000015	0.0013	0.000029	0.00012	0.00024
5-Aug-15	58	500	500																								
12-Aug-15	59	500	495																								
19-Aug-15	60	495	480																								
26-Aug-15	61	480	470	8.0	0.00082	0.000015	0.00017	0.84	0.0045	0.0012	0.000090	0.00022	0.00035	0.36	0.0000059	0.12	0.00000024	0.022	0.18	0.31	0.00000094	0.000014	0.0000059	0.0013	0.000032	0.00024	0.00024
2-Sep-15	62	500	490																								
9-Sep-15	63	490	480																								
16-Sep-15	64	480	470																								
23-Sep-15	65	470	460	8.1	0.00081	0.0000012	0.00016	0.76	0.0033	0.0012	0.00013	0.00020	0.00035	0.33	0.0000069	0.12	0.00000023	0.030	0.15	0.24	0.00000092	0.0000035	0.0000058	0.0012	0.000025	0.00012	0.00023
30-Sep-15	66	500	495																								
7-Oct-15	67	495	485																								
14-Oct-15	68	485	475																								
21-Oct-15	69	475	455	8.1	0.00080	0.0000057	0.00015	0.75	0.0034	0.0011	0.000027	0.00018	0.00034	0.33	0.000023	0.10	0.0000046	0.031	0.14	0.23	0.0000013	0.000018	0.0000057	0.0011	0.000020	0.00011	0.00023
28-Oct-15	70	500	495																								
4-Nov-15	71	495	485																								
11-Nov-15	72	485	470																								
18-Nov-15	73	470	450	8.1	0.0045	0.0000045	0.00013	0.75	0.0034	0.0011	0.00017	0.00017	0.00034	0.33	0.000012	0.10	0.00000034	0.021	0.15	0.14	0.0000033	0.000015	0.000015	0.0012	0.000019	0.00023	0.00023
25-Nov-15	74	500	500	8.1	0.0035	0.000045	0.00046	1.8	0.0083	0.0050	0.00019	0.00030	0.0035	1.0	0.00025	0.28	0.00014	0.060	0.35	0.50	0.0000065	0.0000050	0.00024	0.0030	0.00015	0.00050	0.0010
2-Dec-15	75	500	490	8.0	0.0044	0.000039	0.00040	1.7	0.0074	0.0049	0.00019	0.00029	0.0015	0.94	0.000020	0.28	0.00000098	0.054	0.31	0.44	0.0000025	0.000039	0.00024	0.0028	0.00014	0.00049	0.00098
9-Dec-15	76	500	500	8.1	0.0035	0.000015	0.00037	1.3	0.0067	0.0050	0.00017	0.00025	0.0040	0.80	0.000045	0.22	0.0000085	0.045	0.28	0.40	0.000018	0.000070	0.000085	0.0025	0.00014	0.00050	0.0010
16-Dec-15	77	500	495	8.0	0.0035	0.000084	0.00039	1.6	0.0081	0.0050	0.000089	0.00025	0.0020	0.92	0.000020	0.25	0.0000020	0.050	0.30	0.40	0.0000035	0.000079	0.000025	0.0027	0.00014	0.00050	0.00099
23-Dec-15	78	500	485	8.2	0.0035	0.000045	0.00036	1.4	0.0073	0.0050	0.000079	0.00022	0.0017	0.81	0.000020	0.21	0.0000017	0.054	0.28	0.47	0.0000030	0.000042	0.000050	0.0023	0.00012	0.00050	0.00099
30-Dec-15	79	500	495	7.9	0.0035	0.0000050	0.00032	1.3	0.0065	0.0050	0.000069	0.00020	0.0015	0.70	0.000020	0.17	0.0000015	0.059	0.26	0.54	0.0000025	0.0000050	0.000074	0.0020	0.000099	0.00050	0.00099
6-Jan-16	80	500	490	7.8	0.0034	0.0000049	0.00031	1.3	0.0065	0.0049	0.00014	0.00020	0.0015	0.73	0.000047	0.18	0.0000012	0.044	0.25	0.37	0.0000025	0.000017	0.000098	0.0020	0.000096	0.00049	0.00099
13-Jan-16	81	500	490	7.8	0.0034	0.0000049	0.00030	1.3	0.0064	0.0049	0.00022	0.00020	0.0015	0.75	0.000074	0.20	0.00000098	0.029	0.25	0.20	0.0000025	0.000029	0.00012	0.0020	0.000093	0.00049	0.00098
20-Jan-16	82	500	490	8.0	0.0034	0.0000049	0.00031	1.4	0.0068	0.0049	0.00013	0.00022	0.0015	0.77	0.000047	0.20	0.00000099	0.032	0.26	0.20	0.0000025	0.000042	0.000096	0.0022	0.000094	0.00049	0.00099
27-Jan-16	83	500	495	7.9	0.0035	0.0000050	0.00032	1.4	0.0072	0.0050	0.000035	0.00025	0.0015	0.79	0.000020	0.21	0.00000099	0.035	0.27	0.20	0.0000025	0.000054	0.000069	0.0024	0.000094	0.00050	0.00099
3-Feb-16	84	500	490	8.0	0.0035	0.0000050	0.00032	1.4	0.0072	0.0050	0.000040	0.00022	0.0015	0.75	0.000032	0.20	0.00000100	0.040	0.27	0.42	0.0000025	0.000035	0.000047	0.0022	0.000090	0.00050	0.00100
10-Feb-16	85	500	500	7.9	0.0035	0.0000050	0.00032	1.3	0.0073	0.0050	0.000045	0.00020	0.0015	0.71	0.000045	0.19	0.0000010	0.045	0.27	0.65	0.0000025	0.000015	0.000025	0.0020	0.000085	0.00050	0.0010
17-Feb-16	86	500	490	7.8	0.0035	0.0000050	0.00032	1.3	0.0072	0.0050	0.000050	0.00020	0.0015	0.72	0.000033	0.13	0.0000013	0.033	0.27	0.53	0.0000025	0.000013	0.000025	0.0019	0.000088	0.00050	0.0010
24-Feb-16	87	500	500	7.8	0.0035	0.0000050	0.00032	1.4	0.0071	0.0050	0.000055	0.00020	0.0015	0.74	0.000020	0.070	0.0000015	0.020	0.26	0.40	0.0000025	0.000010	0.000025	0.0018	0.000090	0.00050	0.0010

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC3 (GT)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	400	8.1	121	#N/A	4.8	34	5.0	1.3	0.24	< 0.3	25	0.065	0.0032	0.066	0.042	0.0000080	< 0.000007	0.011	0.0000060	6.5	0.000080	0.00017	0.0021
2-Jul-14	1	500	480	7.9	107	#N/A	5.7	40	13	0.70	0.13	< 0.3	29	0.044	0.0025	0.043	0.045	< 0.000007	< 0.000007	0.0081	< 0.000003	7.5	0.000050	0.00016	0.0012
9-Jul-14	2	500	495	7.9	91	#N/A	1.7	35	8.0	0.30	0.11	< 0.3	26	0.034	0.0024	0.034	0.045	< 0.000007	< 0.000007	0.0075	< 0.000003	6.8	< 0.00003	0.000054	0.00066
16-Jul-14	3	500	485	7.9	80	#N/A	2.0	34	5.0	< 0.2	0.10	< 0.3	26	0.048	0.0025	0.031	0.055	< 0.000007	< 0.000007	0.0069	< 0.000003	6.7	0.00018	0.00029	0.00076
23-Jul-14	4	500	500	7.9	67	#N/A	2.1	32	4.0	< 0.2	0.080	< 0.3	26	0.055	0.0019	0.027	0.069	< 0.000007	< 0.000007	0.0064	< 0.000003	6.9	0.000080	0.00014	0.0012
30-Jul-14	5	500	490	7.8	60	#N/A	2.4	31	4.0	< 0.2	0.060	< 0.3	23	0.052	0.0019	0.022	0.051	< 0.000007	< 0.000007	0.0047	0.0000030	5.8	0.00010	0.00010	0.0013
6-Aug-14	6	500	490	7.8	60	#N/A	2.1	29	3.0	< 0.2	0.070	< 0.3	24	0.030	0.0018	0.020	0.047	< 0.000007	< 0.000007	0.0050	< 0.000003	6.1	< 0.00003	0.000038	0.00029
13-Aug-14	7	500	480	7.8	55	#N/A	2.5	29	5.0	< 0.2	0.070	< 0.3	23	0.061	0.0015	0.018	0.053	< 0.000007	< 0.000007	0.0053	< 0.000003	5.9	0.000070	0.000048	0.00032
20-Aug-14	8	500	500	7.8	52	#N/A	1.8	29	4.0	< 0.2	0.060	< 0.3	24	0.026	0.0012	0.016	0.050	< 0.000007	< 0.000007	0.0055	< 0.000003	6.3	0.000040	0.000063	0.00033
27-Aug-14	9	500	505	7.9	59	#N/A	4.3	31	2.0	< 0.2	< 0.06	< 0.3	25	0.023	0.0013	0.014	0.065	< 0.000007	< 0.000007	0.011	< 0.000003	6.9	< 0.00003	0.000030	0.00029
3-Sep-14	10	500	480	7.8	50	#N/A	4.2	27	5.0	< 0.2	< 0.06	< 0.3	23	0.026	0.0014	0.015	0.050	< 0.000007	< 0.000007	0.0041	0.0000030	6.2	< 0.00003	0.000032	0.00068
10-Sep-14	11	500	515	7.9	54	#N/A	3.2	28	3.0	< 0.2	< 0.06	< 0.3	22	0.046	0.0011	0.013	0.065	< 0.000007	< 0.000007	0.0058	< 0.000003	6.1	< 0.00003	0.000035	0.00041
17-Sep-14	12	500	490	7.9	49	#N/A	6.4	28	4.0	< 0.2	< 0.06	< 0.3	20	0.025	0.0011	0.011	0.043	< 0.000007	< 0.000007	0.0046	0.0000090	5.1	< 0.00003	0.000034	0.00014
24-Sep-14	13	500	480	7.9	48	#N/A	3.7	27	3.0	< 0.2	< 0.06	< 0.3	20	0.034	0.0012	0.012	0.041	< 0.000007	< 0.000007	0.0032	0.0000030	5.3	< 0.00003	0.00010	0.00015
1-Oct-14	14	500	480	7.9	42	#N/A	6.1	28	< 2	< 0.2	< 0.06	< 0.3	19	0.032	0.0012	0.0098	0.038	< 0.000007	< 0.000007	0.0030	0.000051	4.9	< 0.00003	0.00010	< 0.00002
8-Oct-14	15	500	500	7.7	47	#N/A	3.1	23	< 2	< 0.2	< 0.06	< 0.3	20	0.021	0.0010	0.0096	0.047	< 0.000007	< 0.000007	0.013	< 0.000003	5.5	< 0.00003	0.000029	0.00013
15-Oct-14	16	500	490	7.9	52	#N/A	4.6	26	3.0	< 0.2	< 0.06	< 0.3	23	0.051	0.0010	0.013	0.057	< 0.000007	< 0.000007	0.0049	0.000012	6.2	< 0.00003	0.000025	0.00022
22-Oct-14	17	500	510	7.8	52	#N/A	4.1	27	< 2	< 0.2	< 0.06	< 0.3	23	0.024	0.0010	0.0096	0.059	< 0.000007	< 0.000007	0.0059	0.000010	6.3	< 0.00003	0.000027	0.000080
29-Oct-14	18	500	490	7.9	42	#N/A	6.9	27	< 2	< 0.2	< 0.06	< 0.3	19	0.024	0.0010	0.0089	0.044	< 0.000007	< 0.000007	0.0062	< 0.000003	5.1	< 0.00003	0.000020	0.00024
5-Nov-14	19	500	505	7.9	45	#N/A	#N/A	32	< 2	< 0.2	< 0.06	< 0.3	20	0.019	0.00090	0.0081	0.049	< 0.000007	< 0.000007	0.0038	0.000012	5.3	< 0.00003	0.000027	0.00055
12-Nov-14	20	500	505	7.4	48	#N/A	6.8	34	< 2	< 0.2	< 0.06	< 0.3	22	0.024	0.00090	0.0088	0.056	< 0.000007	< 0.000007	0.0045	< 0.000003	6.2	< 0.00003	0.000031	0.00025
19-Nov-14	21	500	490	7.6	57	#N/A	6.6	34	2.0	< 0.2	< 0.06	< 0.3	20	0.034	0.00090	0.0077	0.052	< 0.000007	< 0.000007	0.0031	0.0000040	5.2	< 0.00003	0.000041	0.00031
26-Nov-14	22	500	505	7.7	43	#N/A	2.0	23	2.0	< 0.2	< 0.06	< 0.3	20	0.022	0.00090	0.0081	0.050	< 0.000007	< 0.000007	0.0025	< 0.000003	5.1	< 0.00003	0.000030	0.00012
3-Dec-14	23	500	500	7.8	71	#N/A	3.0	34	< 2	< 0.2	< 0.06	< 0.3	21	0.017	0.00090	0.0081	0.052	< 0.000007	< 0.000007	0.0034	< 0.000003	5.5	< 0.00003	0.000031	0.00015
10-Dec-14	24	500	485	7.8	37	#N/A	4.6	22	2.0	< 0.2	< 0.06	< 0.3	21	0.017	0.00070	0.0066	0.045	< 0.000007	< 0.000007	0.0025	< 0.000003	6.2	< 0.00003	0.000026	0.00021
17-Dec-14	25	500	500	7.8	41	#N/A	3.8	24	< 2	< 0.2	< 0.06	< 0.3	19	0.033	0.00080	0.0079	0.058	< 0.000007	< 0.000007	0.0025	< 0.000003	5.1	< 0.00003	0.000016	0.00016
24-Dec-14	26	500	485	7.8	39	#N/A	3.1	22	< 2	< 0.2	< 0.06	< 0.3	18	0.030	0.00080	0.0063	0.051	< 0.000007	< 0.000007	0.0017	< 0.000003	5.0	< 0.00003	0.000021	0.00017
31-Dec-14	27	500	505	7.6	44	#N/A	1.5	27	< 2	< 0.2	< 0.06	< 0.3	20	0.019	0.00090	0.0067	0.055	< 0.000007	< 0.000007	0.0018	< 0.000003	5.6	< 0.00003	0.000018	0.00015
7-Jan-15	28	500	505	7.7	40	#N/A	2.6	23	< 2	< 1	< 0.06	< 0.3	21	0.016	0.00090	0.0058	0.050	< 0.000007	< 0.000007	0.0021	< 0.000003	5.6	< 0.00003	0.000032	0.00035
14-Jan-15	29	500	495	7.7	36	#N/A	2.2	21	< 2	< 1	< 0.06	< 0.3	17	0.018	0.00080	0.0063	0.042	< 0.000007	< 0.000007	0.0024	< 0.000003	4.7	< 0.00003	0.000020	0.0012
21-Jan-15	30	500	500	8.0	37	#N/A	4.2	26	< 2	< 1	< 0.06	< 0.3	18	0.020	0.00080	0.0052	0.044	< 0.000007	< 0.000007	0.0018	0.0000040	4.8	< 0.00003	0.000024	0.00031
28-Jan-15	31	500	490	7.6	38	#N/A	1.6	21	< 2	< 1	< 0.06	< 0.3	19	0.020	0.0010	0.0059	0.047	< 0.000007	< 0.000007	0.0027	0.0000030	5.0	< 0.00003	0.000019	0.00022
4-Feb-15	32	500	485	7.7	35	#N/A	2.2	20	< 2	< 1	< 0.06	< 0.3	16	0.018	0.00080	0.0053	0.039	< 0.000007	< 0.000007	0.0024	< 0.000003	4.0	< 0.00003	0.000015	0.00074
11-Feb-15	33	500	500	7.6	36	#N/A	1.9	20	< 2	< 1	< 0.06	< 0.3	18	0.020	0.00090	0.0052	0.041	< 0.000007	< 0.000007	0.0025	< 0.000003	4.8	< 0.00003	0.000023	0.00016
18-Feb-15	34	500	485	7.7	35	#N/A	2.3	21	< 2	< 1	< 0.06	< 0.3	17	0.019	0.00090	0.0052	0.042	< 0.000007	< 0.000007	0.0026	< 0.000003	4.7	< 0.00003	0.000024	0.00031
25-Feb-15	35	500	475	7.9	37	#N/A	3.1	23	< 2	< 1	< 0.06	< 0.3	16	0.013	0.00090	0.0047	0.040	< 0.000007	< 0.000007	0.0011	0.0000090	4.2	< 0.00003	0.000023	0.00055
4-Mar-15	36	500	485	7.6	36	#N/A	2.3	22	< 2	< 1	< 0.06	< 0.3	16	0.015	0.00070	0.0046	0.039	< 0.000007	< 0.000007	0.0013	< 0.000003	4.3	0.000050	0.000014	0.00033
11-Mar-15	37	500	510	7.6	35	#N/A	1.9	21	< 2	< 1	< 0.06	< 0.3	16	0.013	0.00080	0.0042	0.041	< 0.000007	< 0.000007	0.0021	0.000036	4.4	0.000060	0.000035	0.0015
18-Mar-15	38	500	490	7.7	37	#N/A	2.5	22	< 2	< 1	< 0.06	< 0.3	17	0.019	0.00080	0.0040	0.039	< 0.000007	< 0.000007	0.0013	0.0000030	4.7	< 0.00003	0.000024	0.00017
25-Mar-15	39	500	485	7.7	37	#N/A	2.7	23	< 2	< 1	< 0.06	< 0.3	19	0.014	0.00090	0.0049	0.043	< 0.000007	< 0.000007	0.0024	< 0.000003	4.8	0.000080	0.000013	0.0013
1-Apr-15	40	500	495	7.8	35	#N/A	3.5	24	< 2	< 1	< 0.06	< 0.3	14	0.016	0.00080	0.0036	0.044	0.000013	< 0.000007	0.0020	0.0000060	3.5	< 0.00003	0.0000060	0.00032
8-Apr-15	41	500	475	7.6	38	#N/A	2.7	23	< 2	< 1	< 0.06	< 0.3	17	0.018	0.0011	0.0044	0.042	< 0.000007	< 0.000007	0.0015	< 0.000003	4.6	< 0.00003	0.000032	0.00042
15-Apr-15	42	500	480	7.8	37	#N/A	4.0	26	< 2	< 1	< 0.06	< 0.3	17	0.016	0.00080	0.0041	0.041	< 0.000007	< 0.000007	0.0041	< 0.000003	4.4	< 0.00003	< 0.000004	0.00099
22-Apr-15	43	500	495	7.7	37	#N/A	3.3	23	3.0	< 1	< 0.06	< 0.3	17	0.016	0.00070	0.0039	0.040	< 0.000007	< 0.000007	0.0035	< 0.000003	4.4	< 0.00003	0.000015	0.00051
29-Apr-15	44	500	500	7.6	34	#N/A	2.1	21	< 2	< 1	< 0.06	< 0.3	16	0.019	0.00080	0.0036	0.041	< 0.000007	< 0.000007	0.0024	< 0.000003	4.4	< 0.00003	0.000021	0.00027
6-May-15	45	500	510	7.7	38	#N/A	2.4	24	< 2	< 1	< 0.06	< 0.3	17	0.019	0.00090	0.0058	0.041	< 0.000007	< 0.000007	0.0017	< 0.000003	4.5	< 0.00003	0.000017	0.00064
13-May-15	46	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	505	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	490	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	510	500	7.9	106	#N/A	3.1	54	< 2	< 1	< 0.06	< 0.3	52	0.011	0.0015	0.0049	0.12	< 0.000007	< 0.000007	0.0049	< 0.000003	15	< 0.00003	0.000042	0.0022
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	480	495	7.9	116	#N/A	3.6	56	< 2	< 1	< 0.06	< 0.3	50	0.015	0.0018	0.0063	0.12	< 0.000007	< 0.000007	0.0047	< 0.000003	14	< 0.00003	0.000041	0.00050
8-Jul-15	54	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	490	485	8.0	108	#N/A	2.3	56																	
5-Aug-15	58	500	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	510	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	485	490	8.0	106	#N/A	1.7	54	< 2	< 1	< 0.06	< 0.3	50	0.015	0.0015	0.0049	0.13	< 0.000007	< 0.000007	0.0049	0.000010	14	0.000060	0.000045	0.00067
2-Sep-15	62	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	485	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	460	460	7.9	109	#N/A	2.0	52	< 2				52	0.011	0.0016	0.0050	0.13	< 0.000007	< 0.000007	0.0051	< 0.000003	15	< 0.00003	0.000040	0.00037
30-Sep-15	66	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	505	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	490	470	8.0	99	#N/A	1.4	52	2.0				49	0.012	0.0014	0.0043	0.12	< 0.000007	< 0.000007	0.0041	< 0.000003	14	< 0.00003	0.000036	0.00033
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	485	485	8.0	98	#N/A	1.2	55	2.0				44	0.012	0.0014	0.0041	0.094	< 0.000007	< 0.000007	0.0022	< 0.000003	12	0.000050	0.000052	0.00039
25-Nov-15	74	500	500	7.7	37	#N/A	0.70	24	2.0				18	0.021	0.00070	0.0041	0.045	< 0.000007	< 0.000007	0.0021	< 0.000003	4.9	< 0.00003	0.000047	0.00038
2-Dec-15	75	500	500	7.5	36	#N/A	2.4	21	< 2				18	0.017	0.00070	0.0036	0.046	< 0.000007	< 0.000007	0.0019	< 0.000003	4.8	< 0.00003	0.000018	0.00022
9-Dec-15	76	500	505	7.7	36	#N/A	3.0	22	2.0				17	0.021	0.00070	0.0036	0.047	0.000015	0.0000090	0.0039	0.0000070	4.7	< 0.00003	0.000023	0.00032
16-Dec-15	77	500	500	7.7	35	#N/A	2.6	17	2.0				19	0.024	0.00060	0.0042	0.051	< 0.000007	< 0.000007	0.0023	0.000026	5.3	0.000050	0.000017	0.00046
23-Dec-15	78	500	505	8.1	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	505	7.5	33	#N/A	1.6	17	2.0				17	0.014	0.00050	0.0031	0.044	< 0.000007	< 0.000007	0.0017	< 0.000003	4.6	< 0.00003	0.0000080	0.00023
6-Jan-16	80	500	505	7.4	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	505	7.4	34	#N/A	1.8	17	2.0				16	0.014	0.00060	0.0030	0.042	< 0.000007	< 0.000007	< 0.002	< 0.000003	4.4	< 0.00003	< 0.000004	0.00036
20-Jan-16	82	500	500	7.6	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	505	7.6	34	#N/A	3.1	18	2.0				16	0.014	0.00050	0.0031	0.046	< 0.000007	< 0.000007	< 0.002	0.0000030	4.6	< 0.00003	0.000016	0.00024
3-Feb-16	84	500	505	7.7	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.5	38	#N/A	2.4	20	2.0				17	0.015	0.00060	0.0032	0.051	< 0.000007	< 0.000007	< 0.002	< 0.000003	4.7	< 0.00003	0.000019	0.00027
17-Feb-16	86	500	505	7.7	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.5	32	#N/A	2.4	17	< 2				16	0.014	0.00050	0.0028	0.044	< 0.000007	< 0.000007	< 0.002	< 0.000003	4.3	< 0.00003	0.0000090	0.00012

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC3 (GT)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	400	8.1	0.012	0.000030	0.0021	2.2	0.0063	0.030	0.013	0.0010	0.028	5.0	0.00042	1.4	< 0.000002	11	0.041	8.2	0.000084	0.00010	0.00033	0.0096	0.00035	0.0020	< 0.002
2-Jul-14	1	500	480	7.9	0.0060	0.000010	0.0019	2.5	0.010	0.020	0.0070	0.0010	0.012	3.8	0.00023	1.1	< 0.000002	7.9	0.046	5.8	0.000059	0.0038	0.00019	0.029	0.00025	< 0.001	< 0.002
9-Jul-14	2	500	495	7.9	< 0.002	< 0.00001	0.0016	2.2	0.0086	< 0.01	0.0058	0.00060	0.016	3.3	0.000090	1.0	< 0.000002	5.2	0.040	3.6	0.000050	0.00090	< 0.00005	0.032	0.00019	< 0.001	< 0.002
16-Jul-14	3	500	485	7.9	0.016	0.000010	0.0014	2.2	0.0075	< 0.01	0.0056	0.00050	< 0.009	2.9	0.000060	0.98	0.0000020	3.7	0.041	2.4	0.000050	0.00014	0.00026	0.032	0.00021	< 0.001	< 0.002
23-Jul-14	4	500	500	7.9	0.024	0.000050	0.0012	2.1	0.0095	< 0.01	0.0036	0.00030	< 0.009	2.4	< 0.00004	0.96	< 0.000002	2.3	0.042	1.5	0.000043	0.0021	0.00031	0.028	0.00018	< 0.001	< 0.002
30-Jul-14	5	500	490	7.8	0.015	0.000020	0.0011	1.9	0.0092	< 0.01	0.0036	0.00020	< 0.009	2.1	< 0.00004	0.83	< 0.000002	1.8	0.036	1.1	0.000041	0.00011	0.00049	0.028	0.00023	< 0.001	< 0.002
6-Aug-14	6	500	490	7.8	0.0020	< 0.00001	0.0011	2.1	0.0078	< 0.01	0.0034	0.00020	0.0090	2.2	< 0.00004	0.87	< 0.000002	1.5	0.039	1.0	0.000039	0.00017	0.000060	0.031	0.00024	< 0.001	< 0.002
13-Aug-14	7	500	480	7.8	0.010	0.000020	0.00099	1.9	0.0084	< 0.01	0.0030	0.00020	0.015	1.9	< 0.00004	0.85	< 0.000002	1.1	0.036	0.78	0.000037	0.00086	0.00048	0.030	0.000080	< 0.001	< 0.002
20-Aug-14	8	500	500	7.8	< 0.002	0.000010	0.00087	2.0	0.0092	< 0.01	0.0026	0.00010	< 0.009	1.9	< 0.00004	0.79	< 0.000002	0.88	0.040	0.69	0.000030	0.0012	< 0.00005	0.031	0.00015	0.0010	< 0.002
27-Aug-14	9	500	505	7.9	< 0.002	< 0.00001	0.00076	1.8	0.011	< 0.01	0.0025	< 0.0001	< 0.009	1.7	< 0.00004	0.74	< 0.000002	0.60	0.039	0.63	0.000037	0.00095	0.00011	0.030	0.00014	< 0.001	< 0.002
3-Sep-14	10	500	480	7.8	< 0.007	0.000050	0.00077	1.8	0.0093	< 0.01	0.0023	0.00010	0.010	1.8	0.000090	0.82	0.000019	0.57	0.036	1.2	0.000039	0.00010	0.00037	0.030	0.00016	< 0.001	< 0.002
10-Sep-14	11	500	515	7.9	0.011	0.000060	0.00067	1.7	0.0099	< 0.01	0.0018	< 0.0001	< 0.003	1.6	< 0.00004	0.77	< 0.000002	0.44	0.035	0.50	0.000038	0.00077	0.00031	0.026	0.00016	< 0.001	< 0.002
17-Sep-14	12	500	490	7.9	< 0.007	< 0.00001	0.00068	1.7	0.0086	< 0.01	0.0019	< 0.0001	< 0.003	1.5	0.000040	0.68	< 0.000002	0.42	0.032	0.90	0.000025	0.00014	0.000050	0.029	0.00013	< 0.001	< 0.002
24-Sep-14	13	500	480	7.9	0.0020	0.000020	0.00066	1.7	0.0061	< 0.01	0.0019	0.00010	< 0.009	1.4	< 0.00004	0.65	0.0000050	0.35	0.033	0.46	0.000025	0.000080	< 0.00005	0.032	0.00014	< 0.001	< 0.002
1-Oct-14	14	500	480	7.9	0.022	< 0.00001	0.00049	1.6	0.012	< 0.01	0.0016	< 0.0001	< 0.009	1.4	< 0.00004	0.69	< 0.000002	0.27	0.032	0.72	0.000010	0.00015	0.00019	0.027	0.00013	< 0.002	< 0.002
8-Oct-14	15	500	500	7.7	< 0.007	< 0.00001	0.00062	1.6	0.0086	< 0.01	0.0015	< 0.0001	< 0.003	1.4	< 0.00004	0.59	< 0.000002	0.25	0.032	0.90	0.000026	0.00048	< 0.00005	0.026	0.00014	< 0.001	< 0.002
15-Oct-14	16	500	490	7.9	0.0080	0.00031	0.00064	1.7	0.0072	< 0.01	0.0016	< 0.0001	< 0.003	1.4	< 0.00004	0.66	< 0.000002	0.28	0.034	0.70	0.000032	0.00040	0.00024	0.030	0.00017	0.0020	< 0.002
22-Oct-14	17	500	510	7.8	< 0.007	0.000020	0.00054	1.9	0.0092	< 0.01	0.0015	< 0.0001	< 0.003	1.4	< 0.00004	0.69	< 0.000002	0.23	0.035	0.60	0.000037	0.00034	0.000050	0.030	0.00011	< 0.001	< 0.002
29-Oct-14	18	500	490	7.9	< 0.007	0.00014	0.00051	1.5	0.0071	< 0.01	0.0013	< 0.0001	< 0.003	1.1	< 0.00004	0.55	< 0.000002	0.18	0.029	0.30	0.000030	0.00026	0.000080	0.026	0.00010	< 0.001	< 0.002
5-Nov-14	19	500	505	7.9	< 0.007	0.000020	0.00045	1.6	0.0069	< 0.01	0.0015	< 0.0001	< 0.003	1.1	< 0.00004	0.59	< 0.000002	0.20	0.030	0.40	0.000038	0.0010	0.00012	0.028	0.000090	< 0.001	< 0.002
12-Nov-14	20	500	505	7.4	< 0.007	< 0.00001	0.00044	1.6	0.0094	< 0.01	0.0016	< 0.0001	< 0.003	1.1	< 0.00004	0.59	< 0.000002	0.17	0.043	0.40	0.000029	0.00096	0.000080	0.028	0.00011	< 0.001	< 0.002
19-Nov-14	21	500	490	7.6	0.010	0.000030	0.00047	1.6	0.0091	< 0.01	0.0012	< 0.0001	< 0.003	1.1	< 0.00004	0.56	< 0.000002	0.17	0.031	0.30	0.000029	0.00055	0.00031	0.026	0.00011	0.0010	< 0.002
26-Nov-14	22	500	505	7.7	< 0.007	< 0.00001	0.00050	1.7	0.0089	< 0.01	0.0012	< 0.0001	0.010	1.1	< 0.00004	0.60	< 0.000002	0.15	0.031	0.40	0.000028	0.00029	0.00010	0.027	0.00010	< 0.001	< 0.002
3-Dec-14	23	500	500	7.8	< 0.007	< 0.00001	0.00048	1.7	0.0084	< 0.01	0.0011	< 0.0001	< 0.003	1.1	< 0.00004	0.51	< 0.000002	0.16	0.029	0.40	0.000026	0.00016	0.000060	0.028	0.00011	0.0010	< 0.002
10-Dec-14	24	500	485	7.8	< 0.007	< 0.00001	0.00037	1.4	0.0081	< 0.01	0.0010	< 0.0001	< 0.003	0.89	< 0.00004	0.57	< 0.000002	0.12	0.026	0.60	0.000023	0.00029	0.000050	0.024	0.000070	0.0010	< 0.002
17-Dec-14	25	500	500	7.8	< 0.007	< 0.00001	0.00043	1.5	0.0089	< 0.01	0.0011	< 0.0001	< 0.003	1.00	< 0.00004	0.50	< 0.000002	0.12	0.030	0.30	0.000026	0.00048	0.000090	0.023	0.00014	< 0.001	< 0.002
24-Dec-14	26	500	485	7.8	< 0.007	< 0.00001	0.00037	1.4	0.0077	< 0.01	0.00087	< 0.0001	< 0.003	0.90	< 0.00004	0.47	< 0.000002	0.11	0.028	0.30	0.000023	0.00021	0.000080	0.024	0.00013	< 0.001	< 0.002
31-Dec-14	27	500	505	7.6	< 0.007	< 0.00001	0.00041	1.6	0.0077	< 0.01	0.00092	< 0.0001	< 0.003	1.0	< 0.00004	0.59	< 0.000002	0.11	0.032	0.40	0.000022	0.00019	0.000060	0.029	0.000090	< 0.001	< 0.002
7-Jan-15	28	500	505	7.7	< 0.007	0.000010	0.00038	1.6	0.0079	< 0.01	0.00090	< 0.0001	< 0.003	0.97	< 0.00004	0.49	< 0.000002	0.10	0.031	0.20	0.000024	0.00021	< 0.00005	0.024	0.00010	< 0.001	< 0.002
14-Jan-15	29	500	495	7.7	< 0.007	0.00013	0.00031	1.4	0.0069	< 0.01	0.00094	< 0.0001	< 0.003	0.87	< 0.00004	0.46	0.0000040	0.090	0.026	0.10	0.000019	0.00018	< 0.00005	0.022	0.00010	0.0010	< 0.002
21-Jan-15	30	500	500	8.0	< 0.007	0.000060	0.00033	1.3	0.0066	< 0.01	0.00088	< 0.0001	< 0.003	0.85	< 0.00004	0.45	< 0.000002	0.090	0.026	< 0.1	0.000019	0.00012	0.000080	0.022	0.00010	< 0.001	< 0.002
28-Jan-15	31	500	490	7.6	< 0.007	< 0.00001	0.00030	1.6	0.0069	< 0.01	0.0017	< 0.0001	< 0.003	0.99	0.000080	0.55	0.0000020	0.10	0.024	0.80	0.000027	0.00019	0.000070	0.025	0.000090	< 0.001	< 0.002
4-Feb-15	32	500	485	7.7	< 0.007	0.000020	0.00035	1.4	0.0060	< 0.01	0.00088	< 0.0001	< 0.003	0.83	< 0.00004	0.43	< 0.000002	0.090	0.028	0.50	0.000019	0.00020	0.000070	0.021	0.000090	0.0010	< 0.002
11-Feb-15	33	500	500	7.6	< 0.007	< 0.00001	0.00031	1.4	0.0065	< 0.01	0.00099	< 0.0001	< 0.003	0.86	< 0.001	0.44	< 0.000002	0.080	0.026	0.20	0.000022	0.00026	0.000050	0.022	0.00014	< 0.001	< 0.002
18-Feb-15	34	500	485	7.7	< 0.007	< 0.00001	0.00037	1.4	0.0069	< 0.01	0.00075	< 0.0001	< 0.003	0.86	< 0.001	0.46	< 0.000002	0.080	0.028	0.20	0.000024	0.00023	0.000060	0.024	0.000090	< 0.001	< 0.002
25-Feb-15	35	500	475	7.9	< 0.007	0.00012	0.00029	1.4	0.0057	< 0.01	0.00080	< 0.0001	< 0.003	0.84	< 0.001	0.43	< 0.000002	0.080	0.026	0.10	0.000032	0.00021	< 0.00005	0.023	0.000070	0.0030	< 0.002
4-Mar-15	36	500	485	7.6	< 0.007	< 0.00001	0.00032	1.3	0.0054	< 0.01	0.00079	< 0.0001	< 0.003	0.79	< 0.001	0.49	< 0.000002	0.070	0.025	0.70	0.000019	0.00020	< 0.00005	0.023	0.000080	< 0.001	< 0.002
11-Mar-15	37	500	510	7.6	0.011	0.00013	0.00037	1.3	0.0060	< 0.01	0.00072	< 0.0001	< 0.003	0.72	< 0.001	0.37	< 0.000002	0.050	0.024	< 0.1	0.000012	0.00036	< 0.00005	0.020	0.00010	0.016	< 0.002
18-Mar-15	38	500	490	7.7	< 0.007	< 0.00001	0.00030	1.3	0.0067	< 0.01	0.00071	< 0.0001	< 0.003	0.80	< 0.001	0.43	< 0.000002	0.060	0.026	0.60	0.000015	0.00018	0.000070	0.021	0.000080	< 0.001	< 0.002
25-Mar-15	39	500	485	7.7	< 0.007	< 0.00001	0.00025	1.6	0.0063	< 0.01	0.00089	< 0.0001	< 0.003	0.86	< 0.001	0.46	< 0.000002	0.15	0.029	0.60	0.000010	0.00042	0.00020	0.024	0.00018	0.0010	< 0.002
1-Apr-15	40	500	495	7.8	< 0.007	0.000020	0.00022	1.2	0.014	< 0.01	0.00060	< 0.0001	< 0.003	0.77	< 0.001	0.28	< 0.000002	0.72	0.025	0.10	0.000015	0.00023	< 0.00005	0.028	0.000060	< 0.001	< 0.002
8-Apr-15	41	500	475	7.6	< 0.007	< 0.00001	0.00027	1.3	0.0066	< 0.01	0.00071	< 0.0001	< 0.003	0.75	< 0.001	0.49	< 0.000002	0.070	0.026	< 0.1	0.000011	0.00031	< 0.00005	0.022	0.00010	< 0.001	< 0.002
15-Apr-15	42	500	480	7.8	< 0.007	< 0.00001	0.00026	1.4	0.0059	< 0.01	0.00069	< 0.0001	< 0.003	0.78	< 0.001	0.40	0.0000020	0.070	0.026	0.30	0.0000060	0.00064	0.00013	0.022	0.000090	< 0.001	< 0.002
22-Apr-15	43	500	495	7.7	< 0.007	0.000040	0.00027	1.4	0.0057	< 0.01	0.00056	< 0.0001	< 0.003	0.76	< 0.001	0.43	0.0000040	0.050	0.025	0.40	0.000025	0.00054	< 0.00005	0.021	0.00010	< 0.001	< 0.002
29-Apr-15	44	500	500	7.6	< 0.007	0.000020	0.00027	1.3	0.0068	< 0.01	0.00061	< 0.0001	< 0.003	0.77	< 0.001	0.38	< 0.000002	0.040	0.024	0.60	0.000017	0.00027	0.000080	0.019	0.000070	< 0.001	< 0.002
6-May-15	45	500	510	7.7	< 0.007	0.000020	0.00026	1.3	0.0066	< 0.01	0.00060	< 0.0001	< 0.003	0.78	< 0.001	0.44	< 0.000002	0.060	0.025	0.30	0.000016	0.00028	0.00010	0.021	0.00012	0.0020	< 0.002
13-May-15	46	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	505	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	490	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	510	500	7.9	< 0.007	0.000030	0.00056	3.9	0.016	< 0.01	0.0014	< 0.0001	< 0.003	1.8	< 0.00004	1.1	< 0.000002	0.14	0.073	0.80	0.000033	0.0015	< 0.00005	0.059	0.00014	0.0020	< 0.002
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	480	495	7.9	< 0.007	< 0.00001	0.00059	3.9	0.016	< 0.01	0.0015	< 0.0001	< 0.003	1.7	0.000050	1.2	< 0.000002	0.16	0.076	0.80	0.000041	0.00076	< 0.00005	0.062	0.00010	0.0010	< 0.002
8-Jul-15	54	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	490	485	8.0																							
5-Aug-15	58	500	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	510	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	485	490	8.0	< 0.007	0.00013	0.00056	3.8	0.014	< 0.01	0.0017	< 0.0001	< 0.003	1.7	< 0.00004	1.1	< 0.000002	0.11	0.074	1.0	0.000042	0.00051	< 0.00005	0.059	0.00012	0.0020	< 0.002
2-Sep-15	62	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	485	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	460	460	7.9	< 0.007	< 0.00001	0.00051	3.7	0.013	< 0.01	0.0017	< 0.0001	< 0.003	1.7	< 0.00004	1.2	< 0.000002	0.14	0.069	0.80	0.000032	0.0010	< 0.00005	0.051	0.000080	< 0.001	< 0.002
30-Sep-15	66	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	505	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	490	470	8.0	< 0.007	0.000020	0.00052	3.8	0.011	< 0.01	0.0010	< 0.0001	< 0.003	1.8	0.00010	1.1	0.000028	0.21	0.066	0.80	0.000034	0.00075	0.000070	0.050	0.000090	< 0.001	< 0.002
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	485	485	8.0	0.018	< 0.00001	0.00045	3.5	0.012	< 0.01	0.0020	< 0.0001	< 0.003	1.6	0.00014	0.95	0.0000030	0.15	0.060	0.60	0.000033	0.00072	0.000070	0.042	0.000090	0.0010	< 0.002
25-Nov-15	74	500	500	7.7	< 0.007	0.000020	0.00025	1.3	0.0071	< 0.01	0.00079	< 0.0001	< 0.003	0.91	0.00032	0.41	0.0081	0.070	0.025	0.40	0.000023	0.00024	0.00010	0.017	0.000080	< 0.001	< 0.002
2-Dec-15	75	500	500	7.5	< 0.007	0.000030	0.00025	1.4	0.0061	< 0.01	0.00042	< 0.0001	< 0.003	0.85	0.000040	0.44	< 0.000002	0.050	0.024	0.50	< 0.000005	0.00023	< 0.00005	0.018	0.000070	< 0.001	< 0.002
9-Dec-15	76	500	505	7.7	< 0.007	< 0.00001	0.00024	1.3	0.0067	< 0.01	0.00059	< 0.0001	0.0030	0.80	0.000060	0.38	0.0000070	0.050	0.024	0.30	0.000037	0.00026	0.000060	0.018	0.000090	< 0.001	< 0.002
16-Dec-15	77	500	500	7.7	< 0.007	0.00017	0.00027	1.4	0.0073	< 0.01	0.00052	< 0.0001	< 0.003	0.90	< 0.00004	0.45	< 0.000002	0.050	0.026	0.20	0.000024	0.00026	< 0.00005	0.019	0.00011	0.0060	< 0.002
23-Dec-15	78	500	505	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	505	7.5	< 0.007	< 0.00001	0.00022	1.3	0.0055	< 0.01	0.00036	< 0.0001	< 0.003	0.74	< 0.00004	0.34	< 0.000002	0.10	0.022	0.70	0.0000060	0.00011	< 0.00005	0.016	0.000070	< 0.001	< 0.002
6-Jan-16	80	500	505	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	505	7.4	< 0.007	< 0.00001	0.00020	1.2	0.0059	< 0.01	0.00054	< 0.0001	< 0.003	0.75	0.00013	0.36	0.0000020	0.040	0.021	< 0.1	< 0.000005	0.00020	< 0.00005	0.015	0.000040	< 0.001	< 0.002
20-Jan-16	82	500	500	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	505	7.6	< 0.007	< 0.00001	0.00019	1.2	0.0062	< 0.01	0.00040	< 0.0001	< 0.003	0.72	< 0.00004	0.38	< 0.000002	0.040	0.024	< 0.1	0.000019	0.00018	< 0.00005	0.017	0.000070	< 0.001	< 0.002
3-Feb-16	84	500	505	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.5	< 0.007	< 0.00001	0.00020	1.4	0.0070	< 0.01	0.00043	< 0.0001	< 0.003	0.76	0.000060	0.37	0.000051	0.070	0.025	0.80	0.000022	0.00021	0.000090	0.016	0.000070	< 0.001	< 0.002
17-Feb-16	86	500	505	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.5	< 0.007	< 0.00001	0.00019	1.2	0.0059	0.010	0.00037	< 0.0001	< 0.003	0.66	< 0.00004	0.13	0.0000020	0.020	0.021	0.50	0.000012	0.00014	< 0.00005	0.013	0.000050	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC3 (GT)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	400	8.1	121	#N/A	1.9	14	2.0	0.52	0.096	0.12	10	0.026	0.0013	0.026	0.017	0.0000032	0.0000028	0.0044	0.0000024	2.6	0.000032	0.000067	0.00084
2-Jul-14	1	500	480	7.9	107	#N/A	2.7	19	6.2	0.34	0.062	0.14	14	0.021	0.0012	0.021	0.022	0.0000034	0.0000034	0.0039	0.0000014	3.6	0.000024	0.000076	0.00055
9-Jul-14	2	500	495	7.9	91	#N/A	0.82	17	4.0	0.15	0.054	0.15	13	0.017	0.0012	0.017	0.022	0.0000035	0.0000035	0.0037	0.0000015	3.4	0.000015	0.000027	0.00033
16-Jul-14	3	500	485	7.9	80	#N/A	0.96	16	2.4	0.097	0.049	0.15	13	0.023	0.0012	0.015	0.027	0.0000034	0.0000034	0.0033	0.0000015	3.3	0.000087	0.00014	0.00037
23-Jul-14	4	500	500	7.9	67	#N/A	1.0	16	2.0	0.10	0.040	0.15	13	0.027	0.00095	0.014	0.034	0.0000035	0.0000035	0.0032	0.0000015	3.5	0.000040	0.000071	0.00059
30-Jul-14	5	500	490	7.8	60	#N/A	1.2	15	2.0	0.098	0.029	0.15	11	0.025	0.00093	0.011	0.025	0.0000034	0.0000034	0.0023	0.0000015	2.8	0.000049	0.000049	0.00064
6-Aug-14	6	500	490	7.8	60	#N/A	1.0	14	1.5	0.098	0.034	0.15	12	0.015	0.00088	0.0099	0.023	0.0000034	0.0000034	0.0025	0.0000015	3.0	0.000015	0.000019	0.00014
13-Aug-14	7	500	480	7.8	55	#N/A	1.2	14	2.4	0.096	0.034	0.14	11	0.029	0.00072	0.0085	0.025	0.0000034	0.0000034	0.0025	0.0000014	2.8	0.000034	0.000023	0.00015
20-Aug-14	8	500	500	7.8	52	#N/A	0.91	14	2.0	0.10	0.030	0.15	12	0.013	0.00060	0.0081	0.025	0.0000035	0.0000035	0.0028	0.0000015	3.1	0.000020	0.000032	0.00017
27-Aug-14	9	500	505	7.9	59	#N/A	2.2	16	1.0	0.10	0.030	0.15	13	0.012	0.00066	0.0072	0.033	0.0000035	0.0000035	0.0054	0.0000015	3.5	0.000015	0.000015	0.00015
3-Sep-14	10	500	480	7.8	50	#N/A	2.0	13	2.4	0.096	0.029	0.14	11	0.013	0.00067	0.0070	0.024	0.0000034	0.0000034	0.0020	0.0000014	3.0	0.000014	0.000015	0.00033
10-Sep-14	11	500	515	7.9	54	#N/A	1.6	14	1.5	0.10	0.031	0.15	11	0.023	0.00057	0.0068	0.033	0.0000036	0.0000036	0.0030	0.0000015	3.1	0.000015	0.000018	0.00021
17-Sep-14	12	500	490	7.9	49	#N/A	3.2	13	2.0	0.098	0.029	0.15	9.6	0.012	0.00054	0.0055	0.021	0.0000034	0.0000034	0.0023	0.0000044	2.5	0.000015	0.000017	0.000069
24-Sep-14	13	500	480	7.9	48	#N/A	1.8	13	1.4	0.096	0.029	0.14	9.6	0.016	0.00058	0.0059	0.020	0.0000034	0.0000034	0.0015	0.0000014	2.5	0.000014	0.000048	0.000072
1-Oct-14	14	500	480	7.9	42	#N/A	2.9	13	0.96	0.096	0.029	0.14	9.1	0.015	0.00058	0.0047	0.018	0.0000034	0.0000034	0.0014	0.000024	2.4	0.000014	0.000048	0.0000096
8-Oct-14	15	500	500	7.7	47	#N/A	1.6	12	1.0	0.10	0.030	0.15	10	0.011	0.00050	0.0048	0.024	0.0000035	0.0000035	0.0066	0.0000015	2.7	0.000015	0.000015	0.000065
15-Oct-14	16	500	490	7.9	52	#N/A	2.3	13	1.5	0.098	0.029	0.15	11	0.025	0.00049	0.0065	0.028	0.0000034	0.0000034	0.0024	0.0000059	3.0	0.000015	0.000012	0.00011
22-Oct-14	17	500	510	7.8	52	#N/A	2.1	14	1.0	0.10	0.031	0.15	12	0.012	0.00051	0.0049	0.030	0.0000036	0.0000036	0.0030	0.0000051	3.2	0.000015	0.000014	0.000041
29-Oct-14	18	500	490	7.9	42	#N/A	3.4	13	0.98	0.098	0.029	0.15	9.2	0.012	0.00049	0.0044	0.022	0.0000034	0.0000034	0.0030	0.0000015	2.5	0.000015	0.0000098	0.00012
5-Nov-14	19	500	505	7.9	45	#N/A	#N/A	16	1.0	0.10	0.030	0.15	9.9	0.0097	0.00045	0.0041	0.025	0.0000035	0.0000035	0.0019	0.0000061	2.7	0.000015	0.000014	0.00028
12-Nov-14	20	500	505	7.4	48	#N/A	3.4	17	1.0	0.10	0.030	0.15	11	0.012	0.00045	0.0044	0.028	0.0000035	0.0000035	0.0023	0.0000015	3.1	0.000015	0.000016	0.00013
19-Nov-14	21	500	490	7.6	57	#N/A	3.2	16	0.98	0.098	0.029	0.15	9.6	0.016	0.00044	0.0038	0.026	0.0000034	0.0000034	0.0015	0.0000020	2.5	0.000015	0.000020	0.00015
26-Nov-14	22	500	505	7.7	43	#N/A	0.99	12	1.0	0.10	0.030	0.15	9.8	0.011	0.00045	0.0041	0.025	0.0000035	0.0000035	0.0013	0.0000015	2.6	0.000015	0.000015	0.000061
3-Dec-14	23	500	500	7.8	71	#N/A	1.5	17	1.0	0.10	0.030	0.15	10	0.0083	0.00045	0.0041	0.026	0.0000035	0.0000035	0.0017	0.0000015	2.7	0.000015	0.000016	0.000075
10-Dec-14	24	500	485	7.8	37	#N/A	2.2	11	0.97	0.097	0.029	0.15	10	0.0084	0.00034	0.0032	0.022	0.0000034	0.0000034	0.0012	0.0000015	3.0	0.000015	0.000013	0.00010
17-Dec-14	25	500	500	7.8	41	#N/A	1.9	12	1.0	0.10	0.030	0.15	9.5	0.017	0.00040	0.0040	0.029	0.0000035	0.0000035	0.0013	0.0000015	2.6	0.000015	0.0000080	0.000080
24-Dec-14	26	500	485	7.8	39	#N/A	1.5	11	0.97	0.097	0.029	0.15	8.9	0.015	0.00039	0.0031	0.025	0.0000034	0.0000034	0.00082	0.0000015	2.4	0.000015	0.000010	0.000082
31-Dec-14	27	500	505	7.6	44	#N/A	0.77	14	1.0	0.10	0.030	0.15	10	0.0095	0.00045	0.0034	0.028	0.0000035	0.0000035	0.00091	0.0000015	2.8	0.000015	0.0000091	0.000076
7-Jan-15	28	500	505	7.7	40	#N/A	1.3	12	1.0	0.51	0.030	0.15	10	0.0079	0.00045	0.0029	0.025	0.0000035	0.0000035	0.0011	0.0000015	2.8	0.000015	0.000016	0.00018
14-Jan-15	29	500	495	7.7	36	#N/A	1.1	11	0.99	0.50	0.030	0.15	8.6	0.0090	0.00040	0.0031	0.021	0.0000035	0.0000035	0.0012	0.0000015	2.3	0.000015	0.0000099	0.00057
21-Jan-15	30	500	500	8.0	37	#N/A	2.1	13	1.0	0.50	0.030	0.15	8.8	0.0099	0.00040	0.0026	0.022	0.0000035	0.0000035	0.00090	0.0000020	2.4	0.000015	0.000012	0.00016
28-Jan-15	31	500	490	7.6	38	#N/A	0.77	10	0.98	0.49	0.029	0.15	9.3	0.0099	0.00049	0.0029	0.023	0.0000034	0.0000034	0.0013	0.0000015	2.4	0.000015	0.0000093	0.00011
4-Feb-15	32	500	485	7.7	35	#N/A	1.1	9.8	0.97	0.49	0.029	0.15	7.6	0.0085	0.00039	0.0026	0.019	0.0000034	0.0000034	0.0012	0.0000015	1.9	0.000015	0.0000073	0.00036
11-Feb-15	33	500	500	7.6	36	#N/A	0.94	10	1.0	0.50	0.030	0.15	8.9	0.0098	0.00045	0.0026	0.020	0.0000035	0.0000035	0.0013	0.0000015	2.4	0.000015	0.000012	0.000080
18-Feb-15	34	500	485	7.7	35	#N/A	1.1	10	0.97	0.49	0.029	0.15	8.4	0.0092	0.00044	0.0025	0.020	0.0000034	0.0000034	0.0013	0.0000015	2.3	0.000015	0.000012	0.00015
25-Feb-15	35	500	475	7.9	37	#N/A	1.5	11	0.95	0.48	0.029	0.14	7.6	0.0063	0.00043	0.0022	0.019	0.0000033	0.0000033	0.00052	0.0000043	2.0	0.000014	0.000011	0.00026
4-Mar-15	36	500	485	7.6	36	#N/A	1.1	11	0.97	0.49	0.029	0.15	7.8	0.0075	0.00034	0.0022	0.019	0.0000034	0.0000034	0.00063	0.0000015	2.1	0.000024	0.0000068	0.00016
11-Mar-15	37	500	510	7.6	35	#N/A	0.96	11	1.0	0.51	0.031	0.15	8.2	0.0068	0.00041	0.0021	0.021	0.0000036	0.0000036	0.0011	0.000018	2.2	0.000031	0.000018	0.00079
18-Mar-15	38	500	490	7.7	37	#N/A	1.2	11	0.98	0.49	0.029	0.15	8.4	0.0095	0.00039	0.0020	0.019	0.0000034	0.0000034	0.00064	0.0000015	2.3	0.000015	0.000012	0.000083
25-Mar-15	39	500	485	7.7	37	#N/A	1.3	11	0.97	0.49	0.029	0.15	9.0	0.0068	0.00044	0.0024	0.021	0.0000034	0.0000034	0.0012	0.0000015	2.3	0.000039	0.0000063	0.00065
1-Apr-15	40	500	495	7.8	35	#N/A	1.7	12	0.99	0.50	0.030	0.15	6.8	0.0081	0.00040	0.0018	0.022	0.0000064	0.0000035	0.00099	0.0000030	1.7	0.000015	0.0000030	0.00016
8-Apr-15	41	500	475	7.6	38	#N/A	1.3	11	0.95	0.48	0.029	0.14	7.9	0.0087	0.00052	0.0021	0.020	0.0000033	0.0000033	0.00071	0.0000014	2.2	0.000014	0.000015	0.00020
15-Apr-15	42	500	480	7.8	37	#N/A	1.9	12	0.96	0.48	0.029	0.14	8.1	0.0078	0.00038	0.0020	0.019	0.0000034	0.0000034	0.0020	0.0000014	2.1	0.000014	0.0000019	0.00048
22-Apr-15	43	500	495	7.7	37	#N/A	1.6	12	1.5	0.50	0.030	0.15	8.3	0.0080	0.00035	0.0019	0.020	0.0000035	0.0000035	0.0017	0.0000015	2.2	0.000015	0.0000074	0.00025
29-Apr-15	44	500	500	7.6	34	#N/A	1.0	10	1.0	0.50	0.030	0.15	8.2	0.0097	0.00040	0.0018	0.021	0.0000035	0.0000035	0.0012	0.0000015	2.2	0.000015	0.000011	0.00014
6-May-15	45	500	510	7.7	38	#N/A	1.2	12	1.0	0.51	0.031	0.15	8.4	0.0096	0.00046	0.0030	0.021	0.0000036	0.0000036	0.00087	0.0000015	2.3	0.000015	0.0000087	0.00033
13-May-15	46	500	505																						
20-May-15	47	505	490																						
27-May-15	48	490	510																						
3-Jun-15	49	510	500	7.9	106	#N/A	1.6	6.8	0.25	0.13	0.0075	0.038	6.5	0.0014	0.00019	0.00061	0.015	0.00000088	0.00000088	0.00061	0.00000038	1.8	0.0000038	0.0000053	0.00028
10-Jun-15	50	500	490																						
17-Jun-15	51	490	500																						
24-Jun-15	52	500	480																						
1-Jul-15	53	480	495	7.9	116	#N/A	1.8	7.0	0.25	0.12	0.0074	0.037	6.2	0.0019	0.00022	0.00078	0.015	0.00000087	0.00000087	0.00058	0.00000037	1.7	0.0000037	0.0000051	0.000062
8-Jul-15	54	500	490																						
15-Jul-15	55	490	490																						
22-Jul-15	56	490	490																						
29-Jul-15	57	490	485	8.0	108	#N/A	1.1	6.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-Aug-15	58	500	510																						
12-Aug-15	59	510	495																						
19-Aug-15	60	495	485																						
26-Aug-15	61	485	490	8.0	106	#N/A	0.83	6.7	0.25	0.12	0.0074	0.037	6.1	0.0018	0.00018	0.00060	0.016	0.00000086	0.00000086	0.00060	0.0000012	1.7	0.0000074	0.0000055	0.000082
2-Sep-15	62	500	490																						
9-Sep-15	63	490	485																						
16-Sep-15	64	485	460																						
23-Sep-15	65	460	460	7.9	109	#N/A	0.92	6.0	0.23				5.9	0.0012	0.00018	0.00058	0.015	0.00000081	0.00000081	0.00059	0.00000035	1.7	0.0000035	0.0000046	0.000043
30-Sep-15	66	500	505																						
7-Oct-15	67	505	495																						
14-Oct-15	68	495	490																						
21-Oct-15	69	490	470	8.0	99	#N/A	0.63	6.1	0.24				5.8	0.0014	0.00016	0.00051	0.014	0.00000082	0.00000082	0.00048	0.00000035	1.6	0.0000035	0.0000042	0.000039
28-Oct-15	70	500	490																						
4-Nov-15	71	490	490																						
11-Nov-15	72	490	485																						
18-Nov-15	73	485	485	8.0	98	#N/A	0.60	6.7	0.24				5.3	0.0015	0.00017	0.00050	0.011	0.00000085	0.00000085	0.00027	0.00000036	1.4	0.0000061	0.0000063	0.000047
25-Nov-15	74	500	500	7.7	37	#N/A	0.34	12	1.0				8.8	0.011	0.00035	0.0021	0.023	0.0000035	0.0000035	0.0011	0.0000015	2.4	0.0000015	0.000024	0.00019
2-Dec-15	75	500	500	7.5	36	#N/A	1.2	10	1.0				8.9	0.0085	0.00035	0.0018	0.023	0.0000035	0.0000035	0.00095	0.0000015	2.4	0.0000015	0.0000090	0.00011
9-Dec-15	76	500	505	7.7	36	#N/A	1.5	11	1.0				8.6	0.011	0.00035	0.0018	0.024	0.0000076	0.0000045	0.0020	0.0000035	2.4	0.0000015	0.000012	0.00016
16-Dec-15	77	500	500	7.7	35	#N/A	1.3	8.6	1.0				9.5	0.012	0.00030	0.0021	0.025	0.0000035	0.0000035	0.0012	0.000013	2.6	0.0000025	0.0000085	0.00023
23-Dec-15	78	500	505	8.1	34	#N/A	1.1	8.5	1.0				8.9	0.0096	0.00028	0.0018	0.024	0.0000035	0.0000035	0.0010	0.0000073	2.5	0.0000020	0.0000063	0.00017
30-Dec-15	79	500	505	7.5	33	#N/A	0.83	8.5	1.0				8.4	0.0072	0.00025	0.0016	0.022	0.0000035	0.0000035	0.00086	0.0000015	2.3	0.0000015	0.0000040	0.00012
6-Jan-16	80	500	505	7.4	36	#N/A	0.86	8.6	1.0				8.2	0.0071	0.00028	0.0015	0.022	0.0000035	0.0000035	0.00093	0.0000015	2.3	0.0000015	0.0000030	0.00015
13-Jan-16	81	500	505	7.4	34	#N/A	0.89	8.7	1.0				8.0	0.0071	0.00030	0.0015	0.021	0.0000035	0.0000035	0.0010	0.0000015	2.2	0.0000015	0.0000020	0.00018
20-Jan-16	82	500	500	7.6	37	#N/A	1.2	9.0	1.0				8.2	0.0071	0.00028	0.0015	0.022	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000051	0.00015
27-Jan-16	83	500	505	7.6	34	#N/A	1.6	9.2	1.0				8.3	0.0072	0.00025	0.0016	0.023	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000081	0.00012
3-Feb-16	84	500	505	7.7	38	#N/A	1.4	9.6	1.0				8.5	0.0074	0.00028	0.0016	0.024	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000088	0.00013
10-Feb-16	85	500	500	7.5	38	#N/A	1.2	10	1.0				8.7	0.0076	0.00030	0.0016	0.025	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000095	0.00014
17-Feb-16	86	500	505	7.7	39	#N/A	1.2	9.3	1.0				8.2	0.0073	0.00028	0.0015	0.024	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000070	0.000098
24-Feb-16	87	500	500	7.5	32	#N/A	1.2	8.5	1.0				7.8	0.0070	0.00025	0.0014	0.022	0.0000035	0.0000035	0.0010	0.0000015	2.2	0.0000015	0.0000045	0.000060

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for HC3 (GT)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	400	8.1	0.0048	0.000012	0.00083	0.87	0.0025	0.012	0.0053	0.00040	0.011	2.0	0.00017	0.57	0.00000080	4.4	0.016	3.3	0.000034	0.000040	0.00013	0.0038	0.00014	0.00080	0.00080
2-Jul-14	1	500	480	7.9	0.0029	0.0000048	0.00089	1.2	0.0049	0.0096	0.0034	0.00048	0.0058	1.8	0.00011	0.52	0.00000096	3.8	0.022	2.8	0.000028	0.0018	0.000091	0.014	0.00012	0.00048	0.00096
9-Jul-14	2	500	495	7.9	0.00099	0.0000050	0.00079	1.1	0.0043	0.0050	0.0029	0.00030	0.0079	1.6	0.000045	0.51	0.00000099	2.6	0.020	1.8	0.000025	0.00045	0.000025	0.016	0.0000094	0.00050	0.00099
16-Jul-14	3	500	485	7.9	0.0078	0.0000049	0.00068	1.1	0.0036	0.0049	0.0027	0.00024	0.0044	1.4	0.000029	0.48	0.00000097	1.8	0.020	1.1	0.000024	0.000068	0.00013	0.015	0.00010	0.00049	0.00097
23-Jul-14	4	500	500	7.9	0.012	0.000025	0.00062	1.0	0.0048	0.0050	0.0018	0.00015	0.0045	1.2	0.000020	0.48	0.0000010	1.2	0.021	0.76	0.000022	0.0010	0.00016	0.014	0.0000090	0.00050	0.0010
30-Jul-14	5	500	490	7.8	0.0074	0.0000098	0.00056	0.95	0.0045	0.0049	0.0018	0.000098	0.0044	1.0	0.000020	0.41	0.00000098	0.86	0.018	0.56	0.000020	0.000054	0.00024	0.014	0.00011	0.00049	0.00098
6-Aug-14	6	500	490	7.8	0.00098	0.0000049	0.00051	1.0	0.0038	0.0049	0.0016	0.000098	0.0044	1.1	0.000020	0.43	0.00000098	0.72	0.019	0.49	0.000019	0.000083	0.000029	0.015	0.00012	0.00049	0.00098
13-Aug-14	7	500	480	7.8	0.0048	0.0000096	0.00048	0.93	0.0040	0.0048	0.0015	0.000096	0.0072	0.92	0.000019	0.41	0.00000096	0.52	0.017	0.37	0.000018	0.00041	0.00023	0.014	0.000038	0.00048	0.00096
20-Aug-14	8	500	500	7.8	0.0010	0.0000050	0.00044	1.0	0.0046	0.0050	0.0013	0.000050	0.0045	0.96	0.000020	0.40	0.0000010	0.44	0.020	0.35	0.000015	0.00062	0.000025	0.016	0.0000075	0.00050	0.0010
27-Aug-14	9	500	505	7.9	0.0010	0.0000051	0.00038	0.93	0.0057	0.0051	0.0013	0.000051	0.0045	0.83	0.000020	0.37	0.0000010	0.30	0.020	0.32	0.000019	0.00048	0.000056	0.015	0.0000071	0.00051	0.0010
3-Sep-14	10	500	480	7.8	0.0034	0.000024	0.00037	0.87	0.0045	0.0048	0.0011	0.000048	0.0048	0.85	0.000043	0.39	0.0000091	0.27	0.017	0.58	0.000019	0.000048	0.00018	0.014	0.0000077	0.00048	0.00096
10-Sep-14	11	500	515	7.9	0.0057	0.000031	0.00035	0.88	0.0051	0.0052	0.00093	0.000052	0.0015	0.80	0.000021	0.40	0.0000010	0.23	0.018	0.26	0.000020	0.00040	0.00016	0.013	0.000082	0.00052	0.0010
17-Sep-14	12	500	490	7.9	0.0034	0.0000049	0.00033	0.81	0.0042	0.0049	0.00092	0.000049	0.0015	0.73	0.000020	0.33	0.00000098	0.21	0.016	0.44	0.000012	0.000069	0.000025	0.014	0.0000064	0.00049	0.00098
24-Sep-14	13	500	480	7.9	0.00096	0.0000096	0.00032	0.81	0.0029	0.0048	0.00091	0.000048	0.0043	0.69	0.000019	0.31	0.0000024	0.17	0.016	0.22	0.000012	0.000038	0.000024	0.015	0.0000067	0.00048	0.00096
1-Oct-14	14	500	480	7.9	0.011	0.0000048	0.00024	0.78	0.0057	0.0048	0.00077	0.000048	0.0043	0.65	0.000019	0.33	0.00000096	0.13	0.015	0.35	0.0000048	0.000072	0.000091	0.013	0.0000062	0.00096	0.00096
8-Oct-14	15	500	500	7.7	0.0035	0.0000050	0.00031	0.81	0.0043	0.0050	0.00075	0.000050	0.0015	0.68	0.000020	0.30	0.0000010	0.13	0.016	0.45	0.000013	0.00024	0.000025	0.013	0.0000070	0.00050	0.0010
15-Oct-14	16	500	490	7.9	0.0039	0.00015	0.00031	0.83	0.0035	0.0049	0.00077	0.000049	0.0015	0.66	0.000020	0.32	0.00000098	0.14	0.017	0.34	0.000016	0.00020	0.00012	0.015	0.0000083	0.00098	0.00098
22-Oct-14	17	500	510	7.8	0.0036	0.000010	0.00028	0.95	0.0047	0.0051	0.00077	0.000051	0.0015	0.69	0.000020	0.35	0.0000010	0.12	0.018	0.31	0.000019	0.00017	0.000026	0.016	0.0000056	0.00051	0.0010
29-Oct-14	18	500	490	7.9	0.0034	0.000069	0.00025	0.73	0.0035	0.0049	0.00063	0.000049	0.0015	0.55	0.000020	0.27	0.00000098	0.088	0.014	0.15	0.000015	0.00013	0.000039	0.013	0.0000049	0.00049	0.00098
5-Nov-14	19	500	505	7.9	0.0035	0.000010	0.00023	0.80	0.0035	0.0051	0.00074	0.000051	0.0015	0.56	0.000020	0.30	0.0000010	0.10	0.015	0.20	0.000019	0.00052	0.000061	0.014	0.0000045	0.00051	0.0010
12-Nov-14	20	500	505	7.4	0.0035	0.0000051	0.00022	0.83	0.0048	0.0051	0.00080	0.000051	0.0015	0.57	0.000020	0.30	0.0000010	0.086	0.022	0.20	0.000015	0.00048	0.000040	0.014	0.0000056	0.00051	0.0010
19-Nov-14	21	500	490	7.6	0.0049	0.000015	0.00023	0.80	0.0044	0.0049	0.00059	0.000049	0.0015	0.54	0.000020	0.27	0.00000098	0.083	0.015	0.15	0.000014	0.00027	0.00015	0.013	0.0000054	0.00049	0.00098
26-Nov-14	22	500	505	7.7	0.0035	0.0000051	0.00025	0.83	0.0045	0.0051	0.00058	0.000051	0.0051	0.55	0.000020	0.30	0.0000010	0.076	0.016	0.20	0.000014	0.00015	0.000051	0.013	0.0000051	0.00051	0.0010
3-Dec-14	23	500	500	7.8	0.0035	0.0000050	0.00024	0.86	0.0042	0.0050	0.00057	0.000050	0.0015	0.53	0.000020	0.26	0.0000010	0.080	0.015	0.20	0.000013	0.000080	0.000030	0.014	0.0000055	0.00050	0.0010
10-Dec-14	24	500	485	7.8	0.0034	0.0000049	0.00018	0.67	0.0039	0.0049	0.00049	0.000049	0.0015	0.43	0.000019	0.28	0.00000097	0.058	0.013	0.29	0.000011	0.00014	0.000024	0.011	0.0000034	0.00049	0.00097
17-Dec-14	25	500	500	7.8	0.0035	0.0000050	0.00022	0.75	0.0044	0.0050	0.00053	0.000050	0.0015	0.50	0.000020	0.25	0.0000010	0.060	0.015	0.15	0.000013	0.00024	0.000045	0.012	0.0000070	0.00050	0.0010
24-Dec-14	26	500	485	7.8	0.0034	0.0000049	0.00018	0.70	0.0037	0.0049	0.00042	0.000049	0.0015	0.44	0.000019	0.23	0.00000097	0.053	0.013	0.15	0.000011	0.00010	0.000039	0.011	0.0000063	0.00049	0.00097
31-Dec-14	27	500	505	7.6	0.0035	0.0000051	0.00021	0.80	0.0039	0.0051	0.00046	0.000051	0.0015	0.52	0.000020	0.30	0.0000010	0.056	0.016	0.20	0.000011	0.000096	0.000030	0.014	0.0000045	0.00051	0.0010
7-Jan-15	28	500	505	7.7	0.0035	0.0000051	0.00019	0.81	0.0040	0.0051	0.00045	0.000051	0.0015	0.49	0.000020	0.25	0.0000010	0.051	0.016	0.10	0.000012	0.00011	0.000025	0.012	0.0000051	0.00051	0.0010
14-Jan-15	29	500	495	7.7	0.0035	0.000064	0.00015	0.69	0.0034	0.0050	0.00047	0.000050	0.0015	0.43	0.000020	0.23	0.0000020	0.045	0.013	0.050	0.0000094	0.000089	0.000025	0.011	0.0000050	0.00050	0.00099
21-Jan-15	30	500	500	8.0	0.0035	0.000030	0.00016	0.67	0.0033	0.0050	0.00044	0.000050	0.0015	0.43	0.000020	0.23	0.0000010	0.045	0.013	0.050	0.0000095	0.000060	0.000040	0.011	0.0000050	0.00050	0.0010
28-Jan-15	31	500	490	7.6	0.0034	0.0000049	0.00015	0.78	0.0034	0.0049	0.00084	0.000049	0.0015	0.48	0.000039	0.27	0.00000098	0.049	0.012	0.39	0.000013	0.000093	0.000034	0.012	0.0000044	0.00049	0.00098
4-Feb-15	32	500	485	7.7	0.0034	0.0000097	0.00017	0.66	0.0029	0.0049	0.00043	0.000049	0.0015	0.40	0.000019	0.21	0.00000097	0.044	0.013	0.24	0.0000092	0.000097	0.000034	0.010	0.0000044	0.00049	0.00097
11-Feb-15	33	500	500	7.6	0.0035	0.0000050	0.00016	0.69	0.0032	0.0050	0.00050	0.000050	0.0015	0.43	0.00050	0.22	0.0000010	0.040	0.013	0.10	0.000011	0.00013	0.000025	0.011	0.0000070	0.00050	0.0010
18-Feb-15	34	500	485	7.7	0.0034	0.0000049	0.00018	0.67	0.0033	0.0049	0.00036	0.000049	0.0015	0.42	0.00049	0.22	0.00000097	0.039	0.014	0.097	0.000012	0.00011	0.000029	0.012	0.0000044	0.00049	0.00097
25-Feb-15	35	500	475	7.9	0.0033	0.000057	0.00014	0.64	0.0027	0.0048	0.00038	0.000048	0.0014	0.40	0.00048	0.20	0.00000095	0.038	0.012	0.048	0.000015	0.000100	0.000024	0.011	0.0000033	0.0014	0.00095
4-Mar-15	36	500	485	7.6	0.0034	0.0000049	0.00015	0.61	0.0026	0.0049	0.00038	0.000049	0.0015	0.38	0.00049	0.24	0.00000097	0.034	0.012	0.34	0.0000092	0.000097	0.000024	0.011	0.0000039	0.00049	0.00097
11-Mar-15	37	500	510	7.6	0.0056	0.000066	0.00019	0.64	0.0031	0.0051	0.00037	0.000051	0.0015	0.37	0.00051	0.19	0.0000010	0.026	0.012	0.051	0.0000061	0.00018	0.000026	0.010	0.0000051	0.0082	0.0010
18-Mar-15	38	500	490	7.7	0.0034	0.0000049	0.00015	0.66	0.0033	0.0049	0.00035	0.000049	0.0015	0.39	0.00049	0.21	0.00000098	0.029	0.013	0.29	0.0000074	0.000088	0.000034	0.010	0.0000039	0.00049	0.00098
25-Mar-15	39	500	485	7.7	0.0034	0.0000049	0.00012	0.77	0.0030	0.0049	0.00043	0.000049	0.0015	0.42	0.00049	0.22	0.00000097	0.073	0.014	0.29	0.0000049	0.00020	0.000097	0.012	0.0000087	0.00049	0.00097
1-Apr-15	40	500	495	7.8	0.0035	0.0000099	0.00011	0.61	0.0067	0.0050	0.00030	0.000050	0.0015	0.38	0.00050	0.14	0.00000099	0.36	0.012	0.050	0.0000074	0.00011	0.000025	0.014	0.0000030	0.00050	0.00099
8-Apr-15	41	500	475	7.6	0.0033	0.0000048	0.00013	0.60	0.0031	0.0048	0.00034	0.000048	0.0014	0.36	0.00048	0.23	0.00000095	0.033	0.012	0.048	0.0000052	0.00015	0.000024	0.010	0.0000048	0.00048	0.00095
15-Apr-15	42	500	480	7.8	0.0034	0.0000048	0.00013	0.69	0.0028	0.0048	0.00033	0.000048	0.0014	0.37	0.00048	0.19	0.00000096	0.034	0.013	0.14	0.0000029	0.00031	0.000062	0.011	0.0000043	0.00048	0.00096
22-Apr-15	43	500	495	7.7	0.0035	0.000020	0.00013	0.68	0.0028	0.0050	0.00028	0.000050	0.0015	0.37	0.00050	0.21	0.0000020	0.025	0.013	0.20	0.000012	0.00027	0.000025	0.010	0.0000050	0.00050	0.00099
29-Apr-15	44	500	500	7.6	0.0035	0.000010	0.00014	0.67	0.0034	0.0050	0.00031	0.000050	0.0015	0.39	0.00050	0.19	0.0000010	0.020	0.012	0.30	0.0000085	0.00014	0.000040	0.0093	0.0000035	0.00050	0.0010
6-May-15	45	500	510	7.7	0.0036	0.000010	0.00013	0.67	0.0034	0.0051	0.00031	0.000051	0.0015	0.40	0.00051	0.22	0.0000010	0.031	0.013	0.15	0.0000082	0.00014	0.000051	0.010	0.0000061	0.0010	0.0010
13-May-15	46	500	505																								
20-May-15	47	505	490																								
27-May-15	48	490	510																								
3-Jun-15	49	510	500	7.9	0.00088	0.0000038	0.000070	0.48	0.0020	0.0013	0.00017	0.000013	0.00038	0.23	0.0000050	0.14	0.00000025	0.018	0.0091	0.10	0.0000041	0.00019	0.0000063	0.0074	0.000018	0.00025	0.00025
10-Jun-15	50	500	490																								
17-Jun-15	51	490	500																								
24-Jun-15	52	500	480																								
1-Jul-15	53	480	495	7.9	0.00087	0.0000012	0.000073	0.48	0.0019	0.0012	0.00019	0.000012	0.00037	0.21	0.0000062	0.14	0.00000025	0.020	0.0094	0.099	0.0000051	0.000094	0.0000062	0.0076	0.000012	0.00012	0.00025
8-Jul-15	54	500	490																								
15-Jul-15	55	490	490																								
22-Jul-15	56	490	490																								
29-Jul-15	57	490	485	8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-Aug-15	58	500	510																								
12-Aug-15	59	510	495																								
19-Aug-15	60	495	485																								
26-Aug-15	61	485	490	8.0	0.00086	0.000016	0.000068	0.46	0.0017	0.0012	0.00021	0.000012	0.00037	0.21	0.0000049	0.14	0.00000025	0.013	0.0091	0.12	0.0000051	0.000062	0.0000061	0.0073	0.000015	0.00025	0.00025
2-Sep-15	62	500	490																								
9-Sep-15	63	490	485																								
16-Sep-15	64	485	460																								
23-Sep-15	65	460	460	7.9	0.00081	0.0000012	0.000059	0.43	0.0015	0.0012	0.00020	0.000012	0.00035	0.20	0.0000046	0.13	0.00000023	0.016	0.0079	0.092	0.0000037	0.00012	0.0000058	0.0059	0.0000092	0.00012	0.00023
30-Sep-15	66	500	505																								
7-Oct-15	67	505	495																								
14-Oct-15	68	495	490																								
21-Oct-15	69	490	470	8.0	0.00082	0.0000024	0.000061	0.45	0.0013	0.0012	0.00012	0.000012	0.00035	0.21	0.000012	0.13	0.0000033	0.025	0.0078	0.094	0.0000040	0.000088	0.0000082	0.0059	0.000011	0.00012	0.00024
28-Oct-15	70	500	490																								
4-Nov-15	71	490	490																								
11-Nov-15	72	490	485																								
18-Nov-15	73	485	485	8.0	0.0022	0.0000012	0.000055	0.42	0.0015	0.0012	0.00024	0.000012	0.00036	0.20	0.000017	0.12	0.00000036	0.018	0.0073	0.073	0.0000040	0.000087	0.0000085	0.0051	0.000011	0.00012	0.00024
25-Nov-15	74	500	500	7.7	0.0035	0.000010	0.00013	0.67	0.0036	0.0050	0.00040	0.000050	0.0015	0.46	0.00016	0.21	0.0040	0.035	0.013	0.20	0.0000012	0.00012	0.000050	0.0085	0.0000040	0.00050	0.0010
2-Dec-15	75	500	500	7.5	0.0035	0.000015	0.00013	0.68	0.0031	0.0050	0.00021	0.000050	0.0015	0.43	0.000020	0.22	0.0000010	0.025	0.012	0.25	0.0000025	0.00012	0.000025	0.0090	0.000035	0.00050	0.0010
9-Dec-15	76	500	505	7.7	0.0035	0.0000051	0.00012	0.65	0.0034	0.0051	0.00030	0.000051	0.0015	0.41	0.000030	0.19	0.0000035	0.025	0.012	0.15	0.000019	0.00013	0.000030	0.0091	0.000045	0.00051	0.0010
16-Dec-15	77	500	500	7.7	0.0035	0.000085	0.00014	0.71	0.0036	0.0050	0.00026	0.000050	0.0015	0.45	0.000020	0.23	0.0000010	0.025	0.013	0.10	0.000012	0.00013	0.000025	0.0097	0.000055	0.0030	0.0010
23-Dec-15	78	500	505	8.1	0.0035	0.000045	0.00012	0.67	0.0032	0.0050	0.00022	0.000050	0.0015	0.41	0.000020	0.20	0.0000010	0.038	0.012	0.23	0.0000075	0.000093	0.000025	0.0089	0.000045	0.0018	0.0010
30-Dec-15	79	500	505	7.5	0.0035	0.0000051	0.00011	0.63	0.0028	0.0051	0.00018	0.000051	0.0015	0.37	0.000020	0.17	0.0000010	0.051	0.011	0.35	0.0000030	0.000056	0.000025	0.0080	0.000035	0.00051	0.0010
6-Jan-16	80	500	505	7.4	0.0035	0.0000051	0.00011	0.62	0.0029	0.0051	0.00023	0.000051	0.0015	0.38	0.000043	0.18	0.0000010	0.035	0.011	0.20	0.0000028	0.000078	0.000025	0.0078	0.000028	0.00051	0.0010
13-Jan-16	81	500	505	7.4	0.0035	0.0000051	0.00010	0.61	0.0030	0.0051	0.00027	0.000051	0.0015	0.38	0.000066	0.18	0.0000010	0.020	0.011	0.051	0.0000025	0.00010	0.000025	0.0076	0.000020	0.00051	0.0010
20-Jan-16	82	500	500	7.6	0.0035	0.0000051	0.000099	0.61	0.0030	0.0051	0.00024	0.000051	0.0015	0.37	0.000043	0.19	0.0000010	0.020	0.011	0.051	0.0000061	0.000096	0.000025	0.0080	0.000028	0.00051	0.0010
27-Jan-16	83	500	505	7.6	0.0035	0.0000051	0.000096	0.62	0.0031	0.0051	0.00020	0.000051	0.0015	0.36	0.000020	0.19	0.0000010	0.020	0.012	0.051	0.0000096	0.000091	0.000025	0.0083	0.000035	0.00051	0.0010
3-Feb-16	84	500	505	7.7	0.0035	0.0000050	0.000099	0.65	0.0033	0.0050	0.00021	0.000050	0.0015	0.37	0.000025	0.19	0.000013	0.028	0.012	0.23	0.000010	0.000098	0.000035	0.0081	0.000035	0.00050	0.0010
10-Feb-16	85	500	500	7.5	0.0035	0.0000050	0.00010	0.69	0.0035	0.0050	0.00022	0.000050	0.0015	0.38	0.000030	0.19	0.000026	0.035	0.012	0.40	0.000011	0.00011	0.000045	0.0079	0.000035	0.00050	0.0010
17-Feb-16	86	500	505	7.7	0.0035	0.0000050	0.000098	0.64	0.0032	0.0050	0.00020	0.000050	0.0015	0.35	0.000025	0.13	0.000013	0.023	0.012	0.33	0.0000085	0.000088	0.000035	0.0072	0.000030	0.00050	0.0010
24-Feb-16	87	500	500	7.5	0.0035	0.0000050	0.000095	0.58	0.0030	0.0050	0.00019	0.000050	0.0015	0.33	0.000020	0.065	0.0000010	0.010	0.011	0.25	0.0000060	0.000070	0.000025	0.0066	0.000025	0.00050	0.0010

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Leachate Concentrations for HC4 (GS)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	335	7.8	547	#N/A	7.1	53	163	1.7	0.19	< 0.3	194	0.029	0.0045	0.028	0.020	< 0.000007	< 0.000007	0.011	< 0.000003	39	0.000080	0.00025	0.0031
2-Jul-14	1	500	505	7.8	446	#N/A	7.8	59	144	0.60	0.16	< 0.3	168	0.024	0.0066	0.032	0.015	< 0.000007	< 0.000007	0.0093	< 0.000003	34	< 0.00003	0.00022	0.0015
9-Jul-14	2	500	475	7.9	258	#N/A	2.1	60	58	< 0.2	0.16	< 0.3	93	0.031	0.0074	0.023	0.019	< 0.000007	< 0.000007	0.0096	< 0.000003	19	< 0.00003	0.000098	0.00079
16-Jul-14	3	500	500	8.0	176	#N/A	2.6	60	17	< 0.2	0.12	< 0.3	67	0.037	0.0068	0.019	0.018	< 0.000007	< 0.000007	0.0067	< 0.000003	14	0.00020	0.00027	0.00065
23-Jul-14	4	500	495	8.0	124	#N/A	2.3	50	9.0	< 0.2	0.10	< 0.3	53	0.044	0.0054	0.018	0.018	< 0.000007	< 0.000007	0.0059	< 0.000003	11	0.000090	0.00014	0.00045
30-Jul-14	5	500	480	8.0	121	#N/A	1.7	59	8.0	< 0.2	0.090	< 0.3	51	0.050	0.0055	0.017	0.018	< 0.000007	< 0.000007	0.0053	< 0.000003	11	0.00010	0.00010	0.0013
6-Aug-14	6	500	485	7.9	104	#N/A	2.0	47	5.0	< 0.2	0.080	< 0.3	46	0.048	0.0048	0.013	0.017	< 0.000007	< 0.000007	0.0044	< 0.000003	9.9	< 0.00003	0.000041	0.00048
13-Aug-14	7	500	485	7.9	85	#N/A	2.3	41	6.0	< 0.2	< 0.06	< 0.3	38	0.058	0.0035	0.011	0.017	< 0.000007	< 0.000007	0.0039	< 0.000003	8.5	0.000050	0.000043	0.00047
20-Aug-14	8	500	480	7.9	78	#N/A	1.9	38	5.0	< 0.2	< 0.06	< 0.3	36	0.055	0.0029	0.011	0.015	< 0.000007	< 0.000007	0.0036	< 0.000003	8.2	0.000070	0.000053	0.00042
27-Aug-14	9	500	500	7.9	103	#N/A	5.3	46	4.0	< 0.2	0.060	< 0.3	44	0.049	0.0041	0.011	0.020	< 0.000007	< 0.000007	0.0075	< 0.000003	10	< 0.00003	0.000025	0.00023
3-Sep-14	10	500	475	7.8	99	#N/A	4.8	45	5.0	< 0.2	< 0.06	< 0.3	44	0.051	0.0040	0.013	0.021	< 0.000007	< 0.000007	0.0033	< 0.000003	11	< 0.00003	0.000027	0.00077
10-Sep-14	11	500	505	7.9	93	#N/A	3.7	42	4.0	< 0.2	< 0.06	< 0.3	38	0.057	0.0038	0.011	0.019	< 0.000007	< 0.000007	0.0040	< 0.000003	9.2	< 0.00003	0.000021	0.00040
17-Sep-14	12	500	490	7.9	93	#N/A	7.3	45	5.0	< 0.2	< 0.06	< 0.3	38	0.057	0.0039	0.010	0.020	< 0.000007	< 0.000007	0.0037	0.0000040	9.0	< 0.00003	0.000021	0.00016
24-Sep-14	13	500	485	7.9	78	#N/A	3.4	38	6.0	< 0.2	< 0.06	< 0.3	34	0.054	0.0040	0.0082	0.016	< 0.000007	< 0.000007	0.0025	< 0.000003	8.0	< 0.00003	0.00011	0.00017
1-Oct-14	14	500	480	7.8	63	#N/A	6.2	35	3.0	< 0.2	< 0.06	< 0.3	29	0.047	0.0038	0.0063	0.014	< 0.000007	< 0.000007	0.0019	< 0.000003	7.0	< 0.00003	0.00	< 0.00002
8-Oct-14	15	500	490	7.7	65	#N/A	3.0	27	< 2	< 0.2	< 0.06	< 0.3	28	0.041	0.0028	0.0065	0.013	< 0.000007	< 0.000007	0.0098	< 0.000003	6.9	< 0.00003	0.000015	0.00014
15-Oct-14	16	500	480	7.8	68	#N/A	4.9	29	3.0	< 0.2	< 0.06	< 0.3	29	0.045	0.0032	0.0068	0.014	< 0.000007	< 0.000007	0.0042	< 0.000003	7.3	< 0.00003	0.000017	0.00012
22-Oct-14	17	500	500	7.8	87	#N/A	5.0	39	4.0	< 0.2	< 0.06	< 0.3	38	0.047	0.0047	0.0083	0.022	< 0.000007	< 0.000007	0.0050	< 0.000003	9.2	< 0.00003	0.000025	0.00011
29-Oct-14	18	500	490	7.7	63	#N/A	7.5	31	2.0	< 0.2	< 0.06	< 0.3	28	0.046	0.0030	0.0055	0.013	< 0.000007	< 0.000007	0.0047	< 0.000003	6.9	< 0.00003	0.000016	0.00055
5-Nov-14	19	500	475	7.8	57	#N/A	#N/A	36	< 2	< 0.2	< 0.06	< 0.3	25	0.036	0.0027	0.0050	0.013	< 0.000007	< 0.000007	0.0026	0.000016	6.3	< 0.00003	0.000019	0.00052
12-Nov-14	20	500	505	7.8	89	#N/A	6.5	34	2.0	< 0.2	< 0.06	< 0.3	41	0.048	0.0049	0.0089	0.020	< 0.000007	< 0.000007	0.0033	< 0.000003	10	< 0.00003	0.000022	0.00028
19-Nov-14	21	500	480	7.9	94	#N/A	6.5	34	< 2	< 0.2	< 0.06	< 0.3	29	0.052	0.0029	0.0064	0.014	< 0.000007	< 0.000007	0.0021	< 0.000003	7.4	< 0.00003	0.000020	0.00033
26-Nov-14	22	500	490	7.8	62	#N/A	2.0	29	< 2	< 0.2	< 0.06	< 0.3	28	0.045	0.0031	0.0061	0.017	< 0.000007	< 0.000007	0.0023	0.0000030	7.1	< 0.00003	0.000018	0.00029
3-Dec-14	23	500	485	7.7	59	#N/A	2.9	29	< 2	< 0.2	< 0.06	< 0.3	29	0.049	0.0029	0.0064	0.015	< 0.000007	< 0.000007	0.0027	< 0.000003	7.5	< 0.00003	0.000014	0.00016
10-Dec-14	24	500	500	7.8	56	#N/A	4.9	29	< 2	< 0.2	< 0.06	< 0.3	26	0.043	0.0029	0.0054	0.013	< 0.000007	< 0.000007	0.0021	0.0000030	6.7	< 0.00003	0.000012	0.00024
17-Dec-14	25	500	485	7.8	64	#N/A	3.8	31	< 2	< 0.2	< 0.06	< 0.3	30	0.061	0.0032	0.0078	0.016	< 0.000007	< 0.000007	0.0019	< 0.000003	7.7	< 0.00003	0.000011	0.00029
24-Dec-14	26	500	480	7.8	74	#N/A	3.3	36	< 2	< 0.2	< 0.06	< 0.3	34	0.060	0.0041	0.0078	0.020	< 0.000007	< 0.000007	0.0016	< 0.000003	8.8	< 0.00003	0.000015	0.00020
31-Dec-14	27	500	500	7.8	71	#N/A	1.4	48	< 2	< 0.2	< 0.06	< 0.3	35	0.047	0.0040	0.0067	0.020	< 0.000007	< 0.000007	0.0015	< 0.000003	9.0	< 0.00003	0.000010	0.00047
7-Jan-15	28	500	495	7.7	69	#N/A	2.7	34	2.0	< 1	< 0.06	< 0.3	31	0.039	0.0038	0.0058	0.018	< 0.000007	< 0.000007	0.0023	< 0.000003	7.9	< 0.00003	0.000021	0.00016
14-Jan-15	29	500	490	7.7	72	#N/A	2.8	37	< 2	< 1	< 0.06	< 0.3	34	0.039	0.0046	0.0069	0.019	< 0.000007	< 0.000007	0.0024	0.0000030	8.6	< 0.00003	0.000015	0.00046
21-Jan-15	30	500	485	7.9	62	#N/A	5.5	36	< 2	< 1	< 0.06	< 0.3	30	0.047	0.0033	0.0054	0.016	< 0.000007	< 0.000007	0.0016	< 0.000003	7.9	< 0.00003	0.000013	0.00037
28-Jan-15	31	500	485	7.7	61	#N/A	1.5	31	< 2	< 1	< 0.06	< 0.3	28	0.045	0.0033	0.0052	0.017	< 0.000007	< 0.000007	0.0025	< 0.000003	7.0	0.00010	0.000010	0.00017
4-Feb-15	32	500	485	7.8	59	#N/A	2.2	30	< 2	< 1	< 0.06	< 0.3	27	0.036	0.0031	0.0045	0.018	< 0.000007	< 0.000007	0.0021	< 0.000003	6.7	< 0.00003	0.0000090	0.00038
11-Feb-15	33	500	475	7.7	55	#N/A	2.2	29	2.0	< 1	< 0.06	< 0.3	25	0.041	0.0028	0.0043	0.014	< 0.000007	< 0.000007	0.0021	< 0.000003	6.6	< 0.00003	0.000014	0.00025
18-Feb-15	34	500	500	7.7	61	#N/A	2.2	31	< 2	< 1	< 0.06	< 0.3	30	0.036	0.0033	0.0048	0.017	< 0.000007	< 0.000007	0.0024	< 0.000003	7.8	< 0.00003	0.000014	0.00051
25-Feb-15	35	500	480	7.8	72	#N/A	3.5	37	< 2	< 1	< 0.06	< 0.3	31	0.036	0.0036	0.0048	0.021	< 0.000007	< 0.000007	0.00080	0.0000040	7.9	0.000060	0.000016	0.00059
4-Mar-15	36	500	490	7.7	58	#N/A	2.3	30	< 2	< 1	< 0.06	< 0.3	26	0.041	0.0024	0.0042	0.015	< 0.000007	< 0.000007	0.00080	< 0.000003	6.8	0.000060	0.000012	0.00014
11-Mar-15	37	500	485	7.7	54	#N/A	1.8	29	2.0	< 1	< 0.06	< 0.3	24	0.031	0.0026	0.0036	0.014	0.0000070	< 0.000007	0.0016	0.000020	6.5	0.000060	0.000026	0.00088
18-Mar-15	38	500	490	7.7	50	#N/A	2.4	27	< 2	< 1	< 0.06	< 0.3	23	0.032	0.0021	0.0030	0.015	< 0.000007	< 0.000007	0.0011	< 0.000003	6.1	< 0.00003	0.000017	0.00037
25-Mar-15	39	500	490	7.7	45	#N/A	2.7	26	< 2	< 1	< 0.06	< 0.3	22	0.030	0.0022	0.0032	0.013	< 0.000007	< 0.000007	0.00090	< 0.000003	5.7	0.000090	0.0000060	0.00076
1-Apr-15	40	500	485	7.9	44	#N/A	4.0	27	< 2	< 1	< 0.06	< 0.3	18	0.028	0.0021	0.0022	0.015	0.000012	< 0.000007	0.0016	0.0000040	4.4	< 0.00003	< 0.000004	0.00026
8-Apr-15	41	500	485	7.6	45	#N/A	2.6	26	< 2	< 1	< 0.06	< 0.3	20	0.026	0.0026	0.0028	0.013	< 0.000007	< 0.000007	0.00080	< 0.000003	5.4	< 0.00003	0.000019	0.00022
15-Apr-15	42	500	475	7.7	57	#N/A	3.7	32	< 2	< 1	< 0.06	< 0.3	26	0.035	0.0026	0.0040	0.016	< 0.000007	< 0.000007	0.0034	< 0.000003	6.9	< 0.00003	< 0.000004	0.0027
22-Apr-15	43	500	505	7.8	65	#N/A	3.2	35	3.0	< 1	< 0.06	< 0.3	29	0.045	0.0029	0.0053	0.019	< 0.000007	< 0.000007	0.0029	< 0.000003	7.7	0.000050	0.000010	0.00095
29-Apr-15	44	500	495	7.8	68	#N/A	2.1	36	< 2	< 1	< 0.06	< 0.3	32	0.049	0.0031	0.0053	0.021	< 0.000007	< 0.000007	0.0021	< 0.000003	8.3	< 0.00003	0.000022	0.00066
6-May-15	45	500	495	7.7	62	#N/A	2.6	34	< 2	< 1	< 0.06	< 0.3	28	0.043	0.0030	0.0063	0.017	< 0.000007	< 0.000007	0.0019	< 0.000003	7.3	< 0.00003	0.000018	0.00040
13-May-15	46	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	495	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	475	475	8.0	172	#N/A	3.8	85	4.0	< 1	0.060	< 0.3	84	0.014	0.0082	0.0068	0.063	< 0.000007	< 0.000007	0.0036	< 0.000003	22	< 0.00003	0.000033	0.00017
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	482	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	480	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	450	445	8.0	186	#N/A	5.0	89	3.0	< 1	< 0.06	< 0.3	83	0.013	0.0070	0.0062	0.069	< 0.000007	< 0.000007	0.0035	< 0.000003	21	< 0.00003	0.000047	0.00037
8-Jul-15	54	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	485	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	470	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	455	445	8.0	175	#N/A	2.8	90	3.0	< 1	< 0.06	< 0.3	86	0.011	0.0064	0.0049	0.066	< 0.000007	< 0.000007	0.0034	0.000010	22	0.000040	0.000038	0.000080
5-Aug-15	58	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	490	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	475	465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	465	445	8.1	177	#N/A	1.8	92	3.0	< 1	< 0.06	< 0.3	94	0.014	0.0063	0.0047	0.073	< 0.000007	< 0.000007	0.0037	0.0000090	26	0.00011	0.000041	0.00061
2-Sep-15	62	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	480	465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	465	465	8.1	171	#N/A	2.2	86	3.0				86	0.012	0.0064	0.0055	0.073	< 0.000007	< 0.000007	0.0040	< 0.000003	22	< 0.00003	0.000038	0.00024
30-Sep-15	66	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	495	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	475	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	470	455	8.1	156	#N/A	1.3	82	3.0				80	0.014	0.0049	0.0037	0.066	< 0.000007	< 0.000007	0.0036	< 0.000003	21	< 0.00003	0.000041	0.00035
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	470	455	8.1	145	#N/A	1.2	84	2.0	-	-	-	68	0.012	0.0040	0.0039	0.049	< 0.000007	< 0.000007	0.0016	< 0.000003	18	0.000070	0.000072	0.00038
25-Nov-15	74	500	490	7.9	72	#N/A	0.90	43	2.0	-	-	-	34	0.041	0.0021	0.0039	0.030	< 0.000007	< 0.000007	0.0014	< 0.000003	9.1	< 0.00003	0.000023	0.00021
2-Dec-15	75	500	490	8.0	85	#N/A	1.7	44	2.0	-	-	-	43	0.037	0.0028	0.0041	0.036	< 0.000007	< 0.000007	0.00090	0.0000030	11	< 0.00003	0.000016	0.00034
9-Dec-15	76	500	495	7.9	70	#N/A	2.8	37	2.0	-	-	-	33	0.037	0.0020	0.0039	0.030	0.0000090	< 0.000007	0.0030	0.000012	8.6	< 0.00003	0.000015	0.00034
16-Dec-15	77	500	495	8.1	77	#N/A	1.5	38	2.0	-	-	-	38	0.051	0.0023	0.0046	0.034	0.0000070	< 0.000007	0.0021	< 0.000003	10.0	0.000050	0.000020	0.00035
23-Dec-15	78	500	485	8.1	62	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	490	7.8	55	#N/A	1.3	29	2.0	-	-	-	28	0.034	0.0012	0.0025	0.024	< 0.000007	< 0.000007	0.0014	< 0.000003	7.4	0.000050	0.0000060	0.00022
6-Jan-16	80	500	490	7.6	53	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	495	7.6	55	#N/A	1.7	29	2.0	-	-	-	26	0.033	0.0013	0.0024	0.022	< 0.000007	< 0.000007	< 0.002	< 0.000003	7.0	< 0.00003	< 0.000004	0.00048
20-Jan-16	82	500	495	7.8	71	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	495	7.8	62	#N/A	2.8	33	2.0	-	-	-	30	0.036	0.0014	0.0027	0.029	< 0.000007	< 0.000007	< 0.002	0.000010	8.2	< 0.00003	0.000024	0.00052
3-Feb-16	84	500	495	7.8	70	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	480	7.7	67	#N/A	2.6	34	2.0	-	-	-	32	0.028	0.0015	0.0028	0.030	< 0.000007	< 0.000007	< 0.002	< 0.000003	8.8	< 0.00003	0.000016	0.000090
17-Feb-16	86	500	505	7.7	64	-	-	-	< 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	480	7.8	70	#N/A	2.3	35	< 2	-	-	-	34	0.034	0.0016	0.0028	0.030	< 0.000007	< 0.000007	< 0.002	< 0.000003	9.0	< 0.00003	0.000010	0.000080

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC4 (GS)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	335	7.8	0.0050	*< 0.00001*	0.0064	23	0.022	*< 0.01*	0.0061	0.0012	0.015	11	0.00082	1.9	*< 0.000002*	24	0.30	65	0.000036	0.00017	0.00011	0.032	0.00044	0.0020	*< 0.002*
2-Jul-14	1	500	505	7.8	*< 0.002*	*< 0.00001*	0.0051	21	0.028	*< 0.01*	0.0046	0.0023	*< 0.009*	8.2	0.00054	2.1	*< 0.000002*	16	0.26	52	0.000022	0.0012	0.000060	0.060	0.00033	0.0020	*< 0.002*
9-Jul-14	2	500	475	7.9	*< 0.002*	*< 0.00001*	0.0038	11	0.015	*< 0.01*	0.0047	0.0010	0.020	6.3	0.00015	2.2	*< 0.000002*	7.9	0.14	20	0.000017	0.0029	0.000080	0.034	0.00043	*< 0.001*	*< 0.002*
16-Jul-14	3	500	500	8.0	0.0070	*< 0.00001*	0.0028	7.8	0.011	*< 0.01*	0.0037	0.00080	*< 0.009*	4.6	0.000050	1.7	0.0000020	4.1	0.11	7.8	0.000015	0.00015	0.000070	0.019	0.00040	*< 0.001*	*< 0.002*
23-Jul-14	4	500	495	8.0	0.013	*< 0.00001*	0.0022	6.1	0.010	*< 0.01*	0.0024	0.00040	*< 0.009*	3.8	*< 0.00004*	1.5	*< 0.000002*	2.4	0.085	4.6	0.000010	0.0016	0.000080	0.012	0.00037	*< 0.001*	*< 0.002*
30-Jul-14	5	500	480	8.0	*< 0.002*	*< 0.00001*	0.0023	5.8	0.0083	*< 0.01*	0.0024	0.00050	*< 0.009*	3.6	0.000070	1.5	0.0000020	1.8	0.083	3.3	0.000018	0.000040	0.00015	0.011	0.00043	*< 0.001*	*< 0.002*
6-Aug-14	6	500	485	7.9	0.0020	0.000050	0.0018	5.2	0.0072	*< 0.01*	0.0015	*< 0.0001*	*< 0.009*	3.3	0.000050	1.4	*< 0.000002*	1.3	0.075	2.4	0.0000080	0.000030	0.000060	0.0094	0.00039	*< 0.001*	*< 0.002*
13-Aug-14	7	500	485	7.9	0.0020	*< 0.00001*	0.0013	4.1	0.0083	*< 0.01*	0.0011	0.00020	*< 0.009*	2.5	*< 0.00004*	1.0	*< 0.000002*	0.76	0.060	1.6	0.0000050	0.000010	0.00018	0.0074	0.00019	*< 0.001*	*< 0.002*
20-Aug-14	8	500	480	7.9	*< 0.002*	*< 0.00001*	0.0012	3.8	0.0078	*< 0.01*	0.0011	0.00020	0.0090	2.4	0.000060	0.98	*< 0.000002*	0.65	0.058	1.6	*< 0.000005*	0.0013	0.00017	0.0078	0.00036	*< 0.001*	*< 0.002*
27-Aug-14	9	500	500	7.9	*< 0.002*	0.000010	0.0013	4.7	0.0086	*< 0.01*	0.0012	0.00020	0.012	2.7	0.000050	1.2	*< 0.000002*	0.72	0.071	1.9	0.000012	0.000090	0.000080	0.0096	0.00034	*< 0.001*	*< 0.002*
3-Sep-14	10	500	475	7.8	*< 0.007*	0.000060	0.0013	4.3	0.0096	*< 0.01*	0.0010	0.00010	0.0060	2.7	0.000090	1.4	0.000018	0.58	0.071	2.4	0.000013	0.00020	*< 0.00005*	0.0092	0.00036	*< 0.001*	*< 0.002*
10-Sep-14	11	500	505	7.9	*< 0.007*	0.000010	0.0011	3.7	0.0087	*< 0.01*	0.00084	0.00010	*< 0.003*	2.4	0.000050	1.2	*< 0.000002*	0.45	0.063	1.5	0.000010	0.000060	0.000090	0.0087	0.00034	*< 0.001*	*< 0.002*
17-Sep-14	12	500	490	7.9	*< 0.007*	*< 0.00001*	0.0012	3.9	0.0071	*< 0.01*	0.00084	0.00010	*< 0.003*	2.6	0.000050	1.1	*< 0.000002*	0.45	0.063	2.1	*< 0.000005*	0.000020	0.00015	0.0097	0.00036	0.0010	*< 0.002*
24-Sep-14	13	500	485	7.9	*< 0.002*	0.000010	0.00099	3.5	0.0065	*< 0.01*	0.00076	0.00020	*< 0.009*	2.1	*< 0.00004*	0.94	0.0000050	0.35	0.055	1.4	*< 0.000005*	0.000020	*< 0.00005*	0.0087	0.00029	0.0010	*< 0.002*
1-Oct-14	14	500	480	7.8	0.0090	*< 0.00001*	0.00066	2.8	0.012	*< 0.01*	0.00080	*< 0.0001*	*< 0.009*	1.7	*< 0.00004*	0.78	*< 0.000002*	0.23	0.047	1.5	*< 0.000005*	0.000030	0.000060	0.0071	0.00026	*< 0.002*	*< 0.002*
8-Oct-14	15	500	490	7.7	*< 0.007*	*< 0.00001*	0.00072	2.5	0.0075	*< 0.01*	0.00056	*< 0.0001*	*< 0.003*	1.7	*< 0.00004*	0.70	*< 0.000002*	0.23	0.043	1.8	0.0000080	0.0011	*< 0.00005*	0.0072	0.00026	*< 0.001*	*< 0.002*
15-Oct-14	16	500	480	7.8	*< 0.007*	*< 0.00001*	0.00087	2.7	0.0081	*< 0.01*	0.00064	*< 0.0001*	*< 0.003*	1.8	*< 0.00004*	0.74	*< 0.000002*	0.24	0.045	1.8	0.0000090	0.00075	0.00016	0.0076	0.00024	*< 0.001*	*< 0.002*
22-Oct-14	17	500	500	7.8	*< 0.007*	0.000060	0.0010	3.7	0.011	*< 0.01*	0.00091	0.00010	*< 0.003*	2.2	*< 0.00004*	1.0	*< 0.000002*	0.29	0.058	2.1	0.000011	0.000040	*< 0.00005*	0.011	0.00028	*< 0.001*	*< 0.002*
29-Oct-14	18	500	490	7.7	*< 0.007*	*< 0.00001*	0.00062	2.5	0.0087	*< 0.01*	0.00055	*< 0.0001*	*< 0.003*	1.4	*< 0.00004*	0.60	*< 0.000002*	0.18	0.040	1.2	0.0000080	0.00089	0.000060	0.0065	0.00018	*< 0.001*	*< 0.002*
5-Nov-14	19	500	475	7.8	*< 0.007*	0.000010	0.00056	2.3	0.0085	*< 0.01*	0.00063	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.60	*< 0.000002*	0.18	0.038	1.2	0.000011	0.00094	0.000070	0.0063	0.00018	*< 0.001*	*< 0.002*
12-Nov-14	20	500	505	7.8	*< 0.007*	*< 0.00001*	0.00088	3.8	0.0093	*< 0.01*	0.0013	0.00010	*< 0.003*	2.1	0.000050	0.99	*< 0.000002*	0.33	0.063	1.9	0.000011	0.00011	*< 0.00005*	0.011	0.00030	*< 0.001*	*< 0.002*
19-Nov-14	21	500	480	7.9	*< 0.007*	0.000020	0.00062	2.6	0.0083	*< 0.01*	0.00062	*< 0.0001*	*< 0.003*	1.4	*< 0.00004*	0.65	*< 0.000002*	0.17	0.045	1.0	0.0000090	0.00030	*< 0.00005*	0.0066	0.00025	0.0010	*< 0.002*
26-Nov-14	22	500	490	7.8	*< 0.007*	*< 0.00001*	0.00064	2.6	0.0100	*< 0.01*	0.00069	*< 0.0001*	0.0090	1.4	*< 0.00004*	0.67	*< 0.000002*	0.17	0.044	1.1	0.000016	0.00079	0.00013	0.0074	0.00025	*< 0.001*	*< 0.002*
3-Dec-14	23	500	485	7.7	*< 0.007*	0.000040	0.00057	2.4	0.011	0.010	0.00072	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.57	*< 0.000002*	0.18	0.038	1.1	0.0000060	0.00026	*< 0.00005*	0.0073	0.00030	*< 0.001*	*< 0.002*
10-Dec-14	24	500	500	7.8	*< 0.007*	*< 0.00001*	0.00056	2.3	0.0094	*< 0.01*	0.00079	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.57	*< 0.000002*	0.14	0.040	1.1	0.000010	0.00038	0.000070	0.0065	0.00021	*< 0.001*	*< 0.002*
17-Dec-14	25	500	485	7.8	*< 0.007*	*< 0.00001*	0.00067	2.6	0.011	*< 0.01*	0.00074	*< 0.0001*	*< 0.003*	1.4	*< 0.00004*	0.73	*< 0.000002*	0.16	0.045	0.90	0.0000090	0.00074	*< 0.00005*	0.0081	0.00029	*< 0.001*	*< 0.002*
24-Dec-14	26	500	480	7.8	*< 0.007*	*< 0.00001*	0.00079	2.9	0.011	*< 0.01*	0.00090	*< 0.0001*	*< 0.003*	1.7	0.000080	0.80	*< 0.000002*	0.18	0.052	1.1	0.000012	0.00041	0.00018	0.0088	0.00033	*< 0.001*	*< 0.002*
31-Dec-14	27	500	500	7.8	*< 0.007*	0.00011	0.00072	3.0	0.011	*< 0.01*	0.00095	*< 0.0001*	*< 0.003*	1.6	*< 0.00004*	0.92	*< 0.000002*	0.17	0.053	1.2	0.000010	0.00035	*< 0.00005*	0.0090	0.00025	*< 0.001*	*< 0.002*
7-Jan-15	28	500	495	7.7	*< 0.007*	0.000020	0.00069	2.8	0.011	*< 0.01*	0.00094	*< 0.0001*	*< 0.003*	1.5	*< 0.00004*	0.71	*< 0.000002*	0.15	0.049	0.80	0.000010	0.00054	0.000080	0.0081	0.00024	*< 0.001*	*< 0.002*
14-Jan-15	29	500	490	7.7	*< 0.007*	0.000020	0.00067	3.1	0.0087	*< 0.01*	0.0011	*< 0.0001*	*< 0.003*	1.7	*< 0.00004*	0.89	*< 0.000002*	0.18	0.051	0.80	0.0000090	0.00017	0.000070	0.0079	0.00026	*< 0.001*	*< 0.002*
21-Jan-15	30	500	485	7.9	*< 0.007*	0.000030	0.00057	2.5	0.0094	*< 0.01*	0.0011	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.66	*< 0.000002*	0.12	0.043	0.50	*< 0.000005*	0.00026	0.00018	0.0071	0.00025	*< 0.001*	*< 0.002*
28-Jan-15	31	500	485	7.7	*< 0.007*	*< 0.00001*	0.00051	2.6	0.0081	*< 0.01*	0.0010	*< 0.0001*	*< 0.003*	1.4	0.000080	0.70	*< 0.000002*	0.16	0.036	1.1	0.0000060	0.00012	0.000060	0.0072	0.00026	*< 0.001*	*< 0.002*
4-Feb-15	32	500	485	7.8	*< 0.007*	0.000020	0.00060	2.5	0.0086	*< 0.01*	0.00086	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.66	*< 0.000002*	0.14	0.045	1.0	*< 0.000005*	0.00024	0.00014	0.0062	0.00022	*< 0.001*	*< 0.002*
11-Feb-15	33	500	475	7.7	*< 0.007*	*< 0.00001*	0.00049	2.1	0.0090	*< 0.01*	0.00079	*< 0.0001*	*< 0.003*	1.2	*< 0.001*	0.58	*< 0.000002*	0.11	0.037	0.50	0.0000060	0.00045	0.00034	0.0054	0.00026	*< 0.001*	*< 0.002*
18-Feb-15	34	500	500	7.7	*< 0.007*	*< 0.00001*	0.00064	2.5	0.0081	*< 0.01*	0.00076	*< 0.0001*	*< 0.003*	1.4	*< 0.001*	0.70	*< 0.000002*	0.12	0.048	0.70	0.0000080	0.00013	0.000060	0.0072	0.00025	*< 0.001*	*< 0.002*
25-Feb-15	35	500	480	7.8	*< 0.007*	0.000020	0.00064	2.9	0.0076	*< 0.01*	0.00083	*< 0.0001*	*< 0.003*	1.7	*< 0.001*	0.71	*< 0.000002*	0.14	0.051	0.70	0.0000080	0.00011	*< 0.00005*	0.0084	0.00024	*< 0.001*	*< 0.002*
4-Mar-15	36	500	490	7.7	*< 0.007*	*< 0.00001*	0.00052	2.2	0.0077	*< 0.01*	0.00063	*< 0.0001*	*< 0.003*	1.2	*< 0.001*	0.68	*< 0.000002*	0.11	0.039	0.90	*< 0.000005*	0.000030	0.000090	0.0065	0.00023	*< 0.001*	*< 0.002*
11-Mar-15	37	500	485	7.7	0.010	0.00010	0.00050	2.0	0.0083	*< 0.01*	0.00060	*< 0.0001*	*< 0.003*	1.0	*< 0.001*	0.49	*< 0.000002*	0.070	0.037	*< 0.1*	*< 0.000005*	0.00057	0.000090	0.0057	0.00020	0.012	*< 0.002*
18-Mar-15	38	500	490	7.7	*< 0.007*	*< 0.00001*	0.00047	1.9	0.0094	*< 0.01*	0.00056	*< 0.0001*	*< 0.003*	1.1	*< 0.001*	0.50	*< 0.000002*	0.080	0.035	0.90	*< 0.000005*	0.00041	0.00021	0.0051	0.00016	*< 0.001*	*< 0.002*
25-Mar-15	39	500	490	7.7	*< 0.007*	*< 0.00001*	0.00033	2.0	0.0088	*< 0.01*	0.00058	0.00010	*< 0.003*	1.0	*< 0.001*	0.49	*< 0.000002*	0.13	0.034	0.70	*< 0.000005*	0.00048	0.000080	0.0052	0.00025	0.0010	*< 0.002*
1-Apr-15	40	500	485	7.9	*< 0.007*	*< 0.00001*	0.00032	1.6	0.016	*< 0.01*	0.00042	*< 0.0001*	*< 0.003*	0.90	*< 0.001*	0.30	*< 0.000002*	0.68	0.030	*< 0.1*	*< 0.000005*	0.00047	*< 0.00005*	0.0062	0.00014	*< 0.001*	*< 0.002*
8-Apr-15	41	500	485	7.6	*< 0.007*	*< 0.00001*	0.00037	1.6	0.0085	*< 0.01*	0.00049	*< 0.0001*	*< 0.003*	0.93	*< 0.001*	0.53	*< 0.000002*	0.070	0.031	0.10	*< 0.000005*	0.00039	0.000050	0.0046	0.00018	*< 0.001*	*< 0.002*
15-Apr-15	42	500	475	7.7	*< 0.007*	*< 0.00001*	0.00050	2.2	0.0090	*< 0.01*	0.00062	*< 0.0001*	*< 0.003*	1.2	*< 0.001*	0.58	*< 0.000002*	0.10	0.039	0.70	*< 0.000005*	0.00098	0.00012	0.0065	0.00025	0.0010	*< 0.002*
22-Apr-15	43	500	505	7.8	*< 0.007*	0.000060	0.00055	2.4	0.0090	*< 0.01*	0.00067	*< 0.0001*	*< 0.003*	1.4	*< 0.001*	0.71	0.0000040	0.11	0.044	0.60	0.000013	0.00036	0.000050	0.0076	0.00027	*< 0.001*	*< 0.002*
29-Apr-15	44	500	495	7.8	*< 0.007*	0.000020	0.00054	2.7	0.010	*< 0.01*	0.00077	*< 0.0001*	*< 0.003*	1.6	*< 0.001*	0.69	*< 0.000002*	0.090	0.047	0.80	*< 0.000005*	0.00038	0.000080	0.0078	0.00027	*< 0.001*	*< 0.002*
6-May-15	45	500	495	7.7	*< 0.007*	0.000010	0.00054	2.3	0.0095	*< 0.01*	0.00064	*< 0.0001*	*< 0.003*	1.3	*< 0.001*	0.70	0.0000020	0.090	0.041	0.70	*< 0.000005*	0.00055	0.00010	0.0069	0.00024	*< 0.001*	*< 0.002*
13-May-15	46	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	495	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	475	475	8.0	*< 0.007*	*< 0.00001*	0.0014	7.2	0.012	*< 0.01*	0.0022	0.00020	*< 0.003*	3.6	*< 0.00004*	2.1	*< 0.000002*	0.25	0.13	1.8	0.000010	0.00038	0.000090	0.022	0.00031	*< 0.001*	*< 0.002*
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	482	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	480	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	450	445	8.0	*< 0.007*	*< 0.00001*	0.0012	7.2	0.017	0.010	0.0020	0.00020	*< 0.003*	2.9	0.000080	1.9	0.0000020	0.26	0.13	1.6	0.000013	0.00090	*< 0.00005*	0.024	0.00027	0.0010	*< 0.002*
8-Jul-15	54	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	485	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	470	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	455	445	8.0	*< 0.007*	*< 0.00001*	0.0013	7.6	0.018	*< 0.01*	0.0013	0.00020	*< 0.003*	2.9	0.000060	1.8	0.000013	0.25	0.14	1.6	*< 0.000005*	0.00042	*< 0.00005*	0.012	0.00018	*< 0.001*	*< 0.002*
5-Aug-15	58	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	490	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	475	465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	465	445	8.1	*< 0.007*	0.00011	0.0012	7.4	0.017	*< 0.01*	0.0021	0.00020	*< 0.003*	3.0	0.000070	2.2	*< 0.000002*	0.22	0.14	1.6	0.000015	0.00097	*< 0.00005*	0.024	0.00029	0.0020	*< 0.002*
2-Sep-15	62	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	480	465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	465	465	8.1	*< 0.007*	*< 0.00001*	0.0012	7.5	0.013	*< 0.01*	0.0016	0.00020	*< 0.003*	3.1	0.000080	1.9	0.000015	0.24	0.14	1.7	0.0000080	0.00081	0.000070	0.020	0.00023	*< 0.001*	*< 0.002*
30-Sep-15	66	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	495	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	475	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	470	455	8.1	*< 0.007*	0.000020	0.0010	6.8	0.014	*< 0.01*	0.0012	0.00020	*< 0.003*	2.7	0.000090	1.6	0.000024	0.25	0.11	1.3	0.000014	0.0012	*< 0.00005*	0.019	0.00019	*< 0.001*	*< 0.002*
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	470	455	8.1	0.022	*< 0.00001*	0.00083	5.8	0.016	*< 0.01*	0.0022	*< 0.0001*	*< 0.003*	2.4	0.00018	1.3	*< 0.000002*	0.21	0.099	0.90	0.000016	0.0011	*< 0.00005*	0.016	0.00020	*< 0.001*	*< 0.002*
25-Nov-15	74	500	490	7.9	*< 0.007*	0.000020	0.00054	2.7	0.0083	*< 0.01*	0.00081	*< 0.0001*	*< 0.003*	1.5	0.00029	0.71	0.00014	0.12	0.049	0.50	0.0000050	0.00047	*< 0.00005*	0.0095	0.00027	*< 0.001*	*< 0.002*
2-Dec-15	75	500	490	8.0	*< 0.007*	0.000030	0.00059	3.9	0.0090	*< 0.01*	0.00088	0.00010	*< 0.003*	1.9	0.000040	0.96	0.0000020	0.12	0.062	0.80	*< 0.000005*	0.00041	0.000080	0.011	0.00025	*< 0.001*	*< 0.002*
9-Dec-15	76	500	495	7.9	*< 0.007*	*< 0.00001*	0.00055	2.7	0.0063	*< 0.01*	0.00062	*< 0.0001*	*< 0.003*	1.5	0.000050	0.69	0.0000040	0.080	0.049	0.30	0.000020	0.00040	0.00014	0.0089	0.00024	*< 0.001*	*< 0.002*
16-Dec-15	77	500	495	8.1	*< 0.007*	0.00013	0.00064	3.3	0.0075	*< 0.01*	0.00058	*< 0.0001*	0.012	1.8	*< 0.00004*	0.88	*< 0.000002*	0.10	0.058	0.20	0.0000070	0.00064	0.00014	0.011	0.00029	*< 0.001*	*< 0.002*
23-Dec-15	78	500	485	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	490	7.8	*< 0.007*	*< 0.00001*	0.00047	2.2	0.0062	*< 0.01*	0.00035	*< 0.0001*	*< 0.003*	1.2	*< 0.00004*	0.52	*< 0.000002*	0.10	0.040	0.80	*< 0.000005*	0.00022	0.00012	0.0069	0.00019	*< 0.001*	*< 0.002*
6-Jan-16	80	500	490	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	495	7.6	*< 0.007*	0.000020	0.00036	2.1	0.0064	*< 0.01*	0.00049	*< 0.0001*	*< 0.003*	1.2	0.00013	0.55	*< 0.000002*	0.060	0.036	*< 0.1*	*< 0.000005*	0.00028	0.00012	0.0060	0.00015	*< 0.001*	*< 0.002*
20-Jan-16	82	500	495	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	495	7.8	*< 0.007*	*< 0.00001*	0.00044	2.4	0.0074	*< 0.01*	0.00036	*< 0.0001*	*< 0.003*	1.2	*< 0.00004*	0.63	*< 0.000002*	0.070	0.044	*< 0.1*	0.0000050	0.00049	0.00011	0.0080	0.00018	*< 0.001*	*< 0.002*
3-Feb-16	84	500	495	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	480	7.7	*< 0.007*	*< 0.00001*	0.00042	2.5	0.0085	*< 0.01*	0.00037	*< 0.0001*	*< 0.003*	1.2	0.000070	0.59	*< 0.000002*	0.10	0.045	0.60	0.0000070	0.00034	0.00014	0.0069	0.00016	*< 0.001*	*< 0.002*
17-Feb-16	86	500	505	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	480	7.8	*< 0.007*	*< 0.00001*	0.00048	2.7	0.0068	*< 0.01*	0.00042	*< 0.0001*	*< 0.003*	1.4	*< 0.00004*	0.47	*< 0.000002*	0.050	0.047	0.50	0.0000050	0.00030	0.00014	0.0079	0.00017	*< 0.001*	*< 0.002*

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC4 (GS)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	335	7.8	547	#N/A	2.4	18	55	0.57	0.064	0.10	65	0.0098	0.0015	0.0094	0.0066	0.0000023	0.0000023	0.0036	0.0000010	13	0.000027	0.000083	0.0010
2-Jul-14	1	500	505	7.8	446	#N/A	4.0	30	73	0.30	0.081	0.15	85	0.012	0.0033	0.016	0.0077	0.0000035	0.0000035	0.0047	0.0000015	17	0.000015	0.00011	0.00074
9-Jul-14	2	500	475	7.9	258	#N/A	1.0	28	28	0.095	0.076	0.14	44	0.015	0.0035	0.011	0.0088	0.0000033	0.0000033	0.0046	0.0000014	9.0	0.000014	0.000047	0.00038
16-Jul-14	3	500	500	8.0	176	#N/A	1.3	30	8.5	0.10	0.060	0.15	33	0.018	0.0034	0.0094	0.0089	0.0000035	0.0000035	0.0034	0.0000015	7.0	0.00010	0.00014	0.00033
23-Jul-14	4	500	495	8.0	124	#N/A	1.1	25	4.5	0.099	0.050	0.15	26	0.022	0.0027	0.0087	0.0089	0.0000035	0.0000035	0.0029	0.0000015	5.6	0.000045	0.000068	0.00022
30-Jul-14	5	500	480	8.0	121	#N/A	0.81	28	3.8	0.096	0.043	0.14	24	0.024	0.0026	0.0081	0.0087	0.0000034	0.0000034	0.0025	0.0000014	5.2	0.000048	0.000048	0.00062
6-Aug-14	6	500	485	7.9	104	#N/A	0.97	23	2.4	0.097	0.039	0.15	22	0.023	0.0023	0.0065	0.0084	0.0000034	0.0000034	0.0021	0.0000015	4.8	0.000015	0.000020	0.00023
13-Aug-14	7	500	485	7.9	85	#N/A	1.1	20	2.9	0.097	0.029	0.15	18	0.028	0.0017	0.0053	0.0081	0.0000034	0.0000034	0.0019	0.0000015	4.1	0.000024	0.000021	0.00023
20-Aug-14	8	500	480	7.9	78	#N/A	0.90	18	2.4	0.096	0.029	0.14	17	0.026	0.0014	0.0054	0.0072	0.0000034	0.0000034	0.0017	0.0000014	3.9	0.000034	0.000025	0.00020
27-Aug-14	9	500	500	7.9	103	#N/A	2.6	23	2.0	0.10	0.030	0.15	22	0.024	0.0021	0.0054	0.010	0.0000035	0.0000035	0.0038	0.0000015	5.0	0.000015	0.000013	0.00012
3-Sep-14	10	500	475	7.8	99	#N/A	2.3	21	2.4	0.095	0.029	0.14	21	0.024	0.0019	0.0060	0.010	0.0000033	0.0000033	0.0016	0.0000014	5.0	0.000014	0.000013	0.00037
10-Sep-14	11	500	505	7.9	93	#N/A	1.8	21	2.0	0.10	0.030	0.15	19	0.029	0.0019	0.0054	0.0096	0.0000035	0.0000035	0.0020	0.0000015	4.6	0.000015	0.000011	0.00020
17-Sep-14	12	500	490	7.9	93	#N/A	3.6	22	2.5	0.098	0.029	0.15	19	0.028	0.0019	0.0050	0.0096	0.0000034	0.0000034	0.0018	0.0000020	4.4	0.000015	0.000010	0.000078
24-Sep-14	13	500	485	7.9	78	#N/A	1.7	18	2.9	0.097	0.029	0.15	17	0.026	0.0019	0.0040	0.0078	0.0000034	0.0000034	0.0012	0.0000015	3.9	0.000015	0.000053	0.000082
1-Oct-14	14	500	480	7.8	63	#N/A	3.0	17	1.4	0.096	0.029	0.14	14	0.023	0.0018	0.0030	0.0065	0.0000034	0.0000034	0.00091	0.0000014	3.3	0.000014	0.00	0.0000096
8-Oct-14	15	500	490	7.7	65	#N/A	1.5	13	0.98	0.098	0.029	0.15	14	0.020	0.0014	0.0032	0.0064	0.0000034	0.0000034	0.0048	0.0000015	3.4	0.000015	0.0000074	0.000069
15-Oct-14	16	500	480	7.8	68	#N/A	2.3	14	1.4	0.096	0.029	0.14	14	0.022	0.0015	0.0033	0.0067	0.0000034	0.0000034	0.0020	0.0000014	3.5	0.000014	0.0000082	0.000058
22-Oct-14	17	500	500	7.8	87	#N/A	2.5	19	2.0	0.10	0.030	0.15	19	0.023	0.0024	0.0042	0.011	0.0000035	0.0000035	0.0025	0.0000015	4.6	0.000015	0.000013	0.000055
29-Oct-14	18	500	490	7.7	63	#N/A	3.7	15	0.98	0.098	0.029	0.15	14	0.022	0.0015	0.0027	0.0064	0.0000034	0.0000034	0.0023	0.0000015	3.4	0.000015	0.0000078	0.00027
5-Nov-14	19	500	475	7.8	57	#N/A	#N/A	17	0.95	0.095	0.029	0.14	12	0.017	0.0013	0.0024	0.0063	0.0000033	0.0000033	0.0012	0.0000076	3.0	0.000014	0.0000090	0.00025
12-Nov-14	20	500	505	7.8	89	#N/A	3.3	17	1.0	0.10	0.030	0.15	21	0.024	0.0025	0.0045	0.0099	0.0000035	0.0000035	0.0017	0.0000015	5.1	0.000015	0.000011	0.00014
19-Nov-14	21	500	480	7.9	94	#N/A	3.1	16	0.96	0.096	0.029	0.14	14	0.025	0.0014	0.0031	0.0069	0.0000034	0.0000034	0.0010	0.0000014	3.6	0.000014	0.0000096	0.00016
26-Nov-14	22	500	490	7.8	62	#N/A	0.96	14	0.98	0.098	0.029	0.15	14	0.022	0.0015	0.0030	0.0085	0.0000034	0.0000034	0.0011	0.0000015	3.5	0.000015	0.0000088	0.00014
3-Dec-14	23	500	485	7.7	59	#N/A	1.4	14	0.97	0.097	0.029	0.15	14	0.024	0.0014	0.0031	0.0072	0.0000034	0.0000034	0.0013	0.0000015	3.6	0.000015	0.0000068	0.000078
10-Dec-14	24	500	500	7.8	56	#N/A	2.4	14	1.0	0.10	0.030	0.15	13	0.022	0.0015	0.0027	0.0067	0.0000035	0.0000035	0.0011	0.0000015	3.3	0.000015	0.0000060	0.00012
17-Dec-14	25	500	485	7.8	64	#N/A	1.8	15	0.97	0.097	0.029	0.15	14	0.030	0.0016	0.0038	0.0078	0.0000034	0.0000034	0.00092	0.0000015	3.7	0.000015	0.0000053	0.00014
24-Dec-14	26	500	480	7.8	74	#N/A	1.6	17	0.96	0.096	0.029	0.14	16	0.029	0.0020	0.0037	0.0096	0.0000034	0.0000034	0.00077	0.0000014	4.2	0.000014	0.0000072	0.000096
31-Dec-14	27	500	500	7.8	71	#N/A	0.72	24	1.0	0.10	0.030	0.15	17	0.024	0.0020	0.0034	0.0099	0.0000035	0.0000035	0.00075	0.0000015	4.5	0.000015	0.0000050	0.00024
7-Jan-15	28	500	495	7.7	69	#N/A	1.3	17	0.99	0.50	0.030	0.15	16	0.019	0.0019	0.0029	0.0089	0.0000035	0.0000035	0.0011	0.0000015	3.9	0.000015	0.000010	0.000079
14-Jan-15	29	500	490	7.7	72	#N/A	1.4	18	0.98	0.49	0.029	0.15	17	0.019	0.0023	0.0034	0.0095	0.0000034	0.0000034	0.0012	0.0000015	4.2	0.000015	0.0000074	0.00023
21-Jan-15	30	500	485	7.9	62	#N/A	2.7	17	0.97	0.49	0.029	0.15	15	0.023	0.0016	0.0026	0.0078	0.0000034	0.0000034	0.00078	0.0000015	3.8	0.000015	0.0000063	0.00018
28-Jan-15	31	500	485	7.7	61	#N/A	0.71	15	0.97	0.49	0.029	0.15	14	0.022	0.0016	0.0025	0.0083	0.0000034	0.0000034	0.0012	0.0000015	3.4	0.000049	0.0000049	0.000082
4-Feb-15	32	500	485	7.8	59	#N/A	1.1	15	0.97	0.49	0.029	0.15	13	0.017	0.0015	0.0022	0.0088	0.0000034	0.0000034	0.0010	0.0000015	3.3	0.000015	0.0000044	0.00018
11-Feb-15	33	500	475	7.7	55	#N/A	1.0	14	0.95	0.48	0.029	0.14	12	0.020	0.0013	0.0020	0.0067	0.0000033	0.0000033	0.00100	0.0000014	3.1	0.000014	0.0000067	0.00012
18-Feb-15	34	500	500	7.7	61	#N/A	1.1	16	1.0	0.50	0.030	0.15	15	0.018	0.0017	0.0024	0.0086	0.0000035	0.0000035	0.0012	0.0000015	3.9	0.000015	0.0000070	0.00026
25-Feb-15	35	500	480	7.8	72	#N/A	1.7	18	0.96	0.48	0.029	0.14	15	0.017	0.0017	0.0023	0.0098	0.0000034	0.0000034	0.00038	0.0000019	3.8	0.000029	0.0000077	0.00028
4-Mar-15	36	500	490	7.7	58	#N/A	1.1	15	0.98	0.49	0.029	0.15	13	0.020	0.0012	0.0021	0.0072	0.0000034	0.0000034	0.00039	0.0000015	3.3	0.000029	0.0000059	0.000069
11-Mar-15	37	500	485	7.7	54	#N/A	0.88	14	0.97	0.49	0.029	0.15	12	0.015	0.0013	0.0017	0.0070	0.0000034	0.0000034	0.00078	0.0000097	3.1	0.000029	0.000013	0.00043
18-Mar-15	38	500	490	7.7	50	#N/A	1.2	13	0.98	0.49	0.029	0.15	11	0.015	0.0010	0.0015	0.0071	0.0000034	0.0000034	0.00054	0.0000015	3.0	0.000015	0.0000083	0.00018
25-Mar-15	39	500	490	7.7	45	#N/A	1.3	13	0.98	0.49	0.029	0.15	11	0.015	0.0011	0.0016	0.0065	0.0000034	0.0000034	0.00044	0.0000015	2.8	0.000044	0.0000029	0.00037
1-Apr-15	40	500	485	7.9	44	#N/A	1.9	13	0.97	0.49	0.029	0.15	8.5	0.014	0.0010	0.0011	0.0071	0.0000058	0.0000034	0.00078	0.0000019	2.2	0.000015	0.0000019	0.00013
8-Apr-15	41	500	485	7.6	45	#N/A	1.3	12	0.97	0.49	0.029	0.15	9.7	0.013	0.0013	0.0014	0.0065	0.0000034	0.0000034	0.00039	0.0000015	2.6	0.000015	0.0000092	0.00011
15-Apr-15	42	500	475	7.7	57	#N/A	1.8	15	0.95	0.48	0.029	0.14	12	0.017	0.0012	0.0019	0.0076	0.0000033	0.0000033	0.0016	0.0000014	3.3	0.000014	0.0000019	0.0013
22-Apr-15	43	500	505	7.8	65	#N/A	1.6	18	1.5	0.51	0.030	0.15	15	0.023	0.0015	0.0027	0.0095	0.0000035	0.0000035	0.0015	0.0000015	3.9	0.000025	0.0000051	0.00048
29-Apr-15	44	500	495	7.8	68	#N/A	1.0	18	0.99	0.50	0.030	0.15	16	0.024	0.0015	0.0026	0.010	0.0000035	0.0000035	0.0010	0.0000015	4.1	0.000015	0.000011	0.00033
6-May-15	45	500	495	7.7	62	#N/A	1.3	17	0.99	0.50	0.030	0.15	14	0.021	0.0015	0.0031	0.0083	0.0000035	0.0000035	0.00094	0.0000015	3.6	0.000015	0.0000089	0.00020
13-May-15	46	500	495																						
20-May-15	47	495	480																						
27-May-15	48	480	475																						
3-Jun-15	49	475	475	8.0	172	#N/A	1.8	10	0.48	0.12	0.0071	0.036	10.0	0.0017	0.00097	0.00081	0.0075	0.00000083	0.00000083	0.00043	0.00000036	2.6	0.0000036	0.0000039	0.000020
10-Jun-15	50	500	490																						
17-Jun-15	51	490	482																						
24-Jun-15	52	480	450																						
1-Jul-15	53	450	445	8.0	186	#N/A	2.2	9.9	0.33	0.11	0.0067	0.033	9.3	0.0015	0.00078	0.00069	0.0076	0.00000078	0.00000078	0.00039	0.00000033	2.4	0.0000033	0.0000052	0.000041
8-Jul-15	54	500	485																						
15-Jul-15	55	485	470																						
22-Jul-15	56	470	455																						
29-Jul-15	57	455	445	8.0	175	#N/A	1.2	10	0.33	0.11	0.0067	0.033	9.5	0.0012	0.00071	0.00055	0.0073	0.00000078	0.00000078	0.00038	0.0000011	2.4	0.0000045	0.0000042	0.0000089
5-Aug-15	58	500	490																						
12-Aug-15	59	490	475																						
19-Aug-15	60	475	465																						
26-Aug-15	61	465	445	8.1	177	#N/A	0.79	10	0.33	0.11	0.0067	0.033	10	0.0015	0.00070	0.00052	0.0081	0.00000078	0.00000078	0.00041	0.0000010	2.8	0.000012	0.0000046	0.000068
2-Sep-15	62	500	500																						
9-Sep-15	63	500	480																						
16-Sep-15	64	480	465																						
23-Sep-15	65	465	465	8.1	171	#N/A	1.0	9.9	0.35				10	0.0014	0.00074	0.00064	0.0085	0.00000081	0.00000081	0.00047	0.00000035	2.6	0.0000035	0.0000044	0.000028
30-Sep-15	66	500	495																						
7-Oct-15	67	495	475																						
14-Oct-15	68	475	470																						
21-Oct-15	69	470	455	8.1	156	#N/A	0.59	9.3	0.34				9.1	0.0016	0.00056	0.00042	0.0075	0.00000080	0.00000080	0.00041	0.00000034	2.4	0.0000034	0.0000047	0.000040
28-Oct-15	70	500	490																						
4-Nov-15	71	490	480																						
11-Nov-15	72	480	470																						
18-Nov-15	73	470	455	8.1	145	#N/A	0.54	9.5	0.23				7.7	0.0014	0.00046	0.00044	0.0055	0.00000080	0.00000080	0.00018	0.00000034	2.0	0.0000080	0.0000082	0.000043
25-Nov-15	74	500	490	7.9	72	#N/A	0.42	21	0.98				16	0.020	0.0010	0.0019	0.015	0.0000034	0.0000034	0.00069	0.0000015	4.4	0.000015	0.000011	0.00010
2-Dec-15	75	500	490	8.0	85	#N/A	0.82	21	0.98				21	0.018	0.0014	0.0020	0.018	0.0000034	0.0000034	0.00044	0.0000015	5.2	0.000015	0.0000078	0.00017
9-Dec-15	76	500	495	7.9	70	#N/A	1.4	18	0.99				16	0.018	0.00099	0.0019	0.015	0.0000045	0.0000035	0.0015	0.0000059	4.3	0.000015	0.0000074	0.00017
16-Dec-15	77	500	495	8.1	77	#N/A	0.73	19	0.99				19	0.025	0.0011	0.0023	0.017	0.0000035	0.0000035	0.0010	0.0000015	4.9	0.000025	0.0000099	0.00017
23-Dec-15	78	500	485	8.1	62	#N/A	0.69	16	0.97				16	0.021	0.00086	0.0018	0.014	0.0000034	0.0000034	0.00086	0.0000015	4.3	0.000025	0.0000064	0.00014
30-Dec-15	79	500	490	7.8	55	#N/A	0.66	14	0.98				14	0.017	0.00059	0.0012	0.012	0.0000034	0.0000034	0.00069	0.0000015	3.6	0.000025	0.0000029	0.00011
6-Jan-16	80	500	490	7.6	53	#N/A	0.75	14	0.98				13	0.016	0.00062	0.0012	0.011	0.0000034	0.0000034	0.00084	0.0000015	3.5	0.000020	0.0000025	0.00017
13-Jan-16	81	500	495	7.6	55	#N/A	0.84	14	0.99				13	0.016	0.00064	0.0012	0.011	0.0000035	0.0000035	0.00099	0.0000015	3.5	0.000015	0.0000020	0.00024
20-Jan-16	82	500	495	7.8	71	#N/A	1.1	15	0.99				14	0.017	0.00067	0.0013	0.013	0.0000035	0.0000035	0.00099	0.0000032	3.7	0.000015	0.0000069	0.00025
27-Jan-16	83	500	495	7.8	62	#N/A	1.4	16	0.99				15	0.018	0.00069	0.0013	0.014	0.0000035	0.0000035	0.00099	0.0000050	4.0	0.000015	0.000012	0.00026
3-Feb-16	84	500	495	7.8	70	#N/A	1.3	16	0.99				15	0.016	0.00071	0.0013	0.014	0.0000034	0.0000034	0.00098	0.0000032	4.1	0.000015	0.0000098	0.00015
10-Feb-16	85	500	480	7.7	67	#N/A	1.2	16	0.96				15	0.014	0.00072	0.0013	0.014	0.0000034	0.0000034	0.00096	0.0000014	4.2	0.000014	0.0000077	0.000043
17-Feb-16	86	500	505	7.7	64	#N/A	1.2	17	1.0				16	0.015	0.00074	0.0013	0.014	0.0000034	0.0000034	0.00096	0.0000014	4.3	0.000014	0.0000062	0.000041
24-Feb-16	87	500	480	7.8	70	#N/A	1.1	17	0.96				16	0.016	0.00077	0.0013	0.014	0.0000034	0.0000034	0.00096	0.0000014	4.3	0.000014	0.0000048	0.000038

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC4 (GS)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	335	7.8	0.0017	0.0000034	0.0021	7.8	0.0072	0.0034	0.0020	0.00040	0.0050	3.7	0.00027	0.64	0.00000067	8.0	0.10	22	0.000012	0.000057	0.000037	0.011	0.00015	0.00067	0.00067
2-Jul-14	1	500	505	7.8	0.0010	0.0000051	0.0026	10	0.014	0.0051	0.0023	0.0012	0.0045	4.1	0.00027	1.0	0.0000010	7.8	0.13	26	0.000011	0.00059	0.000030	0.031	0.00017	0.0010	0.0010
9-Jul-14	2	500	475	7.9	0.00095	0.0000048	0.0018	5.3	0.0070	0.0048	0.0022	0.00048	0.0095	3.0	0.000071	1.0	0.00000095	3.7	0.067	9.6	0.0000081	0.0014	0.000038	0.016	0.00020	0.00048	0.00095
16-Jul-14	3	500	500	8.0	0.0035	0.0000050	0.0014	3.9	0.0054	0.0050	0.0019	0.00040	0.0045	2.3	0.000025	0.87	0.0000010	2.1	0.053	3.9	0.0000075	0.000075	0.000035	0.0096	0.00020	0.00050	0.0010
23-Jul-14	4	500	495	8.0	0.0064	0.0000050	0.0011	3.0	0.0051	0.0050	0.0012	0.00020	0.0045	1.9	0.000020	0.75	0.00000099	1.2	0.042	2.3	0.0000050	0.00081	0.000040	0.0057	0.00018	0.00050	0.00099
30-Jul-14	5	500	480	8.0	0.00096	0.0000048	0.0011	2.8	0.0040	0.0048	0.0012	0.00024	0.0043	1.7	0.000034	0.70	0.00000096	0.84	0.040	1.6	0.0000086	0.000019	0.000072	0.0051	0.00021	0.00048	0.00096
6-Aug-14	6	500	485	7.9	0.00097	0.000024	0.00086	2.5	0.0035	0.0049	0.00074	0.000049	0.0044	1.6	0.000024	0.67	0.00000097	0.61	0.036	1.2	0.0000039	0.000015	0.000029	0.0045	0.00019	0.00049	0.00097
13-Aug-14	7	500	485	7.9	0.00097	0.0000049	0.00065	2.0	0.0040	0.0049	0.00054	0.000097	0.0044	1.2	0.000019	0.50	0.00000097	0.37	0.029	0.78	0.0000024	0.0000049	0.000087	0.0036	0.000092	0.00049	0.00097
20-Aug-14	8	500	480	7.9	0.00096	0.0000048	0.00058	1.8	0.0037	0.0048	0.00050	0.000096	0.0043	1.2	0.000029	0.47	0.00000096	0.31	0.028	0.75	0.0000024	0.00064	0.000082	0.0037	0.00017	0.00048	0.00096
27-Aug-14	9	500	500	7.9	0.0010	0.0000050	0.00067	2.3	0.0043	0.0050	0.00058	0.00010	0.0060	1.4	0.000025	0.62	0.0000010	0.36	0.035	0.95	0.0000060	0.000045	0.000040	0.0048	0.00017	0.00050	0.0010
3-Sep-14	10	500	475	7.8	0.0033	0.000029	0.00062	2.1	0.0045	0.0048	0.00049	0.000048	0.0029	1.3	0.000043	0.67	0.0000086	0.28	0.034	1.1	0.0000062	0.000095	0.000024	0.0044	0.00017	0.00048	0.00095
10-Sep-14	11	500	505	7.9	0.0035	0.0000051	0.00057	1.9	0.0044	0.0051	0.00042	0.000051	0.0015	1.2	0.000025	0.61	0.0000010	0.23	0.032	0.76	0.0000051	0.000030	0.000045	0.0044	0.00017	0.00051	0.0010
17-Sep-14	12	500	490	7.9	0.0034	0.0000049	0.00057	1.9	0.0035	0.0049	0.00041	0.000049	0.0015	1.3	0.000025	0.54	0.00000098	0.22	0.031	1.0	0.0000025	0.0000098	0.000074	0.0048	0.00018	0.00049	0.00098
24-Sep-14	13	500	485	7.9	0.00097	0.0000049	0.00048	1.7	0.0032	0.0049	0.00037	0.000097	0.0044	1.0	0.000019	0.46	0.0000024	0.17	0.027	0.68	0.0000024	0.0000097	0.000024	0.0042	0.00014	0.00049	0.00097
1-Oct-14	14	500	480	7.8	0.0043	0.0000048	0.00032	1.3	0.0056	0.0048	0.00038	0.000048	0.0043	0.83	0.000019	0.37	0.00000096	0.11	0.023	0.73	0.0000024	0.000014	0.000029	0.0034	0.00012	0.00096	0.00096
8-Oct-14	15	500	490	7.7	0.0034	0.0000049	0.00035	1.2	0.0037	0.0049	0.00027	0.000049	0.0015	0.81	0.000020	0.34	0.00000098	0.11	0.021	0.88	0.0000039	0.00052	0.000025	0.0035	0.00013	0.00049	0.00098
15-Oct-14	16	500	480	7.8	0.0034	0.0000048	0.00042	1.3	0.0039	0.0048	0.00031	0.000048	0.0014	0.84	0.000019	0.36	0.00000096	0.12	0.022	0.86	0.0000043	0.00036	0.000077	0.0036	0.00012	0.00048	0.00096
22-Oct-14	17	500	500	7.8	0.0035	0.000030	0.00050	1.9	0.0053	0.0050	0.00046	0.000050	0.0015	1.1	0.000020	0.52	0.0000010	0.15	0.029	1.1	0.0000055	0.000020	0.000025	0.0054	0.00014	0.00050	0.0010
29-Oct-14	18	500	490	7.7	0.0034	0.0000049	0.00030	1.2	0.0043	0.0049	0.00027	0.000049	0.0015	0.69	0.000020	0.29	0.00000098	0.088	0.020	0.59	0.0000039	0.00044	0.000029	0.0032	0.000088	0.00049	0.00098
5-Nov-14	19	500	475	7.8	0.0033	0.0000048	0.00027	1.1	0.0040	0.0048	0.00030	0.000048	0.0014	0.59	0.000019	0.29	0.00000095	0.086	0.018	0.57	0.0000052	0.00045	0.000033	0.0030	0.000086	0.00048	0.00095
12-Nov-14	20	500	505	7.8	0.0035	0.0000051	0.00044	1.9	0.0047	0.0051	0.00067	0.000051	0.0015	1.0	0.000025	0.50	0.0000010	0.17	0.032	0.96	0.0000056	0.000056	0.000025	0.0054	0.00015	0.00051	0.0010
19-Nov-14	21	500	480	7.9	0.0034	0.0000096	0.00030	1.2	0.0040	0.0048	0.00030	0.000048	0.0014	0.68	0.000019	0.31	0.00000096	0.082	0.022	0.48	0.0000043	0.00014	0.000024	0.0032	0.00012	0.00048	0.00096
26-Nov-14	22	500	490	7.8	0.0034	0.0000049	0.00031	1.3	0.0049	0.0049	0.00034	0.000049	0.0044	0.69	0.000020	0.33	0.00000098	0.083	0.022	0.54	0.0000078	0.00039	0.000064	0.0036	0.00012	0.00049	0.00098
3-Dec-14	23	500	485	7.7	0.0034	0.000019	0.00028	1.2	0.0053	0.0049	0.00035	0.000049	0.0015	0.61	0.000019	0.28	0.00000097	0.087	0.018	0.53	0.0000029	0.00013	0.000024	0.0036	0.00015	0.00049	0.00097
10-Dec-14	24	500	500	7.8	0.0035	0.0000050	0.00028	1.1	0.0047	0.0050	0.00040	0.000050	0.0015	0.66	0.000020	0.29	0.0000010	0.070	0.020	0.55	0.0000050	0.00019	0.000035	0.0033	0.00011	0.00050	0.0010
17-Dec-14	25	500	485	7.8	0.0034	0.0000049	0.00032	1.2	0.0052	0.0049	0.00036	0.000049	0.0015	0.68	0.000019	0.35	0.00000097	0.078	0.022	0.44	0.0000044	0.00036	0.000024	0.0039	0.00014	0.00049	0.00097
24-Dec-14	26	500	480	7.8	0.0034	0.0000048	0.00038	1.4	0.0054	0.0048	0.00043	0.000048	0.0014	0.80	0.000038	0.38	0.00000096	0.086	0.025	0.53	0.0000058	0.00020	0.000086	0.0042	0.00016	0.00048	0.00096
31-Dec-14	27	500	500	7.8	0.0035	0.000055	0.00036	1.5	0.0053	0.0050	0.00048	0.000050	0.0015	0.81	0.000020	0.46	0.0000010	0.085	0.027	0.60	0.0000050	0.00018	0.000025	0.0045	0.00013	0.00050	0.0010
7-Jan-15	28	500	495	7.7	0.0035	0.0000099	0.00034	1.4	0.0052	0.0050	0.00047	0.000050	0.0015	0.76	0.000020	0.35	0.00000099	0.074	0.024	0.40	0.0000050	0.00027	0.000040	0.0040	0.00012	0.00050	0.00099
14-Jan-15	29	500	490	7.7	0.0034	0.0000098	0.00033	1.5	0.0043	0.0049	0.00053	0.000049	0.0015	0.85	0.000020	0.44	0.00000098	0.088	0.025	0.39	0.0000044	0.000083	0.000034	0.0039	0.00013	0.00049	0.00098
21-Jan-15	30	500	485	7.9	0.0034	0.000015	0.00028	1.2	0.0046	0.0049	0.00052	0.000049	0.0015	0.65	0.000019	0.32	0.00000097	0.058	0.021	0.24	0.0000024	0.00013	0.000087	0.0035	0.00012	0.00049	0.00097
28-Jan-15	31	500	485	7.7	0.0034	0.0000049	0.00025	1.3	0.0039	0.0049	0.00049	0.000049	0.0015	0.67	0.000039	0.34	0.00000097	0.078	0.017	0.53	0.0000029	0.000058	0.000029	0.0035	0.00013	0.00049	0.00097
4-Feb-15	32	500	485	7.8	0.0034	0.0000097	0.00029	1.2	0.0042	0.0049	0.00042	0.000049	0.0015	0.64	0.000019	0.32	0.00000097	0.068	0.022	0.49	0.0000024	0.00012	0.000068	0.0030	0.00011	0.00049	0.00097
11-Feb-15	33	500	475	7.7	0.0033	0.0000048	0.00023	1.0	0.0043	0.0048	0.00038	0.000048	0.0014	0.57	0.00048	0.28	0.00000095	0.052	0.018	0.24	0.0000029	0.00021	0.00016	0.0026	0.00012	0.00048	0.00095
18-Feb-15	34	500	500	7.7	0.0035	0.0000050	0.00032	1.3	0.0040	0.0050	0.00038	0.000050	0.0015	0.69	0.00050	0.35	0.0000010	0.060	0.024	0.35	0.0000040	0.000065	0.000030	0.0036	0.00013	0.00050	0.0010
25-Feb-15	35	500	480	7.8	0.0034	0.0000096	0.00030	1.4	0.0036	0.0048	0.00040	0.000048	0.0014	0.82	0.00048	0.34	0.00000096	0.067	0.025	0.34	0.0000038	0.000053	0.000024	0.0040	0.00012	0.00048	0.00096
4-Mar-15	36	500	490	7.7	0.0034	0.0000049	0.00026	1.1	0.0038	0.0049	0.00031	0.000049	0.0015	0.61	0.00049	0.33	0.00000098	0.054	0.019	0.44	0.0000025	0.000015	0.000044	0.0032	0.00011	0.00049	0.00098
11-Mar-15	37	500	485	7.7	0.0049	0.000049	0.00024	0.96	0.0040	0.0049	0.00029	0.000049	0.0015	0.50	0.00049	0.24	0.00000097	0.034	0.018	0.049	0.0000024	0.00028	0.000044	0.0028	0.000097	0.0058	0.00097
18-Mar-15	38	500	490	7.7	0.0034	0.0000049	0.00023	0.94	0.0046	0.0049	0.00027	0.000049	0.0015	0.53	0.00049	0.25	0.00000098	0.039	0.017	0.44	0.0000025	0.00020	0.00010	0.0025	0.000078	0.00049	0.00098
25-Mar-15	39	500	490	7.7	0.0034	0.0000049	0.00016	0.98	0.0043	0.0049	0.00028	0.000049	0.0015	0.51	0.00049	0.24	0.00000098	0.064	0.017	0.34	0.0000025	0.00024	0.000039	0.0025	0.00012	0.00049	0.00098
1-Apr-15	40	500	485	7.9	0.0034	0.0000049	0.00015	0.76	0.0080	0.0049	0.00020	0.000049	0.0015	0.44	0.00049	0.15	0.00000097	0.33	0.014	0.049	0.0000024	0.00023	0.000024	0.0030	0.000068	0.00049	0.00097
8-Apr-15	41	500	485	7.6	0.0034	0.0000049	0.00018	0.79	0.0041	0.0049	0.00024	0.000049	0.0015	0.45	0.00049	0.26	0.00000097	0.034	0.015	0.049	0.0000024	0.00019	0.000024	0.0022	0.000087	0.00049	0.00097
15-Apr-15	42	500	475	7.7	0.0033	0.0000048	0.00024	1.0	0.0043	0.0048	0.00029	0.000048	0.0014	0.58	0.00048	0.28	0.00000095	0.048	0.019	0.33	0.0000024	0.00047	0.000057	0.0031	0.00012	0.00048	0.00095
22-Apr-15	43	500	505	7.8	0.0035	0.000030	0.00028	1.2	0.0045	0.0051	0.00034	0.000051	0.0015	0.69	0.00051	0.36	0.0000020	0.056	0.022	0.30	0.0000066	0.00018	0.000025	0.0038	0.00014	0.00051	0.0010
29-Apr-15	44	500	495	7.8	0.0035	0.0000099	0.00027	1.3	0.0050	0.0050	0.00038	0.000050	0.0015	0.77	0.00050	0.34	0.00000099	0.045	0.023	0.40	0.0000025	0.00019	0.000040	0.0038	0.00013	0.00050	0.00099
6-May-15	45	500	495	7.7	0.0035	0.0000050	0.00027	1.1	0.0047	0.0050	0.00032	0.000050	0.0015	0.66	0.00050	0.35	0.00000099	0.045	0.020	0.35	0.0000025	0.00027	0.000050	0.0034	0.00012	0.00050	0.00099
13-May-15	46	500	495																								
20-May-15	47	495	480																								
27-May-15	48	480	475																								
3-Jun-15	49	475	475	8.0	0.00083	0.0000012	0.00016	0.86	0.0014	0.0012	0.00026	0.000024	0.00036	0.42	0.0000048	0.25	0.00000024	0.030	0.015	0.21	0.0000012	0.000045	0.000011	0.0026	0.000037	0.00012	0.00024
10-Jun-15	50	500	490																								
17-Jun-15	51	490	482																								
24-Jun-15	52	480	450																								
1-Jul-15	53	450	445	8.0	0.00078	0.0000011	0.00014	0.81	0.0019	0.0011	0.00022	0.000022	0.00033	0.32	0.0000089	0.21	0.00000022	0.029	0.015	0.18	0.0000014	0.00010	0.0000056	0.0026	0.000030	0.00011	0.00022
8-Jul-15	54	500	485																								
15-Jul-15	55	485	470																								
22-Jul-15	56	470	455																								
29-Jul-15	57	455	445	8.0	0.00078	0.0000011	0.00014	0.85	0.0020	0.0011	0.00015	0.000022	0.00033	0.32	0.0000067	0.20	0.0000014	0.028	0.016	0.18	0.00000056	0.000047	0.0000056	0.0013	0.000020	0.00011	0.00022
5-Aug-15	58	500	490																								
12-Aug-15	59	490	475																								
19-Aug-15	60	475	465																								
26-Aug-15	61	465	445	8.1	0.00078	0.000012	0.00013	0.82	0.0019	0.0011	0.00024	0.000022	0.00033	0.33	0.0000078	0.25	0.00000022	0.024	0.015	0.18	0.0000017	0.00011	0.0000056	0.0027	0.000032	0.00022	0.00022
2-Sep-15	62	500	500																								
9-Sep-15	63	500	480																								
16-Sep-15	64	480	465																								
23-Sep-15	65	465	465	8.1	0.00081	0.0000012	0.00014	0.88	0.0015	0.0012	0.00018	0.000023	0.00035	0.36	0.0000093	0.22	0.0000017	0.028	0.016	0.20	0.00000093	0.000094	0.0000081	0.0023	0.000027	0.00012	0.00023
30-Sep-15	66	500	495																								
7-Oct-15	67	495	475																								
14-Oct-15	68	475	470																								
21-Oct-15	69	470	455	8.1	0.00080	0.0000023	0.00012	0.77	0.0016	0.0011	0.00014	0.000023	0.00034	0.31	0.000010	0.19	0.0000027	0.028	0.013	0.15	0.0000016	0.00014	0.0000057	0.0022	0.000022	0.00011	0.00023
28-Oct-15	70	500	490																								
4-Nov-15	71	490	480																								
11-Nov-15	72	480	470																								
18-Nov-15	73	470	455	8.1	0.0025	0.0000011	0.000094	0.66	0.0018	0.0011	0.00025	0.000011	0.00034	0.27	0.000020	0.15	0.00000023	0.024	0.011	0.10	0.0000018	0.00013	0.0000057	0.0018	0.000023	0.00011	0.00023
25-Nov-15	74	500	490	7.9	0.0034	0.0000098	0.00027	1.3	0.0041	0.0049	0.00040	0.000049	0.0015	0.73	0.00014	0.35	0.000068	0.059	0.024	0.25	0.0000025	0.00023	0.000025	0.0047	0.00013	0.00049	0.00098
2-Dec-15	75	500	490	8.0	0.0034	0.000015	0.00029	1.9	0.0044	0.0049	0.00043	0.000049	0.0015	0.95	0.000020	0.47	0.00000098	0.059	0.030	0.39	0.0000025	0.00020	0.000039	0.0055	0.00012	0.00049	0.00098
9-Dec-15	76	500	495	7.9	0.0035	0.0000050	0.00027	1.3	0.0031	0.0050	0.00031	0.000050	0.0015	0.73	0.000025	0.34	0.0000020	0.040	0.024	0.15	0.0000099	0.00020	0.000069	0.0044	0.00012	0.00050	0.00099
16-Dec-15	77	500	495	8.1	0.0035	0.000064	0.00032	1.6	0.0037	0.0050	0.00029	0.000050	0.0059	0.88	0.000020	0.44	0.00000099	0.050	0.028	0.099	0.0000035	0.00032	0.000069	0.0052	0.00014	0.00050	0.00099
23-Dec-15	78	500	485	8.1	0.0034	0.000035	0.00027	1.4	0.0034	0.0049	0.00023	0.000049	0.0037	0.72	0.000020	0.35	0.00000099	0.049	0.024	0.25	0.0000030	0.00021	0.000064	0.0043	0.00012	0.00049	0.00099
30-Dec-15	79	500	490	7.8	0.0034	0.0000049	0.00023	1.1	0.0030	0.0049	0.00017	0.000049	0.0015	0.57	0.000020	0.25	0.00000098	0.049	0.019	0.39	0.0000025	0.00011	0.000059	0.0034	0.000093	0.00049	0.00098
6-Jan-16	80	500	490	7.6	0.0034	0.0000074	0.00020	1.1	0.0031	0.0049	0.00021	0.000049	0.0015	0.58	0.000042	0.26	0.00000099	0.039	0.019	0.22	0.0000025	0.00012	0.000059	0.0032	0.000084	0.00049	0.00099
13-Jan-16	81	500	495	7.6	0.0035	0.0000099	0.00018	1.0	0.0031	0.0050	0.00024	0.000050	0.0015	0.58	0.000064	0.27	0.00000099	0.030	0.018	0.050	0.0000025	0.00014	0.000059	0.0030	0.000074	0.00050	0.00099
20-Jan-16	82	500	495	7.8	0.0035	0.0000074	0.00020	1.1	0.0034	0.0050	0.00021	0.000050	0.0015	0.60	0.000042	0.29	0.00000099	0.032	0.020	0.050	0.0000025	0.00019	0.000057	0.0035	0.000082	0.00050	0.00099
27-Jan-16	83	500	495	7.8	0.0035	0.0000050	0.00022	1.2	0.0036	0.0050	0.00018	0.000050	0.0015	0.61	0.000020	0.31	0.00000099	0.035	0.022	0.050	0.0000025	0.00024	0.000054	0.0040	0.000089	0.00050	0.00099
3-Feb-16	84	500	495	7.8	0.0034	0.0000049	0.00021	1.2	0.0039	0.0049	0.00018	0.000049	0.0015	0.60	0.000027	0.30	0.00000098	0.041	0.022	0.17	0.0000029	0.00020	0.000061	0.0036	0.000083	0.00049	0.00098
10-Feb-16	85	500	480	7.7	0.0034	0.0000048	0.00020	1.2	0.0041	0.0048	0.00018	0.000048	0.0014	0.59	0.000034	0.28	0.00000096	0.048	0.022	0.29	0.0000034	0.00016	0.000067	0.0033	0.000077	0.00048	0.00096
17-Feb-16	86	500	505	7.7	0.0034	0.0000048	0.00022	1.2	0.0037	0.0048	0.00019	0.000048	0.0014	0.62	0.000026	0.25	0.00000096	0.036	0.022	0.26	0.0000029	0.00015	0.000067	0.0035	0.000079	0.00048	0.00096
24-Feb-16	87	500	480	7.8	0.0034	0.0000048	0.00023	1.3	0.0033	0.0048	0.00020	0.000048	0.0014	0.66	0.000019	0.23	0.00000096	0.024	0.022	0.24	0.0000024	0.00014	0.000067	0.0038	0.000082	0.00048	0.00096

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC5 (OKY Master)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
6-May-15	0	500	290	7.5	232	#N/A	4.4	26	57	5.0	0.23	< 0.3	28	0.14	0.010	0.093	0.0064	0.000028	< 0.000007	0.075	0.000019	7.9	< 0.00003	0.0026	0.0029
13-May-15	1	500	485	7.6	70	#N/A	5.0	17	10	1.0	0.54	< 0.3	3.2	0.50	0.015	0.24	0.0050	0.000037	0.000013	0.053	< 0.000003	0.87	0.000050	0.00049	0.0017
20-May-15	2	500	495	7.4	35	#N/A	3.5	9.7	3.0	1.0	0.82	< 0.3	1.0	0.20	0.011	0.29	0.0018	0.000018	< 0.000007	0.022	< 0.000003	0.28	< 0.00003	0.00014	0.0010
27-May-15	3	500	435	7.3	31	#N/A	2.5	9.2	4.0	1.0	0.72	< 0.3	1.1	0.24	0.010	0.27	0.0018	0.000012	< 0.000007	0.019	< 0.000003	0.29	< 0.00003	0.00012	0.00037
3-Jun-15	4	500	520	7.4	25	#N/A	2.8	7.7	2.0	< 1	0.70	< 0.3	0.87	0.37	0.0078	0.29	0.0029	0.000019	< 0.000007	0.011	0.0000040	0.24	< 0.00003	0.00010	0.00048
10-Jun-15	5	500	495	7.3	23	#N/A	3.0	8.2	3.0	< 1	0.55	< 0.3	0.74	0.052	0.0059	0.27	0.00060	< 0.000007	< 0.000007	0.013	< 0.000003	0.21	< 0.00003	0.000096	0.00089
17-Jun-15	6	500	490	7.4	19	#N/A	3.0	7.3	3.0	< 1	0.41	< 0.3	0.78	0.28	0.0056	0.30	0.0025	0.000019	< 0.000007	0.014	0.0000060	0.22	< 0.00003	0.00011	0.00047
24-Jun-15	7	500	490	7.2	19	#N/A	3.2	5.8	< 2	< 1	0.40	< 0.3	0.76	0.20	0.0053	0.27	0.0015	0.000015	< 0.000007	0.0083	< 0.000003	0.20	< 0.00003	0.00011	0.00029
1-Jul-15	8	500	480	7.6	16	#N/A	3.1	6.5	< 2	< 1	0.33	< 0.3	0.72	0.21	0.0044	0.25	0.0017	0.000015	< 0.000007	0.0049	< 0.000003	0.19	0.000040	0.00010	0.00074
8-Jul-15	9	500	495	7.5	15	#N/A	2.6	5.8	3.0	< 1	0.33	< 0.3	0.70	0.046	0.0039	0.22	0.00049	< 0.000007	< 0.000007	0.0065	< 0.000003	0.20	< 0.00003	0.000091	0.00032
15-Jul-15	10	500	490	7.2	12	#N/A	3.4	5.1	2.0	< 1	0.25	< 0.3	0.61	0.088	0.0032	0.22	0.00072	< 0.000007	< 0.000007	0.0093	< 0.000003	0.16	0.000030	0.000096	0.00052
22-Jul-15	11	500	495	7.0	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	12	500	495	7.3	12	#N/A	2.3	5.1	< 2	< 1	0.18	< 0.3	0.59	0.031	0.0026	0.17	0.00032	0.0000070	< 0.000007	0.0038	< 0.000003	0.16	< 0.00003	0.000073	0.00075
5-Aug-15	13	500	490	6.9	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	14	500	495	6.8	10	#N/A	1.7	3.9	< 2	< 1	0.15	< 0.3	0.76	0.088	0.0022	0.14	0.00067	< 0.000007	0.0000070	0.0090	< 0.000003	0.20	0.000030	0.000090	0.00028
19-Aug-15	15	500	475	7.0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	16	500	515	7.4	11	#N/A	2.6	4.6	2.0	< 1	0.12	< 0.3	0.88	0.068	0.0020	0.11	0.00050	< 0.000007	< 0.000007	0.0032	0.0000060	0.24	< 0.00003	0.00011	0.00012
2-Sep-15	17	500	490	7.0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	18	500	500	7.0	10	#N/A	1.9	3.4	< 2	< 1	0.11	< 0.3	0.87	0.034	0.0016	0.100	0.00033	< 0.000007	< 0.000007	0.0040	< 0.000003	0.24	0.000040	0.000092	0.00044
16-Sep-15	19	500	495	6.9	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	20	500	500	7.1	8.0	#N/A	1.5	3.8	< 2		0.060		0.85	0.020	0.0012	0.065	0.00024	< 0.000007	< 0.000007	0.0022	0.000018	0.23	< 0.00003	0.000079	0.000070
30-Sep-15	21	500	490	6.9	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	22	500	495	7.4	10	#N/A	2.0	5.2	< 2		0.070		1.5	0.041	0.0014	0.052	0.00040	< 0.000007	< 0.000007	0.0027	< 0.000003	0.42	0.000040	0.00011	0.00042
14-Oct-15	23	500	500	7.1	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	24	500	505	7.3	7.0	#N/A	0.80	4.0	2.0		0.070		1.1	0.029	0.0011	0.054	0.00090	< 0.000007	< 0.000007	0.0023	< 0.000003	0.29	< 0.00003	0.00011	0.00040
28-Oct-15	25	500	490	7.3	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	26	500	475	7.3	8.0	#N/A	1.2	4.4	2.0		< 0.06		1.1	0.046	0.0011	0.049	0.00044	< 0.000007	< 0.000007	0.0042	0.0000050	0.30	< 0.00003	0.00011	0.00043
11-Nov-15	27	500	500	7.3	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	28	500	500	7.2	8.0	#N/A	1.4	4.7	2.0		< 0.06		1.1	0.019	0.0010	0.045	0.00021	< 0.000007	< 0.000007	0.00050	< 0.000003	0.31	0.000040	0.00012	0.00048
25-Nov-15	29	500	490	7.1	9.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	30	500	490	6.8	8.0	#N/A	3.0	4.0	2.0		0.070		1.2	0.11	0.0011	0.059	0.00090	< 0.000007	< 0.000007	0.0010	< 0.000003	0.34	< 0.00003	0.00012	0.00015
9-Dec-15	31	500	490	7.3	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	32	500	495	7.3	7.0	#N/A	3.2	3.5	2.0		< 0.06		1.4	0.056	0.00090	0.058	0.00075	0.000017	0.000012	0.0020	0.000030	0.39	0.00024	0.00014	0.00052
23-Dec-15	33	500	490	7.9	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	34	500	505	6.7	4.0	#N/A	2.3	3.6	2.0		< 0.06		1.1	0.040	0.00080	0.045	0.00043	< 0.000007	< 0.000007	0.0016	< 0.000003	0.31	0.000060	0.000094	0.0015
6-Jan-16	35	500	485	6.6	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	36	500	490	6.4	5.0	#N/A	2.4	2.7	2.0		< 0.06		1.2	0.024	0.00060	0.025	0.00036	< 0.000007	< 0.000007	< 0.002	< 0.000003	0.33	< 0.00003	0.000096	0.00044
20-Jan-16	37	500	485	7.3	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	38	500	505	7.2	6.0	#N/A	3.3	3.5	2.0		< 0.06		1.1	0.014	0.00060	0.029	0.00064	< 0.000007	< 0.000007	< 0.002	0.000023	0.30	< 0.00003	0.00013	0.00058
3-Feb-16	39	500	480	7.2	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	40	500	505	6.6	5.0	#N/A	2.5	3.0	2.0		< 0.06		0.98	0.0063	0.00050	0.026	0.00017	< 0.000007	< 0.000007	< 0.002	< 0.000003	0.27	0.000040	0.000097	0.00080
17-Feb-16	41	500	490	7.5	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	42	500	490	6.9	4.0	#N/A	2.4	3.3	< 2		< 0.06		1.2	0.0071	0.00060	0.029	0.00031	< 0.000007	< 0.000007	< 0.002	0.0000050	0.32	< 0.00003	0.00010	0.000060
2-Mar-16	43	500	495	6.7	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	44	500	495	6.9	6.0	#N/A	3.3	4.5	< 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC5 (OKY Master)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO3/kg/wk	mgCaCO3/kg/wk	mgCaCO3/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO3/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
6-May-15	0	500	290	7.5	232	#N/A	1.3	7.5	17	1.5	0.067	0.087	8.0	0.039	0.0030	0.027	0.0019	0.0000081	0.0000020	0.022	0.0000055	2.3	0.0000087	0.00074	0.00083
13-May-15	1	500	485	7.6	70	#N/A	2.4	8.2	4.9	0.49	0.26	0.15	1.6	0.24	0.0071	0.12	0.0024	0.000018	0.0000063	0.025	0.0000015	0.42	0.000024	0.00024	0.00082
20-May-15	2	500	495	7.4	35	#N/A	1.8	4.8	1.5	0.50	0.41	0.15	0.50	0.098	0.0052	0.14	0.00091	0.0000089	0.0000035	0.011	0.0000015	0.14	0.000015	0.000070	0.00051
27-May-15	3	500	435	7.3	31	#N/A	1.1	4.0	1.7	0.44	0.31	0.13	0.48	0.10	0.0044	0.12	0.00078	0.0000052	0.0000030	0.0081	0.0000013	0.13	0.000013	0.000053	0.00016
3-Jun-15	4	500	520	7.4	25	#N/A	1.4	4.0	1.0	0.52	0.36	0.16	0.45	0.19	0.0041	0.15	0.0015	0.0000099	0.0000036	0.0059	0.0000021	0.12	0.000016	0.000053	0.00025
10-Jun-15	5	500	495	7.3	23	#N/A	1.5	4.0	1.5	0.50	0.27	0.15	0.37	0.026	0.0029	0.13	0.00030	0.0000035	0.0000035	0.0063	0.0000015	0.10	0.000015	0.000048	0.00044
17-Jun-15	6	500	490	7.4	19	#N/A	1.5	3.6	1.5	0.49	0.20	0.15	0.38	0.14	0.0027	0.15	0.0012	0.0000093	0.0000034	0.0069	0.0000029	0.11	0.000015	0.000055	0.00023
24-Jun-15	7	500	490	7.2	19	#N/A	1.6	2.8	0.98	0.49	0.20	0.15	0.37	0.098	0.0026	0.13	0.00073	0.0000074	0.0000034	0.0041	0.0000015	0.098	0.000015	0.000052	0.00014
1-Jul-15	8	500	480	7.6	16	#N/A	1.5	3.1	0.96	0.48	0.16	0.14	0.35	0.10	0.0021	0.12	0.00080	0.0000072	0.0000034	0.0024	0.0000014	0.091	0.000019	0.000049	0.00036
8-Jul-15	9	500	495	7.5	15	#N/A	1.3	2.9	1.5	0.50	0.16	0.15	0.35	0.023	0.0019	0.11	0.00024	0.0000035	0.0000035	0.0032	0.0000015	0.099	0.000015	0.000045	0.00016
15-Jul-15	10	500	490	7.2	12	#N/A	1.7	2.5	0.98	0.49	0.12	0.15	0.30	0.043	0.0016	0.11	0.00035	0.0000034	0.0000034	0.0046	0.0000015	0.078	0.000015	0.000047	0.00025
22-Jul-15	11	500	495	7.0	12	#N/A	1.4	2.5	0.99	0.49	0.11	0.15	0.30	0.029	0.0014	0.095	0.00026	0.0000034	0.0000034	0.0032	0.0000015	0.079	0.000015	0.000042	0.00031
29-Jul-15	12	500	495	7.3	12	#N/A	1.1	2.5	0.99	0.50	0.089	0.15	0.29	0.015	0.0013	0.082	0.00016	0.0000035	0.0000035	0.0019	0.0000015	0.079	0.000015	0.000036	0.00037
5-Aug-15	13	500	490	6.9	11	#N/A	0.99	2.2	0.99	0.50	0.082	0.15	0.33	0.029	0.0012	0.076	0.00025	0.0000035	0.0000035	0.0032	0.0000015	0.089	0.000015	0.000040	0.00025
12-Aug-15	14	500	495	6.8	10	#N/A	0.85	1.9	0.99	0.50	0.074	0.15	0.38	0.043	0.0011	0.070	0.00033	0.0000035	0.0000035	0.0045	0.0000015	0.099	0.000015	0.000045	0.00014
19-Aug-15	15	500	475	7.0	10	#N/A	1.1	2.1	1.0	0.51	0.068	0.15	0.41	0.039	0.0011	0.064	0.00029	0.0000035	0.0000035	0.0031	0.0000023	0.11	0.000015	0.000050	0.00010
26-Aug-15	16	500	515	7.4	11	#N/A	1.3	2.4	1.0	0.52	0.062	0.15	0.45	0.035	0.0010	0.059	0.00026	0.0000036	0.0000036	0.0016	0.0000031	0.12	0.000015	0.000055	0.000062
2-Sep-15	17	500	490	7.0	10	#N/A	1.1	2.0	1.0	0.51	0.058	0.15	0.44	0.026	0.00092	0.054	0.00021	0.0000036	0.0000036	0.0018	0.0000023	0.12	0.000018	0.000050	0.00014
9-Sep-15	18	500	500	7.0	10	#N/A	0.95	1.7	1.0	0.50	0.055	0.15	0.44	0.017	0.00080	0.050	0.00017	0.0000035	0.0000035	0.0020	0.0000015	0.12	0.000020	0.000046	0.00022
16-Sep-15	19	500	495	6.9	9.7	#N/A	0.84	1.8	1.0	0.25	0.043	0.075	0.43	0.014	0.00070	0.041	0.00014	0.0000035	0.0000035	0.0016	0.0000053	0.12	0.000018	0.000043	0.00013
23-Sep-15	20	500	500	7.1	8.0	#N/A	0.74	1.9	1.0	0.00	0.030	0.00	0.43	0.010	0.00060	0.033	0.00012	0.0000035	0.0000035	0.0011	0.0000090	0.12	0.000015	0.000040	0.000035
30-Sep-15	21	500	490	6.9	4.9	#N/A	0.86	2.2	1.00	0.00	0.032	0.00	0.58	0.015	0.00065	0.029	0.00016	0.0000035	0.0000035	0.0012	0.0000052	0.16	0.000017	0.000047	0.00012
7-Oct-15	22	500	495	7.4	10	#N/A	0.98	2.6	0.99	0.00	0.035	0.00	0.74	0.020	0.00069	0.026	0.00020	0.0000035	0.0000035	0.0013	0.0000015	0.21	0.000020	0.000055	0.00021
14-Oct-15	23	500	500	7.1	7.8	#N/A	0.68	2.3	1.0	0.00	0.035	0.00	0.65	0.017	0.00062	0.026	0.00033	0.0000035	0.0000035	0.0012	0.0000015	0.18	0.000017	0.000057	0.00020
21-Oct-15	24	500	505	7.3	7.1	#N/A	0.38	2.0	1.0	0.00	0.035	0.00	0.56	0.015	0.00056	0.027	0.00045	0.0000035	0.0000035	0.0012	0.0000015	0.15	0.000015	0.000058	0.00020
28-Oct-15	25	500	490	7.3	8.4	#N/A	0.47	2.1	0.98	0.00	0.032	0.00	0.54	0.018	0.00054	0.025	0.00033	0.0000034	0.0000034	0.0016	0.0000019	0.14	0.000015	0.000056	0.00020
4-Nov-15	26	500	475	7.3	8.0	#N/A	0.55	2.1	0.95	0.00	0.029	0.00	0.52	0.022	0.00052	0.023	0.00021	0.0000033	0.0000033	0.0020	0.0000024	0.14	0.000014	0.000054	0.00020
11-Nov-15	27	500	500	7.3	5.8	#N/A	0.62	2.2	0.98	0.00	0.029	0.00	0.53	0.016	0.00051	0.023	0.00016	0.0000034	0.0000034	0.0011	0.0000019	0.15	0.000017	0.000057	0.00022
18-Nov-15	28	500	500	7.2	7.8	#N/A	0.69	2.3	1.0	0.00	0.030	0.00	0.55	0.0095	0.00050	0.022	0.00011	0.0000035	0.0000035	0.00025	0.0000015	0.16	0.000020	0.000061	0.00024
25-Nov-15	29	500	490	7.1	8.7	#N/A	1.1	2.1	0.99	0.00	0.032	0.00	0.57	0.033	0.00052	0.026	0.00027	0.0000035	0.0000035	0.00037	0.0000015	0.16	0.000017	0.000060	0.00016
2-Dec-15	30	500	490	6.8	7.5	#N/A	1.5	2.0	0.98	0.00	0.034	0.00	0.59	0.056	0.00054	0.029	0.00044	0.0000034	0.0000034	0.00049	0.0000015	0.17	0.000015	0.000059	0.000074
9-Dec-15	31	500	490	7.3	5.3	#N/A	1.5	1.9	0.99	0.00	0.032	0.00	0.64	0.042	0.00049	0.029	0.00041	0.0000059	0.0000047	0.00074	0.0000082	0.18	0.000067	0.000064	0.00017
16-Dec-15	32	500	495	7.3	6.6	#N/A	1.6	1.7	0.99	0.00	0.030	0.00	0.69	0.028	0.00045	0.029	0.00037	0.0000084	0.0000059	0.00099	0.000015	0.19	0.00012	0.000068	0.00026
23-Dec-15	33	500	490	7.9	4.5	#N/A	1.4	1.8	1.0	0.00	0.030	0.00	0.62	0.024	0.00042	0.026	0.00029	0.0000060	0.0000047	0.00090	0.0000082	0.17	0.000075	0.000058	0.00051
30-Dec-15	34	500	505	6.7	4.5	#N/A	1.1	1.8	1.0	0.00	0.030	0.00	0.56	0.020	0.00040	0.023	0.00022	0.0000035	0.0000035	0.00081	0.0000015	0.16	0.000030	0.000047	0.00076
6-Jan-16	35	500	485	6.6	6.5	#N/A	1.2	1.6	1.00	0.00	0.030	0.00	0.57	0.016	0.00035	0.017	0.00020	0.0000035	0.0000035	0.00089	0.0000015	0.16	0.000023	0.000047	0.00049
13-Jan-16	36	500	490	6.4	5.2	#N/A	1.2	1.3	0.98	0.00	0.029	0.00	0.58	0.012	0.00029	0.012	0.00018	0.0000034	0.0000034	0.00098	0.0000015	0.16	0.000015	0.000047	0.00022
20-Jan-16	37	500	485	7.3	8.0	#N/A	1.4	1.5	1.00	0.00	0.030	0.00	0.57	0.0095	0.00030	0.013	0.00025	0.0000035	0.0000035	0.00100	0.0000065	0.16	0.000015	0.000057	0.00025
27-Jan-16	38	500	505	7.2	5.8	#N/A	1.7	1.7	1.0	0.00	0.030	0.00	0.56	0.0072	0.00030	0.015	0.00032	0.0000035	0.0000035	0.0010	0.000012	0.15	0.000015	0.000067	0.00029
3-Feb-16	39	500	480	7.2	2.7	#N/A	1.5	1.6	1.0	0.00	0.030	0.00	0.53	0.0052	0.00028	0.014	0.00020	0.0000035	0.0000035	0.0010	0.0000066	0.14	0.000018	0.000058	0.00035
10-Feb-16	40	500	505	6.6	4.6	#N/A	1.3	1.5	1.0	0.00	0.030	0.00	0.49	0.0032	0.00025	0.013	0.000086	0.0000035	0.0000035	0.0010	0.0000015	0.14	0.000020	0.000049	0.00040
17-Feb-16	41	500	490	7.5	4.5	#N/A	1.2	1.6	1.00	0.00	0.030	0.00	0.54	0.0033	0.00027	0.014	0.00012	0.0000035	0.0000035	0.00100	0.0000020	0.15	0.000017	0.000049	0.00022
24-Feb-16	42	500	490	6.9	3.6	#N/A	1.2	1.6	0.98	0.00	0.029	0.00	0.59	0.0035	0.00029	0.014	0.00015	0.0000034	0.0000034	0.00098	0.0000025	0.16	0.000015	0.000050	0.000029

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC5 (OKY Master)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
6-May-15	0	500	290	7.5	0.042	0.00041	0.0086	1.9	0.27	0.040	0.0012	0.00060	0.022	9.5	< 0.001	11	0.000046	28	0.034	20	0.000085	0.000080	0.0018	0.00074	0.00021	0.019	< 0.002
13-May-15	1	500	485	7.6	0.26	0.0023	0.0032	0.26	0.082	0.020	0.0044	0.00020	0.036	4.2	< 0.001	11	0.000011	11	0.0048	2.7	0.000037	0.000070	0.0068	0.0010	0.00039	0.0040	< 0.002
20-May-15	2	500	495	7.4	0.098	0.0012	0.0016	0.082	0.031	0.010	0.0066	< 0.0001	0.044	2.3	0.000050	9.4	0.0000030	5.1	0.0015	1.6	0.000016	0.00011	0.0024	0.00086	0.00028	0.0010	< 0.002
27-May-15	3	500	435	7.3	0.11	0.00062	0.0014	0.083	0.030	< 0.01	0.0058	< 0.0001	0.038	2.1	< 0.001	11	0.0000040	4.8	0.0015	0.90	0.000010	0.00013	0.0037	0.00038	0.00032	0.0020	< 0.002
3-Jun-15	4	500	520	7.4	0.17	0.0012	0.0012	0.067	0.026	< 0.01	0.0060	< 0.0001	0.046	2.0	< 0.00004	8.7	0.000011	3.7	0.0015	1.1	0.000012	< 0.00001	0.0060	0.00053	0.00038	0.0010	< 0.002
10-Jun-15	5	500	495	7.3	0.026	0.00044	0.0010	0.052	0.024	< 0.01	0.0050	< 0.0001	0.038	1.9	0.000060	7.2	< 0.000002	3.1	0.00087	0.90	0.0000070	0.000080	0.00071	0.00030	0.00022	0.0020	< 0.002
17-Jun-15	6	500	490	7.4	0.15	0.0011	0.0010	0.057	0.026	< 0.01	0.0048	< 0.0001	0.048	1.8	0.000050	7.4	0.0000030	2.5	0.0011	1.0	0.000017	0.000040	0.0048	0.00073	0.00031	0.0020	< 0.002
24-Jun-15	7	500	490	7.2	0.095	0.00066	0.00098	0.062	0.027	< 0.01	0.0033	< 0.0001	0.037	1.9	< 0.00004	6.9	0.0000030	2.4	0.0012	0.80	0.000011	0.000060	0.0031	0.00033	0.00027	0.0010	< 0.002
1-Jul-15	8	500	480	7.6	0.11	0.00072	0.00091	0.057	0.025	0.020	0.0030	< 0.0001	0.032	1.7	< 0.00004	6.7	0.0000050	1.9	0.0012	0.60	0.000011	0.00013	0.0026	0.00045	0.00028	0.0020	< 0.002
8-Jul-15	9	500	495	7.5	0.025	0.00029	0.00080	0.051	0.024	< 0.01	0.0024	< 0.0001	0.026	1.6	0.000060	7.0	0.0000040	1.6	0.00098	1.2	0.000013	0.000040	0.00054	0.00019	0.00016	< 0.001	< 0.002
15-Jul-15	10	500	490	7.2	0.035	0.00023	0.00089	0.051	0.023	< 0.01	0.0029	< 0.0001	0.023	1.4	< 0.00004	5.7	< 0.000002	1.5	0.00091	0.20	0.0000090	0.00014	0.00075	0.00086	0.00021	0.0010	< 0.002
22-Jul-15	11	500	495	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	12	500	495	7.3	0.011	0.000080	0.00078	0.047	0.023	< 0.01	0.0017	< 0.0001	0.024	1.5	< 0.00004	4.9	0.000015	1.0	0.00087	0.50	< 0.000005	0.000050	0.00017	0.0022	0.00017	0.0010	< 0.002
5-Aug-15	13	500	490	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	14	500	495	6.8	0.033	0.00021	0.00070	0.060	0.028	< 0.01	0.0023	< 0.0001	0.022	1.7	< 0.00004	4.9	< 0.000002	0.87	0.0011	0.50	0.000017	0.000040	0.0015	0.0012	0.00018	0.0010	< 0.002
19-Aug-15	15	500	475	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	16	500	515	7.4	0.023	0.00023	0.00075	0.068	0.034	< 0.01	0.0013	< 0.0001	0.016	1.7	< 0.00004	4.4	< 0.000002	0.61	0.0012	0.70	0.0000090	< 0.00001	0.00036	0.00038	0.00014	< 0.001	< 0.002
2-Sep-15	17	500	490	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	18	500	500	7.0	0.011	0.000080	0.00068	0.067	0.032	< 0.01	0.0029	< 0.0001	0.013	1.6	< 0.00004	3.5	0.0000020	0.60	0.0010	3.3	0.000013	0.00016	0.00035	0.0012	0.00016	< 0.001	< 0.002
16-Sep-15	19	500	495	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	20	500	500	7.1	0.0080	0.000040	0.00056	0.064	0.032	< 0.01	0.00070	< 0.0001	0.0050	1.4	< 0.00004	2.8	0.000013	0.38	0.0010	0.50	0.0000070	< 0.00001	0.00025	0.00055	0.000090	< 0.001	< 0.002
30-Sep-15	21	500	490	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	22	500	495	7.4	0.013	0.00010	0.00061	0.10	0.047	< 0.01	0.0024	< 0.0001	0.0090	1.5	< 0.00004	3.4	< 0.000002	0.46	0.0016	0.40	0.0000060	0.000080	0.00033	0.0029	0.00010	< 0.001	< 0.002
14-Oct-15	23	500	500	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	24	500	505	7.3	0.012	0.000090	0.00055	0.080	0.040	< 0.01	0.0036	< 0.0001	0.0090	1.4	0.000040	3.1	0.000019	0.35	0.0015	0.40	0.000010	0.000060	0.00046	0.00045	0.00010	< 0.001	< 0.002
28-Oct-15	25	500	490	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	26	500	475	7.3	0.018	0.00011	0.00048	0.083	0.042	< 0.01	0.013	< 0.0001	0.0040	1.4	< 0.00004	2.9	< 0.000002	0.31	0.0014	0.30	0.0000050	0.000050	0.00061	0.00018	0.00014	0.0010	< 0.002
11-Nov-15	27	500	500	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	28	500	500	7.2	0.033	0.000030	0.00044	0.084	0.042	< 0.01	0.0013	< 0.0001	< 0.003	1.2	0.00013	2.8	< 0.000002	0.30	0.0016	0.20	0.0000080	0.000080	0.00049	0.00032	0.000080	0.0020	< 0.002
25-Nov-15	29	500	490	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	30	500	490	6.8	0.047	0.00019	0.00047	0.097	0.049	< 0.01	0.00065	< 0.0001	0.0050	1.5	< 0.00004	3.2	< 0.000002	0.30	0.0016	0.70	< 0.000005	< 0.00001	0.00079	0.00033	0.00013	< 0.001	< 0.002
9-Dec-15	31	500	490	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	32	500	495	7.3	0.023	0.00024	0.00053	0.12	0.046	< 0.01	0.00054	0.00010	0.010	1.3	0.00012	2.8	0.000019	0.26	0.0022	0.50	0.0000016	0.00012	0.00034	0.00046	0.00012	0.0090	< 0.002
23-Dec-15	33	500	490	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	34	500	505	6.7	0.020	0.00016	0.00052	0.087	0.047	< 0.01	0.00037	< 0.0001	0.0040	1.3	< 0.00004	2.3	< 0.000002	0.25	0.0016	0.80	< 0.000005	0.00039	0.00032	0.00060	0.0000090	0.0020	< 0.002
6-Jan-16	35	500	485	6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	36	500	490	6.4	0.0090	0.00011	0.00037	0.088	0.049	< 0.01	0.00036	< 0.0001	< 0.003	0.95	0.00011	2.0	0.0000020	0.15	0.0015	< 0.1	< 0.000005	0.000040	0.00058	0.00029	0.0000040	< 0.001	< 0.002
20-Jan-16	37	500	485	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	38	500	505	7.2	< 0.007	0.000050	0.00038	0.077	0.044	< 0.01	0.00024	0.00010	< 0.003	0.89	< 0.00004	2.1	< 0.000002	0.24	0.0015	< 0.1	< 0.000005	0.000070	0.00013	0.00021	0.00010	0.010	< 0.002
3-Feb-16	39	500	480	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	40	500	505	6.6	< 0.007	0.000040	0.00032	0.074	0.045	< 0.01	0.00022	< 0.0001	< 0.003	0.78	0.000050	1.5	< 0.000002	0.17	0.0013	0.60	0.0000050	0.000040	0.000070	0.00032	0.0000030	0.0010	< 0.002
17-Feb-16	41	500	490	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	42	500	490	6.9	< 0.007	0.000020	0.00034	0.087	0.051	0.030	0.00027	0.00020	< 0.003	0.92	< 0.00004	1.8	< 0.000002	0.13	0.0015	0.50	< 0.000005	< 0.00001	< 0.00005	0.00027	0.0000040	0.0020	< 0.002
2-Mar-16	43	500	495	6.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	44	500	495	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC5 (OKY Master)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
6-May-15	0	500	290	7.5	0.012	0.00012	0.0025	0.55	0.077	0.012	0.00036	0.00017	0.0064	2.7	0.00029	3.1	0.000013	8.1	0.0097	5.8	0.000025	0.000023	0.00052	0.00021	0.000061	0.0055	0.00058
13-May-15	1	500	485	7.6	0.12	0.0011	0.0015	0.12	0.040	0.0097	0.0021	0.000097	0.017	2.0	0.00049	5.4	0.0000053	5.2	0.0023	1.3	0.000018	0.000034	0.0033	0.00049	0.00019	0.0019	0.00097
20-May-15	2	500	495	7.4	0.049	0.00058	0.00080	0.041	0.015	0.0050	0.0033	0.000050	0.022	1.1	0.000025	4.6	0.0000015	2.5	0.00076	0.79	0.0000079	0.000054	0.0012	0.00042	0.00014	0.00050	0.00099
27-May-15	3	500	435	7.3	0.046	0.00027	0.00061	0.036	0.013	0.0044	0.0025	0.000044	0.017	0.91	0.00044	4.6	0.0000017	2.1	0.00065	0.39	0.0000044	0.000057	0.0016	0.00017	0.00014	0.00087	0.00087
3-Jun-15	4	500	520	7.4	0.088	0.00060	0.00063	0.035	0.014	0.0052	0.0031	0.000052	0.024	1.1	0.000021	4.5	0.0000057	1.9	0.00077	0.57	0.0000062	0.0000052	0.0031	0.00027	0.00020	0.00052	0.0010
10-Jun-15	5	500	495	7.3	0.013	0.00022	0.00051	0.026	0.012	0.0050	0.0025	0.000050	0.019	0.94	0.000030	3.6	0.00000099	1.5	0.00043	0.45	0.0000035	0.000040	0.00035	0.00015	0.00011	0.00099	0.00099
17-Jun-15	6	500	490	7.4	0.073	0.00054	0.00049	0.028	0.013	0.0049	0.0024	0.000049	0.024	0.90	0.000025	3.6	0.0000015	1.2	0.00055	0.49	0.0000083	0.000020	0.0024	0.00036	0.00015	0.00098	0.00098
24-Jun-15	7	500	490	7.2	0.047	0.00032	0.00048	0.030	0.013	0.0049	0.0016	0.000049	0.018	0.91	0.000020	3.4	0.0000015	1.2	0.00057	0.39	0.0000054	0.000029	0.0015	0.00016	0.00013	0.00049	0.00098
1-Jul-15	8	500	480	7.6	0.052	0.00035	0.00044	0.027	0.012	0.0096	0.0014	0.000048	0.015	0.80	0.000019	3.2	0.0000024	0.91	0.00056	0.29	0.0000053	0.000062	0.0013	0.00022	0.00013	0.00096	0.00096
8-Jul-15	9	500	495	7.5	0.012	0.00014	0.00040	0.025	0.012	0.0050	0.0012	0.000050	0.013	0.81	0.000030	3.4	0.0000020	0.80	0.00049	0.59	0.0000064	0.000020	0.00027	0.000095	0.000079	0.00050	0.00099
15-Jul-15	10	500	490	7.2	0.017	0.00011	0.00044	0.025	0.011	0.0049	0.0014	0.000049	0.011	0.70	0.000020	2.8	0.00000098	0.74	0.00045	0.098	0.0000044	0.000069	0.00037	0.00042	0.00010	0.00049	0.00098
22-Jul-15	11	500	495	7.0	0.011	0.000076	0.00041	0.024	0.011	0.0049	0.0011	0.000049	0.012	0.71	0.000020	2.6	0.0000042	0.63	0.00044	0.17	0.0000034	0.000047	0.00023	0.00076	0.000094	0.00049	0.00099
29-Jul-15	12	500	495	7.3	0.0054	0.000040	0.00039	0.023	0.011	0.0050	0.00083	0.000050	0.012	0.73	0.000020	2.4	0.0000074	0.51	0.00043	0.25	0.0000025	0.000025	0.000084	0.0011	0.00084	0.00050	0.00099
5-Aug-15	13	500	490	6.9	0.011	0.000072	0.00037	0.026	0.012	0.0050	0.00098	0.000050	0.011	0.79	0.000020	2.4	0.0000042	0.47	0.00048	0.25	0.0000054	0.000022	0.00041	0.00085	0.000087	0.00050	0.00099
12-Aug-15	14	500	495	6.8	0.016	0.00010	0.00035	0.030	0.014	0.0050	0.0011	0.000050	0.011	0.85	0.000020	2.4	0.00000099	0.43	0.00052	0.25	0.0000084	0.000020	0.00074	0.00060	0.000089	0.00050	0.00099
19-Aug-15	15	500	475	7.0	0.014	0.00011	0.00037	0.032	0.016	0.0051	0.00090	0.000051	0.0096	0.85	0.000020	2.4	0.0000010	0.37	0.00056	0.30	0.0000065	0.000012	0.00046	0.00040	0.000081	0.00051	0.0010
26-Aug-15	16	500	515	7.4	0.012	0.00012	0.00039	0.035	0.018	0.0052	0.00066	0.000052	0.0082	0.85	0.000021	2.3	0.0000010	0.31	0.00060	0.36	0.0000046	0.0000052	0.00019	0.00020	0.000072	0.00052	0.0010
2-Sep-15	17	500	490	7.0	0.0087	0.000079	0.00036	0.034	0.017	0.0051	0.0010	0.000051	0.0074	0.82	0.000020	2.0	0.0000010	0.31	0.00056	1.0	0.0000056	0.000043	0.00018	0.00040	0.000076	0.00051	0.0010
9-Sep-15	18	500	500	7.0	0.0055	0.000040	0.00034	0.034	0.016	0.0050	0.0014	0.000050	0.0065	0.79	0.000020	1.8	0.0000010	0.30	0.00052	1.7	0.0000065	0.000080	0.00018	0.00060	0.000080	0.00050	0.0010
16-Sep-15	19	500	495	6.9	0.0048	0.000030	0.00031	0.033	0.016	0.0050	0.00089	0.000050	0.0045	0.74	0.000020	1.6	0.0000038	0.25	0.00052	0.95	0.0000050	0.000043	0.00015	0.00044	0.000063	0.00050	0.0010
23-Sep-15	20	500	500	7.1	0.0040	0.000020	0.00028	0.032	0.016	0.0050	0.00035	0.000050	0.0025	0.70	0.000020	1.4	0.0000065	0.19	0.00051	0.25	0.0000035	0.0000050	0.00013	0.00027	0.000045	0.00050	0.0010
30-Sep-15	21	500	490	6.9	0.0052	0.000035	0.00029	0.041	0.019	0.0050	0.00077	0.000050	0.0035	0.73	0.000020	1.6	0.0000037	0.21	0.00066	0.22	0.0000032	0.000022	0.00014	0.00086	0.000047	0.00050	0.00100
7-Oct-15	22	500	495	7.4	0.0064	0.000050	0.00030	0.050	0.023	0.0050	0.0012	0.000050	0.0045	0.76	0.000020	1.7	0.00000099	0.23	0.00081	0.20	0.0000030	0.000040	0.00016	0.0014	0.000050	0.00050	0.00099
14-Oct-15	23	500	500	7.1	0.0062	0.000047	0.00029	0.045	0.022	0.0050	0.0015	0.000050	0.0044	0.73	0.000020	1.6	0.0000053	0.20	0.00079	0.20	0.0000040	0.000035	0.00020	0.00083	0.000050	0.00050	0.0010
21-Oct-15	24	500	505	7.3	0.0061	0.000045	0.00028	0.040	0.020	0.0051	0.0018	0.000051	0.0044	0.71	0.000020	1.6	0.0000096	0.18	0.00078	0.20	0.0000051	0.000030	0.00023	0.00023	0.000051	0.00051	0.0010
28-Oct-15	25	500	490	7.3	0.0073	0.000049	0.00025	0.040	0.020	0.0049	0.0039	0.000049	0.0031	0.68	0.000020	1.5	0.0000053	0.16	0.00072	0.17	0.0000037	0.000027	0.00026	0.00016	0.000059	0.00049	0.00098
4-Nov-15	26	500	475	7.3	0.0086	0.000052	0.00023	0.039	0.020	0.0048	0.0061	0.000048	0.0019	0.65	0.000019	1.4	0.00000095	0.15	0.00066	0.14	0.0000024	0.000024	0.00029	0.000084	0.000067	0.00048	0.00095
11-Nov-15	27	500	500	7.3	0.013	0.000034	0.00022	0.041	0.020	0.0049	0.0034	0.000049	0.0017	0.63	0.000042	1.4	0.00000098	0.15	0.00073	0.12	0.0000032	0.000032	0.00027	0.00012	0.000053	0.00074	0.00098
18-Nov-15	28	500	500	7.2	0.017	0.000015	0.00022	0.042	0.021	0.0050	0.00066	0.000050	0.0015	0.61	0.000065	1.4	0.0000010	0.15	0.00081	0.10	0.0000040	0.000040	0.00025	0.00016	0.000040	0.0010	0.0010
25-Nov-15	29	500	490	7.1	0.020	0.000054	0.00023	0.045	0.023	0.0050	0.00049	0.000050	0.0020	0.66	0.000042	1.5	0.00000099	0.15	0.00079	0.22	0.0000032	0.000022	0.00032	0.00016	0.000052	0.00075	0.00099
2-Dec-15	30	500	490	6.8	0.023	0.000093	0.00023	0.048	0.024	0.0049	0.00032	0.000049	0.0025	0.71	0.000020	1.5	0.00000098	0.15	0.00077	0.34	0.0000025	0.0000049	0.00039	0.00016	0.000064	0.00049	0.00098
9-Dec-15	31	500	490	7.3	0.017	0.00011	0.00025	0.052	0.023	0.0049	0.00029	0.000049	0.0037	0.69	0.000040	1.5	0.0000052	0.14	0.00094	0.30	0.0000052	0.000032	0.00028	0.00020	0.000062	0.0025	0.00099
16-Dec-15	32	500	495	7.3	0.011	0.00012	0.00026	0.057	0.023	0.0050	0.00027	0.000050	0.0050	0.66	0.000059	1.4	0.0000094	0.13	0.0011	0.25	0.0000079	0.000059	0.00017	0.00023	0.000059	0.0045	0.00099
23-Dec-15	33	500	490	7.9	0.011	0.000100	0.00026	0.051	0.023	0.0050	0.00023	0.000050	0.0035	0.65	0.000040	1.3	0.0000052	0.13	0.00095	0.33	0.0000052	0.00013	0.00016	0.00026	0.000052	0.0027	0.0010
30-Dec-15	34	500	505	6.7	0.010	0.000081	0.00026	0.044	0.024	0.0051	0.00019	0.000051	0.0020	0.63	0.000020	1.2	0.0000010	0.13	0.00078	0.40	0.0000025	0.00020	0.00016	0.00030	0.000045	0.0010	0.0010
6-Jan-16	35	500	485	6.6	0.0073	0.000067	0.00022	0.044	0.024	0.0050	0.00018	0.000050	0.0017	0.55	0.000037	1.1	0.00000100	0.100	0.00075	0.23	0.0000025	0.00011	0.00022	0.00022	0.000033	0.00075	0.00100
13-Jan-16	36	500	490	6.4	0.0044	0.000054	0.00018	0.043	0.024	0.0049	0.00018	0.000049	0.0015	0.47	0.000054	0.97	0.00000098	0.074	0.00072	0.049	0.0000025	0.000020	0.00028	0.00014	0.000020	0.00049	0.00098
20-Jan-16	37	500	485	7.3	0.0040	0.000040	0.00019	0.041	0.023	0.0050	0.00015	0.000050	0.0015	0.46	0.000037	1.0	0.00000100	0.097	0.00073	0.050	0.0000025	0.000027	0.00017	0.00012	0.000035	0.0028	0.00100
27-Jan-16	38	500	505	7.2	0.0035	0.000025	0.00019	0.039	0.022	0.0051	0.00012	0.000051	0.0015	0.45	0.000020	1.0	0.0000010	0.12	0.00073	0.051	0.0000025	0.000035	0.000066	0.00010	0.000051	0.0051	0.0010
3-Feb-16	39	500	480	7.2	0.0035	0.000023	0.00018	0.038	0.022	0.0051	0.00012	0.000051	0.0015	0.42	0.000023	0.90	0.0000010	0.10	0.00068	0.18	0.0000025	0.000028	0.000051	0.00013	0.000033	0.0028	0.0010
10-Feb-16	40	500	505	6.6	0.0035	0.000020	0.00016	0.037	0.023	0.0051	0.00011	0.000051	0.0015	0.39	0.000025	0.76	0.0000010	0.086	0.00063	0.30	0.0000025	0.000020	0.000035	0.00016	0.000015	0.00051	0.0010
17-Feb-16	41	500	490	7.5	0.0035	0.000015	0.00016	0.040	0.024	0.0099	0.00012	0.000074	0.0015	0.42	0.000022	0.82	0.00000100	0.075	0.00067	0.27	0.0000025	0.000013	0.000030	0.00015	0.000017	0.00074	0.00100
24-Feb-16	42	500	490	6.9	0.0034	0.0000098	0.00016	0.043	0.025	0.015	0.00013	0.000098	0.0015	0.45	0.000020	0.89	0.00000098	0.064	0.00072	0.25	0.0000025	0.0000049	0.000025	0.00013	0.000020	0.00098	0.00098

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC6 (OKY Master (Fresh))

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
6-May-15	0	500	320	7.9	385	#N/A	3.6	96	77	7.0	1.8	< 0.3	85	0.021	0.0056	0.061	0.015	0.0000080	< 0.000007	0.041	0.0000070	26	< 0.00003	0.0014	0.0020
13-May-15	1	500	495	7.6	146	#N/A	6.6	48	13	2.0	1.1	< 0.3	34	0.023	0.0049	0.064	0.0075	< 0.000007	< 0.000007	0.030	0.0000030	10	0.000050	0.00034	0.00080
20-May-15	2	500	490	7.5	95	#N/A	3.7	34	3.0	2.0	0.65	< 0.3	27	0.025	0.0034	0.082	0.0062	< 0.000007	< 0.000007	0.015	< 0.000003	8.4	< 0.00003	0.00014	0.00050
27-May-15	3	500	490	7.6	73	#N/A	2.6	29	3.0	1.0	0.37	< 0.3	23	0.12	0.0030	0.096	0.0062	< 0.000007	< 0.000007	0.012	< 0.000003	7.0	< 0.00003	0.00011	0.00025
3-Jun-15	4	500	490	7.4	65	#N/A	3.3	27	3.0	< 1	0.26	< 0.3	21	0.047	0.0024	0.091	0.0049	< 0.000007	< 0.000007	0.0085	< 0.000003	6.4	0.000030	0.000089	0.00021
10-Jun-15	5	500	495	7.4	59	#N/A	3.6	26	3.0	< 1	0.22	< 0.3	21	0.044	0.0020	0.087	0.0046	< 0.000007	< 0.000007	0.0080	< 0.000003	6.5	< 0.00003	0.000077	0.00017
17-Jun-15	6	500	490	7.3	52	#N/A	3.7	25	3.0	< 1	0.17	< 0.3	18	0.052	0.0020	0.092	0.0044	< 0.000007	< 0.000007	0.0090	< 0.000003	5.7	< 0.00003	0.000075	0.00016
24-Jun-15	7	500	485	7.5	52	#N/A	3.2	22	< 2	< 1	0.16	< 0.3	17	0.041	0.0018	0.083	0.0040	< 0.000007	< 0.000007	0.0060	< 0.000003	5.4	< 0.00003	0.000076	0.00015
1-Jul-15	8	500	485	7.3	43	#N/A	3.8	17	2.0	< 1	0.12	< 0.3	14	0.058	0.0015	0.079	0.0034	< 0.000007	< 0.000007	0.0024	0.0000030	4.2	< 0.00003	0.000065	0.00044
8-Jul-15	9	500	485	7.4	41	#N/A	2.5	17	2.0	< 1	< 0.06	< 0.3	15	0.055	0.0014	0.060	0.0034	< 0.000007	< 0.000007	0.0049	< 0.000003	4.6	< 0.00003	0.000065	0.00066
15-Jul-15	10	500	490	7.3	34	#N/A	3.6	16	< 2	< 1	0.10	< 0.3	12	0.072	0.0012	0.059	0.0030	< 0.000007	< 0.000007	0.0059	< 0.000003	3.8	< 0.00003	0.000059	0.00020
22-Jul-15	11	500	485	7.4	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	12	500	490	7.3	32	#N/A	2.0	14	< 2	< 1	0.090	< 0.3	12	0.068	0.0011	0.043	0.0026	< 0.000007	< 0.000007	0.0029	< 0.000003	3.6	< 0.00003	0.000049	0.00014
5-Aug-15	13	500	480	7.3	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	14	500	495	7.3	28	#N/A	1.7	12	< 2	< 1	0.080	< 0.3	11	0.067	0.00090	0.042	0.0026	< 0.000007	< 0.000007	0.0047	< 0.000003	3.3	< 0.00003	0.000051	0.00033
19-Aug-15	15	500	505	7.3	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	16	500	500	7.5	28	#N/A	1.5	13	< 2	< 1	0.070	< 0.3	10	0.052	0.00090	0.028	0.0025	< 0.000007	< 0.000007	0.0022	0.0000060	3.3	< 0.00003	0.000054	0.00013
2-Sep-15	17	500	490	7.3	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	18	500	485	7.3	28	#N/A	2.0	12	< 2	< 1	0.070	< 0.3	11	0.045	0.00080	0.023	0.0025	< 0.000007	< 0.000007	0.0020	< 0.000003	3.4	< 0.00003	0.000049	0.00025
16-Sep-15	19	500	495	7.3	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	20	500	490	7.3	26	#N/A	1.4	11	< 2		0.070		9.7	0.043	0.0010	0.025	0.0022	< 0.000007	< 0.000007	0.0019	< 0.000003	3.1	0.000050	0.000045	0.000090
30-Sep-15	21	500	495	7.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	22	500	495	7.4	23	#N/A	2.1	12	< 2		0.060		8.8	0.032	0.00070	0.014	0.0019	< 0.000007	< 0.000007	0.0015	< 0.000003	2.8	< 0.00003	0.000043	0.00036
14-Oct-15	23	500	505	7.4	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	24	500	505	7.3	20	#N/A	1.2	9.5	2.0		0.060		8.3	0.059	0.00070	0.016	0.0025	0.0000070	< 0.000007	0.0016	0.0000050	2.6	< 0.00003	0.000068	0.00042
28-Oct-15	25	500	510	7.4	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	26	500	485	7.4	26	#N/A	1.6	12	2.0		0.060		10	0.026	0.00080	0.016	0.0023	< 0.000007	< 0.000007	0.0023	< 0.000003	3.3	< 0.00003	0.000046	0.00033
11-Nov-15	27	500	485	7.3	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	28	500	505	7.3	19	#N/A	1.5	10	2.0		< 0.06		7.3	0.024	0.00070	0.013	0.0014	< 0.000007	< 0.000007	< 0.0002	< 0.000003	2.3	< 0.00003	0.000050	0.00061
25-Nov-15	29	500	485	7.3	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	30	500	485	7.2	23	#N/A	3.0	12	2.0		0.060		9.6	0.12	0.00090	0.017	0.0035	0.0000070	< 0.000007	0.00080	0.0000030	3.0	< 0.00003	0.000071	0.00025
9-Dec-15	31	500	485	7.2	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	32	500	495	7.1	17	#N/A	2.6	9.0	2.0		< 0.06		8.1	0.017	0.00060	0.014	0.0031	0.000010	< 0.000007	0.0016	0.000014	2.5	0.000070	0.000076	0.00023
23-Dec-15	33	500	490	7.5	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	34	500	490	7.1	18	#N/A	1.9	9.9	3.0		< 0.06		8.4	0.023	0.00050	0.012	0.0021	< 0.000007	< 0.000007	0.0010	0.0000040	2.6	< 0.00003	0.000061	0.00026
6-Jan-16	35	500	490	7.1	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	36	500	495	7.0	19	#N/A	2.2	9.9	2.0		< 0.06		7.8	0.011	0.00050	0.0067	0.0021	< 0.000007	< 0.000007	< 0.002	< 0.000003	2.5	< 0.00003	0.000043	0.00033
20-Jan-16	37	500	490	7.1	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	38	500	485	7.1	21	#N/A	3.1	10	2.0		< 0.06		8.6	0.019	0.00050	0.0096	0.0027	< 0.000007	< 0.000007	< 0.002	0.0000030	2.7	< 0.00003	0.000077	0.00045
3-Feb-16	39	500	485	7.0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	40	500	490	6.9	16	#N/A	2.5	9.3	2.0		< 0.06		6.6	0.032	0.00050	0.0079	0.0021	< 0.000007	< 0.000007	< 0.002	< 0.000003	2.1	< 0.00003	0.000067	0.00015
17-Feb-16	41	500	495	7.2	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	42	500	490	7.0	16	#N/A	2.7	8.3	2.0		< 0.06		6.7	0.016	0.00060	0.011	0.0019	< 0.000007	< 0.000007	< 0.002	0.000011	2.1	< 0.00003	0.000066	0.000040
2-Mar-16	43	500	485	7.0	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	44	500	490	7.1	16	#N/A	3.1	8.8	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC6 (OKY Master (Fresh))

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
6-May-15	0	500	320	7.9	385	#N/A	1.2	31	25	2.2	0.59	0.096	27	0.0068	0.0018	0.020	0.0049	0.0000026	0.0000022	0.013	0.0000022	8.3	0.0000096	0.00044	0.00063
13-May-15	1	500	495	7.6	146	#N/A	3.3	24	6.4	0.99	0.56	0.15	17	0.012	0.0024	0.032	0.0037	0.0000035	0.0000035	0.015	0.0000015	5.1	0.000025	0.00017	0.00040
20-May-15	2	500	490	7.5	95	#N/A	1.8	17	1.5	0.98	0.32	0.15	13	0.012	0.0017	0.040	0.0030	0.0000034	0.0000034	0.0071	0.0000015	4.1	0.000015	0.000071	0.00025
27-May-15	3	500	490	7.6	73	#N/A	1.3	14	1.5	0.49	0.18	0.15	11	0.056	0.0015	0.047	0.0030	0.0000034	0.0000034	0.0059	0.0000015	3.4	0.000015	0.000052	0.00012
3-Jun-15	4	500	490	7.4	65	#N/A	1.6	13	1.5	0.49	0.13	0.15	10	0.023	0.0012	0.045	0.0024	0.0000034	0.0000034	0.0042	0.0000015	3.1	0.000015	0.000044	0.00010
10-Jun-15	5	500	495	7.4	59	#N/A	1.8	13	1.5	0.50	0.11	0.15	10	0.022	0.00099	0.043	0.0023	0.0000035	0.0000035	0.0040	0.0000015	3.2	0.000015	0.000038	0.000084
17-Jun-15	6	500	490	7.3	52	#N/A	1.8	12	1.5	0.49	0.083	0.15	8.9	0.025	0.00098	0.045	0.0022	0.0000034	0.0000034	0.0044	0.0000015	2.8	0.000015	0.000037	0.000078
24-Jun-15	7	500	485	7.5	52	#N/A	1.5	11	0.97	0.49	0.078	0.15	8.4	0.020	0.00087	0.040	0.0019	0.0000034	0.0000034	0.0029	0.0000015	2.6	0.000015	0.000037	0.000073
1-Jul-15	8	500	485	7.3	43	#N/A	1.8	8.2	0.97	0.49	0.058	0.15	6.7	0.028	0.00073	0.038	0.0016	0.0000034	0.0000034	0.0012	0.0000015	2.1	0.000015	0.000032	0.00021
8-Jul-15	9	500	485	7.4	41	#N/A	1.2	8.2	0.97	0.49	0.029	0.15	7.2	0.027	0.00068	0.029	0.0017	0.0000034	0.0000034	0.0024	0.0000015	2.2	0.000015	0.000032	0.00032
15-Jul-15	10	500	490	7.3	34	#N/A	1.8	7.8	0.98	0.49	0.049	0.15	6.0	0.035	0.00059	0.029	0.0015	0.0000034	0.0000034	0.0029	0.0000015	1.9	0.000015	0.000029	0.000098
22-Jul-15	11	500	485	7.4	36	#N/A	1.4	7.3	0.98	0.49	0.047	0.15	5.9	0.034	0.00056	0.025	0.0014	0.0000034	0.0000034	0.0022	0.0000015	1.8	0.000015	0.000026	0.000083
29-Jul-15	12	500	490	7.3	32	#N/A	0.98	6.9	0.98	0.49	0.044	0.15	5.7	0.033	0.00054	0.021	0.0013	0.0000034	0.0000034	0.0014	0.0000015	1.8	0.000015	0.000024	0.000069
5-Aug-15	13	500	480	7.3	31	#N/A	0.91	6.4	0.99	0.49	0.042	0.15	5.4	0.033	0.00049	0.021	0.0013	0.0000034	0.0000034	0.0019	0.0000015	1.7	0.000015	0.000025	0.00012
12-Aug-15	14	500	495	7.3	28	#N/A	0.83	6.0	0.99	0.50	0.040	0.15	5.2	0.033	0.00045	0.021	0.0013	0.0000035	0.0000035	0.0023	0.0000015	1.6	0.000015	0.000025	0.00016
19-Aug-15	15	500	505	7.3	29	#N/A	0.80	6.2	1.00	0.50	0.037	0.15	5.2	0.030	0.00045	0.017	0.0012	0.0000035	0.0000035	0.0017	0.0000022	1.6	0.000015	0.000026	0.00011
26-Aug-15	16	500	500	7.5	28	#N/A	0.76	6.4	1.0	0.50	0.035	0.15	5.2	0.026	0.00045	0.014	0.0012	0.0000035	0.0000035	0.0011	0.0000030	1.7	0.000015	0.000027	0.000065
2-Sep-15	17	500	490	7.3	32	#N/A	0.86	6.2	0.99	0.49	0.034	0.15	5.2	0.024	0.00042	0.013	0.0012	0.0000034	0.0000034	0.0010	0.0000022	1.7	0.000015	0.000025	0.000093
9-Sep-15	18	500	485	7.3	28	#N/A	0.95	6.0	0.97	0.49	0.034	0.15	5.2	0.022	0.00039	0.011	0.0012	0.0000034	0.0000034	0.00097	0.0000015	1.6	0.000015	0.000024	0.00012
16-Sep-15	19	500	495	7.3	27	#N/A	0.82	5.7	0.98	0.24	0.034	0.073	5.0	0.022	0.00044	0.012	0.0012	0.0000034	0.0000034	0.00095	0.0000015	1.6	0.000020	0.000023	0.000083
23-Sep-15	20	500	490	7.3	26	#N/A	0.68	5.3	0.98	0.00	0.034	0.00	4.8	0.021	0.00049	0.012	0.0011	0.0000034	0.0000034	0.00093	0.0000015	1.5	0.000025	0.000022	0.000044
30-Sep-15	21	500	495	7.2	24	#N/A	0.87	5.6	0.99	0.00	0.032	0.00	4.6	0.019	0.00042	0.0097	0.0010	0.0000034	0.0000034	0.00084	0.0000015	1.4	0.000020	0.000022	0.00011
7-Oct-15	22	500	495	7.4	23	#N/A	1.1	5.9	0.99	0.00	0.030	0.00	4.4	0.016	0.00035	0.0071	0.00093	0.0000035	0.0000035	0.00074	0.0000015	1.4	0.000015	0.000021	0.00018
14-Oct-15	23	500	505	7.4	24	#N/A	0.83	5.4	1.0	0.00	0.030	0.00	4.3	0.023	0.00035	0.0075	0.0011	0.0000035	0.0000035	0.00078	0.0000020	1.3	0.000015	0.000028	0.00020
21-Oct-15	24	500	505	7.3	20	#N/A	0.60	4.8	1.0	0.00	0.030	0.00	4.2	0.030	0.00035	0.0079	0.0012	0.0000035	0.0000035	0.00081	0.0000025	1.3	0.000015	0.000034	0.00021
28-Oct-15	25	500	510	7.4	22	#N/A	0.69	5.4	0.99	0.00	0.030	0.00	4.6	0.021	0.00037	0.0077	0.0012	0.0000035	0.0000035	0.00096	0.0000020	1.5	0.000015	0.000028	0.00019
4-Nov-15	26	500	485	7.4	26	#N/A	0.79	5.9	0.97	0.00	0.029	0.00	5.0	0.013	0.00039	0.0076	0.0011	0.0000034	0.0000034	0.0011	0.0000015	1.6	0.000015	0.000022	0.00016
11-Nov-15	27	500	485	7.3	23	#N/A	0.77	5.6	0.99	0.00	0.030	0.00	4.4	0.012	0.00037	0.0070	0.00092	0.0000035	0.0000035	0.00061	0.0000015	1.4	0.000015	0.000024	0.00023
18-Nov-15	28	500	505	7.3	19	#N/A	0.76	5.2	1.0	0.00	0.030	0.00	3.7	0.012	0.00035	0.0064	0.00072	0.0000035	0.0000035	0.00010	0.0000015	1.2	0.000015	0.000025	0.00031
25-Nov-15	29	500	485	7.3	27	#N/A	1.1	5.5	0.99	0.00	0.030	0.00	4.2	0.036	0.00040	0.0074	0.0012	0.0000035	0.0000035	0.00024	0.0000015	1.3	0.000015	0.000030	0.00021
2-Dec-15	30	500	485	7.2	23	#N/A	1.4	5.8	0.97	0.00	0.029	0.00	4.7	0.060	0.00044	0.0084	0.0017	0.0000034	0.0000034	0.00039	0.0000015	1.5	0.000015	0.000034	0.00012
9-Dec-15	31	500	485	7.2	20	#N/A	1.4	5.1	0.98	0.00	0.029	0.00	4.3	0.034	0.00037	0.0076	0.0016	0.0000042	0.0000034	0.00059	0.0000042	1.4	0.000025	0.000036	0.00012
16-Dec-15	32	500	495	7.1	17	#N/A	1.3	4.5	0.99	0.00	0.030	0.00	4.0	0.0086	0.00030	0.0067	0.0015	0.0000050	0.0000035	0.00079	0.0000069	1.3	0.000035	0.000038	0.00011
23-Dec-15	33	500	490	7.5	19	#N/A	1.1	4.6	1.2	0.00	0.030	0.00	4.1	0.0099	0.00027	0.0064	0.0013	0.0000042	0.0000034	0.00064	0.0000044	1.3	0.000025	0.000034	0.00012
30-Dec-15	34	500	490	7.1	18	#N/A	0.92	4.8	1.5	0.00	0.029	0.00	4.1	0.011	0.00025	0.0061	0.0010	0.0000034	0.0000034	0.00049	0.0000020	1.3	0.000015	0.000030	0.00013
6-Jan-16	35	500	490	7.1	21	#N/A	1.00	4.9	1.2	0.00	0.030	0.00	4.0	0.0083	0.00025	0.0047	0.0010	0.0000034	0.0000034	0.00074	0.0000017	1.3	0.000015	0.000026	0.00015
13-Jan-16	36	500	495	7.0	19	#N/A	1.1	4.9	0.99	0.00	0.030	0.00	3.9	0.0054	0.00025	0.0033	0.0010	0.0000035	0.0000035	0.00099	0.0000015	1.2	0.000015	0.000021	0.00016
20-Jan-16	37	500	490	7.1	17	#N/A	1.3	4.9	0.98	0.00	0.029	0.00	4.0	0.0074	0.00025	0.0040	0.0012	0.0000034	0.0000034	0.00098	0.0000015	1.3	0.000015	0.000029	0.00019
27-Jan-16	38	500	485	7.1	21	#N/A	1.5	5.0	0.97	0.00	0.029	0.00	4.2	0.0094	0.00024	0.0047	0.0013	0.0000034	0.0000034	0.00097	0.0000015	1.3	0.000015	0.000037	0.00022
3-Feb-16	39	500	485	7.0	17	#N/A	1.4	4.8	0.98	0.00	0.029	0.00	3.7	0.012	0.00024	0.0043	0.0012	0.0000034	0.0000034	0.00098	0.0000015	1.2	0.000015	0.000035	0.00015
10-Feb-16	40	500	490	6.9	16	#N/A	1.2	4.6	0.98	0.00	0.029	0.00	3.2	0.016	0.00025	0.0039	0.0010	0.0000034	0.0000034	0.00098	0.0000015	1.0	0.000015	0.000033	0.000074
17-Feb-16	41	500	495	7.2	16	#N/A	1.3	4.3	0.98	0.00	0.029	0.00	3.3	0.012	0.00027	0.0045	0.00097	0.0000034	0.0000034	0.00098	0.0000034	1.0	0.000015	0.000033	0.000047
24-Feb-16	42	500	490	7.0	16	#N/A	1.3	4.1	0.98	0.00	0.029	0.00	3.3	0.0080	0.00029	0.0051	0.00092	0.0000034	0.0000034	0.00098	0.0000054	1.0	0.000015	0.000032	0.000020

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC6 (OKY Master (Fresh))

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
6-May-15	0	500	320	7.9	< 0.007	0.000030	0.026	4.9	0.24	0.020	0.014	0.00050	0.028	16	< 0.001	5.3	0.000033	35	0.065	26	0.000070	0.000080	0.000090	0.026	0.00059	0.0040	< 0.002
13-May-15	1	500	495	7.6	0.011	0.000030	0.011	2.1	0.11	0.010	0.011	0.00030	0.022	8.9	< 0.001	4.6	0.000017	11	0.027	4.9	0.000033	0.000090	0.00034	0.0080	0.00066	0.0010	< 0.002
20-May-15	2	500	490	7.5	0.0070	0.000020	0.0063	1.4	0.074	< 0.01	0.0060	< 0.0001	0.025	6.3	< 0.00004	5.1	0.0000090	3.9	0.020	2.9	0.000022	0.000090	0.00044	0.0020	0.00087	< 0.001	< 0.002
27-May-15	3	500	490	7.6	0.043	0.00011	0.0042	1.3	0.067	0.010	0.0035	< 0.0001	0.030	4.7	< 0.001	5.1	0.0000050	2.4	0.017	1.6	0.000016	0.000080	0.0017	0.0019	0.0010	< 0.001	< 0.002
3-Jun-15	4	500	490	7.4	0.021	0.000070	0.0034	1.2	0.062	< 0.01	0.0024	< 0.0001	0.032	4.6	< 0.00004	4.3	0.0000030	1.7	0.016	1.8	0.000012	< 0.00001	0.00072	0.0022	0.0011	< 0.001	< 0.002
10-Jun-15	5	500	495	7.4	0.021	0.000070	0.0028	1.1	0.061	< 0.01	0.0019	< 0.0001	0.028	4.2	< 0.00004	4.0	< 0.000002	1.3	0.015	1.5	0.000013	0.000020	0.00072	0.0022	0.0011	< 0.001	< 0.002
17-Jun-15	6	500	490	7.3	0.020	0.000070	0.0024	0.95	0.056	< 0.01	0.0016	< 0.0001	0.028	3.4	0.000040	3.9	0.0000020	0.97	0.014	1.6	0.000018	0.000050	0.00078	0.0022	0.0011	< 0.001	< 0.002
24-Jun-15	7	500	485	7.5	0.018	0.000080	0.0022	0.94	0.059	< 0.01	0.0012	< 0.0001	0.026	3.0	< 0.00004	3.7	< 0.000002	0.89	0.013	1.1	0.000014	0.000050	0.00032	0.0020	0.0010	< 0.001	< 0.002
1-Jul-15	8	500	485	7.3	0.018	0.000050	0.0019	0.79	0.053	0.020	0.00093	< 0.0001	0.025	2.4	< 0.00004	3.3	0.0000020	0.73	0.012	1.0	0.000010	0.00015	0.00048	0.0017	0.0010	< 0.001	< 0.002
8-Jul-15	9	500	485	7.4	0.020	0.000090	0.0018	0.82	0.054	< 0.01	0.00085	< 0.0001	0.017	2.4	< 0.00004	3.7	< 0.000002	0.63	0.011	1.6	0.000012	0.00023	0.00046	0.0016	0.00098	< 0.001	< 0.002
15-Jul-15	10	500	490	7.3	0.022	0.000080	0.0016	0.69	0.051	< 0.01	0.00089	< 0.0001	0.013	1.9	< 0.00004	3.2	< 0.000002	0.62	0.0096	0.70	0.000013	0.000070	0.00085	0.0016	0.0010	< 0.001	< 0.002
22-Jul-15	11	500	485	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	12	500	490	7.3	0.019	0.000080	0.0014	0.61	0.048	< 0.01	0.00061	< 0.0001	0.0090	1.7	< 0.00004	2.7	0.0000050	0.46	0.0091	0.70	< 0.000005	0.000020	0.00067	0.0013	0.00078	< 0.001	< 0.002
5-Aug-15	13	500	480	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	14	500	495	7.3	0.015	0.000090	0.0011	0.56	0.044	< 0.01	0.00071	< 0.0001	0.012	1.6	< 0.00004	2.9	< 0.000002	0.42	0.0081	0.50	0.000013	0.000080	0.00057	0.0010	0.00077	< 0.001	< 0.002
19-Aug-15	15	500	505	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	16	500	500	7.5	0.011	0.00013	0.0011	0.52	0.053	< 0.01	0.00058	< 0.0001	0.012	1.3	< 0.00004	2.8	0.0000020	0.34	0.0079	0.70	0.000010	< 0.00001	0.00030	0.00092	0.00057	< 0.001	< 0.002
2-Sep-15	17	500	490	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	18	500	485	7.3	0.0080	0.000040	0.00098	0.56	0.058	< 0.01	0.00097	< 0.0001	0.0080	1.3	< 0.00004	2.4	0.0000030	0.40	0.0077	3.2	0.000011	0.00013	0.00026	0.00095	0.00047	< 0.001	< 0.002
16-Sep-15	19	500	495	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	20	500	490	7.3	0.010	< 0.00001	0.00089	0.49	0.057	< 0.01	0.00044	< 0.0001	0.0030	1.1	< 0.00004	2.8	0.000010	0.38	0.0072	0.70	0.0000060	< 0.00001	0.00035	0.00082	0.00044	< 0.001	< 0.002
30-Sep-15	21	500	495	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	22	500	495	7.4	0.0080	0.000050	0.00066	0.45	0.058	< 0.01	0.0011	< 0.0001	0.0030	0.84	< 0.00004	1.9	< 0.000002	0.31	0.0066	0.30	< 0.000005	0.00012	0.00030	0.0012	0.00031	< 0.001	< 0.002
14-Oct-15	23	500	505	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	24	500	505	7.3	0.029	0.00017	0.00072	0.44	0.063	< 0.01	0.0025	< 0.0001	0.0060	0.95	< 0.00004	2.3	0.000018	0.31	0.0061	0.50	0.000011	0.000070	0.00064	0.00081	0.00036	0.0020	< 0.002
28-Oct-15	25	500	510	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	26	500	485	7.4	0.0080	0.000040	0.00076	0.54	0.074	0.010	0.0035	< 0.0001	0.0080	1.1	< 0.00004	2.4	< 0.000002	0.33	0.0079	0.60	0.0000090	0.000080	0.00021	0.00084	0.00038	< 0.001	< 0.002
11-Nov-15	27	500	485	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	28	500	505	7.3	0.019	0.000020	0.00052	0.38	0.058	< 0.01	0.00090	< 0.0001	< 0.003	0.81	0.00010	2.1	< 0.000002	0.28	0.0056	0.30	0.0000070	0.000090	0.00022	0.00060	0.00028	0.0010	< 0.002
25-Nov-15	29	500	485	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	30	500	485	7.2	0.042	0.00018	0.00064	0.53	0.080	< 0.01	0.00051	< 0.0001	< 0.003	1.1	< 0.00004	3.0	< 0.000002	0.34	0.0073	0.90	< 0.000005	0.000030	0.0013	0.00079	0.00038	0.0020	< 0.002
9-Dec-15	31	500	485	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	32	500	495	7.1	< 0.007	0.00017	0.00057	0.43	0.076	< 0.01	0.00031	< 0.0001	< 0.003	0.87	< 0.00004	2.4	0.0000040	0.29	0.0067	0.60	0.000012	0.00013	0.0010	0.00089	0.00027	< 0.001	< 0.002
23-Dec-15	33	500	490	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	34	500	490	7.1	0.0070	0.000030	0.00058	0.44	0.078	0.010	0.00021	< 0.0001	< 0.003	0.83	< 0.00004	2.2	0.0000020	0.30	0.0067	0.70	< 0.000005	< 0.00001	0.00011	0.00072	0.00026	< 0.001	< 0.002
6-Jan-16	35	500	490	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	36	500	495	7.0	< 0.007	0.000020	0.00048	0.42	0.082	< 0.01	0.00025	< 0.0001	< 0.003	0.74	0.00011	1.8	0.0000020	0.22	0.0057	0.20	< 0.000005	0.000040	< 0.00005	0.00061	0.00014	< 0.001	< 0.002
20-Jan-16	37	500	490	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	38	500	485	7.1	< 0.007	0.000020	0.00051	0.45	0.088	< 0.01	0.00021	< 0.0001	< 0.003	0.80	< 0.00004	2.5	< 0.000002	0.25	0.0069	0.40	0.0000050	0.000040	0.000090	0.00081	0.00020	< 0.001	< 0.002
3-Feb-16	39	500	485	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	40	500	490	6.9	0.014	0.00012	0.00038	0.36	0.079	< 0.01	0.00019	< 0.0001	< 0.003	0.64	0.000050	1.7	< 0.000002	0.25	0.0052	0.90	0.0000060	0.000020	0.00045	0.00060	0.00015	0.0010	< 0.002
17-Feb-16	41	500	495	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	42	500	490	7.0	< 0.007	0.000020	0.00044	0.35	0.075	0.030	0.00020	0.00020	< 0.003	0.72	< 0.00004	2.1	< 0.000002	0.19	0.0052	0.60	0.0000050	0.000040	0.00010	0.00063	0.00019	0.0010	< 0.002
2-Mar-16	43	500	485	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	44	500	490	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC6 (OKY Master (Fresh))

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
6-May-15	0	500	320	7.9	0.0022	0.0000096	0.0082	1.6	0.077	0.0064	0.0045	0.00016	0.0090	5.0	0.00032	1.7	0.000011	11	0.021	8.3	0.000022	0.000026	0.000029	0.0082	0.00019	0.0013	0.00064
13-May-15	1	500	495	7.6	0.0054	0.000015	0.0054	1.0	0.053	0.0050	0.0056	0.00015	0.011	4.4	0.00050	2.3	0.0000084	5.2	0.014	2.4	0.000016	0.000045	0.00017	0.0039	0.00033	0.00050	0.00099
20-May-15	2	500	490	7.5	0.0034	0.0000098	0.0031	0.71	0.036	0.0049	0.0029	0.000049	0.012	3.1	0.000020	2.5	0.0000044	1.9	0.0096	1.4	0.000011	0.000044	0.00022	0.00099	0.00043	0.00049	0.00098
27-May-15	3	500	490	7.6	0.021	0.000054	0.0021	0.61	0.033	0.0049	0.0017	0.000049	0.015	2.3	0.00049	2.5	0.0000025	1.2	0.0082	0.78	0.0000078	0.000039	0.00082	0.00091	0.00050	0.00049	0.00098
3-Jun-15	4	500	490	7.4	0.010	0.000034	0.0017	0.56	0.030	0.0049	0.0012	0.000049	0.016	2.3	0.000020	2.1	0.0000015	0.81	0.0077	0.88	0.0000059	0.0000049	0.00035	0.0011	0.00054	0.00049	0.00098
10-Jun-15	5	500	495	7.4	0.010	0.000035	0.0014	0.54	0.030	0.0050	0.00094	0.000050	0.014	2.1	0.000020	2.0	0.00000099	0.62	0.0072	0.74	0.0000064	0.0000099	0.00036	0.0011	0.00053	0.00050	0.00099
17-Jun-15	6	500	490	7.3	0.0098	0.000034	0.0012	0.47	0.027	0.0049	0.00079	0.000049	0.014	1.7	0.000020	1.9	0.00000098	0.48	0.0067	0.78	0.0000088	0.000025	0.00038	0.0011	0.00053	0.00049	0.00098
24-Jun-15	7	500	485	7.5	0.0087	0.000039	0.0011	0.46	0.029	0.0049	0.00060	0.000049	0.013	1.4	0.000019	1.8	0.00000097	0.43	0.0065	0.53	0.0000068	0.000024	0.00016	0.00098	0.00050	0.00049	0.00097
1-Jul-15	8	500	485	7.3	0.0087	0.000024	0.00094	0.39	0.026	0.0097	0.00045	0.000049	0.012	1.2	0.000019	1.6	0.00000097	0.35	0.0056	0.49	0.0000049	0.000073	0.00023	0.00083	0.00050	0.00049	0.00097
8-Jul-15	9	500	485	7.4	0.0097	0.000044	0.00085	0.40	0.026	0.0049	0.00041	0.000049	0.0082	1.1	0.000019	1.8	0.00000097	0.31	0.0055	0.78	0.0000058	0.00011	0.00022	0.00077	0.00048	0.00049	0.00097
15-Jul-15	10	500	490	7.3	0.011	0.000039	0.00077	0.34	0.025	0.0049	0.00044	0.000049	0.0064	0.91	0.000020	1.5	0.00000098	0.30	0.0047	0.34	0.0000064	0.000034	0.00042	0.00076	0.00050	0.00049	0.00098
22-Jul-15	11	500	485	7.4	0.010	0.000039	0.00074	0.32	0.024	0.0049	0.00037	0.000049	0.0054	0.86	0.000020	1.4	0.0000017	0.26	0.0046	0.34	0.0000044	0.000022	0.00037	0.00070	0.00044	0.00049	0.00098
29-Jul-15	12	500	490	7.3	0.0093	0.000039	0.00070	0.30	0.024	0.0049	0.00030	0.000049	0.0044	0.81	0.000020	1.3	0.0000025	0.23	0.0044	0.34	0.0000025	0.0000098	0.00033	0.00064	0.00038	0.00049	0.00098
5-Aug-15	13	500	480	7.3	0.0084	0.000042	0.00063	0.29	0.023	0.0049	0.00033	0.000049	0.0052	0.80	0.000020	1.4	0.0000017	0.22	0.0042	0.30	0.0000044	0.000025	0.00031	0.00058	0.00038	0.00049	0.00099
12-Aug-15	14	500	495	7.3	0.0074	0.000045	0.00055	0.28	0.022	0.0050	0.00035	0.000050	0.0059	0.79	0.000020	1.4	0.00000099	0.21	0.0040	0.25	0.0000064	0.000040	0.00028	0.00051	0.00038	0.00050	0.00099
19-Aug-15	15	500	505	7.3	0.0065	0.000055	0.00054	0.27	0.024	0.0050	0.00032	0.000050	0.0060	0.72	0.000020	1.4	0.00000100	0.19	0.0040	0.30	0.0000057	0.000022	0.00022	0.00048	0.00033	0.00050	0.00100
26-Aug-15	16	500	500	7.5	0.0055	0.000065	0.00053	0.26	0.027	0.0050	0.00029	0.000050	0.0060	0.65	0.000020	1.4	0.0000010	0.17	0.0040	0.35	0.0000050	0.0000050	0.00015	0.00046	0.00029	0.00050	0.0010
2-Sep-15	17	500	490	7.3	0.0047	0.000042	0.00050	0.27	0.027	0.0049	0.00038	0.000049	0.0049	0.64	0.000020	1.3	0.0000012	0.18	0.0038	0.95	0.0000052	0.000034	0.00014	0.00046	0.00026	0.00049	0.00099
9-Sep-15	18	500	485	7.3	0.0039	0.000019	0.00048	0.27	0.028	0.0049	0.00047	0.000049	0.0039	0.63	0.000019	1.2	0.0000015	0.19	0.0037	1.6	0.0000053	0.000063	0.00013	0.00046	0.00023	0.00049	0.00097
16-Sep-15	19	500	495	7.3	0.0044	0.000012	0.00046	0.26	0.028	0.0049	0.00034	0.000049	0.0027	0.59	0.000020	1.3	0.0000032	0.19	0.0036	0.95	0.0000041	0.000034	0.00015	0.00043	0.00022	0.00049	0.00098
23-Sep-15	20	500	490	7.3	0.0049	0.0000049	0.00043	0.24	0.028	0.0049	0.00022	0.000049	0.0015	0.55	0.000020	1.4	0.0000049	0.19	0.0035	0.34	0.0000029	0.0000049	0.00017	0.00040	0.00022	0.00049	0.00098
30-Sep-15	21	500	495	7.2	0.0044	0.000015	0.00038	0.23	0.028	0.0049	0.00039	0.000049	0.0015	0.48	0.000020	1.1	0.0000029	0.17	0.0034	0.25	0.0000027	0.000032	0.00016	0.00050	0.00018	0.00049	0.00099
7-Oct-15	22	500	495	7.4	0.0040	0.000025	0.00033	0.22	0.029	0.0050	0.00056	0.000050	0.0015	0.42	0.000020	0.94	0.00000099	0.15	0.0033	0.15	0.0000025	0.000059	0.00015	0.00061	0.00015	0.00050	0.00099
14-Oct-15	23	500	505	7.4	0.0093	0.000055	0.00034	0.22	0.030	0.0050	0.00092	0.000050	0.0022	0.45	0.000020	1.0	0.0000050	0.16	0.0032	0.20	0.0000040	0.000047	0.00024	0.00051	0.00017	0.00075	0.0010
21-Oct-15	24	500	505	7.3	0.015	0.000086	0.00036	0.22	0.032	0.0051	0.0013	0.000051	0.0029	0.48	0.000020	1.1	0.0000091	0.16	0.0031	0.25	0.0000056	0.000035	0.00032	0.00041	0.00018	0.0010	0.0010
28-Oct-15	25	500	510	7.4	0.0093	0.000053	0.00036	0.24	0.034	0.0050	0.0015	0.000050	0.0034	0.50	0.000020	1.2	0.0000050	0.16	0.0035	0.27	0.0000050	0.000037	0.00021	0.00041	0.00018	0.00075	0.00099
4-Nov-15	26	500	485	7.4	0.0039	0.000019	0.00037	0.26	0.036	0.0049	0.0017	0.000049	0.0039	0.52	0.000019	1.2	0.00000097	0.16	0.0038	0.29	0.0000044	0.000039	0.00010	0.00041	0.00018	0.00049	0.00097
11-Nov-15	27	500	485	7.3	0.0067	0.000015	0.00032	0.23	0.033	0.0050	0.0011	0.000050	0.0027	0.46	0.000035	1.1	0.00000099	0.15	0.0033	0.22	0.0000040	0.000042	0.00011	0.00035	0.00016	0.00050	0.00099
18-Nov-15	28	500	505	7.3	0.0096	0.000010	0.00026	0.19	0.029	0.0051	0.00045	0.000051	0.0015	0.41	0.000051	1.1	0.0000010	0.14	0.0028	0.15	0.0000035	0.000045	0.00011	0.00030	0.00014	0.00051	0.0010
25-Nov-15	29	500	485	7.3	0.015	0.000049	0.00029	0.22	0.034	0.0050	0.00035	0.000050	0.0015	0.46	0.000035	1.3	0.00000099	0.15	0.0032	0.29	0.0000030	0.000030	0.00037	0.00034	0.00016	0.00074	0.00099
2-Dec-15	30	500	485	7.2	0.020	0.000087	0.00031	0.26	0.039	0.0049	0.00025	0.000049	0.0015	0.52	0.000019	1.5	0.00000097	0.16	0.0036	0.44	0.0000024	0.000015	0.00064	0.00038	0.00018	0.00097	0.00097
9-Dec-15	31	500	485	7.2	0.012	0.000086	0.00030	0.23	0.038	0.0049	0.00020	0.000049	0.0015	0.48	0.000020	1.3	0.0000015	0.15	0.0034	0.37	0.0000042	0.000039	0.00057	0.00041	0.00016	0.00073	0.00098
16-Dec-15	32	500	495	7.1	0.0035	0.000084	0.00028	0.21	0.038	0.0050	0.00015	0.000050	0.0015	0.43	0.000020	1.2	0.0000020	0.14	0.0033	0.30	0.0000059	0.000064	0.00050	0.00044	0.00013	0.00050	0.00099
23-Dec-15	33	500	490	7.5	0.0034	0.000049	0.00028	0.21	0.038	0.0049	0.00013	0.000049	0.0015	0.42	0.000020	1.1	0.0000015	0.15	0.0033	0.32	0.0000042	0.000035	0.00028	0.00040	0.00013	0.00049	0.00099
30-Dec-15	34	500	490	7.1	0.0034	0.000015	0.00028	0.21	0.038	0.0049	0.00010	0.000049	0.0015	0.41	0.000020	1.1	0.00000098	0.15	0.0033	0.34	0.0000025	0.0000049	0.000054	0.00035	0.00013	0.00049	0.00098
6-Jan-16	35	500	490	7.1	0.0034	0.000012	0.00026	0.21	0.039	0.0049	0.00011	0.000049	0.0015	0.39	0.000037	1.0	0.00000099	0.13	0.0031	0.22	0.0000025	0.000012	0.000039	0.00033	0.000098	0.00049	0.00099
13-Jan-16	36	500	495	7.0	0.0035	0.0000099	0.00024	0.21	0.040	0.0050	0.00012	0.000050	0.0015	0.37	0.000054	0.91	0.00000099	0.11	0.0028	0.099	0.0000025	0.000020	0.000025	0.00030	0.000069	0.00050	0.00099
20-Jan-16	37	500	490	7.1	0.0034	0.0000098	0.00024	0.21	0.042	0.0049	0.00011	0.000049	0.0015	0.38	0.000037	1.1	0.00000098	0.12	0.0031	0.15	0.0000025	0.000020	0.000034	0.00035	0.000083	0.00049	0.00098
27-Jan-16	38	500	485	7.1	0.0034	0.0000097	0.00024	0.22	0.043	0.0049	0.00010	0.000049	0.0015	0.39	0.000019	1.2	0.00000097	0.12	0.0033	0.19	0.0000024	0.000019	0.000044	0.00039	0.000097	0.00049	0.00097
3-Feb-16	39	500	485	7.0	0.0051	0.000034	0.00021	0.20	0.041	0.0049	0.000097	0.000049	0.0015	0.35	0.000022	1.0	0.00000098	0.12	0.0030	0.32	0.0000027	0.000015	0.00013	0.00034	0.000085	0.00049	0.00098
10-Feb-16	40	500	490	6.9	0.0069	0.000059	0.00018	0.18	0.039	0.0049	0.000093	0.000049	0.0015	0.31	0.000025	0.84	0.00000098	0.12	0.0026	0.44	0.0000029	0.0000098	0.00022	0.00029	0.000074	0.00049	0.00098
17-Feb-16	41	500	495	7.2	0.0051	0.000034	0.00020	0.17	0.038	0.0098	0.000096	0.000074	0.0015	0.33	0.000022	0.94	0.00000098	0.11	0.0026	0.37	0.0000027	0.000015	0.00013	0.00030	0.000083	0.00049	0.00098
24-Feb-16	42	500	490	7.0	0.0034	0.0000098	0.00022	0.17	0.037	0.015	0.000098	0.000098	0.0015	0.35	0.000020	1.0	0.00000098	0.093	0.0025	0.29	0.0000025	0.000020	0.000049	0.00031	0.000093	0.00049	0.00098

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC7 (KAM036824)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
12-Aug-15	0	500	415	7.4	598	#N/A	3.7	32	244	3.0	0.11	*< 0.3*	247	0.0092	0.016	0.038	0.013	*< 0.000007*	0.000010	0.0062	0.0000080	59	0.000060	0.0048	0.0044
19-Aug-15	1	500	495	7.4	219	#N/A	1.9	17	83	1.0	*< 0.06*	*< 0.3*	79	0.014	0.0092	0.033	0.011	*< 0.000007*	*< 0.000007*	0.0040	*< 0.000003*	18	*< 0.00003*	0.0014	0.00064
26-Aug-15	2	500	505	7.5	138	#N/A	1.6	17	42	1.0	*< 0.06*	*< 0.3*	51	0.016	0.0090	0.036	0.011	*< 0.000007*	*< 0.000007*	0.0022	0.0000070	12	*< 0.00003*	0.00089	0.00049
2-Sep-15	3	500	475	7.5	109	#N/A	1.7	16	32	*< 1*	0.060	*< 0.3*	40	0.037	0.0084	0.036	0.011	*< 0.000007*	*< 0.000007*	0.0019	0.0000040	9.6	0.000050	0.00059	0.00061
9-Sep-15	4	500	490	7.9	93	#N/A	1.5	23	21	*< 1*	0.060	*< 0.3*	32	0.017	0.0085	0.041	0.0073	*< 0.000007*	*< 0.000007*	0.0018	*< 0.000003*	7.5	*< 0.00003*	0.00058	0.00056
16-Sep-15	5	500	480	7.5	81	#N/A	1.5	18	17	*< 1*	0.060	*< 0.3*	30	0.019	0.0085	0.036	0.0067	*< 0.000007*	*< 0.000007*	0.0017	*< 0.000003*	7.4	0.000060	0.00045	0.00041
23-Sep-15	6	500	495	7.5	76	#N/A	1.6	20	13	*< 1*	*< 0.06*	*< 0.3*	30	0.017	0.0086	0.033	0.0068	*< 0.000007*	*< 0.000007*	0.0014	*< 0.000003*	7.1	*< 0.00003*	0.00049	0.00045
30-Sep-15	7	500	485	7.5	65	#N/A	1.9	21	12	*< 1*	0.060	*< 0.3*	26	0.017	0.0079	0.034	0.0052	*< 0.000007*	*< 0.000007*	0.0026	0.0000050	6.1	*< 0.00003*	0.00040	0.00033
7-Oct-15	8	500	480	7.6	56	#N/A	1.9	17	7.0	*< 1*	*< 0.06*	*< 0.3*	22	0.016	0.0071	0.023	0.0052	*< 0.000007*	*< 0.000007*	0.00090	*< 0.000003*	5.1	*< 0.00003*	0.00037	0.00019
14-Oct-15	9	500	475	7.7	64	#N/A	1.7	23	8.0	*< 1*	0.060	*< 0.3*	25	0.021	0.0078	0.029	0.0069	*< 0.000007*	*< 0.000007*	0.0038	*< 0.000003*	5.8	*< 0.00003*	0.00027	0.00038
21-Oct-15	10	500	495	7.6	63	#N/A	1.2	23	8.0	*< 1*	0.060	*< 0.3*	28	0.019	0.0084	0.022	0.0071	*< 0.000007*	*< 0.000007*	0.0014	*< 0.000003*	6.6	*< 0.00003*	0.00042	0.00050
28-Oct-15	11	500	505	7.7	59	#N/A	2.3	26	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	12	500	480	7.6	51	#N/A	1.1	18	5.0	*< 1*	*< 0.06*	*< 0.3*	22	0.020	0.0066	0.021	0.0053	*< 0.000007*	*< 0.000007*	0.00090	*< 0.000003*	5.1	*< 0.00003*	0.00030	0.00037
11-Nov-15	13	500	465	7.6	52	#N/A	1.5	20	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	14	500	495	7.7	58	#N/A	1.0	28	5.0	*< 1*	*< 0.06*	*< 0.3*	24	0.017	0.0073	0.022	0.0064	*< 0.000007*	*< 0.000007*	*< 0.0002*	*< 0.000003*	5.8	0.000030	0.00034	0.00041
25-Nov-15	15	500	465	7.6	46	#N/A	1.0	22	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	16	500	485	7.5	51	#N/A	2.4	23	4.0	*< 1*	*< 0.06*	*< 0.3*	24	0.020	0.0069	0.021	0.0076	*< 0.000007*	*< 0.000007*	0.00030	0.0000070	5.7	*< 0.00003*	0.00034	0.00044
9-Dec-15	17	500	470	7.7	45	#N/A	2.9	21	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	18	500	500	7.6	50	#N/A	2.4	22	4.0	*< 1*	*< 0.06*	*< 0.3*	25	0.017	0.0073	0.021	0.0088	0.0000080	*< 0.000007*	0.0012	0.0000040	6.0	0.000040	0.00034	0.00032
23-Dec-15	19	500	485	8.0	43	#N/A	3.5	21	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	20	500	490	7.5	43	#N/A	1.6	18	4.0	*< 1*	*< 0.06*	*< 0.3*	21	0.015	0.0054	0.017	0.0074	*< 0.000007*	*< 0.000007*	0.00070	0.0000030	5.1	0.000040	0.00026	0.00019
6-Jan-16	21	500	465	7.4	43	#N/A	1.7	17	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	22	500	490	7.5	48	#N/A	1.6	22	4.0	*< 1*	*< 0.06*	*< 0.3*	23	0.014	0.0062	0.015	0.0077	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	5.4	*< 0.00003*	0.00028	0.00016
20-Jan-16	23	500	475	7.5	42	#N/A	2.6	17	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	24	500	490	7.6	49	#N/A	2.8	23	3.0	*< 1*	*< 0.06*	*< 0.3*	23	0.013	0.0062	0.015	0.0085	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	5.5	*< 0.00003*	0.00027	0.00030
3-Feb-16	25	500	480	7.5	41	#N/A	2.9	18	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	26	500	495	7.5	52	#N/A	2.4	24	3.0	*< 1*	*< 0.06*	*< 0.3*	24	0.010	0.0061	0.016	0.0091	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	5.7	*< 0.00003*	0.00033	0.00011
17-Feb-16	27	500	490	7.6	45	#N/A	4.6	22	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	28	500	490	7.6	49	#N/A	2.2	22	2.0	*< 1*	*< 0.06*	*< 0.3*	24	0.014	0.0059	0.015	0.0090	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	5.6	*< 0.00003*	0.00028	0.000080
2-Mar-16	29	500	485	7.5	46	#N/A	2.1	22	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	30	500	495	7.5	48	#N/A	2.5	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC7 (KAM036824)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
12-Aug-15	0	500	415	7.4	598	#N/A	1.6	13	101	1.2	0.046	0.12	103	0.0038	0.0067	0.016	0.0054	0.0000029	0.0000042	0.0026	0.0000033	24	0.000025	0.0020	0.0018
19-Aug-15	1	500	495	7.4	219	#N/A	0.96	8.3	41	0.50	0.030	0.15	39	0.0068	0.0046	0.016	0.0054	0.0000035	0.0000035	0.0020	0.0000015	8.9	0.000015	0.00070	0.00032
26-Aug-15	2	500	505	7.5	138	#N/A	0.81	8.5	21	0.51	0.030	0.15	26	0.0083	0.0045	0.018	0.0057	0.0000035	0.0000035	0.0011	0.0000035	6.3	0.000015	0.00045	0.00025
2-Sep-15	3	500	475	7.5	109	#N/A	0.80	7.8	15	0.48	0.029	0.14	19	0.017	0.0040	0.017	0.0050	0.0000033	0.0000033	0.00090	0.0000019	4.5	0.000024	0.00028	0.00029
9-Sep-15	4	500	490	7.9	93	#N/A	0.72	11	10	0.49	0.029	0.15	16	0.0081	0.0042	0.020	0.0036	0.0000034	0.0000034	0.00088	0.0000015	3.7	0.000015	0.00029	0.00027
16-Sep-15	5	500	480	7.5	81	#N/A	0.74	8.4	8.2	0.48	0.029	0.14	15	0.0091	0.0041	0.017	0.0032	0.0000034	0.0000034	0.00082	0.0000014	3.6	0.000029	0.00021	0.00020
23-Sep-15	6	500	495	7.5	76	#N/A	0.79	10.0	6.4	0.50	0.030	0.15	15	0.0086	0.0043	0.016	0.0034	0.0000035	0.0000035	0.00069	0.0000015	3.5	0.000015	0.00024	0.00022
30-Sep-15	7	500	485	7.5	65	#N/A	0.93	10	5.8	0.49	0.029	0.15	13	0.0081	0.0038	0.016	0.0025	0.0000034	0.0000034	0.0013	0.0000024	3.0	0.000015	0.00019	0.00016
7-Oct-15	8	500	480	7.6	56	#N/A	0.92	8.3	3.4	0.48	0.029	0.14	10	0.0075	0.0034	0.011	0.0025	0.0000034	0.0000034	0.00043	0.0000014	2.4	0.000014	0.00018	0.000091
14-Oct-15	9	500	475	7.7	64	#N/A	0.81	11	3.8	0.48	0.029	0.14	12	0.0099	0.0037	0.014	0.0033	0.0000033	0.0000033	0.0018	0.0000014	2.7	0.000014	0.00013	0.00018
21-Oct-15	10	500	495	7.6	63	#N/A	0.57	11	4.0	0.50	0.030	0.15	14	0.0094	0.0042	0.011	0.0035	0.0000035	0.0000035	0.00069	0.0000015	3.3	0.000015	0.00021	0.00025
28-Oct-15	11	500	505	7.7	59	#N/A	1.2	13	3.5	0.49	0.029	0.15	12	0.0096	0.0037	0.011	0.0030	0.0000034	0.0000034	0.00056	0.0000015	2.9	0.000015	0.00017	0.00021
4-Nov-15	12	500	480	7.6	51	#N/A	0.54	8.5	2.4	0.48	0.029	0.14	10	0.0097	0.0032	0.010	0.0025	0.0000034	0.0000034	0.00043	0.0000014	2.4	0.000014	0.00014	0.00018
11-Nov-15	13	500	465	7.6	52	#N/A	0.70	9.4	1.9	0.49	0.029	0.15	11	0.0091	0.0034	0.010	0.0029	0.0000034	0.0000034	0.00027	0.0000015	2.6	0.000015	0.00015	0.00019
18-Nov-15	14	500	495	7.7	58	#N/A	0.48	14	2.5	0.50	0.030	0.15	12	0.0086	0.0036	0.011	0.0032	0.0000035	0.0000035	0.000099	0.0000015	2.9	0.000015	0.00017	0.00020
25-Nov-15	15	500	465	7.6	46	#N/A	0.48	10	1.9	0.49	0.029	0.15	12	0.0092	0.0035	0.010	0.0034	0.0000034	0.0000034	0.00012	0.0000024	2.8	0.000015	0.00017	0.00021
2-Dec-15	16	500	485	7.5	51	#N/A	1.2	11	1.9	0.49	0.029	0.15	12	0.0097	0.0033	0.010	0.0037	0.0000034	0.0000034	0.00015	0.0000034	2.7	0.000015	0.00016	0.00021
9-Dec-15	17	500	470	7.7	45	#N/A	1.4	9.8	1.4	0.49	0.030	0.15	12	0.0090	0.0035	0.010	0.0040	0.0000037	0.0000034	0.00037	0.0000027	2.9	0.000017	0.00017	0.00019
16-Dec-15	18	500	500	7.6	50	#N/A	1.2	11	2.0	0.50	0.030	0.15	13	0.0084	0.0037	0.010	0.0044	0.0000040	0.0000035	0.00060	0.0000020	3.0	0.000020	0.00017	0.00016
23-Dec-15	19	500	485	8.0	43	#N/A	1.7	10	1.5	0.50	0.030	0.15	11	0.0078	0.0031	0.0093	0.0040	0.0000037	0.0000035	0.00047	0.0000017	2.7	0.000020	0.00015	0.00013
30-Dec-15	20	500	490	7.5	43	#N/A	0.77	8.7	2.0	0.49	0.029	0.15	10	0.0072	0.0026	0.0081	0.0036	0.0000034	0.0000034	0.00034	0.0000015	2.5	0.000020	0.00013	0.000093
6-Jan-16	21	500	465	7.4	43	#N/A	0.77	8.0	1.4	0.49	0.029	0.15	11	0.0070	0.0028	0.0078	0.0037	0.0000034	0.0000034	0.00066	0.0000015	2.6	0.000017	0.00013	0.000086
13-Jan-16	22	500	490	7.5	48	#N/A	0.79	11	2.0	0.49	0.029	0.15	11	0.0068	0.0030	0.0075	0.0038	0.0000034	0.0000034	0.00098	0.0000015	2.6	0.000015	0.00014	0.000078
20-Jan-16	23	500	475	7.5	42	#N/A	1.2	8.2	1.4	0.49	0.029	0.15	11	0.0066	0.0030	0.0075	0.0040	0.0000034	0.0000034	0.00098	0.0000015	2.7	0.000015	0.00014	0.00011
27-Jan-16	24	500	490	7.6	49	#N/A	1.4	11	1.5	0.49	0.029	0.15	11	0.0064	0.0030	0.0075	0.0042	0.0000034	0.0000034	0.00098	0.0000015	2.7	0.000015	0.00013	0.00015
3-Feb-16	25	500	480	7.5	41	#N/A	1.4	8.6	0.96	0.49	0.030	0.15	12	0.0058	0.0030	0.0077	0.0043	0.0000034	0.0000034	0.00099	0.0000015	2.8	0.000015	0.00015	0.00010
10-Feb-16	26	500	495	7.5	52	#N/A	1.2	12	1.5	0.50	0.030	0.15	12	0.0051	0.0030	0.0078	0.0045	0.0000035	0.0000035	0.00099	0.0000015	2.8	0.000015	0.00016	0.000054
17-Feb-16	27	500	490	7.6	45	#N/A	2.2	11	0.98	0.49	0.030	0.15	12	0.0060	0.0030	0.0075	0.0045	0.0000034	0.0000034	0.00099	0.0000015	2.8	0.000015	0.00015	0.000047
24-Feb-16	28	500	490	7.6	49	#N/A	1.1	11	0.98	0.49	0.029	0.15	12	0.0069	0.0029	0.0072	0.0044	0.0000034	0.0000034	0.00098	0.0000015	2.7	0.000015	0.00014	0.000039

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC7 (KAM036824)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
12-Aug-15	0	500	415	7.4	0.0070	0.00011	0.0050	24	0.10	< 0.01	0.0020	0.036	0.0080	6.1	0.00020	0.67	0.0000016	18	0.30	86	0.0000035	0.0022	< 0.00005	0.024	0.00027	0.0040	< 0.002
19-Aug-15	1	500	495	7.4	0.034	0.000020	0.0020	8.4	0.031	< 0.01	0.00066	0.012	< 0.003	2.7	< 0.00004	0.42	< 0.000002	5.6	0.095	26	0.0000080	< 0.00001	0.00023	0.0097	0.00030	< 0.001	< 0.002
26-Aug-15	2	500	505	7.5	< 0.007	0.00012	0.0016	4.8	0.022	< 0.01	0.00055	0.0075	0.0040	2.1	0.000080	0.40	0.0000030	3.2	0.058	15	0.0000080	0.000020	< 0.00005	0.0097	0.00035	< 0.001	< 0.002
2-Sep-15	3	500	475	7.5	0.012	0.00012	0.0013	3.8	0.014	< 0.01	0.00031	0.0049	< 0.003	1.8	< 0.00004	0.36	0.0000040	2.2	0.044	12	0.0000070	< 0.00001	0.00018	0.0077	0.00038	< 0.001	< 0.002
9-Sep-15	4	500	490	7.9	< 0.007	0.000030	0.0011	3.2	0.014	< 0.01	0.0022	0.0039	< 0.003	1.7	0.000070	0.35	0.0000050	1.7	0.035	11	0.000011	0.000080	0.000070	0.0090	0.00033	< 0.001	< 0.002
16-Sep-15	5	500	480	7.5	< 0.007	0.000080	0.0013	2.9	0.011	< 0.01	0.00023	0.0028	< 0.003	1.6	< 0.00004	0.34	0.0000050	1.4	0.030	7.0	0.0000070	0.000060	< 0.00005	0.0066	0.00033	< 0.001	< 0.002
23-Sep-15	6	500	495	7.5	< 0.007	< 0.00001	0.0010	2.9	0.013	< 0.01	0.00033	0.0032	< 0.003	1.5	< 0.00004	0.39	0.000020	1.1	0.030	5.2	< 0.000005	< 0.00001	0.000080	0.0062	0.00031	< 0.001	< 0.002
30-Sep-15	7	500	485	7.5	0.0070	0.000040	0.00093	2.6	0.011	< 0.01	0.00027	0.0032	< 0.003	1.4	< 0.00004	0.27	< 0.000002	0.91	0.027	4.4	< 0.000005	0.000070	0.00010	0.0055	0.00034	0.0040	< 0.002
7-Oct-15	8	500	480	7.6	< 0.007	0.000020	0.00081	2.2	0.0095	< 0.01	0.00047	0.0023	< 0.003	1.1	< 0.00004	0.26	< 0.000002	0.60	0.022	3.5	< 0.000005	0.000040	< 0.00005	0.0048	0.00025	< 0.001	< 0.002
14-Oct-15	9	500	475	7.7	< 0.007	0.000010	0.00099	2.5	0.0097	< 0.01	0.00046	0.0018	< 0.003	1.4	< 0.00004	0.35	0.0000020	0.66	0.026	4.2	0.0000060	0.000090	< 0.00005	0.0055	0.00040	< 0.001	< 0.002
21-Oct-15	10	500	495	7.6	< 0.007	0.000040	0.00094	2.8	0.012	< 0.01	0.0019	0.0023	< 0.003	1.4	0.000040	0.37	0.000013	0.60	0.029	3.4	0.0000070	0.00013	0.00037	0.0064	0.00027	< 0.001	< 0.002
28-Oct-15	11	500	505	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	12	500	480	7.6	< 0.007	0.000020	0.00072	2.2	0.0089	< 0.01	0.0014	0.0017	0.0080	1.2	< 0.00004	0.27	< 0.000002	0.39	0.023	2.4	< 0.000005	< 0.00001	< 0.00005	0.0052	0.00025	< 0.001	< 0.002
11-Nov-15	13	500	465	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	14	500	495	7.7	0.019	0.000030	0.00072	2.4	0.012	< 0.01	0.00068	0.0016	< 0.003	1.1	0.00013	0.32	< 0.000002	0.35	0.026	2.2	< 0.000005	0.000050	< 0.00005	0.0042	0.00026	< 0.001	< 0.002
25-Nov-15	15	500	465	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	16	500	485	7.5	< 0.007	0.000080	0.00066	2.4	0.010	< 0.01	0.00028	0.0018	< 0.003	1.1	< 0.00004	0.31	< 0.000002	0.27	0.024	2.2	< 0.000005	0.000060	0.00022	0.0053	0.00031	< 0.001	< 0.002
9-Dec-15	17	500	470	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	18	500	500	7.6	< 0.007	0.00012	0.00070	2.5	0.012	< 0.01	0.00013	0.0017	< 0.003	1.1	< 0.00004	0.34	0.0000030	0.23	0.026	1.8	< 0.000005	0.000070	0.00010	0.0052	0.00025	< 0.001	< 0.002
23-Dec-15	19	500	485	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	20	500	490	7.5	< 0.007	0.000030	0.00062	2.1	0.010	0.010	0.00036	0.0014	< 0.003	0.92	< 0.00004	0.24	< 0.000002	0.20	0.021	1.9	< 0.000005	< 0.00001	0.00010	0.0040	0.00022	< 0.001	< 0.002
6-Jan-16	21	500	465	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	22	500	490	7.5	< 0.007	0.000030	0.00056	2.2	0.011	< 0.01	0.00018	0.0013	< 0.003	0.95	0.00017	0.28	0.0000030	0.15	0.021	1.1	< 0.000005	0.000030	< 0.00005	0.0043	0.00021	< 0.001	< 0.002
20-Jan-16	23	500	475	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	24	500	490	7.6	< 0.007	< 0.00001	0.00054	2.2	0.012	< 0.01	0.000060	0.0013	< 0.003	0.89	< 0.00004	0.27	< 0.000002	0.16	0.023	1.2	< 0.000005	0.000030	< 0.00005	0.0049	0.00026	< 0.001	< 0.002
3-Feb-16	25	500	480	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	26	500	495	7.5	< 0.007	0.000040	0.00053	2.4	0.013	< 0.01	0.000080	0.0015	< 0.003	0.86	0.000050	0.26	< 0.000002	0.15	0.024	1.6	< 0.000005	< 0.00001	< 0.00005	0.0041	0.00017	< 0.001	< 0.002
17-Feb-16	27	500	490	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	28	500	490	7.6	< 0.007	0.000030	0.00055	2.4	0.013	0.020	0.000090	0.0013	< 0.003	0.83	< 0.00004	0.040	< 0.000002	0.070	0.022	1.3	< 0.000005	0.000090	0.000070	0.0039	0.00020	< 0.001	< 0.002
2-Mar-16	29	500	485	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	30	500	495	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC7 (KAM036824)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
12-Aug-15	0	500	415	7.4	0.0029	0.000046	0.0021	10	0.042	0.0042	0.00084	0.015	0.0033	2.5	0.000083	0.28	0.0000066	7.4	0.12	35	0.000015	0.00092	0.000021	0.0098	0.00011	0.0017	0.00083
19-Aug-15	1	500	495	7.4	0.017	0.0000099	0.00098	4.1	0.016	0.0050	0.00033	0.0060	0.0015	1.4	0.000020	0.21	0.00000099	2.8	0.047	13	0.0000040	0.0000050	0.00011	0.0048	0.00015	0.00050	0.00099
26-Aug-15	2	500	505	7.5	0.0035	0.000061	0.00082	2.4	0.011	0.0051	0.00028	0.0038	0.0020	1.1	0.000040	0.20	0.0000015	1.6	0.029	7.4	0.0000040	0.000010	0.000025	0.0049	0.00018	0.00051	0.0010
2-Sep-15	3	500	475	7.5	0.0057	0.000057	0.00062	1.8	0.0068	0.0048	0.00015	0.0023	0.0014	0.87	0.000019	0.17	0.0000019	1.0	0.021	5.9	0.0000033	0.0000048	0.000086	0.0036	0.00018	0.00048	0.00095
9-Sep-15	4	500	490	7.9	0.0034	0.000015	0.00056	1.6	0.0070	0.0049	0.0011	0.0019	0.0015	0.82	0.000034	0.17	0.0000025	0.82	0.017	5.2	0.0000054	0.000039	0.000034	0.0044	0.00016	0.00049	0.00098
16-Sep-15	5	500	480	7.5	0.0034	0.000038	0.00064	1.4	0.0054	0.0048	0.00011	0.0013	0.0014	0.76	0.000019	0.16	0.0000024	0.65	0.014	3.4	0.0000034	0.000029	0.000024	0.0032	0.00016	0.00048	0.00096
23-Sep-15	6	500	495	7.5	0.0035	0.0000050	0.00050	1.4	0.0065	0.0050	0.00016	0.0016	0.0015	0.74	0.000020	0.19	0.0000099	0.55	0.015	2.6	0.0000025	0.0000050	0.000040	0.0031	0.00015	0.00050	0.00099
30-Sep-15	7	500	485	7.5	0.0034	0.000019	0.00045	1.2	0.0051	0.0049	0.00013	0.0016	0.0015	0.69	0.000019	0.13	0.00000097	0.44	0.013	2.1	0.0000024	0.000034	0.000049	0.0026	0.00016	0.0019	0.00097
7-Oct-15	8	500	480	7.6	0.0034	0.0000096	0.00039	1.1	0.0046	0.0048	0.00023	0.0011	0.0014	0.55	0.000019	0.12	0.00000096	0.29	0.011	1.7	0.0000024	0.000019	0.000024	0.0023	0.00012	0.00048	0.00096
14-Oct-15	9	500	475	7.7	0.0033	0.0000048	0.00047	1.2	0.0046	0.0048	0.00022	0.00086	0.0014	0.65	0.000019	0.17	0.00000095	0.31	0.012	2.0	0.0000029	0.000043	0.000024	0.0026	0.00019	0.00048	0.00095
21-Oct-15	10	500	495	7.6	0.0035	0.000020	0.00046	1.4	0.0061	0.0050	0.00096	0.0011	0.0015	0.68	0.000020	0.18	0.0000064	0.30	0.014	1.7	0.0000035	0.000064	0.00018	0.0032	0.00013	0.00050	0.00099
28-Oct-15	11	500	505	7.7	0.0034	0.000015	0.00040	1.2	0.0052	0.0049	0.00081	0.00098	0.0027	0.62	0.000020	0.16	0.0000037	0.24	0.013	1.4	0.0000029	0.000035	0.00010	0.0028	0.00013	0.00049	0.00098
4-Nov-15	12	500	480	7.6	0.0034	0.0000096	0.00034	1.0	0.0042	0.0048	0.00065	0.00082	0.0038	0.55	0.000019	0.13	0.00000096	0.19	0.011	1.2	0.0000024	0.0000048	0.000024	0.0025	0.00012	0.00048	0.00096
11-Nov-15	13	500	465	7.6	0.0064	0.000012	0.00035	1.1	0.0050	0.0049	0.00049	0.00080	0.0027	0.55	0.000042	0.14	0.00000098	0.18	0.012	1.1	0.0000024	0.000015	0.000024	0.0023	0.00012	0.00049	0.00098
18-Nov-15	14	500	495	7.7	0.0094	0.000015	0.00036	1.2	0.0057	0.0050	0.00034	0.00079	0.0015	0.55	0.000064	0.16	0.00000099	0.17	0.013	1.1	0.0000025	0.000025	0.000025	0.0021	0.00013	0.00050	0.00099
25-Nov-15	15	500	465	7.6	0.0064	0.000027	0.00034	1.2	0.0054	0.0049	0.00024	0.00083	0.0015	0.55	0.000042	0.15	0.00000098	0.15	0.012	1.1	0.0000025	0.000027	0.000066	0.0023	0.00014	0.00049	0.00098
2-Dec-15	16	500	485	7.5	0.0034	0.000039	0.00032	1.2	0.0050	0.0049	0.00014	0.00087	0.0015	0.55	0.000019	0.15	0.00000097	0.13	0.011	1.1	0.0000024	0.000029	0.00011	0.0026	0.00015	0.00049	0.00097
9-Dec-15	17	500	470	7.7	0.0034	0.000049	0.00034	1.2	0.0056	0.0049	0.00010	0.00086	0.0015	0.55	0.000020	0.16	0.0000012	0.12	0.012	0.98	0.0000025	0.000032	0.000078	0.0026	0.00014	0.00049	0.00099
16-Dec-15	18	500	500	7.6	0.0035	0.000060	0.00035	1.2	0.0061	0.0050	0.000065	0.00085	0.0015	0.56	0.000020	0.17	0.0000015	0.12	0.013	0.90	0.0000025	0.000035	0.000050	0.0026	0.00013	0.00050	0.0010
23-Dec-15	19	500	485	8.0	0.0035	0.000037	0.00033	1.1	0.0055	0.0050	0.00012	0.00077	0.0015	0.50	0.000020	0.14	0.0000012	0.11	0.012	0.92	0.0000025	0.000020	0.000050	0.0023	0.00012	0.00050	0.00099
30-Dec-15	20	500	490	7.5	0.0034	0.000015	0.00030	1.0	0.0050	0.0049	0.00018	0.00069	0.0015	0.45	0.000020	0.12	0.00000098	0.098	0.010	0.93	0.0000025	0.0000049	0.000049	0.0020	0.00011	0.00049	0.00098
6-Jan-16	21	500	465	7.4	0.0034	0.000015	0.00029	1.1	0.0052	0.0049	0.00013	0.00066	0.0015	0.46	0.000051	0.13	0.0000012	0.086	0.010	0.74	0.0000025	0.0000098	0.000037	0.0020	0.00011	0.00049	0.00098
13-Jan-16	22	500	490	7.5	0.0034	0.000015	0.00027	1.1	0.0054	0.0049	0.000088	0.00064	0.0015	0.47	0.000083	0.14	0.0000015	0.074	0.010	0.54	0.0000025	0.000015	0.000025	0.0021	0.00010	0.00049	0.00098
20-Jan-16	23	500	475	7.5	0.0034	0.0000098	0.00027	1.1	0.0055	0.0049	0.000059	0.00064	0.0015	0.45	0.000051	0.13	0.0000012	0.076	0.011	0.56	0.0000025	0.000015	0.000025	0.0023	0.00012	0.00049	0.00098
27-Jan-16	24	500	490	7.6	0.0034	0.0000049	0.00026	1.1	0.0057	0.0049	0.000029	0.00064	0.0015	0.44	0.000020	0.13	0.00000098	0.078	0.011	0.59	0.0000025	0.000015	0.000025	0.0024	0.00013	0.00049	0.00098
3-Feb-16	25	500	480	7.5	0.0034	0.000012	0.00026	1.1	0.0061	0.0049	0.000035	0.00069	0.0015	0.43	0.000022	0.13	0.00000099	0.076	0.011	0.69	0.0000025	0.0000098	0.000025	0.0022	0.00011	0.00049	0.00099
10-Feb-16	26	500	495	7.5	0.0035	0.000020	0.00026	1.2	0.0066	0.0050	0.000040	0.00074	0.0015	0.42	0.000025	0.13	0.00000099	0.074	0.012	0.79	0.0000025	0.0000050	0.000025	0.0020	0.000084	0.00050	0.00099
17-Feb-16	27	500	490	7.6	0.0034	0.000017	0.00026	1.2	0.0064	0.0074	0.000042	0.00069	0.0015	0.42	0.000022	0.074	0.00000099	0.054	0.011	0.71	0.0000025	0.000025	0.000030	0.0020	0.000091	0.00049	0.00099
24-Feb-16	28	500	490	7.6	0.0034	0.000015	0.00027	1.2	0.0062	0.0098	0.000044	0.00064	0.0015	0.41	0.000020	0.020	0.00000098	0.034	0.011	0.64	0.0000025	0.000044	0.000034	0.0019	0.000098	0.00049	0.00098

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC8 (KAM092488)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
12-Aug-15	0	500	410	7.6	128	#N/A	2.5	22	29	*< 1*	0.080	*< 0.3*	24	0.075	0.0037	0.13	0.0077	0.000014	0.000010	0.016	0.000025	5.7	0.00011	0.00031	0.016
19-Aug-15	1	500	505	7.5	68	#N/A	1.9	15	13	*< 1*	*< 0.06*	*< 0.3*	16	0.024	0.0030	0.063	0.0084	*< 0.000007*	*< 0.000007*	0.0084	0.0000040	3.8	*< 0.00003*	0.00017	0.0032
26-Aug-15	2	500	495	7.5	38	#N/A	1.3	12	3.0	*< 1*	*< 0.06*	*< 0.3*	9.3	0.021	0.0025	0.050	0.0049	*< 0.000007*	*< 0.000007*	0.0053	0.0000090	2.3	*< 0.00003*	0.000070	0.0020
2-Sep-15	3	500	500	7.5	32	#N/A	1.6	12	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.5	0.018	0.0025	0.043	0.0045	*< 0.000007*	*< 0.000007*	0.0047	0.0000060	2.1	*< 0.00003*	0.000053	0.0014
9-Sep-15	4	500	495	7.5	25	#N/A	1.6	11	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.2	0.019	0.0021	0.038	0.0045	*< 0.000007*	*< 0.000007*	0.0039	*< 0.000003*	1.9	*< 0.00003*	0.000048	0.0011
16-Sep-15	5	500	495	7.4	24	#N/A	1.5	11	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.3	0.017	0.0021	0.038	0.0049	*< 0.000007*	*< 0.000007*	0.0037	0.0000060	2.0	*< 0.00003*	0.000030	0.00082
23-Sep-15	6	500	495	7.4	24	#N/A	1.4	12	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.9	0.014	0.0021	0.035	0.0056	*< 0.000007*	*< 0.000007*	0.0030	*< 0.000003*	2.1	*< 0.00003*	0.000034	0.00081
30-Sep-15	7	500	490	7.4	21	#N/A	1.5	12	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.7	0.012	0.0018	0.032	0.0054	*< 0.000007*	*< 0.000007*	0.0032	0.0000050	2.0	*< 0.00003*	0.000037	0.00086
7-Oct-15	8	500	500	7.5	19	#N/A	1.5	10	2.0	*< 1*	*< 0.06*	*< 0.3*	8.0	0.011	0.0016	0.022	0.0052	*< 0.000007*	*< 0.000007*	0.0018	*< 0.000003*	1.9	*< 0.00003*	0.000024	0.00059
14-Oct-15	9	500	490	7.6	19	#N/A	1.5	11	2.0	*< 1*	*< 0.06*	*< 0.3*	8.1	0.012	0.0016	0.027	0.0052	*< 0.000007*	*< 0.000007*	0.0031	*< 0.000003*	1.9	*< 0.00003*	0.000027	0.00052
21-Oct-15	10	500	495	7.5	21	#N/A	1.2	11	2.0	*< 1*	*< 0.06*	*< 0.3*	9.4	0.014	0.0016	0.022	0.0065	*< 0.000007*	*< 0.000007*	0.0022	0.0000050	2.2	*< 0.00003*	0.000025	0.00065
28-Oct-15	11	500	510	7.7	21	#N/A	2.4	13	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	12	500	495	7.4	20	#N/A	1.1	11	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.4	0.012	0.0013	0.018	0.0061	*< 0.000007*	*< 0.000007*	0.00080	*< 0.000003*	2.0	0.000040	0.000017	0.00045
11-Nov-15	13	500	480	7.4	19	#N/A	1.6	10	*< 2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	14	500	505	7.5	22	#N/A	0.80	13	2.0	*< 1*	*< 0.06*	*< 0.3*	9.6	0.013	0.0014	0.020	0.0069	*< 0.000007*	*< 0.000007*	*< 0.0002*	*< 0.000003*	2.3	*< 0.00003*	0.000024	0.00055
25-Nov-15	15	500	475	7.3	17	#N/A	1.0	9.7	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	16	500	490	7.1	18	#N/A	2.8	11	2.0	*< 1*	*< 0.06*	*< 0.3*	8.7	0.017	0.0013	0.018	0.0056	*< 0.000007*	*< 0.000007*	0.00060	0.0000050	2.1	*< 0.00003*	0.000016	0.00059
9-Dec-15	17	500	495	7.6	19	#N/A	3.1	11	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	18	500	490	7.6	18	#N/A	2.7	9.9	2.0	*< 1*	*< 0.06*	*< 0.3*	9.3	0.015	0.0013	0.018	0.0061	0.0000080	*< 0.000007*	0.0015	0.0000060	2.3	0.00012	0.000027	0.00065
23-Dec-15	19	500	495	8.1	15	#N/A	3.9	11	*< 2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	20	500	495	7.2	16	#N/A	1.3	9.5	2.0	*< 1*	*< 0.06*	*< 0.3*	8.7	0.0091	0.0011	0.013	0.0062	*< 0.000007*	*< 0.000007*	0.0010	*< 0.000003*	2.1	*< 0.00003*	0.000017	0.00021
6-Jan-16	21	500	485	7.1	17	#N/A	1.7	9.2	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	22	500	490	7.2	19	#N/A	1.8	10	2.0	*< 1*	*< 0.06*	*< 0.3*	8.9	0.011	0.0013	0.014	0.0061	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	2.2	*< 0.00003*	0.0000040	0.00027
20-Jan-16	23	500	485	7.4	17	#N/A	2.5	9.6	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	24	500	490	7.5	20	#N/A	2.8	11	2.0	*< 1*	*< 0.06*	*< 0.3*	8.8	0.012	0.0013	0.016	0.0060	*< 0.000007*	*< 0.000007*	*< 0.002*	0.0000050	2.1	*< 0.00003*	0.000016	0.00034
3-Feb-16	25	500	500	7.4	18	#N/A	3.5	10	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	26	500	495	7.3	20	#N/A	2.0	11	2.0	*< 1*	*< 0.06*	*< 0.3*	9.3	0.0080	0.0014	0.017	0.0057	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	2.3	*< 0.00003*	0.000023	0.00024
17-Feb-16	27	500	490	7.6	15	#N/A	4.0	11	*< 2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	28	500	500	7.4	17	#N/A	2.6	11	2.0	*< 1*	*< 0.06*	*< 0.3*	9.1	0.013	0.0013	0.016	0.0061	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	2.3	*< 0.00003*	0.0000080	0.0020
2-Mar-16	29	500	500	7.2	19	#N/A	2.2	11	*< 2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	30	500	500	7.4	19	#N/A	2.5	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC8 (KAM092488)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
12-Aug-15	0	500	410	7.6	128	#N/A	1.0	9.2	12	0.41	0.033	0.12	9.7	0.031	0.0015	0.055	0.0031	0.0000057	0.0000041	0.0066	0.000010	2.3	0.000045	0.00013	0.0064
19-Aug-15	1	500	505	7.5	68	#N/A	0.94	7.7	6.6	0.51	0.030	0.15	8.1	0.012	0.0015	0.032	0.0042	0.0000035	0.0000035	0.0042	0.0000020	1.9	0.000015	0.000085	0.0016
26-Aug-15	2	500	495	7.5	38	#N/A	0.66	6.2	1.5	0.50	0.030	0.15	4.6	0.010	0.0012	0.025	0.0024	0.0000035	0.0000035	0.0026	0.0000045	1.1	0.000015	0.000035	0.0010
2-Sep-15	3	500	500	7.5	32	#N/A	0.82	6.1	1.0	0.50	0.030	0.15	4.3	0.0090	0.0013	0.022	0.0023	0.0000035	0.0000035	0.0024	0.0000030	1.0	0.000015	0.000027	0.00069
9-Sep-15	4	500	495	7.5	25	#N/A	0.78	5.4	0.99	0.50	0.030	0.15	4.1	0.0094	0.0010	0.019	0.0022	0.0000035	0.0000035	0.0019	0.0000015	0.96	0.000015	0.000024	0.00052
16-Sep-15	5	500	495	7.4	24	#N/A	0.72	5.6	0.99	0.50	0.030	0.15	4.1	0.0086	0.0010	0.019	0.0024	0.0000035	0.0000035	0.0018	0.0000030	0.99	0.000015	0.000015	0.00041
23-Sep-15	6	500	495	7.4	24	#N/A	0.67	5.7	0.99	0.50	0.030	0.15	4.4	0.0067	0.0010	0.017	0.0028	0.0000035	0.0000035	0.0015	0.0000015	1.0	0.000015	0.000017	0.00040
30-Sep-15	7	500	490	7.4	21	#N/A	0.74	5.8	0.98	0.49	0.029	0.15	4.2	0.0060	0.00088	0.016	0.0026	0.0000034	0.0000034	0.0016	0.0000025	0.98	0.000015	0.000018	0.00042
7-Oct-15	8	500	500	7.5	19	#N/A	0.77	5.2	1.0	0.50	0.030	0.15	4.0	0.0057	0.00080	0.011	0.0026	0.0000035	0.0000035	0.00090	0.0000015	0.96	0.000015	0.000012	0.00030
14-Oct-15	9	500	490	7.6	19	#N/A	0.75	5.4	0.98	0.49	0.029	0.15	4.0	0.0058	0.00078	0.013	0.0026	0.0000034	0.0000034	0.0015	0.0000015	0.93	0.000015	0.000013	0.00025
21-Oct-15	10	500	495	7.5	21	#N/A	0.59	5.6	0.99	0.50	0.030	0.15	4.7	0.0068	0.00079	0.011	0.0032	0.0000035	0.0000035	0.0011	0.0000025	1.1	0.000015	0.000012	0.00032
28-Oct-15	11	500	510	7.7	21	#N/A	1.2	6.8	1.5	0.50	0.030	0.15	4.4	0.0064	0.00072	0.0097	0.0031	0.0000035	0.0000035	0.00074	0.0000020	1.0	0.000017	0.000010	0.00027
4-Nov-15	12	500	495	7.4	20	#N/A	0.52	5.2	0.99	0.50	0.030	0.15	4.2	0.0060	0.00064	0.0087	0.0030	0.0000035	0.0000035	0.00040	0.0000015	0.99	0.000020	0.0000084	0.00022
11-Nov-15	13	500	480	7.4	19	#N/A	0.77	4.9	0.96	0.50	0.030	0.15	4.5	0.0063	0.00068	0.0093	0.0033	0.0000035	0.0000035	0.00025	0.0000015	1.1	0.000017	0.000010	0.00025
18-Nov-15	14	500	505	7.5	22	#N/A	0.40	6.6	1.0	0.51	0.030	0.15	4.8	0.0066	0.00071	0.0098	0.0035	0.0000035	0.0000035	0.00010	0.0000015	1.2	0.000015	0.000012	0.00028
25-Nov-15	15	500	475	7.3	17	#N/A	0.48	4.6	0.95	0.50	0.030	0.15	4.6	0.0074	0.00067	0.0093	0.0031	0.0000035	0.0000035	0.00020	0.0000020	1.1	0.000015	0.0000100	0.00028
2-Dec-15	16	500	490	7.1	18	#N/A	1.4	5.2	0.98	0.49	0.029	0.15	4.3	0.0081	0.00064	0.0088	0.0027	0.0000034	0.0000034	0.00029	0.0000025	1.0	0.000015	0.0000078	0.00029
9-Dec-15	17	500	495	7.6	19	#N/A	1.5	5.6	0.99	0.49	0.029	0.15	4.4	0.0076	0.00064	0.0089	0.0029	0.0000037	0.0000034	0.00051	0.0000027	1.1	0.000037	0.000011	0.00030
16-Dec-15	18	500	490	7.6	18	#N/A	1.3	4.8	0.98	0.49	0.029	0.15	4.6	0.0072	0.00064	0.0090	0.0030	0.0000039	0.0000034	0.00074	0.0000029	1.1	0.000059	0.000013	0.00032
23-Dec-15	19	500	495	8.1	15	#N/A	1.9	5.3	0.99	0.49	0.030	0.15	4.4	0.0059	0.00059	0.0078	0.0030	0.0000037	0.0000034	0.00062	0.0000022	1.1	0.000037	0.000011	0.00021
30-Dec-15	20	500	495	7.2	16	#N/A	0.65	4.7	0.99	0.50	0.030	0.15	4.3	0.0045	0.00054	0.0066	0.0030	0.0000035	0.0000035	0.00050	0.0000015	1.0	0.000015	0.0000084	0.00010
6-Jan-16	21	500	485	7.1	17	#N/A	0.84	4.5	0.97	0.49	0.030	0.15	4.3	0.0049	0.00059	0.0067	0.0030	0.0000034	0.0000034	0.00074	0.0000015	1.1	0.000015	0.0000052	0.00012
13-Jan-16	22	500	490	7.2	19	#N/A	0.87	5.0	0.98	0.49	0.029	0.15	4.4	0.0054	0.00064	0.0069	0.0030	0.0000034	0.0000034	0.00098	0.0000015	1.1	0.000015	0.0000020	0.00013
20-Jan-16	23	500	485	7.4	17	#N/A	1.2	4.6	0.97	0.49	0.029	0.15	4.3	0.0057	0.00064	0.0073	0.0030	0.0000034	0.0000034	0.00098	0.0000020	1.1	0.000015	0.0000049	0.00015
27-Jan-16	24	500	490	7.5	20	#N/A	1.4	5.3	0.98	0.49	0.029	0.15	4.3	0.0059	0.00064	0.0076	0.0029	0.0000034	0.0000034	0.00098	0.0000025	1.0	0.000015	0.0000078	0.00017
3-Feb-16	25	500	500	7.4	18	#N/A	1.7	5.1	1.0	0.49	0.030	0.15	4.5	0.0049	0.00067	0.0080	0.0029	0.0000034	0.0000034	0.00099	0.0000020	1.1	0.000015	0.0000096	0.00014
10-Feb-16	26	500	495	7.3	20	#N/A	0.98	5.4	0.99	0.50	0.030	0.15	4.6	0.0040	0.00069	0.0084	0.0028	0.0000035	0.0000035	0.00099	0.0000015	1.1	0.000015	0.000011	0.00012
17-Feb-16	27	500	490	7.6	15	#N/A	1.9	5.3	0.98	0.50	0.030	0.15	4.6	0.0051	0.00067	0.0081	0.0029	0.0000035	0.0000035	0.00100	0.0000015	1.1	0.000015	0.0000077	0.00057
24-Feb-16	28	500	500	7.4	17	#N/A	1.3	5.3	1.0	0.50	0.030	0.15	4.6	0.0063	0.00065	0.0079	0.0031	0.0000035	0.0000035	0.0010	0.0000015	1.1	0.000015	0.0000040	0.0010

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC8 (KAM092488)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
12-Aug-15	0	500	410	7.6	0.021	0.00061	0.0049	2.3	0.012	*< 0.01*	0.0033	0.0018	0.025	3.7	0.00067	0.92	0.0000040	14	0.096	10	0.000017	0.0021	0.00063	0.024	0.00038	0.0070	*< 0.002*
19-Aug-15	1	500	505	7.5	0.013	0.000070	0.0019	1.6	0.013	*< 0.01*	0.0015	0.0011	*< 0.003*	2.4	0.00024	0.60	*< 0.000002*	5.2	0.062	4.1	0.0000070	*< 0.00001*	0.00015	0.017	0.00014	*< 0.001*	*< 0.002*
26-Aug-15	2	500	495	7.5	*< 0.007*	0.00014	0.0013	0.88	0.0082	*< 0.01*	0.0011	0.00060	*< 0.003*	1.6	0.00014	0.45	0.0000050	2.5	0.036	1.9	0.0000060	0.000020	*< 0.00005*	0.021	0.00012	*< 0.001*	*< 0.002*
2-Sep-15	3	500	500	7.5	*< 0.007*	0.000090	0.0012	0.84	0.0063	*< 0.01*	0.00074	0.00040	*< 0.003*	1.5	0.000080	0.43	0.0000020	1.7	0.033	1.5	0.0000050	*< 0.00001*	*< 0.00005*	0.022	0.00011	*< 0.001*	*< 0.002*
9-Sep-15	4	500	495	7.5	*< 0.007*	0.000020	0.00096	0.82	0.0056	*< 0.01*	0.0016	0.00030	*< 0.003*	1.3	0.000080	0.40	0.0000040	1.1	0.031	4.0	0.0000080	0.00010	*< 0.00005*	0.020	0.00011	*< 0.001*	*< 0.002*
16-Sep-15	5	500	495	7.4	*< 0.007*	0.000020	0.0012	0.80	0.0048	*< 0.01*	0.00037	*< 0.0001*	*< 0.003*	1.3	0.000060	0.45	0.0000020	0.81	0.030	1.3	*< 0.000005*	0.000050	*< 0.00005*	0.020	0.000090	*< 0.001*	*< 0.002*
23-Sep-15	6	500	495	7.4	*< 0.007*	*< 0.00001*	0.00088	0.89	0.0051	0.010	0.00037	0.00020	*< 0.003*	1.2	*< 0.00004*	0.43	0.0000070	0.56	0.033	0.50	*< 0.000005*	*< 0.00001*	0.000060	0.019	0.000090	*< 0.001*	*< 0.002*
30-Sep-15	7	500	490	7.4	*< 0.007*	0.000010	0.00077	0.89	0.0047	*< 0.01*	0.00032	0.00030	*< 0.003*	1.1	*< 0.00004*	0.32	*< 0.000002*	0.43	0.030	0.90	*< 0.000005*	0.000080	0.000060	0.018	0.000080	*< 0.001*	*< 0.002*
7-Oct-15	8	500	500	7.5	*< 0.007*	0.000010	0.00067	0.79	0.0046	*< 0.01*	0.00042	0.00020	*< 0.003*	0.92	*< 0.00004*	0.31	*< 0.000002*	0.25	0.029	0.50	*< 0.000005*	0.000050	0.000070	0.017	0.000080	*< 0.001*	*< 0.002*
14-Oct-15	9	500	490	7.6	*< 0.007*	0.000060	0.00071	0.81	0.0042	*< 0.01*	0.00043	0.00020	*< 0.003*	0.90	*< 0.00004*	0.36	*< 0.000002*	0.21	0.029	0.40	*< 0.000005*	0.000050	*< 0.00005*	0.018	0.000070	0.0010	*< 0.002*
21-Oct-15	10	500	495	7.5	*< 0.007*	0.000050	0.00072	0.94	0.0046	*< 0.01*	0.0014	0.00020	*< 0.003*	0.93	*< 0.00004*	0.39	0.000010	0.19	0.033	0.40	*< 0.000005*	0.00013	0.000050	0.020	0.000070	*< 0.001*	*< 0.002*
28-Oct-15	11	500	510	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	12	500	495	7.4	*< 0.007*	0.000010	0.00054	0.84	0.0045	0.020	0.00088	0.00020	0.0030	0.79	*< 0.00004*	0.30	*< 0.000002*	0.11	0.030	0.30	*< 0.000005*	0.000020	*< 0.00005*	0.019	0.000070	*< 0.001*	*< 0.002*
11-Nov-15	13	500	480	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	14	500	505	7.5	0.0090	0.000010	0.00053	0.94	0.0053	*< 0.01*	0.00055	*< 0.0001*	*< 0.003*	0.74	0.00012	0.34	*< 0.000002*	0.090	0.034	0.10	*< 0.000005*	0.000030	0.000050	0.021	0.000050	*< 0.001*	*< 0.002*
25-Nov-15	15	500	475	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	16	500	490	7.1	*< 0.007*	0.000060	0.00044	0.87	0.0049	*< 0.01*	0.00026	0.00020	*< 0.003*	0.64	*< 0.00004*	0.31	*< 0.000002*	0.050	0.029	0.70	*< 0.000005*	0.000040	*< 0.00005*	0.021	0.000070	*< 0.001*	*< 0.002*
9-Dec-15	17	500	495	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	18	500	490	7.6	*< 0.007*	0.00023	0.00050	0.89	0.0054	*< 0.01*	0.00015	0.00020	*< 0.003*	0.61	*< 0.00004*	0.31	*< 0.000002*	0.060	0.032	0.20	*< 0.000005*	0.000080	*< 0.00005*	0.022	0.000080	0.0010	*< 0.002*
23-Dec-15	19	500	495	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	20	500	495	7.2	*< 0.007*	0.000050	0.00043	0.84	0.0054	0.010	0.00032	*< 0.0001*	*< 0.003*	0.50	*< 0.00004*	0.26	0.0000020	0.060	0.029	0.80	*< 0.000005*	*< 0.00001*	*< 0.00005*	0.019	0.000050	*< 0.001*	*< 0.002*
6-Jan-16	21	500	485	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	22	500	490	7.2	*< 0.007*	0.000040	0.00035	0.84	0.0055	*< 0.01*	0.00016	*< 0.0001*	*< 0.003*	0.48	0.00013	0.27	*< 0.000002*	0.030	0.028	*< 0.1*	*< 0.000005*	0.000030	*< 0.00005*	0.019	0.000040	*< 0.001*	*< 0.002*
20-Jan-16	23	500	485	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	24	500	490	7.5	*< 0.007*	*< 0.00001*	0.00034	0.85	0.0060	*< 0.01*	0.000060	*< 0.0001*	*< 0.003*	0.43	*< 0.00004*	0.27	*< 0.000002*	0.050	0.029	0.10	*< 0.000005*	0.000040	*< 0.00005*	0.021	0.000060	*< 0.001*	*< 0.002*
3-Feb-16	25	500	500	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	26	500	495	7.3	*< 0.007*	0.000010	0.00033	0.88	0.0066	*< 0.01*	0.00010	*< 0.0001*	*< 0.003*	0.40	0.000050	0.26	*< 0.000002*	0.050	0.030	0.70	*< 0.000005*	*< 0.00001*	*< 0.00005*	0.019	0.000030	*< 0.001*	*< 0.002*
17-Feb-16	27	500	490	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	28	500	500	7.4	*< 0.007*	0.000020	0.00032	0.84	0.0059	0.030	0.00011	*< 0.0001*	*< 0.003*	0.36	*< 0.00004*	0.040	*< 0.000002*	*< 0.01*	0.027	0.50	*< 0.000005*	0.000070	*< 0.00005*	0.020	0.000020	*< 0.001*	*< 0.002*
2-Mar-16	29	500	500	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	30	500	500	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC8 (KAM092488)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
12-Aug-15	0	500	410	7.6	0.0086	0.00025	0.0020	0.95	0.0048	0.0041	0.0014	0.00074	0.010	1.5	0.00027	0.38	0.0000016	5.5	0.039	4.2	0.0000070	0.00087	0.00026	0.0096	0.00016	0.0029	0.00082
19-Aug-15	1	500	505	7.5	0.0066	0.000035	0.00095	0.80	0.0066	0.0051	0.00075	0.00056	0.0015	1.2	0.00012	0.30	0.0000010	2.6	0.031	2.1	0.0000035	0.0000051	0.000076	0.0085	0.000071	0.00051	0.0010
26-Aug-15	2	500	495	7.5	0.0035	0.000069	0.00065	0.43	0.0040	0.0050	0.00052	0.00030	0.0015	0.81	0.000069	0.22	0.0000025	1.3	0.018	0.94	0.0000030	0.0000099	0.000025	0.010	0.000059	0.00050	0.00099
2-Sep-15	3	500	500	7.5	0.0035	0.000045	0.00058	0.42	0.0031	0.0050	0.00037	0.00020	0.0015	0.73	0.000040	0.22	0.0000010	0.83	0.016	0.75	0.0000025	0.0000050	0.000025	0.011	0.000055	0.00050	0.0010
9-Sep-15	4	500	495	7.5	0.0035	0.0000099	0.00048	0.41	0.0028	0.0050	0.00081	0.00015	0.0015	0.66	0.000040	0.20	0.0000020	0.54	0.015	2.0	0.0000040	0.000050	0.000025	0.010	0.000054	0.00050	0.00099
16-Sep-15	5	500	495	7.4	0.0035	0.0000099	0.00057	0.40	0.0024	0.0050	0.00018	0.000050	0.0015	0.65	0.000030	0.22	0.00000099	0.40	0.015	0.64	0.0000025	0.000025	0.000025	0.0097	0.000045	0.00050	0.00099
23-Sep-15	6	500	495	7.4	0.0035	0.0000050	0.00044	0.44	0.0025	0.0050	0.00018	0.000099	0.0015	0.58	0.000020	0.21	0.0000035	0.28	0.016	0.25	0.0000025	0.0000050	0.000030	0.0092	0.000045	0.00050	0.00099
30-Sep-15	7	500	490	7.4	0.0034	0.0000049	0.00038	0.44	0.0023	0.0049	0.00016	0.00015	0.0015	0.56	0.000020	0.16	0.00000098	0.21	0.015	0.44	0.0000025	0.000039	0.000029	0.0090	0.000039	0.00049	0.00098
7-Oct-15	8	500	500	7.5	0.0035	0.0000050	0.00034	0.40	0.0023	0.0050	0.00021	0.00010	0.0015	0.46	0.000020	0.16	0.0000010	0.13	0.015	0.25	0.0000025	0.000025	0.000035	0.0087	0.000040	0.00050	0.0010
14-Oct-15	9	500	490	7.6	0.0034	0.000029	0.00035	0.40	0.0021	0.0049	0.00021	0.000098	0.0015	0.44	0.000020	0.18	0.00000098	0.10	0.014	0.20	0.0000025	0.000025	0.000025	0.0090	0.000034	0.00049	0.00098
21-Oct-15	10	500	495	7.5	0.0035	0.000025	0.00035	0.46	0.0023	0.0050	0.00071	0.000099	0.0015	0.46	0.000020	0.19	0.0000050	0.094	0.016	0.20	0.0000025	0.000064	0.000025	0.0100	0.000035	0.00050	0.00099
28-Oct-15	11	500	510	7.7	0.0035	0.000015	0.00031	0.44	0.0022	0.0074	0.00057	0.000099	0.0015	0.42	0.000020	0.17	0.0000030	0.074	0.016	0.17	0.0000025	0.000037	0.000025	0.0097	0.000035	0.00050	0.00099
4-Nov-15	12	500	495	7.4	0.0035	0.0000050	0.00027	0.41	0.0022	0.0099	0.00044	0.000099	0.0015	0.39	0.000020	0.15	0.00000099	0.054	0.015	0.15	0.0000025	0.0000099	0.000025	0.0095	0.000035	0.00050	0.00099
11-Nov-15	13	500	480	7.4	0.0040	0.0000050	0.00027	0.44	0.0024	0.0075	0.00036	0.000075	0.0015	0.38	0.000040	0.16	0.0000010	0.050	0.016	0.100	0.0000025	0.000013	0.000025	0.0100	0.000030	0.00050	0.0010
18-Nov-15	14	500	505	7.5	0.0045	0.0000051	0.00027	0.47	0.0027	0.0051	0.00028	0.000051	0.0015	0.37	0.000061	0.17	0.0000010	0.045	0.017	0.051	0.0000025	0.000015	0.000025	0.011	0.000025	0.00051	0.0010
25-Nov-15	15	500	475	7.3	0.0040	0.000017	0.00024	0.45	0.0025	0.0050	0.00020	0.000074	0.0015	0.34	0.000040	0.16	0.00000100	0.035	0.016	0.20	0.0000025	0.000017	0.000025	0.010	0.000030	0.00050	0.00100
2-Dec-15	16	500	490	7.1	0.0034	0.000029	0.00021	0.43	0.0024	0.0049	0.00013	0.000098	0.0015	0.31	0.000020	0.15	0.00000098	0.025	0.014	0.34	0.0000025	0.000020	0.000025	0.010	0.000034	0.00049	0.00098
9-Dec-15	17	500	495	7.6	0.0034	0.000071	0.00023	0.43	0.0025	0.0049	0.00010	0.000098	0.0015	0.31	0.000020	0.15	0.00000098	0.027	0.015	0.22	0.0000025	0.000029	0.000025	0.010	0.000037	0.00049	0.00098
16-Dec-15	18	500	490	7.6	0.0034	0.00011	0.00025	0.44	0.0026	0.0049	0.000074	0.000098	0.0015	0.30	0.000020	0.15	0.00000098	0.029	0.016	0.098	0.0000025	0.000039	0.000025	0.011	0.000039	0.00049	0.00098
23-Dec-15	19	500	495	8.1	0.0034	0.000069	0.00023	0.43	0.0026	0.0049	0.00012	0.000074	0.0015	0.27	0.000020	0.14	0.00000099	0.030	0.015	0.25	0.0000025	0.000022	0.000025	0.0100	0.000032	0.00049	0.00099
30-Dec-15	20	500	495	7.2	0.0035	0.000025	0.00021	0.41	0.0026	0.0050	0.00016	0.000050	0.0015	0.25	0.000020	0.13	0.00000099	0.030	0.014	0.40	0.0000025	0.0000050	0.000025	0.0094	0.000025	0.00050	0.00099
6-Jan-16	21	500	485	7.1	0.0034	0.000022	0.00019	0.41	0.0027	0.0049	0.00012	0.000049	0.0015	0.24	0.000042	0.13	0.00000099	0.022	0.014	0.22	0.0000025	0.0000098	0.000025	0.0093	0.000022	0.00049	0.00099
13-Jan-16	22	500	490	7.2	0.0034	0.000020	0.00017	0.41	0.0027	0.0049	0.000078	0.000049	0.0015	0.24	0.000064	0.13	0.00000098	0.015	0.014	0.049	0.0000025	0.000015	0.000025	0.0093	0.000020	0.00049	0.00098
20-Jan-16	23	500	485	7.4	0.0034	0.000012	0.00017	0.41	0.0028	0.0049	0.000054	0.000049	0.0015	0.22	0.000042	0.13	0.00000098	0.020	0.014	0.049	0.0000025	0.000017	0.000025	0.0099	0.000025	0.00049	0.00098
27-Jan-16	24	500	490	7.5	0.0034	0.0000049	0.00017	0.42	0.0029	0.0049	0.000029	0.000049	0.0015	0.21	0.000020	0.13	0.00000098	0.025	0.014	0.049	0.0000025	0.000020	0.000025	0.010	0.000029	0.00049	0.00098
3-Feb-16	25	500	500	7.4	0.0034	0.0000049	0.00016	0.43	0.0031	0.0049	0.000039	0.000049	0.0015	0.20	0.000022	0.13	0.00000099	0.025	0.015	0.20	0.0000025	0.000012	0.000025	0.0099	0.000022	0.00049	0.00099
10-Feb-16	26	500	495	7.3	0.0035	0.0000050	0.00016	0.43	0.0033	0.0050	0.000050	0.000050	0.0015	0.20	0.000025	0.13	0.00000099	0.025	0.015	0.35	0.0000025	0.0000050	0.000025	0.0094	0.000015	0.00050	0.00099
17-Feb-16	27	500	490	7.6	0.0035	0.0000075	0.00016	0.43	0.0031	0.0100	0.000052	0.000050	0.0015	0.19	0.000022	0.074	0.00000100	0.015	0.014	0.30	0.0000025	0.000020	0.000025	0.0097	0.000012	0.00050	0.00100
24-Feb-16	28	500	500	7.4	0.0035	0.000010	0.00016	0.42	0.0029	0.015	0.000055	0.000050	0.0015	0.18	0.000020	0.020	0.0000010	0.0050	0.014	0.25	0.0000025	0.000035	0.000025	0.0099	0.000010	0.00050	0.0010

Notes:

Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Waste Rock Field Kinetic Tests

Sample ID		**FB-GO**				**FB-GT**				**FB-GS**				**FB-SO**				**FB-ST**				**FB-SS**				**FB-GGT**		**FB-GGS**	
Date Sampled		**17-Jun-14**	**25-Sep-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**6-Oct-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**6-Oct-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**25-Sep-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**25-Sep-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**25-Sep-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-15**	**22-Oct-15**	**17-Jun-15**	**22-Oct-15**
Weeks		**0**	**14**	**50**	**70**	**0**	**16**	**50**	**70**	**0**	**16**	**50**	**70**	**0**	**14**	**50**	**70**	**0**	**14**	**50**	**70**	**0**	**14**	**50**	**70**	**0**	**18**	**0**	**18**
Volume	L	4	0.55	8.2	5	4	1.5	3.8	4	4	1.5	8	4	4	2	7.8	4	4	2	6.2	3	4	2	7.8	3	1.5	5	4	6
Conductivity	uS/cm	1000	633	323	304	1100	1250	781	1230	1920	3310	1970	2110	2360	382	516	412	1130	1260	924	1200	1370	2810	1320	1710	991	1450	1530	1090
Hardness (as CaCO3)	mg/L	222		34.5	45.3	299	428	227	527	1160	2070	1090	1200	927	96	87.3	122	518	598	399	571	629		614	892	230	-	643	448
pH		7.8	8.19	8.34	8.18	7.68	8.06	8.04	7.89	7.61	7.66	7.94	7.97	7.86	7.68	8.19	8.13	7.77	7.75	8.02	7.88	7.65	7.81	8.07	8.08	7.94	6.43	8.27	7.69
TDS	mg/L	978		234	211	734	963	552	909	2060	3540	1730	1750	2380	294	330	265	874	1040	677	909	1300		1030	1350	758	1110	1210	785
Anions and Nutrients																													
T-Alkalinity (as CaCO3)	mg/L	339	148	114	75.6	243	91	69	62.7	251	97.4	61.8	75.7	499	41	88.9	84.5	118	45.6	70.1	50.7	294	146	78.6	91.4	123	1.2	227	41.4
T-Ammonia-N	mg/L	0.0261		0.01	*< 0.005*	0.0086	0.0254	0.0097	*< 0.005*	0.167	0.0117	0.0366	*< 0.005*	0.166	*< 0.005*	*< 0.005*	*< 0.005*	0.0444	*< 0.005*	*< 0.005*	*< 0.005*	0.293		0.0211	-	1.58	0.725	0.417	0.185
Nitrate-N	mg/L	3.62	0.0839	0.0081	0.218	0.431	*< 0.05*	*< 0.005*	0.041	2.43	1.53	0.722	1.08	3.15	*< 0.005*	*< 0.005*	*< 0.005*	0.97	*< 0.05*	*< 0.005*	0.26	0.947	*< 0.1*	*< 0.025*	0.025 *	1.23	0.015	0.403	0.066
Nitrite-N	mg/L	0.141		*< 0.001*	0.0011	0.023		0.0012	0.0020 *	0.045		*< 0.01*	0.0050 *	0.219		*< 0.001*	*< 0.001*	0.014		*< 0.001*	0.0020 *	0.013		*< 0.005*	0.0050 *	0.165	0.0020 *	0.0296	0.0698
Br	mg/L	*< 0.5*		*< 0.05*	*< 0.05*	*< 0.5*		*< 0.1*	*< 0.25*	*< 1*		*< 0.5*	*< 0.5*	*< 1*		*< 0.05*	*< 0.05*	*< 0.5*		*< 0.1*	*< 0.25*	*< 0.5*		*< 0.25*	*< 0.25*	*< 0.1*	*< 0.25*	*< 0.25*	*< 0.25*
Cl	mg/L	44.2	13.5	2.34	2.37	19.6	12.8	5.29	5.4	17	17	*< 5*	2.8	68	5.94	3.82	2.89	15	5.5	1.68	4.4	23.6	24	3.8	6.9	26.4	6	24.4	5
F	mg/L	0.7		0.581	0.868	0.51		0.373	0.345	*< 0.4*		0.43	0.19	0.69		0.471	0.52	0.5		0.409	0.217	0.83		0.36	0.25	*< 0.2*	0.095	*< 0.8*	0.861
S(6)	mg/L	109	150	51.8	63.9	301	572	310	570	1060	2280	1120	1180	732	133	158	109	516	633	416	575	451	1660	679	882	317	708	597	497
Cyanides																													
WAD Cyanide	mg/L	-	-	-	-	-	0.005	-	-	-	0.005	-	-	-	0.005	-	-	-	0.0148	-	-	-	-	-	-	-	-	-	-
T-Cyanide	mg/L	-	-	-	-	-	0.005	-	-	-	0.005	-	-	-	0.005	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-
Organic / Inorganic Carbon																													
DOC	mg/L	147	-	-	6.61	54	9.5	-	7.13	109	8.23	-	2.7	350	27.2	-	5.41	45.6	15.9	-	-	161	-	-	-	-	4.68	-	3.27
Total Metals																													
Al	mg/L	-	-	-	-	-	0.155	-	-	-	0.0252	-	-	-	0.198	-	-	-	0.128	-	-	-	-	-	-	-	-	-	-
Sb	mg/L	-	-	-	-	-	0.0103	-	-	-	0.0123	-	-	-	0.00336	-	-	-	0.00152	-	-	-	-	-	-	-	-	-	-
As	mg/L	-	-	-	-	-	0.0487	-	-	-	0.0147	-	-	-	0.0229	-	-	-	0.00301	-	-	-	-	-	-	-	-	-	-
Ba	mg/L	-	-	-	-	-	0.037	-	-	-	*< 0.02*	-	-	-	0.058	-	-	-	0.033	-	-	-	-	-	-	-	-	-	-
Be	mg/L	-	-	-	-	-	*< 0.001*	-	-	-	*< 0.001*	-	-	-	*< 0.001*	-	-	-	*< 0.001*	-	-	-	-	-	-	-	-	-	-
B	mg/L	-	-	-	-	-	*< 0.1*	-	-	-	*< 0.1*	-	-	-	*< 0.1*	-	-	-	*< 0.1*	-	-	-	-	-	-	-	-	-	-
Cd	mg/L	-	-	-	-	-	0.000015	-	-	-	*< 2E-05*	-	-	-	0.000041	-	-	-	0.000021	-	-	-	-	-	-	-	-	-	-
Ca	mg/L	-	-	-	-	-	96.3	-	-	-	376	-	-	-	22.9	-	-	-	124	-	-	-	-	-	-	-	-	-	-
Cr	mg/L	-	-	-	-	-	*< 0.001*	-	-	-	*< 0.001*	-	-	-	0.0019	-	-	-	0.0012	-	-	-	-	-	-	-	-	-	-
Co	mg/L	-	-	-	-	-	0.00071	-	-	-	0.00144	-	-	-	0.00116	-	-	-	0.00046	-	-	-	-	-	-	-	-	-	-
Cu	mg/L	-	-	-	-	-	0.0027	-	-	-	0.0023	-	-	-	0.004	-	-	-	0.002	-	-	-	-	-	-	-	-	-	-
Fe	mg/L	-	-	-	-	-	0.236	-	-	-	0.032	-	-	-	1.07	-	-	-	0.206	-	-	-	-	-	-	-	-	-	-
Pb	mg/L	-	-	-	-	-	*< 0.0005*	-	-	-	*< 0.0005*	-	-	-	0.00307	-	-	-	0.00114	-	-	-	-	-	-	-	-	-	-
Li	mg/L	-	-	-	-	-	0.0058	-	-	-	0.0125	-	-	-	*< 0.005*	-	-	-	0.012	-	-	-	-	-	-	-	-	-	-
Mg	mg/L	-	-	-	-	-	43.9	-	-	-	265	-	-	-	9.02	-	-	-	67.7	-	-	-	-	-	-	-	-	-	-
Mn	mg/L	-	-	-	-	-	0.0259	-	-	-	0.0449	-	-	-	0.118	-	-	-	0.0406	-	-	-	-	-	-	-	-	-	-
Hg	mg/L	0.000261	-	-	-	0.000211	0.000016	-	-	*< 0.00005*	*< 1E-05*	-	-	0.000365	0.000189	-	-	*< 0.00005*	*< 0.00001*	-	-	*< 0.00005*	-	-	-	-	-	-	-
Mo	mg/L	-	-	-	-	-	0.0512	-	-	-	0.0169	-	-	-	0.0014	-	-	-	0.0156	-	-	-	-	-	-	-	-	-	-
Ni	mg/L	-	-	-	-	-	0.0014	-	-	-	0.008	-	-	-	0.0019	-	-	-	0.0029	-	-	-	-	-	-	-	-	-	-
K	mg/L	-	-	-	-	-	22.1	-	-	-	28	-	-	-	4.4	-	-	-	15.5	-	-	-	-	-	-	-	-	-	-
Se	mg/L	-	-	-	-	-	0.00216	-	-	-	0.00625	-	-	-	0.00109	-	-	-	0.00695	-	-	-	-	-	-	-	-	-	-
Ag	mg/L	-	-	-	-	-	*< 2E-05*	-	-	-	*< 2E-05*	-	-	-	*< 0.00002*	-	-	-	*< 0.00002*	-	-	-	-	-	-	-	-	-	-
Na	mg/L	-	-	-	-	-	120	-	-	-	165	-	-	-	39.9	-	-	-	63	-	-	-	-	-	-	-	-	-	-
Tl	mg/L	-	-	-	-	-	0.00029	-	-	-	*< 0.0002*	-	-	-	*< 0.0002*	-	-	-	*< 0.0002*	-	-	-	-	-	-	-	-	-	-
Sn	mg/L	-	-	-	-	-	*< 0.0005*	-	-	-	*< 0.0005*	-	-	-	*< 0.0005*	-	-	-	*< 0.0005*	-	-	-	-	-	-	-	-	-	-
Ti	mg/L	-	-	-	-	-	0.019	-	-	-	0.03	-	-	-	*< 0.01*	-	-	-	0.025	-	-	-	-	-	-	-	-	-	-
U	mg/L	-	-	-	-	-	0.601	-	-	-	0.773	-	-	-	0.00394	-	-	-	0.0647	-	-	-	-	-	-	-	-	-	-
V	mg/L	-	-	-	-	-	*< 0.001*	-	-	-	*< 0.002*	-	-	-	0.0015	-	-	-	*< 0.001*	-	-	-	-	-	-	-	-	-	-
Zn	mg/L	-	-	-	-	-	0.0116	-	-	-	*< 0.005*	-	-	-	0.557	-	-	-	0.216	-	-	-	-	-	-	-	-	-	-

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Leachate Concentrations for Waste Rock Field Kinetic Tests

Sample ID		FB-GO				FB-GT				FB-GS				FB-SO				FB-ST				FB-SS				FB-GGT		FB-GGS	
Dissolved Metals																													
Al	mg/L	0.008	0.006	0.017	0.0479	0.009	0.005	0.003	0.0049	0.009	0.005	0.002	0.0091	0.006	0.024	0.003	0.003	0.011	0.014	0.003	0.0023	0.013	< 0.005	0.002	0.0037	0.012	0.0284	0.006	0.0037
Sb	mg/L	0.008	0.004	0.004	0.0041	0.018	0.01	0.01	0.00727	0.017	0.012	0.012	0.0102	0.009	0.001	0.003	0.00296	0.002	0.001	0.002	0.0013	0.059	0.043	0.041	0.0248	0.016	0.00887	0.009	0.0073
As	mg/L	0.047	0.032	0.041	0.0663	0.088	0.045	0.043	0.0354	0.066	0.015	0.013	0.0117	0.031	0.004	0.01	0.00915	0.013	0.003	0.003	0.00215	0.088	0.019	0.014	0.00924	0.639	0.154	0.126	0.0806
Ba	mg/L	0.107	0.044	0.015	0.0289	0.077	0.03	0.02	0.0262	0.049	< 0.02	0.011	0.0294	0.089	0.03	0.013	0.0541	0.052	0.029	0.023	0.0336	0.055	0.025	0.015	0.0229	0.049	0.0266	0.083	0.03
Be	mg/L	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	0	0.00014	< 0.00002	< 0.00002
Bi	mg/L	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.00005	0.00025 *	< 0.00005	< 0.00005
B	mg/L	0.077	< 0.1	0.023	0.02	0.068	< 0.1	0.026	0.021	0.036	< 0.1	0.022	0.038	0.044	< 0.1	0.012	< 0.01	0.035	< 0.1	0.029	0.021	0.033	< 0.1	0.018	0.015	0.225	0.171	0.105	0.064
Cd	mg/L	< 0.00002	< 0.00001	< 5E-06	< 5E-06	< 0.00002	0.000014	< 5E-06	0.0000185	0.000012	< 2E-05	< 5E-06	0.0000073	0.000013	0.000023	< 5E-06	0.0000061	< 0.00001	0.000021	< 5E-06	0.0000134	0.000011	< 0.00002	< 5E-06	< 5E-06	0.000111	0.000201	0.000091	0.0000728
Ca	mg/L	55.7	26.3	7.92	11.6	67.6	97.4	46.3	122	218	384	194	239	215	23.3	15.4	28.4	112	127	79	124	118	271	104	168	66.5	139	187	140
Cr	mg/L	0.001	0.002	0	0.00332	0	< 0.001	< 0.0001	0.00022	< 0.0001	< 0.001	0	< 0.0001	0.002	< 0.001	0.001	0.00229	< 0.0001	< 0.001	0	0.00052	0	< 0.001	< 0.0001	< 0.0001	< 0.0001	0.00050 *	< 0.0001	< 0.0001
Co	mg/L	0.001	< 0.0003	0	0.00016	0.001	0.001	0	0.00029	0.002	0.001	0	0.00035	0.001	0.001	< 0.0001	0.00012	0.001	0	0	0.00018	0.002	0.004	0.001	0.00114	0.021	0.0739	0.029	0.00535
Cu	mg/L	0.007	0.003	0.001	0.00216	0.01	0.002	0.001	0.00178	0.007	0.002	0.001	0.00126	0.006	0.003	0.001	0.00063	0.006	0.002	0.001	0.00087	0.011	0.003	0.001	0.00096	0.001	0.0011	0.003	0.00048
Fe	mg/L	< 0.01	< 0.03	< 0.01	0.044	< 0.01	< 0.03	< 0.01	< 0.01	< 0.01	< 0.03	< 0.01	< 0.01	< 0.01	0.07	< 0.01	< 0.01	< 0.01	0.03	< 0.01	< 0.01	< 0.01	< 0.03	< 0.01	< 0.01	< 0.01	0.013	< 0.01	< 0.01
Pb	mg/L	< 0.00005	< 0.0005	< 0.00005	0.000155	< 0.00005	< 0.0005	< 0.00005	0.000085	< 0.00005	< 0.0005	< 0.00005	< 0.00005	< 0.00005	0.00084	< 0.00005	0.000126	< 0.00005	0.00067	< 0.00005	0.000053	< 0.00005	< 0.0005	< 0.00005	< 0.00005	< 0.00005	< 0.00025	0.000053	< 0.00005
Li	mg/L	0.017	< 0.005	0.002	< 0.001	0.024	0.006	0.005	0.0034	0.023	0.012	0.008	0.0072	0.04	< 0.005	0.005	0.003	0.026	0.012	0.014	0.0115	0.025	0.015	0.011	0.009	0.028	0.0315	0.072	0.0184
Mg	mg/L	20.2	9.45	3.58	3.98	31.5	44.8	26.9	54	150	270	147	146	95	9.16	11.8	12.3	57.9	67.9	49	63.4	81.4	195	85.7	115	15.5	32.1	42.4	23.8
Mn	mg/L	0.027	0.007	0	0.00583	0.065	0.016	0.001	0.00753	0.141	0.044	0.006	0.0131	0.036	0.096	0.001	0.0114	0.049	0.036	0.002	0.0195	0.053	0.149	0.014	0.0527	3.73	24.8	3.73	3.09
Hg	mg/L	0.000232	0.000021	0.000008	0.000011	0.000195	< 1E-05	< 5E-06	0.000007	0.00002	< 1E-05	< 5E-06	< 5E-06	0.000309	0.000059	0.000009	0.0000052	0.000019	< 0.00001	< 5E-06	< 5E-06	< 0.00001	< 0.00001	< 5E-06	< 5E-06	0.000046	< 5E-06	< 5E-06	< 5E-06
Mo	mg/L	0.036	0.056	0.058	0.155	0.044	0.049	0.046	0.049	0.017	0.016	0.013	0.023	0.004	0.001	0.005	0.0059	0.023	0.015	0.022	0.0162	0.012	0.017	0.008	0.00719	0.001	0.00045	0.02	0.0195
Ni	mg/L	0.004	0.001	< 0.0005	< 0.0005	0.007	0.001	0.001	0.00071	0.011	0.008	0.004	0.00284	0.005	< 0.001	< 0.0005	< 0.0005	0.012	0.002	0.001	0.00131	0.063	0.058	0.021	0.0153	0.005	0.02	0.003	0.00068
P	mg/L	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
K	mg/L	20.1	8	5.1	5.64	30.8	22.3	16.6	21.6	29.2	28.6	19	22.3	30.3	4.5	6.7	6.53	21.1	15.9	16.1	18.5	40.8	40.9	26.6	32.9	28.3	40.6	44.6	25.6
Se	mg/L	0.005	0.002	0	0.00033	0.004	0.002	0.001	0.000441	0.005	0.006	0.001	0.000603	0.008	0.001	0.001	0.000314	0.013	0.007	0.002	0.00236	0.005	0.006	0.001	0.000487	0.001	0.00049	0.001	0.000186
Si	mg/L	7.1	-	4.1	4.48	5.5	-	3.67	3.36	4.83	-	2.93	3.01	6.17	-	3.12	2.93	4.61	-	3.85	2.74	3.72	-	2.09	1.52	16.4	19.9	7.89	6.78
Ag	mg/L	< 0.00001	< 0.00002	< 0.00001	< 0.00001	< 0.00001	< 2E-05	< 0.00001	< 0.00001	< 0.00001	< 2E-05	< 0.00001	< 0.00001	< 0.00001	< 0.00002	< 0.00001	< 0.00001	< 0.00001	< 0.00002	< 0.00001	< 0.00001	0	< 0.00002	< 0.00001	< 0.00001	< 0.00001	< 0.00005	< 0.00001	< 0.00001
Na	mg/L	142	98.2	56.2	43.6	118	120	74.1	71.3	104	168	83.7	70	241	41	71.3	38.5	68.2	64.7	52.1	49.8	95.5	148	64.3	60.7	105	94.5	89.4	59.3
Sr	mg/L	0.291	-	0.046	0.0609	0.374	-	0.258	0.578	1.67	-	1.49	1.72	1.27	-	0.127	0.183	3.04	-	3.67	7.37	4.01	-	5.92	9.87	0.259	0.498	0.586	0.318
Tl	mg/L	0	< 0.0002	0	0.000018	0	0	0	0.000157	0	< 0.0002	0	0.000054	0	< 0.0002	0	0.000066	0	< 0.0002	0	0.000014	0	< 0.0002	0	0.00005	0	0.000362	0	0.000063
Sn	mg/L	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	0	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	0	< 0.0005	< 0.0001	< 0.0001
Ti	mg/L	< 0.01	< 0.01	< 0.0003	0.00104	< 0.01	0.017	< 0.0003	< 0.0003	< 0.01	0.028	< 0.0003	< 0.0003	< 0.01	< 0.01	< 0.0003	< 0.0003	< 0.01	0.019	< 0.0003	< 0.0003	< 0.01	0.026	< 0.0003	< 0.0003	< 0.0003	< 0.0015	< 0.0003	< 0.0003
U	mg/L	0.133	0.164	0.075	0.0674	0.439	0.591	0.39	0.572	0.402	0.752	0.433	0.491	0.032	0.004	0.005	0.00624	0.047	0.064	0.044	0.0454	0.132	0.573	0.223	0.245	0.006	0.000797	0.526	0.123
V	mg/L	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.002	< 0.0005	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	0.001	< 0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0025	< 0.0005	< 0.0005
Zn	mg/L	0.004	0.019	< 0.001	0.0091	0.005	0.01	0.005	0.105	0.001	< 0.005	0.002	0.0762	0.003	0.56	0.024	0.152	< 0.001	0.214	0.03	0.107	0.002	0.012	0.001	0.0878	0.141	0.247	0.007	0.0075
Radioisotopes																													
Ra-226	Bq/L	-	-	0.026	0.026	-	-	0.026	0.026	-	-	0.06	0.057	-	-	<0.0100	0.011	-	-	0.025	0.023	-	-	0.016	0.028	-	0.028	0.39	0.099

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.1-4: Shake Flask Extraction Results for Waste Rock Kinetic Test Samples

Sample ID	Kinetic Test IDs	Volume Nanopure Water	Sample Weight	pH	Redox	Conductivity	Acidity (to pH 4.5)	Total Acidity (to pH 8.3)	Alkalinity	Sulphate
				meter	meter	meter	titration	titration	titration	Turbidity
		mL	g		mV	uS/cm	mg CaCO3/L	mg CaCO3/L	mg CaCO3/L	mg/L
GO	FB-GO, Col 5	750	250	7.88	384.27	101.19	#N/A	2.35	47.85	3
GS	FB-GS, HC3	750	250	7.84	375	198.51	#N/A	2.61	44.06	36
GT	FB-GT, Col6, HC3	750	250	7.76	381.34	89.22	#N/A	2.59	35.63	5
SO	FB-SO, Col3	750	250	7.96	371.58	142.46	#N/A	2.33	52.46	12
SS	FB-SS, HC2	750	250	7.98	368.65	156.94	#N/A	2.29	54.15	14
ST	FB-ST, HC1, Col 3	750	250	7.98	372.07	196.53	#N/A	2.3	47.91	36
KAM036824	HC7	750	250	7.65	364.74	204.91	#N/A	3.05	39.83	60
OKY Master	Col 13, HC5, FB-GGT	750	250	7.49	292.96	41.26	#N/A	2.63	9.69	6
OKY Master Sulphide	Col 14, HC6, FB-GGS	750	250	7.55	294.92	98.09	#N/A	3.02	34.85	11
KAM092488	HC8- No SFE performed due to limited sample size									

Appendix D.1-4: Shake Flask Extraction Results for Waste Rock Kinetic Test Samples

Sample ID	Ion Balance	Major Anions	Major Cations	Difference	Balance (%)	Dissolved Metals	Hardness CaCO3	Aluminum Al	Antimony Sb	Arsenic As	Barium Ba	Beryllium Be	Bismuth Bi
		Calc	Calc	Calc	Calc			ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
		meq/L	meq/L	meq/L	%		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GO		1.0195	1.022534239	-0.003034239	-0.001485891		24.2	0.119	0.0039	0.0615	0.027	< 0.000007	< 0.000007
GS		1.6312	1.87800014	-0.24680014	-0.070329457		72.2	0.072	0.0076	0.0379	0.0324	< 0.000007	< 0.000007
GT		0.816766667	0.871236699	-0.054470032	-0.032268912		28.4	0.155	0.0038	0.0757	0.0999	< 0.000007	< 0.000007
SO		1.2992	1.4093294	-0.1101294	-0.040660219		48	0.0541	0.0086	0.0257	0.0906	< 0.000007	< 0.000007
SS		1.374666667	1.534757719	-0.160091052	-0.055024991		51.8	0.115	0.0297	0.0674	0.113	< 0.000007	< 0.000007
ST		1.7082	1.829127954	-0.120927954	-0.034186243		61	0.053	0.0016	0.0157	0.0759	< 0.000007	< 0.000007
KAM036824		2.0466	1.913945841	0.132654159	0.033493908		77.5	0.105	0.0221	0.0655	0.0232	0.000008	< 0.000007
OKY Master		0.321219355	0.403744358	-0.082525003	-0.113833288		0.89	0.183	0.0071	0.167	0.00162	0.000012	< 0.000007
OKY Master Sulphide		0.927424731	0.933909099	-0.006484368	-0.003483721		25.1	0.108	0.003	0.0423	0.0077	0.000008	< 0.000007
KAM092488													

Appendix D.1-4: Shake Flask Extraction Results for Waste Rock Kinetic Test Samples

Sample ID	Boron B	Cadmium Cd	Calcium Ca	Chromium Cr	Cobalt Co	Copper Cu	Iron Fe	Lead Pb	Lithium Li	Magnesium Mg	Manganese Mn	Mercury Hg	Molybdenum Mo	Nickel Ni
	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L
GO	0.0173	0.000009	6.96	0.00025	0.000099	0.0017	0.033	0.00005	0.00156	1.65	0.0022	0.02	0.0146	0.0009
GS	0.0081	0.000006	16.3	< 0.00003	0.000072	0.00109	< 0.002	< 0.00001	0.00292	7.67	0.0092	< 0.01	0.00359	0.0006
GT	0.0095	0.000007	7.5	< 0.00003	0.000091	0.00114	0.012	0.00003	0.00164	2.36	0.0036	0.01	0.00709	0.0007
SO	0.0095	0.000004	13.9	0.00027	0.000079	0.00094	0.006	0.00001	0.00283	3.23	0.0019	0.02	0.00494	0.0006
SS	0.0086	0.000004	11.5	0.00009	0.000077	0.00126	0.004	0.00002	0.00324	5.6	0.0049	< 0.01	0.00149	0.0024
ST	0.0132	0.000004	15.2	0.00017	0.000115	0.00203	0.01	0.00001	0.00363	5.6	0.0041	< 0.01	0.0076	0.0022
KAM036824	0.0093	< 0.000003	18.4	0.00017	0.000587	0.00085	0.024	0.0001	0.00337	7.64	0.0233	< 0.01	0.00063	0.0067
OKY Master	0.0246	0.000005	0.24	0.00005	0.00009	0.00162	0.103	0.00075	0.00281	0.069	0.0215	0.01	0.00282	< 0.0001
OKY Master Sulphide	0.021	< 0.000003	7.82	0.00004	0.000122	0.00074	0.033	0.0001	0.00744	1.35	0.0814	< 0.01	0.00513	< 0.0001
KAM092488														

Appendix D.1-4: Shake Flask Extraction Results for Waste Rock Kinetic Test Samples

Sample ID	Phosphorus P	Potassium K	Selenium Se	Silicon Si	Silver Ag	Sodium Na	Strontium Sr	Sulphur (S)	Thallium Tl	Tin Sn	Titanium Ti	Uranium U	Vanadium V	Zinc Zn	Zirconium Zr
	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GO	0.044	3.51	0.00012	3.97	< 0.000002	9.83	0.0345	1.26	0.000026	0.00009	0.00091	0.0106	0.00079	< 0.001	< 0.002
GS	< 0.009	5.73	0.00007	2.59	< 0.000002	6.35	0.119	16.5	0.00002	0.00003	0.00012	0.0101	0.00083	0.001	< 0.002
GT	0.018	3.65	0.00014	2.4	< 0.000002	4.42	0.0504	3.01	0.000087	0.0001	0.0003	0.0108	0.00053	< 0.001	< 0.002
SO	< 0.009	3.67	0.00026	2.82	< 0.000002	8.05	0.0803	5.63	0.000071	0.00007	0.00021	0.00125	0.00028	< 0.001	< 0.002
SS	< 0.009	8.23	0.00021	2.2	< 0.000002	5.97	0.68	6.98	0.000022	0.00007	0.00039	0.0072	0.00304	< 0.001	< 0.002
ST	< 0.009	6.54	0.00075	3.45	< 0.000002	9.55	0.936	15.1	0.00002	0.00005	0.00064	0.00453	0.00098	0.001	< 0.002
KAM036824	< 0.003	4.68	0.0001	1.19	0.000033	5.26	0.0945	19.3	0.000038	0.00004	0.00039	0.00766	0.00102	< 0.001	< 0.002
OKY Master	0.025	3.98	< 0.001	7.14	0.000003	5.79	0.00119	2.5	0.000033	0.00004	0.00327	0.000469	0.00037	0.001	< 0.002
OKY Master Sulphide	0.013	6.16	< 0.001	5.26	0.000002	5.97	0.0185	3.9	0.000044	< 0.00001	0.0011	0.00191	0.00103	< 0.001	< 0.002
KAM092488															

APPENDIX D.2: KINETIC TEST RESULTS FOR ORE

Appendix D.2-1: Overview of Operating Procedures for the Coffee Gold Mine Ore Kinetic Tests

Kinetic Test ID	Test Sample ID	Sample Description	Type of Test	Lithology	Weathering Facies	Column Dimensions		Dry Wt. of Sample (kg)	Temp (°C)	Operation Procedure	Sampling Frequency	Total Volume of Initial Flushings (mL)	Flushing Rate/ Weekly Input* (mL)	Start Date	Test Status	Cycles/ Weeks
						Inner Diameter (cm)	Length (cm)									
Col 7	72139B	Kona Oxide Ore	Unsaturated Column	Granite	Oxide	21.0	20.5	4.39	4°	Trickle Leach	Biweekly	750	variable	22-Apr-15	active	45
Col 8	72140B	Kona Transition Ore	Unsaturated Column	Granite	Transition	21.0	20.5	4.35	4°	Trickle Leach	Biweekly	700	variable	22-Apr-15	active	45
Col 9	50% 72135B, 50% 72136B	Latte Oxide Ore	Unsaturated Column	Schist	Oxide	21.0	20.5	5	4°	Trickle Leach	Biweekly	700	variable	22-Apr-15	active	45
Col 10	50% 72137B, 50% 72138B	Latte Transition Ore	Unsaturated Column	Schist	Transition	21.0	20.5	5	4°	Trickle Leach	Biweekly	700	variable	22-Apr-15	active	45
Col 11	50% 72144B, 50% 72145B	Supremo Oxide Ore	Unsaturated Column	Gneiss	Oxide	21.0	20.5	5	4°	Trickle Leach	Biweekly	700	variable	22-Apr-15	active	45
Col 12	72146B	Supremo Transition Ore	Unsaturated Column	Gneiss	Transition	21.0	20.5	4.33	4°	Trickle Leach	Biweekly	750	variable	22-Apr-15	active	45

Notes:
Columns and humidity cells are composed of Plexiglas with an acrylic perforated disk & nylon mesh
No sample preparation was conducted prior to leachate sampling for any tests
* generally 400-500 mL, see individual leachate results in Appendix D.2-3 for specific input volumes

Appendix D.2-2 Static Test Results for Ore Kinetic Test Samples

Acid-Base Accounting Results

Kinetic Tests	Description	Test Sample ID	Lithology	Weathering Facies	Rinse pH	Paste pH	TIC	CaNP	Total C	Total S	S(SO4)	S(S-2)	Insoluble S	AP	Sobek NP	Siderite NP	Sobek NNP	Siderite NNP	Fizz Test
					s.u.	s.u.	%	kg $CaCO_3$/t	%	%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	
				Method Code	*Sobek*	*Sobek*	*CSB02V*	*Calc.*	*CSA06V*	*CSA06V*	*CSA07V*	*CSA08D*	*Calc.*	*Calc.*	*Sobek*	*Siderite Corr.*	*Calc.*	*Calc.*	*Sobek*
				Limit of Detection	*0.20*	*0.20*	*0.01*	*#N/A*	*0.005*	*0.005*	*0.01*	*0.01*	*#N/A*	*#N/A*	*0.5*	*0.5*	*#N/A*	*#N/A*	*#N/A*
Col 7	Kona Oxide	72139B	Granite	Oxide	5.7	5.9	0.020	1.7	0.024	0.027	*<0.01*	0.010	0.017	0.31	0.73	7.1	0.41	6.8	none
Col 8	Kona 80% CN	72140B	Granite	Transition	4.4	4.9	0.020	1.7	0.039	0.15	0.020	0.11	0.021	3.4	0.48	7.0	-3.0	3.6	none
Col 9	Latte Oxide Ore	50% 72135B, 50% 72136B	Schist	Oxide	7.4	7.5	1.5	125	1.6	0.14	0.035	0.090	0.017	2.8	79	105	76	102	moderate
Col 10	Latte Transition Ore	50% 72137B, 50% 72138B	Schist	Transition	7.4	7.4	1.8	148	1.8	0.54	0.050	0.44	0.052	14	100	129	86	115	moderate
Col 11	Supremo Oxide Ore	50% 72144B, 50% 72145B	Gneiss	Oxide	7.4	7.3	0.060	5.0	0.082	0.024	*<0.01*	*<0.01*	0.024	0.31	8.5	15	8.5	15	none
Col 12	Supremo 80%	72146B	Gneiss	Transition	7.3	7.5	0.40	33	0.44	0.13	0.020	0.090	0.018	2.8	38	44	35	42	slight

Notes:
Values in grey italics are below the analytical detection limit
CaNP = carbonate NP calculated from total inorganic carbon (TIC)
NNP = net neutralization potential, derived by subtracting acid potential (AP) from NP

Appendix D.2-2 Static Test Results for Ore Kinetic Test Samples

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Description	Test Sample ID	Lithology	Weathering Facies	Ag	Al	As	B	Ba	Be	Bi	Ca	Flushing Rate/ Weekly Input* (mL)	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Lu	Mg	Mn
					ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm
				Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
				Limit of Detection	*0.01*	*0.01*	*1*	*10*	*5*	*0.1*	*0.02*	*0.01*	*0.01*	*0.05*	*0.1*	*1*	*0.05*	*0.5*	*0.01*	*0.1*	*0.1*	*0.05*	*0.01*	*0.02*	*0.01*	*0.1*	*1*	*0.01*	*0.01*	*2*
Col 7	Kona Oxide	72139B	Granite	Oxide	0.080	0.41	3080	*<10*	64	0.50	0.080	0.050	0.060	26	1.2	77	1.5	0.80	1.3	1.4	*<0.1*	0.32	0.83	*<0.02*	0.13	15	*<1*	0.13	0.020	114
Col 8	Kona 80% CN	72140B	Granite	Transition	0.090	0.34	5770	*<10*	44	0.40	0.10	0.050	0.040	24	1.9	76	1.4	3.8	1.5	1.2	*<0.1*	0.27	4.0	*<0.02*	0.12	14	*<1*	0.11	0.010	217
Col 9	Latte Oxide Ore	50% 72135B, 50% 72136B	Schist	Oxide	0.25	0.44	1265	*<10*	548	1.1	0.52	3.9	0.10	52	11	86	2.1	20	2.7	1.5	*<0.1*	0.13	0.48	0.020	0.21	28	1.0	0.20	0.73	545
Col 10	Latte Transition Ore	50% 72137B, 50% 72138B	Schist	Transition	0.29	0.65	1215	*<10*	313	0.85	0.48	4.0	0.090	52	11	83	2.5	21	2.6	2.2	*<0.1*	0.11	0.47	0.020	0.27	29	2.5	0.20	1.2	502
Col 11	Supremo Oxide Ore	50% 72144B, 50% 72145B	Gneiss	Oxide	0.11	0.43	940	*<10*	198	0.95	0.21	0.32	0.060	54	5.6	84	1.9	4.1	1.6	1.3	*<0.1*	0.17	0.96	*<0.02*	0.20	32	1.0	0.17	0.10	300
Col 12	Supremo 80%	72146B	Gneiss	Transition	0.16	0.56	1700	*<10*	191	0.90	0.30	1.1	0.040	57	6.6	107	2.4	3.5	1.8	1.9	*<0.1*	0.17	1.2	*<0.02*	0.26	34	2.0	0.17	0.42	396

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.2-2 Static Test Results for Ore Kinetic Test Samples

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Description	Test Sample ID	Lithology	Weathering Facies	Mo	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
					ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
				Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
				Limit of Detection	*0.05*	*0.01*	*0.05*	*0.5*	*0.005*	*0.2*	*0.2*	*0.01*	*0.05*	*0.1*	*1*	*0.3*	*0.5*	*0.05*	*0.02*	*0.05*	*0.1*	*0.01*	*0.02*	*0.05*	*1*	*0.1*	*0.05*	*0.1*	*1*	*0.5*
Col 7	Kona Oxide	72139B	Granite	Oxide	1.9	*<0.01*	0.41	1.9	0.013	15	11	0.020	37	2.5	*<1*	*<0.3*	18	*<0.05*	0.24	*<0.05*	18	*<0.01*	0.56	9.6	10	0.20	7.2	0.80	18	12
Col 8	Kona 80% CN	72140B	Granite	Transition	2.3	*<0.01*	0.34	2.3	0.014	16	8.8	0.14	128	2.3	*<1*	0.30	21	*<0.05*	0.22	*<0.05*	17	*<0.01*	1.2	9.7	8.0	0.10	6.3	0.70	19	11
Col 9	Latte Oxide Ore	50% 72135B, 50% 72136B	Schist	Oxide	1.5	0.010	*<0.05*	52	0.043	17	12	0.14	21	4.8	*<1*	0.40	135	*<0.05*	0.50	0.060	12	*<0.01*	0.33	2.8	18	0.70	14	1.3	55	4.4
Col 10	Latte Transition Ore	50% 72137B, 50% 72138B	Schist	Transition	2.8	0.015	0.070	44	0.043	17	16	0.54	36	5.2	*<1*	0.45	165	*<0.05*	0.51	0.070	12	0.010	0.57	2.6	23	0.25	14	1.4	48	3.4
Col 11	Supremo Oxide Ore	50% 72144B, 50% 72145B	Gneiss	Oxide	2.0	0.010	*<0.05*	17	0.026	13	12	0.010	40	2.9	*<1*	0.55	24	*<0.05*	0.38	*<0.05*	25	*<0.01*	0.68	13	15	0.45	11	1.1	26	5.7
Col 12	Supremo 80%	72146B	Gneiss	Transition	3.1	0.010	0.070	12	0.030	14	17	0.12	20	2.8	*<1*	0.30	49	*<0.05*	0.40	0.060	25	*<0.01*	1.2	11	14	0.20	11	1.1	27	6.1

Notes:

Values in grey italics are below the analytical detection limit

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 7 (Kona Granite Oxide Ore)

Date	Cycle	Week	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Flushing Rate/ Weekly Input* (mL)	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
	No.		Input	Output		umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	750	300	7.6	622	#N/A	5.9	43	242	23	0.090	*< 0.3*	159	0.0084	0.028	0.30	0.00032	*< 7E-06*	*< 7E-06*	0.028	0.000011	45	0.000040	0.0080
6-May-15	2	3	400	350	7.6	281	#N/A	3.0	20	96	6.0	0.18	*< 0.3*	49	0.10	0.029	0.28	0.00088	*< 7E-06*	*< 7E-06*	0.019	*< 3E-06*	14	*< 3E-05*	0.0013
20-May-15	3	5	400	390	7.7	167	#N/A	2.9	16	45	3.0	0.23	*< 0.3*	22	0.052	0.028	0.41	0.00024	*< 7E-06*	*< 7E-06*	0.018	*< 3E-06*	6.0	*< 3E-05*	0.00040
3-Jun-15	4	7	400	270	7.7	128	#N/A	3.3	21	32	2.0	0.25	*< 0.3*	16	0.24	0.030	0.47	0.00086	0.0000070	*< 7E-06*	0.021	*< 3E-06*	4.4	0.000040	0.00024
17-Jun-15	5	9	500	470	7.5	85	#N/A	3.2	18	18	1.2	0.25	*< 0.3*	9.0	0.11	0.032	0.70	0.00043	*< 7E-06*	*< 7E-06*	0.018	0.0000050	2.5	0.000030	0.00016
1-Jul-15	6	11	500	475	7.8	69	#N/A	3.0	18	11	*< 1*	0.26	*< 0.3*	7.0	0.16	0.031	0.71	0.00050	*< 7E-06*	*< 7E-06*	0.015	*< 3E-06*	2.0	*< 3E-05*	0.00011
15-Jul-15	7	13	500	460	7.5	61	#N/A	3.2	21	8.0	*< 1*	0.25	*< 0.3*	7.5	0.20	0.027	0.59	0.00063	*< 7E-06*	*< 7E-06*	0.017	*< 3E-06*	2.0	0.000030	0.00014
29-Jul-15	8	15	400	375	7.6	60	#N/A	2.0	17	9.0	1.0	0.44	*< 0.3*	6.8	0.34	0.027	0.55	0.0011	0.000015	0.000012	0.020	*< 3E-06*	1.9	0.00011	0.00020
12-Aug-15	9	17	400	405	7.4	56	#N/A	1.9	16	8.0	*< 1*	0.24	*< 0.3*	7.4	0.12	0.025	0.53	0.00037	*< 7E-06*	*< 7E-06*	0.016	*< 3E-06*	2.1	0.000040	0.000096
26-Aug-15	10	19	500	470	7.4	53	#N/A	2.0	14	7.0	1.0	0.25	0.30	6.9	0.26	0.025	0.54	0.0010	0.000012	0.0000070	0.015	0.0000030	1.9	0.000055	0.000093
9-Sep-15	11	21	500	485	7.4	46	#N/A	2.1	13	6.0	*< 1*	0.25	*< 0.3*	6.3	0.41	0.025	0.56	0.0017	0.000016	*< 7E-06*	0.014	*< 3E-06*	1.8	0.000070	0.000089
23-Sep-15	12	23	500	475	7.4	49	#N/A	1.5	14	5.0	1.0	0.24	0.30	6.7	0.26	0.024	0.51	0.0010	0.000012	0.0000070	0.012	0.0000030	1.9	0.000065	0.000074
7-Oct-15	13	25	500	385	7.6	46	#N/A	1.8	16	5.0	*< 1*	0.23	-	7.1	0.10	0.024	0.46	0.00033	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	2.0	0.000060	0.000059
21-Oct-15	14	27	400	400	7.5	42	#N/A	1.4	12	5.0	*< 1*	0.23	-	6.9	0.017	0.022	0.44	0.00018	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	1.9	0.000070	0.000075
4-Nov-15	15	29	400	385	7.4	42	#N/A	1.8	11	5.0	*< 1*	0.22	-	7.1	0.024	0.017	0.43	0.00018	*< 7E-06*	*< 7E-06*	0.0067	*< 3E-06*	2.0	0.000040	0.0000050
18-Nov-15	16	31	400	385	7.7	42	#N/A	0.90	13	5.0	*< 1*	0.22	-	7.3	0.16	0.018	0.44	0.00065	*< 7E-06*	*< 7E-06*	0.0084	*< 3E-06*	2.0	0.000040	0.000080
2-Dec-15	17	33	400	380	7.1	45	#N/A	2.9	11	4.0	*< 1*	0.20	-	9.2	0.055	0.018	0.42	0.00095	*< 7E-06*	*< 7E-06*	0.011	0.0000030	2.6	0.000050	0.00041
16-Dec-15	18	35	400	370	8.1	43	#N/A	3.1	13	4.0	*< 1*	0.19	-	9.0	0.36	0.019	0.42	0.0012	0.000017	*< 7E-06*	0.012	*< 3E-06*	2.5	0.000060	0.000082
30-Dec-15	19	37	400	375	7.1	41	#N/A	2.1	9.1	4.0	*< 1*	0.20	-	8.8	0.12	0.016	0.37	0.00046	*< 7E-06*	*< 7E-06*	0.0086	0.0000050	2.4	0.000070	0.000082
13-Jan-16	20	39	400	360	7.0	46	#N/A	2.2	9.0	4.0	*< 1*	0.18	-	9.5	0.067	0.016	0.31	0.00031	0.000031	*< 7E-06*	0.015	0.000010	2.6	0.000050	0.00010
27-Jan-16	21	41	400	370	6.9	44	#N/A	3.6	9.6	3.0	*< 1*	0.19	-	9.6	0.068	0.016	0.35	0.00063	*< 7E-06*	*< 7E-06*	0.0090	0.0000040	2.6	*< 3E-05*	0.000081
10-Feb-16	22	43	400	400	7.0	43	#N/A	2.7	9.8	3.0	*< 1*	0.16	-	9.4	0.10	0.016	0.37	0.00061	*< 7E-06*	*< 7E-06*	0.0070	0.0000050	2.6	*< 3E-05*	0.000069
24-Feb-16	23	45	400	355	7.1	44	#N/A	3.0	9.0	3.0															
9-Mar-16	24	47	400	375	7.1	40	#N/A	3.0	9.4	3.0															

Calculated Loading Rates for Col 7

Date	Cycle	Week	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
-	No.	-	Input	Output	-	umhos/cm	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	750	300	7.6	622	#N/A	0.40	2.9	17	1.6	0.0062	0.021	11	0.00057	0.0019	0.021	0.000022	0.00000048	0.00000048	0.0019	0.00000075	3.1	0.0000027	0.00055
6-May-15	2	3	400	350	7.6	281	#N/A	0.12	0.81	3.8	0.24	0.0072	0.012	1.9	0.0041	0.0012	0.011	0.000035	0.00000028	0.00000028	0.00077	0.00000012	0.55	0.0000012	0.000050
20-May-15	3	5	400	390	7.7	167	#N/A	0.13	0.70	2.0	0.13	0.010	0.013	0.96	0.0023	0.0013	0.018	0.000011	0.00000031	0.00000031	0.00080	0.00000013	0.27	0.0000013	0.000018
3-Jun-15	4	7	400	270	7.7	128	#N/A	0.10	0.66	0.98	0.062	0.0077	0.0092	0.49	0.0075	0.00093	0.014	0.000026	0.00000022	0.00000022	0.00065	0.000000092	0.14	0.0000012	0.0000073
17-Jun-15	5	9	500	470	7.5	85	#N/A	0.17	0.95	0.96	0.064	0.013	0.016	0.48	0.0056	0.0017	0.037	0.000023	0.00000037	0.00000037	0.00098	0.00000027	0.14	0.0000016	0.0000086
1-Jul-15	6	11	500	475	7.8	69	#N/A	0.16	0.95	0.60	0.054	0.014	0.016	0.38	0.0084	0.0017	0.038	0.000027	0.00000038	0.00000038	0.00080	0.00000016	0.11	0.0000016	0.0000062
15-Jul-15	7	13	500	460	7.5	61	#N/A	0.17	1.1	0.42	0.052	0.013	0.016	0.39	0.011	0.0014	0.031	0.000033	0.00000037	0.00000037	0.00091	0.00000016	0.11	0.0000016	0.0000075
29-Jul-15	8	15	400	375	7.6	60	#N/A	0.085	0.73	0.38	0.043	0.019	0.013	0.29	0.015	0.0011	0.024	0.000046	0.00000064	0.00000051	0.00086	0.00000013	0.081	0.0000047	0.0000085
12-Aug-15	9	17	400	405	7.4	56	#N/A	0.089	0.74	0.37	0.046	0.011	0.014	0.34	0.0053	0.0011	0.024	0.000017	0.00000032	0.00000032	0.00076	0.00000014	0.095	0.0000018	0.0000044
26-Aug-15	10	19	500	470	7.4	53	0.00	0.11	0.77	0.37	0.054	0.013	0.016	0.37	0.014	0.0013	0.029	0.000056	0.00000062	0.00000037	0.00082	0.00000016	0.10	0.0000029	0.0000050
9-Sep-15	11	21	500	485	7.4	46	#N/A	0.11	0.70	0.33	0.055	0.014	0.017	0.35	0.023	0.0014	0.031	0.000095	0.00000088	0.00000039	0.00078	0.00000017	0.097	0.0000039	0.0000049
23-Sep-15	12	23	500	475	7.4	49	#N/A	0.083	0.74	0.27	0.054	0.013	0.016	0.36	0.014	0.0013	0.028	0.000055	0.00000062	0.00000038	0.00067	0.00000016	0.10	0.0000035	0.0000040
7-Oct-15	13	25	500	385	7.6	46	#N/A	0.079	0.68	0.22	0.044	0.010		0.31	0.0046	0.0010	0.020	0.000014	0.00000031	0.00000031	0.00047	0.00000013	0.086	0.0000026	0.0000026
21-Oct-15	14	27	400	400	7.5	42	#N/A	0.063	0.56	0.23	0.046	0.010		0.31	0.00076	0.00099	0.020	0.0000082	0.00000032	0.00000032	0.00062	0.00000014	0.087	0.0000032	0.0000034
4-Nov-15	15	29	400	385	7.4	42	#N/A	0.081	0.49	0.22	0.044	0.0096		0.31	0.0010	0.00076	0.019	0.0000079	0.00000031	0.00000031	0.00029	0.00000013	0.086	0.0000018	0.00000022
18-Nov-15	16	31	400	385	7.7	42	#N/A	0.040	0.56	0.22	0.044	0.0096		0.32	0.0070	0.00079	0.019	0.000029	0.00000031	0.00000031	0.00037	0.00000013	0.087	0.0000018	0.0000035
2-Dec-15	17	33	400	380	7.1	45	#N/A	0.12	0.49	0.17	0.043	0.0087		0.40	0.0024	0.00079	0.018	0.000041	0.00000030	0.00000030	0.00047	0.00000013	0.11	0.0000022	0.000018
16-Dec-15	18	35	400	370	8.1	43	#N/A	0.13	0.55	0.17	0.042	0.0080		0.38	0.015	0.00078	0.018	0.000048	0.00000072	0.00000029	0.00052	0.00000013	0.10	0.0000025	0.0000035
30-Dec-15	19	37	400	375	7.1	41	#N/A	0.090	0.39	0.17	0.043	0.0085		0.38	0.0051	0.00066	0.016	0.000020	0.00000030	0.00000030	0.00037	0.00000021	0.10	0.0000030	0.0000035
13-Jan-16	20	39	400	360	7.0	46	#N/A	0.090	0.37	0.16	0.041	0.0074		0.39	0.0027	0.00064	0.013	0.000013	0.0000013	0.00000029	0.00062	0.00000041	0.11	0.0000021	0.0000042
27-Jan-16	21	41	400	370	6.9	44	#N/A	0.15	0.40	0.13	0.042	0.0080		0.40	0.0028	0.00067	0.015	0.000027	0.00000029	0.00000029	0.00038	0.00000017	0.11	0.0000013	0.0000034
10-Feb-16	22	43	400	400	7.0	43	#N/A	0.12	0.44	0.14	0.046	0.0073		0.43	0.0047	0.00071	0.017	0.000028	0.00000032	0.00000032	0.00032	0.00000023	0.12	0.0000014	0.0000031
24-Feb-16	23	45	400	355	7.1	44	#N/A	0.12	0.36	0.12															
9-Mar-16	24	47	400	375	7.1	40	#N/A	0.13	0.40	0.13															

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 7 (Kona Granite Oxide Ore)

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	750	300	0.0069	*< 0.007*	0.00018	0.0035	11	0.75	0.28	0.00044	0.0039	0.015	7.4	0.0019	5.7	0.000088	67	0.36	85	0.00025	0.00014	0.000080	0.0015	0.00014	0.0080	*< 0.002*
6-May-15	2	3	400	350	0.0039	0.0090	0.000020	0.0011	3.4	0.15	0.030	0.0020	0.0013	0.0050	3.8	*< 0.001*	2.7	0.000014	32	0.091	35	0.000094	*< 1E-05*	0.00020	0.00096	0.00015	0.0030	*< 0.002*
20-May-15	3	5	400	390	0.0028	*< 0.007*	0.000020	0.00066	1.6	0.058	0.020	0.0071	0.00080	0.010	2.5	0.00029	2.4	0.000017	19	0.040	15	0.000066	0.000060	0.00016	0.00050	0.00012	*< 0.001*	*< 0.002*
3-Jun-15	4	7	400	270	0.0031	0.028	0.00013	0.00061	1.2	0.035	0.020	0.0032	0.00050	0.010	2.2	0.00018	2.6	0.000013	16	0.029	11	0.000056	0.00034	0.00063	0.0012	0.00033	0.0020	*< 0.002*
17-Jun-15	5	9	500	470	0.0012	0.013	0.000030	0.00044	0.65	0.021	0.010	0.0075	0.00030	0.025	1.6	0.00022	2.2	0.000011	12	0.017	6.9	0.000054	0.000030	0.00025	0.00041	0.00018	*< 0.001*	*< 0.002*
1-Jul-15	6	11	500	475	0.00091	0.016	0.000020	0.00041	0.52	0.015	0.030	0.0034	0.00020	0.027	1.4	0.00010	2.2	0.0000040	9.8	0.013	4.0	0.000048	0.000060	0.00098	0.0013	0.00018	*< 0.001*	*< 0.002*
15-Jul-15	7	13	500	460	0.0014	0.025	0.00012	0.00039	0.59	0.019	0.020	0.0021	0.00020	0.019	1.4	0.000070	2.3	0.000010	9.8	0.014	3.1	0.000053	0.000060	0.00065	0.00049	0.00020	*< 0.001*	*< 0.002*
29-Jul-15	8	15	400	375	0.0011	0.046	0.00015	0.00045	0.50	0.015	0.010	0.0024	0.00020	0.024	1.4	0.00011	2.5	0.0000040	8.5	0.013	3.3	0.000048	0.000070	0.00086	0.00043	0.00029	*< 0.001*	*< 0.002*
12-Aug-15	9	17	400	405	0.0012	0.013	0.000040	0.00040	0.56	0.015	0.010	0.0025	0.00020	0.020	1.5	0.00010	2.3	0.0000050	8.3	0.014	2.9	0.000055	0.00010	0.00032	0.00042	0.00020	*< 0.001*	*< 0.002*
26-Aug-15	10	19	500	470	0.0014	0.033	0.00011	0.00038	0.52	0.014	0.015	0.0023	0.00020	0.021	1.5	0.000085	2.4	0.0000070	7.3	0.012	4.0	0.000051	0.00011	0.00069	0.00040	0.00024	0.0015	0.0020
9-Sep-15	11	21	500	485	0.0015	0.053	0.00017	0.00037	0.47	0.012	0.020	0.0021	0.00020	0.022	1.4	0.000070	2.5	0.0000090	6.4	0.011	5.1	0.000046	0.00012	0.0011	0.00037	0.00028	0.0020	*< 0.002*
23-Sep-15	12	23	500	475	0.0012	0.033	0.00013	0.00034	0.50	0.013	0.015	0.0017	0.00015	0.018	1.4	0.000055	2.3	0.0000060	6.2	0.012	3.7	0.000036	0.00010	0.00064	0.00056	0.00022	0.0015	0.0020
7-Oct-15	13	25	500	385	0.00076	0.012	0.000080	0.00031	0.54	0.014	0.010	0.0014	0.00010	0.013	1.3	*< 4E-05*	2.1	0.0000030	6.1	0.013	2.3	0.000026	0.000080	0.00022	0.00075	0.00015	*< 0.001*	*< 0.002*
21-Oct-15	14	27	400	400	0.0023	*< 0.007*	0.000060	0.00032	0.52	0.015	*< 0.01*	0.0040	0.00010	0.011	1.2	0.000060	2.1	0.0000040	5.0	0.012	1.8	0.000046	0.00058	*< 5E-05*	0.00029	0.00014	*< 0.001*	*< 0.002*
4-Nov-15	15	29	400	385	0.0018	0.0090	0.000050	0.00022	0.52	0.012	0.010	0.0012	0.00010	0.0090	1.3	*< 4E-05*	1.8	*< 2E-06*	4.9	0.012	1.7	0.000049	0.00021	*< 5E-05*	0.00024	0.00019	0.0010	*< 0.002*
18-Nov-15	16	31	400	385	0.00059	0.028	0.000070	0.00032	0.56	0.013	0.030	0.0031	*< 0.0001*	0.010	1.3	0.00013	2.1	0.0000040	4.9	0.015	1.6	0.000040	0.000020	0.00091	0.0027	0.00018	*< 0.001*	*< 0.002*
2-Dec-15	17	33	400	380	0.0014	0.010	0.000020	0.00029	0.67	0.021	*< 0.01*	0.0023	0.00080	0.013	1.4	0.00014	2.1	0.0000030	5.4	0.016	2.4	0.000023	0.000050	0.000070	0.00023	0.00016	0.0090	*< 0.002*
16-Dec-15	18	35	400	370	0.0011	0.051	0.00011	0.00037	0.68	0.021	0.020	0.0015	0.00020	0.015	1.5	0.000080	2.7	0.0000020	5.0	0.016	1.3	0.000028	0.000070	0.0011	0.00027	0.00027	0.0030	*< 0.002*
30-Dec-15	19	37	400	375	0.0010	0.020	0.000070	0.00034	0.69	0.019	0.020	0.0012	0.00020	0.0060	1.3	*< 4E-05*	2.0	0.0000050	4.5	0.016	2.0	0.000027	*< 1E-05*	0.00033	0.0012	0.00016	0.0020	*< 0.002*
13-Jan-16	20	39	400	360	0.00070	0.011	0.000030	0.00033	0.73	0.022	0.010	0.0020	0.00010	0.0040	1.4	0.00019	2.2	0.0000020	4.4	0.015	1.3	*< 5E-06*	0.000060	0.00024	0.00019	0.00011	0.0010	*< 0.002*
27-Jan-16	21	41	400	370	0.00063	0.012	*< 1E-05*	0.00033	0.74	0.023	0.010	0.00092	0.00010	0.011	1.4	*< 4E-05*	2.2	0.0000020	4.0	0.017	1.4	0.000035	0.000050	0.000070	0.00041	0.00011	0.0010	*< 0.002*
10-Feb-16	22	43	400	400	0.00076	0.014	0.00011	0.00033	0.72	0.019	0.020	0.00080	0.00020	0.0060	1.3	0.000060	2.2	*< 2E-06*	3.6	0.016	1.9	0.000037	0.00029	0.00018	0.00075	0.00013	0.0010	*< 0.002*
24-Feb-16	23	45	400	355																								
9-Mar-16	24	47	400	375																								

Calculated Loading Rates for Col 7

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	750	300	0.00047	0.00048	0.000012	0.00024	0.77	0.051	0.019	0.000030	0.00027	0.0010	0.51	0.00013	0.39	0.0000060	4.6	0.025	5.8	0.000017	0.0000096	0.0000055	0.00011	0.0000096	0.00055	0.00014
6-May-15	2	3	400	350	0.00015	0.00036	0.00000080	0.000043	0.13	0.0059	0.0012	0.000078	0.000052	0.00020	0.15	0.000040	0.11	0.00000056	1.3	0.0036	1.4	0.0000037	0.00000040	0.0000080	0.000038	0.0000060	0.00012	0.000080
20-May-15	3	5	400	390	0.00012	0.00031	0.00000089	0.000029	0.069	0.0026	0.00089	0.00032	0.000036	0.00044	0.11	0.000013	0.11	0.00000076	0.85	0.0018	0.67	0.0000029	0.0000027	0.0000071	0.000022	0.0000053	0.000044	0.000089
3-Jun-15	4	7	400	270	0.000096	0.00086	0.0000040	0.000019	0.036	0.0011	0.00062	0.000097	0.000015	0.00031	0.068	0.0000055	0.079	0.00000040	0.50	0.00090	0.34	0.0000017	0.000010	0.000019	0.000038	0.000010	0.000062	0.000062
17-Jun-15	5	9	500	470	0.000065	0.00070	0.0000016	0.000023	0.035	0.0011	0.00054	0.00040	0.000016	0.0013	0.086	0.000012	0.12	0.00000059	0.64	0.00090	0.37	0.0000029	0.0000016	0.000013	0.000022	0.0000096	0.000054	0.00011
1-Jul-15	6	11	500	475	0.000049	0.00087	0.0000011	0.000022	0.028	0.00083	0.0016	0.00018	0.000011	0.0015	0.074	0.0000054	0.12	0.00000022	0.53	0.00072	0.22	0.0000026	0.0000032	0.000053	0.000070	0.0000097	0.000054	0.00011
15-Jul-15	7	13	500	460	0.000073	0.0013	0.0000063	0.000020	0.031	0.0010	0.0010	0.00011	0.000010	0.00100	0.074	0.0000037	0.12	0.00000052	0.51	0.00075	0.16	0.0000028	0.0000031	0.000034	0.000026	0.000010	0.000052	0.00010
29-Jul-15	8	15	400	375	0.000046	0.0020	0.0000064	0.000019	0.021	0.00063	0.00043	0.00010	0.0000085	0.0010	0.058	0.0000047	0.10	0.00000017	0.36	0.00054	0.14	0.0000021	0.0000030	0.000037	0.000019	0.000012	0.000043	0.000085
12-Aug-15	9	17	400	405	0.000056	0.00060	0.0000018	0.000019	0.026	0.00069	0.00046	0.00012	0.0000092	0.00092	0.069	0.0000046	0.10	0.00000023	0.38	0.00062	0.13	0.0000025	0.0000046	0.000015	0.000020	0.0000092	0.000046	0.000092
26-Aug-15	10	19	500	470	0.000074	0.0018	0.0000056	0.000021	0.028	0.00073	0.00080	0.00012	0.000011	0.0011	0.079	0.0000046	0.13	0.00000037	0.39	0.00067	0.21	0.0000027	0.0000059	0.000037	0.000021	0.000013	0.000080	0.00011
9-Sep-15	11	21	500	485	0.000085	0.0029	0.0000094	0.000020	0.026	0.00067	0.0011	0.00011	0.000011	0.0012	0.080	0.0000039	0.14	0.00000050	0.35	0.00063	0.28	0.0000025	0.0000066	0.000059	0.000020	0.000015	0.00011	0.00011
23-Sep-15	12	23	500	475	0.000062	0.0018	0.0000068	0.000018	0.027	0.00071	0.00081	0.000093	0.0000081	0.00095	0.074	0.0000030	0.12	0.00000032	0.34	0.00066	0.20	0.0000019	0.0000054	0.000035	0.000030	0.000012	0.000081	0.00011
7-Oct-15	13	25	500	385	0.000033	0.00053	0.0000035	0.000013	0.024	0.00062	0.00044	0.000061	0.0000044	0.00057	0.057	0.0000018	0.091	0.00000013	0.27	0.00057	0.10	0.0000011	0.0000035	0.0000096	0.000033	0.0000066	0.000044	0.000088
21-Oct-15	14	27	400	400	0.00010	0.00032	0.0000027	0.000014	0.024	0.00067	0.00046	0.00018	0.0000046	0.00050	0.056	0.0000027	0.094	0.00000018	0.23	0.00055	0.082	0.0000021	0.000026	0.0000023	0.000013	0.0000064	0.000046	0.000091
4-Nov-15	15	29	400	385	0.000078	0.00039	0.0000022	0.0000097	0.023	0.00053	0.00044	0.000054	0.0000044	0.00039	0.055	0.0000018	0.081	0.000000088	0.22	0.00052	0.075	0.0000021	0.0000092	0.0000022	0.000011	0.0000083	0.000044	0.000088
18-Nov-15	16	31	400	385	0.000026	0.0012	0.0000031	0.000014	0.025	0.00057	0.0013	0.00014	0.0000044	0.00044	0.058	0.0000057	0.093	0.00000018	0.21	0.00064	0.070	0.0000018	0.00000088	0.000040	0.00012	0.0000079	0.000044	0.000088
2-Dec-15	17	33	400	380	0.000062	0.00043	0.00000087	0.000013	0.029	0.00090	0.00043	0.00010	0.000035	0.00056	0.061	0.0000061	0.093	0.00000013	0.23	0.00068	0.10	0.00000100	0.0000022	0.0000030	0.000010	0.0000069	0.00039	0.000087
16-Dec-15	18	35	400	370	0.000046	0.0021	0.0000046	0.000016	0.029	0.00086	0.00084	0.000064	0.0000084	0.00063	0.062	0.0000034	0.11	0.000000084	0.21	0.00068	0.055	0.0000012	0.0000029	0.000046	0.000011	0.000011	0.00013	0.000084
30-Dec-15	19	37	400	375	0.000044	0.00085	0.0000030	0.000014	0.029	0.00083	0.00085	0.000049	0.0000085	0.00026	0.057	0.0000017	0.086	0.00000021	0.19	0.00067	0.085	0.0000012	0.00000043	0.000014	0.000050	0.0000068	0.000085	0.000085
13-Jan-16	20	39	400	360	0.000029	0.00045	0.0000012	0.000014	0.030	0.00089	0.00041	0.000083	0.0000041	0.00016	0.055	0.0000078	0.089	0.000000082	0.18	0.00063	0.053	0.00000021	0.0000025	0.0000098	0.0000079	0.0000045	0.000041	0.000082
27-Jan-16	21	41	400	370	0.000027	0.00051	0.00000042	0.000014	0.031	0.00097	0.00042	0.000039	0.0000042	0.00046	0.057	0.0000017	0.092	0.000000084	0.17	0.00073	0.059	0.0000015	0.0000021	0.0000029	0.000017	0.0000046	0.000042	0.000084
10-Feb-16	22	43	400	400	0.000035	0.00064	0.0000050	0.000015	0.033	0.00086	0.00091	0.000036	0.0000091	0.00027	0.058	0.0000027	0.10	0.000000091	0.16	0.00074	0.087	0.0000017	0.000013	0.0000082	0.000034	0.0000059	0.000046	0.000091
24-Feb-16	23	45	400	355																								
9-Mar-16	24	47	400	375																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 8 (Kona Granite Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	375	4.7	1588	#N/A	50	*< 0.1*	1056	17	0.59	*< 0.3*	739	6.6	0.0090	5.4	0.0040	0.0035	*< 7E-06*	0.055	0.00051	216	0.00051	0.83
6-May-15	2	3	400	370	4.8	1162	#N/A	38	*< 0.1*	641	11	0.48	*< 0.3*	454	2.9	0.0067	53	0.0016	0.0021	*< 7E-06*	0.047	0.00028	129	0.00013	0.55
20-May-15	3	5	400	380	5.1	666	#N/A	27	0.30	307	13	0.23	*< 0.3*	226	0.97	0.0051	65	0.00069	0.0011	*< 7E-06*	0.036	0.00015	65	0.000090	0.28
3-Jun-15	4	7	400	290	5.2	499	#N/A	21	0.80	230	12	0.18	*< 0.3*	163	0.61	0.0054	65	0.00066	0.00088	*< 7E-06*	0.039	0.00011	47	0.000060	0.20
17-Jun-15	5	9	500	450	5.1	360	#N/A	19	0.40	164	*< 1*	0.13	*< 0.3*	123	0.45	0.0057	63	0.00035	0.00077	*< 7E-06*	0.026	0.00010	35	0.000060	0.15
1-Jul-15	6	11	500	470	5.5	281	#N/A	14	0.90	121	*< 1*	0.10	*< 0.3*	85	0.30	0.0066	45	0.00031	0.00065	*< 7E-06*	0.019	0.000076	24	0.000040	0.11
15-Jul-15	7	13	500	465	5.2	247	#N/A	16	0.30	95	*< 1*	0.090	*< 0.3*	74	0.28	0.0073	28	0.00030	0.00055	*< 7E-06*	0.020	0.000065	20	0.000050	0.10
29-Jul-15	8	15	400	385	5.2	238	#N/A	8.8	0.60	99	*< 1*	0.11	*< 0.3*	77	0.27	0.0075	19	0.00077	0.00059	*< 7E-06*	0.020	0.000059	22	0.000080	0.100
12-Aug-15	9	17	400	405	4.8	227	#N/A	10	*< 0.1*	89	1.0	0.10	*< 0.3*	74	0.26	0.0072	15	0.00021	0.00056	*< 7E-06*	0.017	0.000069	21	0.000060	0.093
26-Aug-15	10	19	500	455	5.2	223	-	9.6	0.10	79	1.0	0.090	0.30	68	0.24	0.0075	13	0.00063	0.00053	0.0000070	0.015	0.000066	20	0.000055	0.088
9-Sep-15	11	21	500	495	4.9	186	#N/A	9.1	*< 0.1*	74	*< 1*	0.080	*< 0.3*	63	0.22	0.0078	12	0.0011	0.00049	*< 7E-06*	0.013	0.000063	18	0.000050	0.082
23-Sep-15	12	23	500	480	5.1	176	#N/A	8.5	0.070	68	1.0	0.080	-	60	0.20	0.0076	12	0.00065	0.00047	0.0000070	0.012	0.000062	17	0.000070	0.074
7-Oct-15	13	25	400	390	5.1	180	#N/A	8.2	0.50	65	*< 1*	0.080	-	57	0.19	0.0074	12	0.00025	0.00045	*< 7E-06*	0.0096	0.000060	16	0.000090	0.065
21-Oct-15	14	27	400	400	5.0	177	#N/A	8.6	*< 0.1*	59	*< 1*	0.080	-	56	0.21	0.0075	12	0.00023	0.00048	*< 7E-06*	0.011	0.000054	16	0.000090	0.074
4-Nov-15	15	29	400	405	4.7	181	#N/A	9.3	*< 0.1*	63	*< 1*	0.090	-	60	0.21	0.0065	11	0.00021	0.00043	*< 7E-06*	0.0076	0.000076	17	0.000040	0.073
18-Nov-15	16	31	400	385	5.2	178	#N/A	7.8	*< 0.1*	56	*< 1*	0.080	-	53	0.18	0.0066	11	0.0011	0.00043	*< 7E-06*	0.0069	0.000094	15	0.000060	0.065
2-Dec-15	17	33	401	385	4.5	168	#N/A	14	0.10	58	*< 1*	0.080	-	57	0.19	0.0071	11	0.00035	0.00044	*< 7E-06*	0.0089	0.000078	16	0.000080	0.071
16-Dec-15	18	35	401	380	4.6	165	#N/A	14	*< 0.1*	64	*< 1*	0.080	-	58	0.20	0.0070	11	0.00027	0.00049	*< 7E-06*	0.0096	0.00012	16	0.000040	0.073
30-Dec-15	19	37	402	395	4.5	161	#N/A	12	*< 0.1*	59	*< 1*	0.080	-	54	0.19	0.0064	9.7	0.00031	0.00049	*< 7E-06*	0.0075	0.000067	16	0.00010	0.066
13-Jan-16	20	39	402	375	4.4	160	0.90	12	0.10	60	*< 1*	0.080	-	52	0.17	0.0067	11	0.00083	0.00044	*< 7E-06*	0.010	0.000072	15	0.000040	0.061
27-Jan-16	21	41	403	405	4.5	155	#N/A	14	*< 0.1*	52	*< 1*	0.080	-	49	0.17	0.0068	10	0.00092	0.00045	*< 7E-06*	0.0070	0.000063	14	0.000060	0.061
10-Feb-16	22	43	404	400	4.5	149	0.90	14	0.10	52	*< 1*	0.080	-	47	0.16	0.0069	9.7	0.00028	0.00045	*< 7E-06*	0.0050	0.000056	13	0.000040	0.059
24-Feb-16	23	45	405	375	4.5	158	#N/A	13	*< 0.1*	54	*< 1*	0.11	-	53	0.18	0.0066	10	0.00094	0.00050	*< 7E-06*	0.0050	0.000067	15	0.000050	0.061
9-Mar-16	24	47	405	385	4.5	151	#N/A	13	*< 0.1*	57															

Calculated Loading Rates for Col 8

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	375	4.7	1588	#N/A	4.3	0.0086	91	1.5	0.051	0.026	64	0.57	0.00078	0.47	0.00034	0.00030	0.00000060	0.0047	0.000044	19	0.000044	0.071
6-May-15	2	3	400	370	4.8	1162	#N/A	1.6	0.0043	27	0.47	0.020	0.013	19	0.12	0.00028	2.3	0.000066	0.000091	0.00000030	0.0020	0.000012	5.5	0.0000055	0.024
20-May-15	3	5	400	380	5.1	666	#N/A	1.2	0.014	13	0.57	0.010	0.013	9.9	0.042	0.00022	2.8	0.000030	0.000050	0.00000031	0.0016	0.0000067	2.8	0.0000039	0.012
3-Jun-15	4	7	400	290	5.2	499	#N/A	0.71	0.028	7.7	0.40	0.0060	0.010	5.4	0.020	0.00018	2.2	0.000022	0.000029	0.00000023	0.0013	0.0000035	1.6	0.0000020	0.0067
17-Jun-15	5	9	500	450	5.1	360	#N/A	0.97	0.018	8.5	0.052	0.0067	0.016	6.4	0.023	0.00029	3.2	0.000018	0.000040	0.00000036	0.0013	0.0000053	1.8	0.0000031	0.0078
1-Jul-15	6	11	500	470	5.5	281	#N/A	0.75	0.046	6.5	0.054	0.0054	0.016	4.6	0.016	0.00036	2.4	0.000017	0.000035	0.00000038	0.0010	0.0000041	1.3	0.0000022	0.0058
15-Jul-15	7	13	500	465	5.2	247	#N/A	0.83	0.016	5.1	0.053	0.0048	0.016	3.9	0.015	0.00039	1.5	0.000016	0.000029	0.00000037	0.0011	0.0000035	1.1	0.0000027	0.0054
29-Jul-15	8	15	400	385	5.2	238	#N/A	0.39	0.026	4.4	0.044	0.0049	0.013	3.4	0.012	0.00033	0.83	0.000034	0.000026	0.00000031	0.00089	0.0000026	0.97	0.0000035	0.0044
12-Aug-15	9	17	400	405	4.8	227	#N/A	0.47	0.0047	4.1	0.047	0.0047	0.014	3.4	0.012	0.00034	0.68	0.0000098	0.000026	0.00000033	0.00077	0.0000032	0.98	0.0000028	0.0043
26-Aug-15	10	19	500	455	5.2	223	#N/A	0.50	0.0052	4.1	0.052	0.0047	0.016	3.6	0.012	0.00039	0.70	0.000033	0.000028	0.00000037	0.00078	0.0000035	1.0	0.0000029	0.0046
9-Sep-15	11	21	500	495	4.9	186	#N/A	0.52	0.0057	4.2	0.057	0.0046	0.017	3.6	0.012	0.00044	0.69	0.000060	0.000028	0.00000040	0.00076	0.0000036	1.0	0.0000028	0.0047
23-Sep-15	12	23	500	480	5.1	176	#N/A	0.47	0.0039	3.8	0.055	0.0044		3.3	0.011	0.00042	0.67	0.000036	0.000026	0.00000039	0.00063	0.0000034	0.95	0.0000039	0.0041
7-Oct-15	13	25	400	390	5.1	180	#N/A	0.37	0.020	2.9	0.045	0.0036		2.6	0.0084	0.00033	0.55	0.000011	0.000020	0.00000031	0.00043	0.0000027	0.74	0.0000040	0.0029
21-Oct-15	14	27	400	400	5.0	177	#N/A	0.40	0.0046	2.7	0.046	0.0037		2.6	0.0096	0.00034	0.53	0.000011	0.000022	0.00000032	0.00052	0.0000025	0.74	0.0000041	0.0034
4-Nov-15	15	29	400	405	4.7	181	#N/A	0.43	0.0047	2.9	0.047	0.0042		2.8	0.0096	0.00030	0.50	0.0000098	0.000020	0.00000033	0.00035	0.0000035	0.81	0.0000019	0.0034
18-Nov-15	16	31	400	385	5.2	178	#N/A	0.34	0.0044	2.5	0.044	0.0035		2.4	0.0079	0.00029	0.50	0.000047	0.000019	0.00000031	0.00031	0.0000042	0.66	0.0000027	0.0029
2-Dec-15	17	33	401	385	4.5	168	#N/A	0.60	0.0044	2.6	0.044	0.0035		2.5	0.0083	0.00031	0.48	0.000015	0.000019	0.00000031	0.00039	0.0000035	0.70	0.0000035	0.0032
16-Dec-15	18	35	401	380	4.6	165	#N/A	0.63	0.0044	2.8	0.044	0.0035		2.5	0.0088	0.00031	0.47	0.000012	0.000021	0.00000031	0.00042	0.0000050	0.71	0.0000017	0.0032
30-Dec-15	19	37	402	395	4.5	161	#N/A	0.56	0.0045	2.7	0.045	0.0036		2.5	0.0084	0.00029	0.44	0.000014	0.000022	0.00000032	0.00034	0.0000030	0.70	0.0000045	0.0030
13-Jan-16	20	39	402	375	4.4	160	0.86	0.53	0.0043	2.6	0.043	0.0034		2.2	0.0072	0.00029	0.48	0.000036	0.000019	0.00000030	0.00043	0.0000031	0.63	0.0000017	0.0026
27-Jan-16	21	41	403	405	4.5	155	#N/A	0.63	0.0047	2.4	0.047	0.0037		2.3	0.0078	0.00032	0.48	0.000043	0.000021	0.00000033	0.00033	0.0000029	0.65	0.0000028	0.0028
10-Feb-16	22	43	404	400	4.5	149	0.89	0.64	0.0046	2.4	0.046	0.0037		2.2	0.0073	0.00032	0.45	0.000013	0.000021	0.00000032	0.00023	0.0000026	0.62	0.0000018	0.0027
24-Feb-16	23	45	405	375	4.5	158	#N/A	0.54	0.0043	2.3	0.043	0.0047		2.3	0.0078	0.00028	0.44	0.000041	0.000021	0.00000030	0.00022	0.0000029	0.66	0.0000022	0.0026
9-Mar-16	24	47	405	385	4.5	151	#N/A	0.58	0.0044	2.5															

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 8 (Kona Granite Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	375	0.17	11	0.00030	0.076	49	25	0.43	0.000040	0.19	0.0070	26	0.0092	8.5	0.000035	62	1.1	337	0.0030	0.000080	0.00010	0.033	0.00014	0.78	*< 0.002*
6-May-15	2	3	400	370	0.060	7.6	0.00012	0.046	32	17	0.11	0.00031	0.13	*< 0.003*	18	0.0050	14	0.000011	29	0.73	234	0.0016	0.000070	0.00012	0.018	0.000070	0.50	*< 0.002*
20-May-15	3	5	400	380	0.028	3.2	0.000040	0.026	15	8.5	0.080	0.0012	0.064	*< 0.003*	12	0.0027	13	0.000010	13	0.37	110	0.0011	0.000090	0.00023	0.0084	0.000050	0.26	*< 0.002*
3-Jun-15	4	7	400	290	0.021	2.1	0.000030	0.019	11	6.1	0.080	0.00036	0.046	*< 0.003*	10	0.0020	12	0.0000040	8.4	0.27	86	0.00092	0.000010	0.00013	0.0054	0.000090	0.19	*< 0.002*
17-Jun-15	5	9	500	450	0.019	1.4	0.000040	0.012	8.6	4.9	0.050	0.0011	0.037	*< 0.003*	8.3	0.0018	10	0.0000060	5.4	0.19	62	0.00073	0.00014	0.00016	0.0040	0.000080	0.18	*< 0.002*
1-Jul-15	6	11	500	470	0.015	0.85	*< 1E-05*	0.0091	6.0	3.6	0.040	0.000050	0.027	0.0050	6.4	0.0013	8.8	0.0000020	3.2	0.14	37	0.00057	0.000040	0.00013	0.0022	0.00010	0.13	*< 0.002*
15-Jul-15	7	13	500	465	0.016	0.61	0.000030	0.0074	5.6	3.3	0.020	0.00016	0.024	0.0040	5.6	0.00094	8.7	0.0000050	2.4	0.11	31	0.00056	0.000050	0.00017	0.0018	0.00010	0.12	*< 0.002*
29-Jul-15	8	15	400	385	0.016	0.43	0.00015	0.0074	5.3	3.5	*< 0.01*	0.00023	0.023	0.0080	5.7	0.00086	8.7	0.0000020	1.8	0.12	32	0.00053	*< 1E-05*	*< 5E-05*	0.0017	0.00010	0.11	*< 0.002*
12-Aug-15	9	17	400	405	0.016	0.35	0.000030	0.0061	5.2	3.3	0.020	0.00039	0.023	0.014	5.8	0.00080	9.2	*< 2E-06*	1.5	0.11	28	0.00044	0.000060	0.000050	0.0015	0.00010	0.12	*< 0.002*
26-Aug-15	10	19	500	455	0.015	0.28	0.000025	0.0053	4.8	3.1	0.015	0.00042	0.021	0.016	5.6	0.00071	8.1	0.0000030	1.2	0.10	28	0.00042	0.000050	0.000050	0.0013	0.00013	0.11	0.0020
9-Sep-15	11	21	500	495	0.015	0.21	0.000020	0.0045	4.4	2.9	0.010	0.00045	0.020	0.018	5.3	0.00062	7.0	0.0000040	0.99	0.090	29	0.00039	0.000040	*< 5E-05*	0.0012	0.00015	0.098	*< 0.002*
23-Sep-15	12	23	500	480	0.014	0.18	0.000020	0.0041	4.2	2.7	0.010	0.00027	0.018	0.019	4.9	0.00060	6.8	0.0000050	0.83	0.085	25	0.00035	0.000030	0.000050	0.0011	0.00012	0.094	0.0020
7-Oct-15	13	25	400	390	0.012	0.14	0.000020	0.0036	4.0	2.5	*< 0.01*	0.000090	0.016	0.020	4.4	0.00057	6.5	0.0000060	0.66	0.079	22	0.00030	0.000020	*< 5E-05*	0.0011	0.000080	0.090	*< 0.002*
21-Oct-15	14	27	400	400	0.015	0.15	0.000030	0.0035	3.7	2.5	*< 0.01*	0.0013	0.019	0.014	4.3	0.00050	6.6	0.0000020	0.61	0.083	22	0.00041	0.000050	0.000080	0.0013	0.00012	0.099	*< 0.002*
4-Nov-15	15	29	400	405	0.015	0.15	0.000050	0.0028	4.1	2.6	0.010	0.00016	0.020	0.018	4.5	0.00050	6.4	0.0000030	0.55	0.080	22	0.00038	0.000080	*< 5E-05*	0.0012	0.00015	0.097	*< 0.002*
18-Nov-15	16	31	400	385	0.015	0.13	0.00032	0.0030	3.8	2.6	*< 0.01*	0.00098	0.016	0.018	4.2	0.00060	5.9	*< 2E-06*	0.48	0.078	22	0.00027	0.000020	*< 5E-05*	0.0013	0.00013	0.10	*< 0.002*
2-Dec-15	17	33	401	385	0.020	0.13	0.0011	0.0028	4.3	2.6	*< 0.01*	0.00095	0.019	0.020	4.4	0.00059	5.7	*< 2E-06*	0.49	0.083	22	0.00033	0.000050	0.000060	0.0012	0.00011	0.11	*< 0.002*
16-Dec-15	18	35	401	380	0.024	0.12	0.0028	0.0029	4.1	2.8	*< 0.01*	0.00044	0.019	0.022	4.4	0.00047	6.3	*< 2E-06*	0.42	0.084	22	0.00033	0.000060	*< 5E-05*	0.0012	0.00010	0.11	*< 0.002*
30-Dec-15	19	37	402	395	0.015	0.11	0.00056	0.0027	3.8	2.5	0.020	0.00034	0.017	0.019	3.9	0.00042	5.4	0.0000070	0.43	0.076	18	0.00033	*< 1E-05*	*< 5E-05*	0.0013	0.00012	0.096	*< 0.002*
13-Jan-16	20	39	402	375	0.013	0.10	0.00015	0.0024	3.7	2.5	*< 0.01*	0.00057	0.016	0.022	4.0	0.00056	5.8	0.0000020	0.37	0.070	19	0.00026	0.000060	*< 5E-05*	0.0011	0.000090	0.093	*< 0.002*
27-Jan-16	21	41	403	405	0.014	0.11	0.00013	0.0022	3.5	2.4	*< 0.01*	0.000080	0.015	0.022	3.9	0.00032	5.2	*< 2E-06*	0.32	0.075	20	0.00034	0.000020	*< 5E-05*	0.0012	0.000090	0.092	*< 0.002*
10-Feb-16	22	43	404	400	0.015	0.096	0.000090	0.0020	3.3	2.4	*< 0.01*	0.000070	0.015	0.023	3.7	0.00037	4.8	*< 2E-06*	0.31	0.070	19	0.00030	0.000070	*< 5E-05*	0.0012	0.000090	0.10	*< 0.002*
24-Feb-16	23	45	405	375	0.015	0.10	0.000040	0.0020	3.7	2.5	0.020	0.000070	0.016	0.025	3.8	0.00035	5.2	*< 2E-06*	0.25	0.072	18	0.00030	0.000080	*< 5E-05*	0.0011	0.000070	0.11	*< 0.002*
9-Mar-16	24	47	405	385																								

Calculated Loading Rates for Col 8

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	375	0.014	0.92	0.000026	0.0066	4.2	2.1	0.037	0.0000034	0.016	0.00060	2.2	0.00079	0.73	0.0000030	5.4	0.091	29	0.00026	0.0000069	0.0000086	0.0029	0.0000012	0.068	0.00017
6-May-15	2	3	400	370	0.0025	0.32	0.0000051	0.0020	1.4	0.72	0.0047	0.000013	0.0057	0.00013	0.76	0.00021	0.58	0.00000047	1.2	0.031	10.0	0.000069	0.0000030	0.0000051	0.00077	0.0000030	0.021	0.000085
20-May-15	3	5	400	380	0.0012	0.14	0.0000017	0.0011	0.67	0.37	0.0035	0.000051	0.0028	0.00013	0.52	0.00012	0.55	0.00000044	0.56	0.016	4.8	0.000048	0.0000039	0.000010	0.00037	0.0000022	0.011	0.000087
3-Jun-15	4	7	400	290	0.00070	0.068	0.0000010	0.00064	0.37	0.20	0.0027	0.000012	0.0015	0.00010	0.34	0.000067	0.40	0.00000013	0.28	0.0090	2.9	0.000031	0.00000033	0.0000043	0.00018	0.0000030	0.0063	0.000067
17-Jun-15	5	9	500	450	0.00098	0.074	0.0000021	0.00064	0.45	0.25	0.0026	0.000058	0.0019	0.00016	0.43	0.000092	0.52	0.00000031	0.28	0.010	3.2	0.000038	0.0000072	0.0000083	0.00021	0.0000041	0.0091	0.00010
1-Jul-15	6	11	500	470	0.00079	0.046	0.00000054	0.00049	0.32	0.20	0.0022	0.0000027	0.0015	0.00027	0.34	0.000069	0.48	0.00000011	0.17	0.0075	2.0	0.000031	0.0000022	0.0000070	0.00012	0.0000054	0.0072	0.00011
15-Jul-15	7	13	500	465	0.00084	0.032	0.0000016	0.00040	0.30	0.18	0.0011	0.0000086	0.0013	0.00021	0.30	0.000050	0.46	0.00000027	0.13	0.0060	1.7	0.000030	0.0000027	0.0000091	0.000094	0.0000053	0.0062	0.00011
29-Jul-15	8	15	400	385	0.00070	0.019	0.0000066	0.00033	0.23	0.15	0.00044	0.000010	0.0010	0.00035	0.25	0.000038	0.38	0.000000089	0.080	0.0053	1.4	0.000023	0.00000044	0.0000022	0.000073	0.0000044	0.0050	0.000089
12-Aug-15	9	17	400	405	0.00073	0.016	0.0000014	0.00029	0.24	0.15	0.00093	0.000018	0.0011	0.00065	0.27	0.000037	0.43	0.000000093	0.068	0.0052	1.3	0.000021	0.0000028	0.0000023	0.000069	0.0000047	0.0054	0.000093
26-Aug-15	10	19	500	455	0.00079	0.015	0.0000013	0.00028	0.25	0.16	0.00078	0.000022	0.0011	0.00084	0.29	0.000037	0.42	0.00000016	0.064	0.0053	1.5	0.000022	0.0000026	0.0000026	0.000070	0.0000065	0.0056	0.00010
9-Sep-15	11	21	500	495	0.00084	0.012	0.0000011	0.00026	0.25	0.17	0.00057	0.000026	0.0011	0.0010	0.30	0.000035	0.40	0.00000023	0.056	0.0051	1.6	0.000022	0.0000023	0.0000028	0.000067	0.0000085	0.0056	0.00011
23-Sep-15	12	23	500	480	0.00075	0.0097	0.0000011	0.00022	0.23	0.15	0.00055	0.000015	0.00100	0.0010	0.27	0.000033	0.37	0.00000028	0.046	0.0047	1.4	0.000019	0.0000017	0.0000028	0.000062	0.0000063	0.0052	0.00011
7-Oct-15	13	25	400	390	0.00056	0.0063	0.00000090	0.00016	0.18	0.11	0.00045	0.0000040	0.00074	0.00090	0.20	0.000026	0.29	0.00000027	0.030	0.0036	0.98	0.000014	0.00000090	0.0000022	0.000048	0.0000036	0.0040	0.000090
21-Oct-15	14	27	400	400	0.00070	0.0070	0.0000014	0.00016	0.17	0.11	0.00046	0.000057	0.00089	0.00064	0.20	0.000023	0.30	0.000000092	0.028	0.0038	1.00	0.000019	0.0000023	0.0000037	0.000058	0.0000055	0.0046	0.000092
4-Nov-15	15	29	400	405	0.00069	0.0070	0.0000023	0.00013	0.19	0.12	0.00047	0.0000074	0.00092	0.00084	0.21	0.000023	0.30	0.00000014	0.026	0.0037	1.0	0.000018	0.0000037	0.0000023	0.000054	0.0000070	0.0045	0.000093
18-Nov-15	16	31	400	385	0.00065	0.0055	0.000014	0.00013	0.17	0.12	0.00044	0.000043	0.00069	0.00080	0.19	0.000027	0.26	0.000000089	0.021	0.0034	0.96	0.000012	0.00000089	0.0000022	0.000057	0.0000058	0.0044	0.000089
2-Dec-15	17	33	401	385	0.00087	0.0058	0.000049	0.00012	0.19	0.12	0.00044	0.000042	0.00084	0.00089	0.20	0.000026	0.25	0.000000089	0.022	0.0037	0.96	0.000015	0.0000022	0.0000027	0.000052	0.0000049	0.0049	0.000089
16-Dec-15	18	35	401	380	0.0010	0.0051	0.00012	0.00013	0.18	0.12	0.00044	0.000019	0.00085	0.00096	0.19	0.000021	0.28	0.000000087	0.018	0.0037	0.95	0.000014	0.0000026	0.0000022	0.000051	0.0000044	0.0048	0.000087
30-Dec-15	19	37	402	395	0.00069	0.0050	0.000025	0.00012	0.17	0.12	0.00091	0.000015	0.00076	0.00086	0.18	0.000019	0.24	0.00000032	0.020	0.0034	0.81	0.000015	0.00000045	0.0000023	0.000059	0.0000054	0.0044	0.000091
13-Jan-16	20	39	402	375	0.00056	0.0045	0.0000065	0.00010	0.16	0.11	0.00043	0.000025	0.00068	0.00095	0.17	0.000024	0.25	0.000000086	0.016	0.0030	0.81	0.000011	0.0000026	0.0000022	0.000045	0.0000039	0.0040	0.000086
27-Jan-16	21	41	403	405	0.00064	0.0050	0.0000061	0.00010	0.16	0.11	0.00047	0.0000037	0.00071	0.0010	0.18	0.000015	0.24	0.000000093	0.015	0.0035	0.92	0.000016	0.00000093	0.0000023	0.000056	0.0000042	0.0043	0.000093
10-Feb-16	22	43	404	400	0.00070	0.0044	0.0000041	0.000091	0.15	0.11	0.00046	0.0000032	0.00071	0.0011	0.17	0.000017	0.22	0.000000092	0.014	0.0032	0.85	0.000014	0.0000032	0.0000023	0.000054	0.0000041	0.0047	0.000092
24-Feb-16	23	45	405	375	0.00064	0.0044	0.0000017	0.000088	0.16	0.11	0.00086	0.0000030	0.00069	0.0011	0.16	0.000015	0.23	0.000000086	0.011	0.0031	0.79	0.000013	0.0000034	0.0000022	0.000049	0.0000030	0.0045	0.000086
9-Mar-16	24	47	405	385																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 9 (Latte Schist Oxide Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	360	7.6	3083	#N/A	12	139	2100	33	0.34	*< 0.3*	1890	0.0037	0.0070	0.11	0.024	*< 7E-06*	*< 7E-06*	0.022	0.000018	442	0.00029	0.0027
6-May-15	2	3	400	355	7.7	1878	#N/A	7.0	80	1352	10	0.37	*< 0.3*	1200	0.0028	0.0044	0.095	0.011	*< 7E-06*	*< 7E-06*	0.017	0.000010	293	*< 3E-05*	0.0015
20-May-15	3	5	400	375	7.8	1274	#N/A	7.1	73	720	2.0	0.37	*< 0.3*	712	0.0014	0.0031	0.081	0.0079	*< 7E-06*	*< 7E-06*	0.013	0.0000040	183	0.00011	0.00081
3-Jun-15	4	7	400	255	7.8	1162	#N/A	6.7	82	560	1.0	0.43	*< 0.3*	542	0.0053	0.0032	0.087	0.0086	*< 7E-06*	*< 7E-06*	0.017	0.0000030	137	0.000060	0.00055
17-Jun-15	5	9	500	445	7.9	776	#N/A	7.0	85	353	*< 1*	0.42	*< 0.3*	374	0.0048	0.0032	0.096	0.0081	*< 7E-06*	*< 7E-06*	0.014	0.0000030	96	0.000060	0.00034
1-Jul-15	6	11	500	390	7.9	687	#N/A	7.0	90	235	*< 1*	0.47	*< 0.3*	276	0.0038	0.0030	0.097	0.0097	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	68	0.000080	0.00023
15-Jul-15	7	13	500	455	7.9	521	#N/A	5.8	93	182	*< 1*	0.50	*< 0.3*	230	0.0047	0.0031	0.093	0.011	*< 7E-06*	*< 7E-06*	0.015	*< 3E-06*	54	0.000090	0.00021
29-Jul-15	8	15	400	375	7.9	490	#N/A	3.9	93	155	*< 1*	0.51	*< 0.3*	219	0.0036	0.0033	0.085	0.011	*< 7E-06*	*< 7E-06*	0.014	0.0000080	54	0.000080	0.00015
12-Aug-15	9	17	400	395	7.9	440	#N/A	4.4	94	122	*< 1*	0.50	*< 0.3*	197	0.0025	0.0032	0.079	0.012	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	48	0.000070	0.00011
26-Aug-15	10	19	500	460	7.6	408	#N/A	4.2	94	100	1.0	0.51	0.30	189	0.0039	0.0033	0.086	0.014	0.0000070	0.0000070	0.010	0.0000040	45	0.000075	0.00010
9-Sep-15	11	21	500	450	7.9	374	#N/A	4.0	94	89	-	0.52	-	180	0.0050	0.0034	0.10	0.016	*< 7E-06*	*< 7E-06*	0.011	0.0000050	43	0.000080	0.00010
23-Sep-15	12	23	500	465	8.0	346	#N/A	3.4	98	79	-	0.51	-	171	0.0046	0.0036	0.11	0.016	0.0000070	0.0000070	0.0098	0.0000045	41	0.000095	0.000080
7-Oct-15	13	25	400	370	7.9	349	#N/A	3.2	107	70	-	0.49	-	161	0.0038	0.0037	0.12	0.016	*< 7E-06*	*< 7E-06*	0.0091	0.0000040	40	0.00011	0.000066
21-Oct-15	14	27	400	385	8.1	321	#N/A	2.1	102	56	-	0.47	-	150	0.0051	0.0037	0.11	0.018	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	38	0.00010	0.000058
4-Nov-15	15	29	400	385	8.0	316	#N/A	2.3	107	54	-	0.48	-	155	0.0097	0.0031	0.12	0.019	*< 7E-06*	*< 7E-06*	0.0068	0.000011	39	0.000070	0.000042
18-Nov-15	16	31	400	370	8.1	316	#N/A	1.4	117	49	-	0.48	-	149	0.0036	0.0032	0.12	0.015	*< 7E-06*	*< 7E-06*	0.0066	*< 3E-06*	37	0.00011	0.000055
2-Dec-15	17	33	400	375	8.2	306	#N/A	1.8	105	46	-	0.48	-	158	0.0036	0.0033	0.11	0.021	*< 7E-06*	*< 7E-06*	0.0077	0.0000070	39	0.000080	0.000091
16-Dec-15	18	35	400	360	8.2	296	#N/A	2.1	97	44	-	0.46	-	155	0.0030	0.0035	0.14	0.022	*< 7E-06*	*< 7E-06*	0.0092	0.0000080	38	0.000060	0.000076
30-Dec-15	19	37	400	385	8.2	288	#N/A	1.4	95	45	-	0.47	-	146	0.0052	0.0030	0.12	0.022	*< 7E-06*	*< 7E-06*	0.0078	0.000011	36	0.00014	0.000054
13-Jan-16	20	39	400	355	8.2	285	#N/A	1.5	98	46	-	0.45	-	143	0.0022	0.0032	0.11	0.021	*< 7E-06*	*< 7E-06*	0.0090	*< 3E-06*	35	0.00015	0.000082
27-Jan-16	21	41	400	370	8.1	276	#N/A	2.8	98	44	-	0.47	-	136	0.0030	0.0033	0.088	0.024	*< 7E-06*	*< 7E-06*	0.0070	0.000010	33	0.000070	0.000058
10-Feb-16	22	43	400	385	8.1	276	#N/A	2.4	101	38	-	0.42	-	139	0.0031	0.0033	0.083	0.025	0.000011	*< 7E-06*	0.0060	*< 3E-06*	34	0.000070	0.000045
24-Feb-16	23	45	400	360	8.1	285	#N/A	2.2	101	38	-	0.41	-	148	0.0012	0.0032	0.094	0.026	*< 7E-06*	*< 7E-06*	0.0050	0.0000040	36	0.00012	0.000058
9-Mar-16	24	47	400	365	8.1	270	#N/A	2.0	97	33															

Calculated Loading Rates for Col 9

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	360	7.6	3083	#N/A	0.88	10	151	2.4	0.024	0.022	136	0.00027	0.00050	0.0079	0.0017	0.00000050	0.00000050	0.0015	0.0000013	32	0.000021	0.00020
6-May-15	2	3	400	355	7.7	1878	#N/A	0.25	2.8	48	3.6	0.013	0.011	43	0.000099	0.00016	0.0034	0.00038	0.00000025	0.00000025	0.00061	0.00000036	10	0.0000011	0.000053
20-May-15	3	5	400	375	7.8	1274	#N/A	0.27	2.7	27	0.75	0.014	0.011	27	0.000053	0.00012	0.0030	0.00029	0.00000026	0.00000026	0.00049	0.00000015	6.9	0.0000041	0.000030
3-Jun-15	4	7	400	255	7.8	1162	#N/A	0.17	2.1	14	0.26	0.011	0.0077	14	0.00014	0.000082	0.0022	0.00022	0.00000018	0.00000018	0.00043	0.000000077	3.5	0.0000015	0.000014
17-Jun-15	5	9	500	445	7.9	776	#N/A	0.31	3.8	16	0.45	0.019	0.013	17	0.00021	0.00014	0.0043	0.00036	0.00000031	0.00000031	0.00061	0.00000013	4.3	0.0000027	0.000015
1-Jul-15	6	11	500	390	7.9	687	#N/A	0.27	3.5	9.2	0.39	0.018	0.012	11	0.00015	0.00012	0.0038	0.00038	0.00000027	0.00000027	0.00041	0.00000012	2.7	0.0000031	0.0000090
15-Jul-15	7	13	500	455	7.9	521	#N/A	0.26	4.2	8.3	0.46	0.023	0.014	10	0.00021	0.00014	0.0042	0.00049	0.00000032	0.00000032	0.00069	0.00000014	2.5	0.0000041	0.0000096
29-Jul-15	8	15	400	375	7.9	490	#N/A	0.15	3.5	5.8	0.38	0.019	0.011	8.2	0.00014	0.00012	0.0032	0.00041	0.00000026	0.00000026	0.00051	0.00000030	2.0	0.0000030	0.0000057
12-Aug-15	9	17	400	395	7.9	440	#N/A	0.18	3.7	4.8	0.40	0.020	0.012	7.8	0.000099	0.00013	0.0031	0.00047	0.00000028	0.00000028	0.00040	0.00000012	1.9	0.0000028	0.0000045
26-Aug-15	10	19	500	460	7.6	408	0.00	0.19	4.3	4.6	0.46	0.023	0.014	8.7	0.00018	0.00015	0.0040	0.00063	0.00000032	0.00000032	0.00048	0.00000018	2.1	0.0000035	0.0000048
9-Sep-15	11	21	500	450	7.9	374	#N/A	0.18	4.2	4.6	0.00	0.027	0.00	9.3	0.00027	0.00018	0.0048	0.00080	0.00000036	0.00000036	0.00054	0.00000026	2.2	0.0000041	0.0000049
23-Sep-15	12	23	500	465	8.0	346	#N/A	0.16	4.6	4.2	0.00	0.027		9.1	0.00024	0.00019	0.0056	0.00084	0.00000037	0.00000037	0.00052	0.00000024	2.2	0.0000051	0.0000043
7-Oct-15	13	25	400	370	7.9	349	#N/A	0.12	4.0	3.0	0.00	0.021		6.8	0.00016	0.00016	0.0050	0.00068	0.00000030	0.00000030	0.00039	0.00000017	1.7	0.0000047	0.0000028
21-Oct-15	14	27	400	385	8.1	321	#N/A	0.081	3.9	2.5	0.00	0.021		6.6	0.00023	0.00016	0.0050	0.00078	0.00000031	0.00000031	0.00044	0.00000013	1.7	0.0000044	0.0000026
4-Nov-15	15	29	400	385	8.0	316	#N/A	0.089	4.1	2.4	0.00	0.021		6.9	0.00043	0.00014	0.0054	0.00084	0.00000031	0.00000031	0.00030	0.00000049	1.7	0.0000031	0.0000019
18-Nov-15	16	31	400	370	8.1	316	#N/A	0.053	4.3	2.1	0.00	0.020		6.3	0.00015	0.00014	0.0049	0.00065	0.00000030	0.00000030	0.00028	0.00000013	1.6	0.0000047	0.0000023
2-Dec-15	17	33	400	375	8.2	306	#N/A	0.068	3.9	2.0	0.00	0.021		6.8	0.00016	0.00014	0.0048	0.00090	0.00000030	0.00000030	0.00033	0.00000030	1.7	0.0000034	0.0000039
16-Dec-15	18	35	400	360	8.2	296	#N/A	0.075	3.5	1.8	0.00	0.019		6.4	0.00012	0.00014	0.0056	0.00093	0.00000029	0.00000029	0.00038	0.00000033	1.6	0.0000025	0.0000031
30-Dec-15	19	37	400	385	8.2	288	#N/A	0.054	3.7	2.0	0.00	0.021		6.5	0.00023	0.00013	0.0054	0.00099	0.00000031	0.00000031	0.00035	0.00000049	1.6	0.0000062	0.0000024
13-Jan-16	20	39	400	355	8.2	285	#N/A	0.054	3.5	1.9	0.00	0.018		5.8	0.000090	0.00013	0.0045	0.00087	0.00000029	0.00000029	0.00037	0.00000012	1.4	0.0000061	0.0000033
27-Jan-16	21	41	400	370	8.1	276	#N/A	0.11	3.6	1.9	0.00	0.020		5.8	0.00013	0.00014	0.0037	0.0010	0.00000030	0.00000030	0.00030	0.00000043	1.4	0.0000030	0.0000025
10-Feb-16	22	43	400	385	8.1	276	#N/A	0.092	3.9	1.7	0.00	0.019		6.2	0.00014	0.00015	0.0037	0.0011	0.00000049	0.00000031	0.00027	0.00000013	1.5	0.0000031	0.0000020
24-Feb-16	23	45	400	360	8.1	285	#N/A	0.078	3.6	1.6	0.00	0.017		6.1	0.000050	0.00013	0.0039	0.0011	0.00000029	0.00000029	0.00021	0.00000017	1.5	0.0000050	0.0000024
9-Mar-16	24	47	400	365	8.1	270	#N/A	0.073	3.5	1.4															

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 9 (Latte Schist Oxide Ore)

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	360	0.0087	*< 0.007*	*< 1E-05*	0.020	192	0.13	0.26	0.0030	0.029	0.017	17	0.019	4.8	0.000046	131	3.0	672	0.00033	0.00012	0.00013	0.069	0.00013	0.0030	*< 0.002*
6-May-15	2	3	400	355	0.0034	*< 0.007*	*< 1E-05*	0.012	114	0.094	0.050	0.0026	0.017	*< 0.003*	11	0.015	4.2	0.000014	67	1.8	467	0.00017	*< 1E-05*	0.000050	0.031	0.00010	0.0020	*< 0.002*
20-May-15	3	5	400	375	0.0020	0.010	*< 1E-05*	0.0088	62	0.049	0.010	0.0031	0.0084	*< 0.003*	7.8	0.0077	4.3	0.000015	34	1.1	237	0.00014	0.00018	0.000060	0.018	0.000040	0.0020	*< 0.002*
3-Jun-15	4	7	400	255	0.0012	*< 0.007*	*< 1E-05*	0.0078	48	0.029	*< 0.01*	0.0028	0.0061	*< 0.003*	7.2	0.0056	4.2	0.000011	26	0.85	189	0.00012	0.000050	*< 5E-05*	0.014	0.000080	0.0010	*< 0.002*
17-Jun-15	5	9	500	445	0.0011	*< 0.007*	*< 1E-05*	0.0059	33	0.016	*< 0.01*	0.0030	0.0039	*< 0.003*	5.7	0.0037	4.0	0.000010	16	0.56	121	0.00012	0.000090	0.00010	0.0099	0.00010	0.0010	*< 0.002*
1-Jul-15	6	11	500	390	0.0013	*< 0.007*	*< 1E-05*	0.0054	26	0.0093	0.020	0.0027	0.0027	*< 0.003*	4.9	0.0027	4.0	0.0000080	12	0.45	76	0.00010	0.000080	*< 5E-05*	0.0078	0.000060	0.0020	*< 0.002*
15-Jul-15	7	13	500	455	0.00074	*< 0.007*	0.000010	0.0049	23	0.010	*< 0.01*	0.0026	0.0021	*< 0.003*	4.4	0.0017	3.8	0.0000080	8.8	0.38	60	0.00011	0.000080	0.000090	0.0063	0.000090	0.0010	*< 0.002*
29-Jul-15	8	15	400	375	0.00074	*< 0.007*	0.000010	0.0047	21	0.0073	*< 0.01*	0.0028	0.0017	*< 0.003*	4.3	0.0013	3.5	*< 2E-06*	6.7	0.37	52	0.000090	0.000080	*< 5E-05*	0.0053	0.000070	0.0010	*< 0.002*
12-Aug-15	9	17	400	395	0.00049	*< 0.007*	*< 1E-05*	0.0041	19	0.0048	*< 0.01*	0.0026	0.0015	*< 0.003*	4.4	0.0010	3.7	0.000018	5.2	0.34	40	0.000064	0.000040	*< 5E-05*	0.0040	0.000060	0.0010	*< 0.002*
26-Aug-15	10	19	500	460	0.00065	0.0070	0.000015	0.0039	18	0.0048	0.010	0.0026	0.0015	0.0040	4.5	0.00093	3.6	0.000013	4.4	0.32	40	0.000066	0.000085	0.000050	0.0033	0.000070	0.0010	0.0020
9-Sep-15	11	21	500	450	0.00080	*< 0.007*	0.000020	0.0036	18	0.00	*< 0.01*	0.0027	0.0014	0.0050	4.5	0.00082	3.4	0.0000070	3.7	0.31	40	0.000068	0.00013	*< 5E-05*	0.0026	0.000080	0.0010	*< 0.002*
23-Sep-15	12	23	500	465	0.00073	0.0070	0.000015	0.0035	16	0.0039	0.010	0.0024	0.0013	0.0040	4.1	0.00075	3.4	0.0000065	3.0	0.28	32	0.000066	0.000080	0.000050	0.0023	0.000070	0.0010	0.0020
7-Oct-15	13	25	400	370	0.00064	*< 0.007*	*< 1E-05*	0.0033	15	0.0029	*< 0.01*	0.0021	0.0011	*< 0.003*	3.7	0.00067	3.4	0.0000060	2.3	0.26	25	0.000064	0.000030	*< 5E-05*	0.0021	0.000060	*< 0.001*	*< 0.002*
21-Oct-15	14	27	400	385	0.00067	*< 0.007*	*< 1E-05*	0.0030	13	0.0024	*< 0.01*	0.0029	0.0012	*< 0.003*	3.5	0.00059	3.5	0.0000030	1.9	0.24	22	0.000096	0.000060	*< 5E-05*	0.0021	0.000060	*< 0.001*	*< 0.002*
4-Nov-15	15	29	400	385	0.0031	*< 0.007*	0.00021	0.0025	14	0.0020	*< 0.01*	0.0027	0.0012	0.0050	3.5	0.00054	3.3	0.0000030	1.8	0.24	21	0.000095	0.00072	*< 5E-05*	0.0018	0.00017	0.0030	*< 0.002*
18-Nov-15	16	31	400	370	0.00066	0.013	0.00015	0.0028	14	0.0017	*< 0.01*	0.0027	0.00080	*< 0.003*	3.5	0.00066	3.3	*< 2E-06*	1.5	0.24	20	0.000066	0.000040	*< 5E-05*	0.0015	0.000080	0.0010	*< 0.002*
2-Dec-15	17	33	400	375	0.00069	*< 0.007*	0.000020	0.0027	15	0.0050	*< 0.01*	0.0029	0.0012	*< 0.003*	3.7	0.00066	3.3	*< 2E-06*	1.5	0.25	19	0.000059	0.000060	0.000070	0.0016	0.000060	0.0010	*< 0.002*
16-Dec-15	18	35	400	360	0.00077	*< 0.007*	0.000060	0.0028	15	0.0054	*< 0.01*	0.0025	0.0011	*< 0.003*	3.7	0.00056	3.5	*< 2E-06*	1.3	0.25	18	0.000082	0.00013	0.000070	0.0016	0.000040	*< 0.001*	*< 0.002*
30-Dec-15	19	37	400	385	0.00060	0.0070	0.00013	0.0028	14	0.0046	0.010	0.0025	0.0010	*< 0.003*	3.4	0.00050	3.0	0.0000040	1.2	0.24	15	0.000076	0.000020	0.000060	0.0015	0.000080	0.0010	*< 0.002*
13-Jan-16	20	39	400	355	0.00089	*< 0.007*	0.000050	0.0026	14	0.0055	*< 0.01*	0.0025	0.00090	*< 0.003*	3.5	0.00064	3.4	0.0000030	1.0	0.22	15	0.000038	0.000060	*< 5E-05*	0.0012	0.000050	*< 0.001*	*< 0.002*
27-Jan-16	21	41	400	370	0.00069	*< 0.007*	0.000010	0.0026	13	0.0027	*< 0.01*	0.0024	0.00080	*< 0.003*	3.5	0.00043	3.3	*< 2E-06*	0.93	0.24	15	0.000064	0.000060	*< 5E-05*	0.0013	0.000050	0.0020	*< 0.002*
10-Feb-16	22	43	400	385	0.00053	*< 0.007*	0.000060	0.0025	13	0.0018	*< 0.01*	0.0023	0.00090	*< 0.003*	3.4	0.00049	3.2	*< 2E-06*	0.88	0.23	14	0.000057	0.000040	*< 5E-05*	0.0011	0.000050	*< 0.001*	*< 0.002*
24-Feb-16	23	45	400	360	0.00035	*< 0.007*	*< 1E-05*	0.0026	14	0.0033	0.020	0.0023	0.00090	*< 0.003*	3.5	0.00045	3.2	*< 2E-06*	0.73	0.23	13	0.000060	0.000010	*< 5E-05*	0.0011	0.000040	0.0010	*< 0.002*
9-Mar-16	24	47	400	365																								

Calculated Loading Rates for Col 9

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	360	0.00063	0.00050	0.00000072	0.0014	14	0.0093	0.019	0.00021	0.0021	0.0012	1.2	0.0014	0.34	0.0000033	9.4	0.21	48	0.000024	0.0000086	0.0000094	0.0049	0.0000094	0.00022	0.00014
6-May-15	2	3	400	355	0.00012	0.00025	0.00000036	0.00043	4.0	0.0033	0.0018	0.000092	0.00062	0.00011	0.39	0.00053	0.15	0.00000050	2.4	0.062	17	0.0000061	0.00000036	0.0000018	0.0011	0.0000036	0.000071	0.000071
20-May-15	3	5	400	375	0.000075	0.00038	0.00000038	0.00033	2.3	0.0018	0.00038	0.00012	0.00032	0.00011	0.29	0.00029	0.16	0.00000056	1.3	0.040	8.9	0.0000053	0.0000068	0.0000023	0.00068	0.0000015	0.000075	0.000075
3-Jun-15	4	7	400	255	0.000031	0.00018	0.00000026	0.00020	1.2	0.00073	0.00026	0.000071	0.00016	0.000077	0.18	0.00014	0.11	0.00000028	0.65	0.022	4.8	0.0000031	0.0000013	0.0000013	0.00036	0.0000020	0.000026	0.000051
17-Jun-15	5	9	500	445	0.000047	0.00031	0.00000045	0.00026	1.5	0.00071	0.00045	0.00013	0.00017	0.00013	0.25	0.00017	0.18	0.00000045	0.73	0.025	5.4	0.0000052	0.0000040	0.0000045	0.00044	0.0000045	0.000045	0.000089
1-Jul-15	6	11	500	390	0.000052	0.00027	0.00000039	0.00021	1.0	0.00036	0.00078	0.00010	0.00011	0.00012	0.19	0.00011	0.16	0.00000031	0.46	0.018	3.0	0.0000040	0.0000031	0.0000020	0.00030	0.0000023	0.000078	0.000078
15-Jul-15	7	13	500	455	0.000034	0.00032	0.00000046	0.00022	1.0	0.00046	0.00046	0.00012	0.000096	0.00014	0.20	0.000078	0.17	0.00000036	0.40	0.017	2.7	0.0000049	0.0000036	0.0000041	0.00029	0.0000041	0.000046	0.000091
29-Jul-15	8	15	400	375	0.000028	0.00026	0.00000038	0.00018	0.77	0.00027	0.00038	0.00010	0.000064	0.00011	0.16	0.000047	0.13	0.000000075	0.25	0.014	2.0	0.0000034	0.0000030	0.0000019	0.00020	0.0000026	0.000038	0.000075
12-Aug-15	9	17	400	395	0.000019	0.00028	0.00000040	0.00016	0.73	0.00019	0.00040	0.00010	0.000059	0.00012	0.17	0.000041	0.14	0.00000071	0.20	0.013	1.6	0.0000025	0.0000016	0.0000020	0.00016	0.0000024	0.000040	0.000079
26-Aug-15	10	19	500	460	0.000030	0.00032	0.00000069	0.00018	0.84	0.00022	0.00046	0.00012	0.000067	0.00018	0.21	0.000043	0.16	0.00000058	0.20	0.015	1.8	0.0000030	0.0000039	0.0000023	0.00015	0.0000032	0.000046	0.000092
9-Sep-15	11	21	500	450	0.000042	0.00036	0.0000010	0.00019	0.93	0.00025	0.00052	0.00014	0.000072	0.00026	0.23	0.000042	0.18	0.00000036	0.19	0.016	2.1	0.0000035	0.0000067	0.0000026	0.00013	0.0000041	0.000052	0.00010
23-Sep-15	12	23	500	465	0.000039	0.00037	0.00000080	0.00019	0.88	0.00021	0.00053	0.00013	0.000067	0.00021	0.22	0.000040	0.18	0.00000035	0.16	0.015	1.7	0.0000035	0.0000043	0.0000027	0.00013	0.0000037	0.000053	0.00011
7-Oct-15	13	25	400	370	0.000027	0.00030	0.00000043	0.00014	0.64	0.00013	0.00043	0.000087	0.000047	0.00013	0.16	0.000028	0.14	0.00000026	0.097	0.011	1.1	0.0000027	0.0000013	0.0000021	0.000089	0.0000026	0.000043	0.000085
21-Oct-15	14	27	400	385	0.000030	0.00031	0.00000044	0.00013	0.59	0.00011	0.00044	0.00013	0.000053	0.00013	0.16	0.000026	0.15	0.00000013	0.085	0.011	0.98	0.0000042	0.0000027	0.0000022	0.000093	0.0000027	0.000044	0.000089
4-Nov-15	15	29	400	385	0.00014	0.00031	0.0000093	0.00011	0.62	0.000090	0.00044	0.00012	0.000053	0.00022	0.16	0.000024	0.15	0.00000013	0.079	0.010	0.92	0.0000042	0.000032	0.0000022	0.000081	0.0000075	0.00013	0.000089
18-Nov-15	16	31	400	370	0.000028	0.00055	0.0000064	0.00012	0.59	0.000072	0.00043	0.00011	0.000034	0.00013	0.15	0.000028	0.14	0.000000085	0.065	0.0100	0.84	0.0000028	0.0000017	0.0000021	0.000065	0.0000034	0.000043	0.000085
2-Dec-15	17	33	400	375	0.000030	0.00030	0.00000086	0.00012	0.64	0.00022	0.00043	0.00012	0.000052	0.00013	0.16	0.000028	0.14	0.000000086	0.066	0.011	0.81	0.0000025	0.0000026	0.0000030	0.000070	0.0000026	0.000043	0.000086
16-Dec-15	18	35	400	360	0.000032	0.00029	0.0000025	0.00012	0.60	0.00022	0.00041	0.00010	0.000046	0.00012	0.15	0.000023	0.14	0.000000083	0.055	0.010	0.74	0.0000034	0.0000054	0.0000029	0.000067	0.0000017	0.000041	0.000083
30-Dec-15	19	37	400	385	0.000027	0.00031	0.0000058	0.00012	0.61	0.00020	0.00044	0.00011	0.000044	0.00013	0.15	0.000022	0.13	0.00000018	0.054	0.011	0.66	0.0000034	0.00000089	0.0000027	0.000065	0.0000035	0.000044	0.000089
13-Jan-16	20	39	400	355	0.000036	0.00029	0.0000020	0.00011	0.55	0.00022	0.00041	0.00010	0.000037	0.00012	0.14	0.000026	0.14	0.00000012	0.042	0.0090	0.59	0.0000016	0.0000024	0.0000020	0.000050	0.0000020	0.000041	0.000082
27-Jan-16	21	41	400	370	0.000029	0.00030	0.00000043	0.00011	0.54	0.00011	0.00043	0.00010	0.000034	0.00013	0.15	0.000018	0.14	0.000000085	0.040	0.010	0.62	0.0000027	0.0000026	0.0000021	0.000056	0.0000021	0.000085	0.000085
10-Feb-16	22	43	400	385	0.000023	0.00031	0.0000027	0.00011	0.58	0.000077	0.00044	0.00010	0.000040	0.00013	0.15	0.000022	0.14	0.000000089	0.039	0.010	0.61	0.0000025	0.0000018	0.0000022	0.000050	0.0000022	0.000044	0.000089
24-Feb-16	23	45	400	360	0.000014	0.00029	0.00000041	0.00011	0.58	0.00013	0.00083	0.000097	0.000037	0.00012	0.15	0.000019	0.13	0.000000083	0.030	0.0096	0.54	0.0000025	0.00000041	0.0000021	0.000047	0.0000017	0.000041	0.000083
9-Mar-16	24	47	400	365																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 10 (Latte Schist Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	435	7.7	3558	#N/A	13	142	2538	31	0.31	*< 0.3*	2390	0.0027	0.027	0.18	0.013	*< 7E-06*	*< 7E-06*	0.014	0.000018	507	0.000050	0.0069
6-May-15	2	3	400	355	7.6	2779	#N/A	7.8	70	1837	14	0.33	*< 0.3*	1740	0.0026	0.018	0.14	0.0054	*< 7E-06*	*< 7E-06*	0.010	0.0000080	425	*< 3E-05*	0.0041
20-May-15	3	5	400	360	7.7	2305	#N/A	9.0	60	1421	1.0	0.34	*< 0.3*	1340	0.0052	0.014	0.12	0.0046	*< 7E-06*	*< 7E-06*	0.0070	0.0000040	351	0.000050	0.0030
3-Jun-15	4	7	400	270	7.7	2125	#N/A	8.2	63	1280	*< 1*	0.36	*< 0.3*	1277	0.0049	0.015	0.12	0.0048	*< 7E-06*	*< 7E-06*	0.011	0.0000040	348	0.000040	0.0026
17-Jun-15	5	9	500	455	7.8	1396	#N/A	8.1	65	848	*< 1*	0.37	*< 0.3*	826	0.0044	0.014	0.12	0.0041	*< 7E-06*	*< 7E-06*	0.0084	0.0000040	229	0.000080	0.0017
1-Jul-15	6	11	500	470	7.8	873	#N/A	7.1	66	639	*< 1*	0.38	*< 0.3*	611	0.0040	0.014	0.12	0.0043	*< 7E-06*	*< 7E-06*	0.0053	*< 3E-06*	168	*< 3E-05*	0.0013
15-Jul-15	7	13	500	450	7.8	825	#N/A	5.6	69	521	*< 1*	0.41	*< 0.3*	530	0.0060	0.014	0.11	0.0046	*< 7E-06*	0.0000070	0.0097	*< 3E-06*	140	*< 3E-05*	0.0013
29-Jul-15	8	15	400	365	7.8	988	#N/A	4.6	69	485	*< 1*	0.41	*< 0.3*	516	0.0051	0.014	0.10	0.0051	*< 7E-06*	*< 7E-06*	0.0089	*< 3E-06*	141	0.00013	0.0010
12-Aug-15	9	17	400	375	7.8	788	#N/A	4.8	71	396	*< 1*	0.39	*< 0.3*	448	0.0047	0.014	0.11	0.0051	*< 7E-06*	*< 7E-06*	0.0063	0.0000050	123	0.00014	0.00082
26-Aug-15	10	19	500	445	7.7	788	#N/A	4.5	70	343	1.0	0.41	0.30	396	0.0048	0.015	0.11	0.0056	0.0000070	0.0000070	0.0061	0.0000040	109	0.000085	0.00070
9-Sep-15	11	21	500	450	7.9	602	#N/A	4.2	70	283	*< 1*	0.42	*< 0.3*	344	0.0049	0.017	0.11	0.0062	*< 7E-06*	*< 7E-06*	0.0058	*< 3E-06*	96	*< 3E-05*	0.00058
23-Sep-15	12	23	500	465	7.9	586	#N/A	3.6	74	251	-	0.41	-	322	0.0043	0.017	0.11	0.0063	0.0000070	0.0000070	0.0054	0.0000030	89	0.000055	0.00052
7-Oct-15	13	25	400	360	7.9	630	#N/A	3.9	81	241	-	0.39	-	299	0.0036	0.018	0.11	0.0065	*< 7E-06*	*< 7E-06*	0.0050	*< 3E-06*	83	0.000080	0.00045
21-Oct-15	14	27	400	360	8.0	583	#N/A	2.1	79	178	-	0.39	-	267	0.0060	0.018	0.12	0.0076	*< 7E-06*	*< 7E-06*	0.0064	0.0000030	76	0.000050	0.00041
4-Nov-15	15	29	400	375	8.0	585	#N/A	2.9	84	225	-	0.38	-	284	0.0051	0.016	0.12	0.0085	*< 7E-06*	*< 7E-06*	0.0043	*< 3E-06*	80	*< 3E-05*	0.00036
18-Nov-15	16	31	400	360	8.1	534	#N/A	1.7	90	168	-	0.39	-	244	0.0037	0.015	0.12	0.0056	*< 7E-06*	*< 7E-06*	0.0029	*< 3E-06*	69	0.000040	0.00032
2-Dec-15	17	33	400	375	8.1	492	#N/A	2.4	81	136	-	0.39	-	250	0.0048	0.017	0.12	0.0086	*< 7E-06*	*< 7E-06*	0.0050	0.0000070	69	0.000040	0.00049
16-Dec-15	18	35	400	355	8.1	438	#N/A	2.3	75	144	-	0.37	-	246	0.0037	0.017	0.14	0.0099	*< 7E-06*	*< 7E-06*	0.0056	0.0000050	69	*< 3E-05*	0.00043
30-Dec-15	19	37	400	345	8.1	443	#N/A	1.8	77	120	-	0.37	-	222	0.0043	0.016	0.13	0.0094	*< 7E-06*	*< 7E-06*	0.0047	*< 3E-06*	62	0.000070	0.00039
13-Jan-16	20	39	400	365	8.1	403	#N/A	1.7	77	112	-	0.36	-	196	0.0032	0.016	0.12	0.0095	*< 7E-06*	*< 7E-06*	0.0060	*< 3E-06*	54	*< 3E-05*	0.00031
27-Jan-16	21	41	400	365	8.0	386	#N/A	3.4	77	108	-	0.42	-	188	0.0040	0.017	0.13	0.011	*< 7E-06*	*< 7E-06*	0.0040	0.0000030	53	*< 3E-05*	0.00032
10-Feb-16	22	43	401	375	8.1	380	#N/A	2.5	81	103	-	0.36	-	183	0.0049	0.017	0.14	0.011	*< 7E-06*	*< 7E-06*	0.0030	*< 3E-06*	51	*< 3E-05*	0.00028
24-Feb-16	23	45	402	350	8.1	397	#N/A	2.5	82	103	-	0.37	-	201	0.0020	0.017	0.14	0.011	*< 7E-06*	*< 7E-06*	0.0020	0.0000040	56	*< 3E-05*	0.00031
9-Mar-16	24	47	403	370	8.1	379	#N/A	2.3	78	79															

Calculated Loading Rates for Col 10

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	435	7.7	3558	#N/A	1.1	12	221	2.7	0.027	0.026	208	0.00023	0.0024	0.015	0.0011	0.00000061	0.00000061	0.0012	0.0000016	44	0.0000044	0.00060
6-May-15	2	3	400	355	7.6	2779	#N/A	0.28	2.5	65	0.50	0.012	0.011	62	0.000092	0.00063	0.0049	0.00019	0.00000025	0.00000025	0.00036	0.00000028	15	0.0000011	0.00015
20-May-15	3	5	400	360	7.7	2305	#N/A	0.33	2.1	51	0.036	0.012	0.011	48	0.00019	0.00050	0.0043	0.00016	0.00000025	0.00000025	0.00025	0.00000014	13	0.0000018	0.00011
3-Jun-15	4	7	400	270	7.7	2125	#N/A	0.22	1.7	35	0.027	0.0097	0.0081	34	0.00013	0.00040	0.0032	0.00013	0.00000019	0.00000019	0.00030	0.00000011	9.4	0.0000011	0.000070
17-Jun-15	5	9	500	455	7.8	1396	#N/A	0.37	3.0	39	0.046	0.017	0.014	38	0.00020	0.00065	0.0056	0.00018	0.00000032	0.00000032	0.00038	0.00000018	10	0.0000036	0.000077
1-Jul-15	6	11	500	470	7.8	873	#N/A	0.33	3.1	30	0.047	0.018	0.014	29	0.00019	0.00067	0.0055	0.00020	0.00000033	0.00000033	0.00025	0.00000014	7.9	0.0000014	0.000062
15-Jul-15	7	13	500	450	7.8	825	#N/A	0.25	3.1	23	0.045	0.018	0.014	24	0.00027	0.00063	0.0051	0.00021	0.00000032	0.00000032	0.00044	0.00000014	6.3	0.0000014	0.000057
29-Jul-15	8	15	400	365	7.8	988	#N/A	0.17	2.5	18	0.037	0.015	0.011	19	0.00019	0.00051	0.0037	0.00019	0.00000026	0.00000026	0.00032	0.00000011	5.1	0.0000047	0.000038
12-Aug-15	9	17	400	375	7.8	788	#N/A	0.18	2.7	15	0.038	0.015	0.011	17	0.00018	0.00053	0.0039	0.00019	0.00000026	0.00000026	0.00024	0.00000019	4.6	0.0000053	0.000031
26-Aug-15	10	19	500	445	7.7	788	0.00	0.20	3.1	15	0.045	0.018	0.013	18	0.00021	0.00068	0.0048	0.00025	0.00000031	0.00000031	0.00027	0.00000018	4.9	0.0000038	0.000031
9-Sep-15	11	21	500	450	7.9	602	#N/A	0.19	3.1	15	0.045	0.022	0.016	18	0.00025	0.00086	0.0056	0.00032	0.00000036	0.00000036	0.00030	0.00000016	5.0	0.0000016	0.000030
23-Sep-15	12	23	500	465	7.9	586	#N/A	0.17	3.4	13	0.00	0.022		17	0.00023	0.00092	0.0060	0.00034	0.00000037	0.00000037	0.00029	0.00000016	4.8	0.0000029	0.000028
7-Oct-15	13	25	400	360	7.9	630	#N/A	0.14	2.9	10.0	0.00	0.016		12	0.00015	0.00074	0.0047	0.00027	0.00000029	0.00000029	0.00021	0.00000012	3.4	0.0000033	0.000019
21-Oct-15	14	27	400	360	8.0	583	#N/A	0.077	2.8	7.4	0.00	0.016		11	0.00025	0.00072	0.0050	0.00031	0.00000029	0.00000029	0.00026	0.00000012	3.1	0.0000021	0.000017
4-Nov-15	15	29	400	375	8.0	585	#N/A	0.11	3.2	9.7	0.00	0.016		12	0.00022	0.00067	0.0053	0.00037	0.00000030	0.00000030	0.00019	0.00000013	3.4	0.0000013	0.000015
18-Nov-15	16	31	400	360	8.1	534	#N/A	0.060	3.3	7.0	0.00	0.016		10	0.00015	0.00064	0.0050	0.00023	0.00000029	0.00000029	0.00012	0.00000012	2.8	0.0000017	0.000013
2-Dec-15	17	33	400	375	8.1	492	#N/A	0.088	3.0	5.9	0.00	0.017		11	0.00021	0.00073	0.0050	0.00037	0.00000030	0.00000030	0.00022	0.00000030	3.0	0.0000017	0.000021
16-Dec-15	18	35	400	355	8.1	438	#N/A	0.082	2.6	5.9	0.00	0.015		10	0.00015	0.00071	0.0056	0.00041	0.00000029	0.00000029	0.00023	0.00000020	2.8	0.0000012	0.000017
30-Dec-15	19	37	400	345	8.1	443	#N/A	0.062	2.6	4.8	0.00	0.015		8.8	0.00017	0.00063	0.0051	0.00037	0.00000028	0.00000028	0.00019	0.00000012	2.5	0.0000028	0.000015
13-Jan-16	20	39	400	365	8.1	403	#N/A	0.062	2.8	4.7	0.00	0.015		8.2	0.00013	0.00068	0.0048	0.00040	0.00000029	0.00000029	0.00025	0.00000013	2.3	0.0000013	0.000013
27-Jan-16	21	41	400	365	8.0	386	#N/A	0.12	2.8	4.5	0.00	0.018		7.9	0.00017	0.00070	0.0053	0.00044	0.00000029	0.00000029	0.00017	0.00000013	2.2	0.0000013	0.000013
10-Feb-16	22	43	401	375	8.1	380	#N/A	0.095	3.0	4.4	0.00	0.016		7.9	0.00021	0.00073	0.0060	0.00046	0.00000030	0.00000030	0.00013	0.00000013	2.2	0.0000013	0.000012
24-Feb-16	23	45	402	350	8.1	397	#N/A	0.088	2.9	4.1	0.00	0.015		8.1	0.000080	0.00069	0.0055	0.00046	0.00000028	0.00000028	0.000080	0.00000016	2.2	0.0000012	0.000012
9-Mar-16	24	47	403	370	8.1	379	#N/A	0.084	2.9	3.4	0.00														

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 10 (Latte Schist Transition Ore)

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	435	0.0085	*< 0.007*	*< 1E-05*	0.020	272	0.41	0.26	0.0049	0.048	0.014	21	0.028	3.9	0.00020	68	3.8	807	0.00065	0.000080	0.000060	0.065	0.00015	0.0020	*< 0.002*
6-May-15	2	3	400	355	0.0037	*< 0.007*	0.000020	0.011	164	0.33	0.040	0.0047	0.033	*< 0.003*	14	0.018	3.1	0.000012	31	2.6	720	0.00042	*< 1E-05*	*< 5E-05*	0.042	0.00013	0.0030	*< 0.002*
20-May-15	3	5	400	360	0.0018	*< 0.007*	0.000010	0.0088	112	0.27	*< 0.01*	0.0046	0.022	*< 0.003*	11	0.0089	3.3	0.0000060	17	2.0	447	0.00039	0.00013	0.00012	0.031	0.00014	0.0010	*< 0.002*
3-Jun-15	4	7	400	270	0.010	*< 0.007*	0.00016	0.0085	99	0.23	*< 0.01*	0.0051	0.019	*< 0.003*	11	0.0064	3.3	0.0000060	13	1.9	434	0.00036	0.0020	*< 5E-05*	0.029	0.00013	0.0090	*< 0.002*
17-Jun-15	5	9	500	455	0.0012	*< 0.007*	*< 1E-05*	0.0062	62	0.13	*< 0.01*	0.0039	0.013	*< 0.003*	8.1	0.0042	3.0	0.0000060	7.5	1.2	285	0.00029	0.000050	0.000060	0.018	0.00011	0.0010	*< 0.002*
1-Jul-15	6	11	500	470	0.00093	*< 0.007*	*< 1E-05*	0.0054	47	0.10	*< 0.01*	0.0036	0.0098	*< 0.003*	6.8	0.0032	2.9	0.0000030	5.0	0.91	195	0.00025	0.000050	*< 5E-05*	0.015	0.00011	0.0010	*< 0.002*
15-Jul-15	7	13	500	450	0.0011	*< 0.007*	0.000020	0.0051	44	0.099	*< 0.01*	0.0034	0.0087	*< 0.003*	5.9	0.0024	3.1	0.0000030	4.2	0.77	171	0.00024	0.000070	*< 5E-05*	0.014	0.00014	0.0010	*< 0.002*
29-Jul-15	8	15	400	365	0.0014	*< 0.007*	0.000030	0.0049	40	0.082	*< 0.01*	0.0038	0.0068	*< 0.003*	6.2	0.0019	2.6	*< 2E-06*	3.3	0.78	167	0.00021	0.00015	*< 5E-05*	0.014	0.00013	*< 0.001*	*< 0.002*
12-Aug-15	9	17	400	375	0.00043	*< 0.007*	*< 1E-05*	0.0042	34	0.067	*< 0.01*	0.0036	0.0060	*< 0.003*	6.0	0.0015	2.9	0.0000080	2.7	0.68	130	0.00018	0.000040	0.000080	0.011	0.00012	*< 0.001*	*< 0.002*
26-Aug-15	10	19	500	445	0.00056	0.0070	0.000010	0.0038	30	0.057	0.010	0.0033	0.0051	0.0030	5.6	0.0014	2.7	0.0000055	2.2	0.59	118	0.00017	0.000085	0.000065	0.0096	0.00015	0.0010	0.0020
9-Sep-15	11	21	500	450	0.00068	*< 0.007*	*< 1E-05*	0.0035	26	0.047	*< 0.01*	0.0031	0.0042	*< 0.003*	5.2	0.0012	2.5	0.0000030	1.8	0.50	105	0.00016	0.00013	*< 5E-05*	0.0082	0.00018	*< 0.001*	*< 0.002*
23-Sep-15	12	23	500	465	0.00060	0.0070	0.000010	0.0033	24	0.044	0.010	0.0028	0.0040	0.0030	4.9	0.0012	2.4	0.0000025	1.6	0.48	94	0.00014	0.000070	0.000050	0.0080	0.00014	0.0010	0.0020
7-Oct-15	13	25	400	360	0.00051	*< 0.007*	*< 1E-05*	0.0031	22	0.041	*< 0.01*	0.0025	0.0037	*< 0.003*	4.5	0.0012	2.4	0.0000020	1.4	0.46	83	0.00012	0.000010	*< 5E-05*	0.0077	0.00010	0.0010	*< 0.002*
21-Oct-15	14	27	400	360	0.00060	*< 0.007*	0.000010	0.0030	19	0.037	*< 0.01*	0.0034	0.0036	*< 0.003*	4.2	0.0011	2.5	*< 2E-06*	1.3	0.40	74	0.00016	0.000040	*< 5E-05*	0.0079	0.00011	0.0080	*< 0.002*
4-Nov-15	15	29	400	375	0.0013	*< 0.007*	0.000070	0.0025	21	0.036	*< 0.01*	0.0030	0.0039	*< 0.003*	4.4	0.0010	2.4	*< 2E-06*	1.2	0.40	74	0.00017	0.000070	*< 5E-05*	0.0081	0.00012	0.0010	*< 0.002*
18-Nov-15	16	31	400	360	0.00035	*< 0.007*	*< 1E-05*	0.0027	18	0.030	*< 0.01*	0.0032	0.0028	*< 0.003*	4.0	0.0012	2.3	*< 2E-06*	0.98	0.36	63	0.00012	0.000030	*< 5E-05*	0.0050	0.00011	*< 0.001*	*< 0.002*
2-Dec-15	17	33	400	375	0.00089	*< 0.007*	0.000040	0.0026	19	0.038	*< 0.01*	0.0033	0.0033	*< 0.003*	4.3	0.0011	2.4	*< 2E-06*	1.0	0.35	58	0.00012	0.000040	*< 5E-05*	0.0061	0.00012	0.0020	*< 0.002*
16-Dec-15	18	35	400	355	0.00048	*< 0.007*	*< 1E-05*	0.0027	18	0.042	*< 0.01*	0.0032	0.0032	*< 0.003*	4.2	0.0010	2.5	*< 2E-06*	0.89	0.36	57	0.00013	0.000040	*< 5E-05*	0.0062	0.00012	*< 0.001*	*< 0.002*
30-Dec-15	19	37	400	345	0.00071	*< 0.007*	0.000040	0.0027	16	0.035	0.010	0.0031	0.0029	*< 0.003*	3.9	0.00090	2.2	0.0000030	0.85	0.32	44	0.00012	0.000020	0.000050	0.0053	0.00017	0.0010	*< 0.002*
13-Jan-16	20	39	400	365	0.00064	*< 0.007*	0.000070	0.0024	15	0.031	*< 0.01*	0.0028	0.0025	*< 0.003*	3.8	0.0010	2.3	0.0000020	0.69	0.28	41	0.000085	0.000040	*< 5E-05*	0.0043	0.00011	*< 0.001*	*< 0.002*
27-Jan-16	21	41	400	365	0.00035	*< 0.007*	0.00020	0.0023	14	0.028	*< 0.01*	0.0027	0.0022	*< 0.003*	3.8	0.00078	2.2	*< 2E-06*	0.63	0.29	41	0.00012	0.000040	*< 5E-05*	0.0045	0.00011	*< 0.001*	*< 0.002*
10-Feb-16	22	43	401	375	0.00044	*< 0.007*	0.000080	0.0023	14	0.025	*< 0.01*	0.0027	0.0023	*< 0.003*	3.6	0.00088	2.2	*< 2E-06*	0.61	0.28	37	0.00012	0.000030	*< 5E-05*	0.0039	0.00013	*< 0.001*	*< 0.002*
24-Feb-16	23	45	402	350	0.00037	*< 0.007*	0.000030	0.0025	15	0.027	0.020	0.0029	0.0024	*< 0.003*	4.0	0.00091	2.2	*< 2E-06*	0.52	0.29	37	0.00011	0.000010	*< 5E-05*	0.0043	0.00011	*< 0.001*	*< 0.002*
9-Mar-16	24	47	403	370																								

Calculated Loading Rates for Col 10

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	435	0.00074	0.00061	0.00000087	0.0017	24	0.036	0.023	0.00043	0.0042	0.0012	1.8	0.0024	0.34	0.000017	6.0	0.33	70	0.000057	0.0000070	0.0000052	0.0056	0.000013	0.00017	0.00017
6-May-15	2	3	400	355	0.00013	0.00025	0.00000071	0.00039	5.8	0.012	0.0014	0.00017	0.0012	0.00011	0.48	0.00064	0.11	0.00000043	1.1	0.091	26	0.000015	0.00000036	0.0000018	0.0015	0.0000046	0.00011	0.000071
20-May-15	3	5	400	360	0.000063	0.00025	0.00000036	0.00032	4.0	0.0096	0.00036	0.00016	0.00077	0.00011	0.40	0.00032	0.12	0.00000022	0.63	0.071	16	0.000014	0.0000047	0.0000043	0.0011	0.0000050	0.000036	0.000072
3-Jun-15	4	7	400	270	0.00028	0.00019	0.0000043	0.00023	2.7	0.0062	0.00027	0.00014	0.00050	0.000081	0.29	0.00017	0.090	0.00000016	0.35	0.050	12	0.0000097	0.000054	0.0000014	0.00077	0.0000035	0.00024	0.000054
17-Jun-15	5	9	500	455	0.000053	0.00032	0.00000046	0.00028	2.8	0.0060	0.00046	0.00018	0.00057	0.00014	0.37	0.00019	0.14	0.00000027	0.34	0.052	13	0.000013	0.0000023	0.0000027	0.00084	0.0000050	0.000046	0.000091
1-Jul-15	6	11	500	470	0.000044	0.00033	0.00000047	0.00025	2.2	0.0048	0.00047	0.00017	0.00046	0.00014	0.32	0.00015	0.14	0.00000014	0.23	0.043	9.2	0.000012	0.0000024	0.0000024	0.00072	0.0000052	0.000047	0.000094
15-Jul-15	7	13	500	450	0.000047	0.00032	0.00000090	0.00023	2.0	0.0045	0.00045	0.00015	0.00039	0.00014	0.27	0.00011	0.14	0.00000014	0.19	0.035	7.7	0.000011	0.0000032	0.0000023	0.00063	0.0000063	0.000045	0.000090
29-Jul-15	8	15	400	365	0.000050	0.00026	0.0000011	0.00018	1.5	0.0030	0.00037	0.00014	0.00025	0.00011	0.23	0.000069	0.096	0.000000073	0.12	0.028	6.1	0.0000078	0.0000055	0.0000018	0.00050	0.0000047	0.000037	0.000073
12-Aug-15	9	17	400	375	0.000016	0.00026	0.00000038	0.00016	1.3	0.0025	0.00038	0.00013	0.00023	0.00011	0.22	0.000057	0.11	0.00000030	0.10	0.026	4.9	0.0000069	0.0000015	0.0000030	0.00041	0.0000045	0.000038	0.000075
26-Aug-15	10	19	500	445	0.000025	0.00031	0.00000045	0.00017	1.3	0.0025	0.00045	0.00015	0.00023	0.00013	0.25	0.000061	0.12	0.00000024	0.100	0.026	5.2	0.0000077	0.0000038	0.0000029	0.00043	0.0000067	0.000045	0.000089
9-Sep-15	11	21	500	450	0.000035	0.00036	0.00000052	0.00018	1.3	0.0024	0.00052	0.00016	0.00022	0.00016	0.27	0.000063	0.13	0.00000016	0.094	0.026	5.4	0.0000083	0.0000067	0.0000026	0.00042	0.0000093	0.000052	0.00010
23-Sep-15	12	23	500	465	0.000032	0.00037	0.00000053	0.00018	1.3	0.0023	0.00053	0.00015	0.00021	0.00016	0.26	0.000065	0.13	0.00000013	0.086	0.026	5.0	0.0000075	0.0000037	0.0000027	0.00043	0.0000075	0.000053	0.00011
7-Oct-15	13	25	400	360	0.000021	0.00029	0.00000041	0.00013	0.92	0.0017	0.00041	0.00010	0.00015	0.00012	0.19	0.000050	0.100	0.000000083	0.057	0.019	3.5	0.0000050	0.00000041	0.0000021	0.00032	0.0000041	0.000041	0.000083
21-Oct-15	14	27	400	360	0.000025	0.00029	0.00000041	0.00012	0.79	0.0015	0.00041	0.00014	0.00015	0.00012	0.17	0.000044	0.11	0.000000083	0.053	0.016	3.0	0.0000067	0.0000017	0.0000021	0.00032	0.0000046	0.00033	0.000083
4-Nov-15	15	29	400	375	0.000054	0.00030	0.0000030	0.00011	0.89	0.0016	0.00043	0.00013	0.00017	0.00013	0.19	0.000044	0.10	0.000000086	0.050	0.017	3.2	0.0000072	0.0000030	0.0000022	0.00035	0.0000052	0.000043	0.000086
18-Nov-15	16	31	400	360	0.000014	0.00029	0.00000041	0.00011	0.73	0.0012	0.00041	0.00013	0.00012	0.00012	0.17	0.000048	0.095	0.000000083	0.041	0.015	2.6	0.0000048	0.0000012	0.0000021	0.00021	0.0000046	0.000041	0.000083
2-Dec-15	17	33	400	375	0.000038	0.00030	0.0000017	0.00011	0.81	0.0016	0.00043	0.00014	0.00014	0.00013	0.19	0.000046	0.10	0.000000086	0.044	0.015	2.5	0.0000053	0.0000017	0.0000022	0.00026	0.0000052	0.000086	0.000086
16-Dec-15	18	35	400	355	0.000020	0.00029	0.00000041	0.00011	0.73	0.0017	0.00041	0.00013	0.00013	0.00012	0.17	0.000041	0.10	0.000000082	0.036	0.015	2.3	0.0000054	0.0000016	0.0000020	0.00025	0.0000049	0.000041	0.000082
30-Dec-15	19	37	400	345	0.000028	0.00028	0.0000016	0.00011	0.64	0.0014	0.00040	0.00012	0.00012	0.00012	0.15	0.000036	0.089	0.00000012	0.034	0.013	1.7	0.0000049	0.00000079	0.0000020	0.00021	0.0000067	0.000040	0.000079
13-Jan-16	20	39	400	365	0.000027	0.00029	0.0000029	0.00010	0.62	0.0013	0.00042	0.00012	0.00010	0.00013	0.16	0.000043	0.095	0.000000084	0.029	0.012	1.7	0.0000036	0.0000017	0.0000021	0.00018	0.0000046	0.000042	0.000084
27-Jan-16	21	41	400	365	0.000015	0.00029	0.0000084	0.000096	0.58	0.0012	0.00042	0.00011	0.000092	0.00013	0.16	0.000033	0.094	0.000000084	0.026	0.012	1.7	0.0000050	0.0000017	0.0000021	0.00019	0.0000046	0.000042	0.000084
10-Feb-16	22	43	401	375	0.000019	0.00030	0.0000034	0.000100	0.58	0.0011	0.00043	0.00012	0.000099	0.00013	0.16	0.000038	0.093	0.000000086	0.026	0.012	1.6	0.0000050	0.0000013	0.0000022	0.00017	0.0000056	0.000043	0.000086
24-Feb-16	23	45	402	350	0.000015	0.00028	0.0000012	0.00010	0.60	0.0011	0.00080	0.00012	0.000097	0.00012	0.16	0.000037	0.088	0.000000080	0.021	0.012	1.5	0.0000044	0.00000040	0.0000020	0.00017	0.0000044	0.000040	0.000080
9-Mar-16	24	47	403	370																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 11 (Supremo Gneiss Oxide Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	360	8.0	538	#N/A	6.0	165	54	14	0.20	*< 0.3*	178	0.0060	0.010	0.082	0.15	*< 7E-06*	*< 7E-06*	0.019	0.0000030	49	0.00027	0.0022
6-May-15	2	3	400	335	8.0	301	#N/A	4.4	98	51	4.0	0.33	*< 0.3*	88	0.0029	0.0092	0.13	0.048	*< 7E-06*	*< 7E-06*	0.013	0.0000030	23	0.000060	0.00097
20-May-15	3	5	400	380	8.1	269	#N/A	4.2	86	37	1.0	0.35	*< 0.3*	80	0.0040	0.0067	0.13	0.041	*< 7E-06*	*< 7E-06*	0.0097	0.0000070	22	0.00023	0.00050
3-Jun-15	4	7	400	275	8.0	242	#N/A	4.4	94	28	*< 1*	0.35	*< 0.3*	80	0.0054	0.0068	0.14	0.045	*< 7E-06*	*< 7E-06*	0.014	0.0000070	22	0.00016	0.00030
17-Jun-15	5	9	500	465	8.1	212	#N/A	4.5	87	21	*< 1*	0.32	*< 0.3*	70	0.0043	0.0066	0.15	0.037	*< 7E-06*	*< 7E-06*	0.012	0.000015	19	0.00015	0.00022
1-Jul-15	6	11	500	475	8.0	206	#N/A	4.8	84	16	*< 1*	0.34	*< 0.3*	69	0.0040	0.0064	0.15	0.040	*< 7E-06*	*< 7E-06*	0.0088	0.0000030	19	0.00016	0.00014
15-Jul-15	7	13	500	475	8.0	184	#N/A	4.2	86	14	*< 1*	0.34	*< 0.3*	72	0.0041	0.0059	0.14	0.044	*< 7E-06*	*< 7E-06*	0.013	0.0000060	19	0.00016	0.00014
29-Jul-15	8	15	400	380	8.0	188	#N/A	3.5	86	12	*< 1*	0.33	*< 0.3*	75	0.0043	0.0054	0.13	0.043	*< 7E-06*	*< 7E-06*	0.012	*< 3E-06*	21	0.00015	0.000093
12-Aug-15	9	17	400	390	8.0	186	#N/A	3.1	86	10	*< 1*	0.31	*< 0.3*	77	0.0025	0.0053	0.13	0.045	*< 7E-06*	*< 7E-06*	0.0092	0.0000090	21	0.00016	0.000073
26-Aug-15	10	19	500	465	7.5	184	#N/A	3.0	83	10	1.0	0.32	0.30	76	0.0034	0.0055	0.13	0.046	0.0000070	0.0000070	0.0090	0.0000060	21	0.00015	0.000069
9-Sep-15	11	21	500	475	8.0	175	#N/A	3.0	80	8.0	*< 1*	0.32	*< 0.3*	75	0.0043	0.0057	0.13	0.046	*< 7E-06*	*< 7E-06*	0.0087	*< 3E-06*	21	0.00014	0.000064
23-Sep-15	12	23	500	470	8.0	176	#N/A	2.4	82	8.0	-	0.30	-	79	0.0041	0.0058	0.13	0.046	0.0000070	0.0000070	0.0079	0.0000040	22	0.00013	0.000056
7-Oct-15	13	25	400	380	8.0	186	#N/A	3.1	89	7.0	-	0.28	-	82	0.0038	0.0058	0.12	0.046	*< 7E-06*	*< 7E-06*	0.0071	0.0000050	23	0.00012	0.000047
21-Oct-15	14	27	400	390	8.1	173	#N/A	1.4	84	7.0	-	0.27	-	76	0.0036	0.0058	0.13	0.053	*< 7E-06*	*< 7E-06*	0.0083	0.0000040	21	0.00017	0.000049
4-Nov-15	15	29	400	390	8.1	177	#N/A	2.3	88	7.0	-	0.28	-	83	0.0039	0.0049	0.12	0.055	*< 7E-06*	*< 7E-06*	0.0055	0.0000070	23	0.00029	*< 4E-06*
18-Nov-15	16	31	400	380	8.2	176	#N/A	1.0	95	7.0	-	0.27	-	79	0.0030	0.0047	0.13	0.042	*< 7E-06*	*< 7E-06*	0.0046	*< 3E-06*	21	0.00012	0.000067
2-Dec-15	17	33	400	380	8.1	178	#N/A	2.0	83	6.0	-	0.26	-	87	0.0032	0.0051	0.11	0.057	*< 7E-06*	*< 7E-06*	0.0061	*< 3E-06*	23	0.00017	0.000050
16-Dec-15	18	35	400	360	8.1	174	#N/A	2.0	77	7.0	-	0.26	-	87	0.0032	0.0054	0.13	0.059	*< 7E-06*	*< 7E-06*	0.0075	*< 3E-06*	24	0.00014	0.000053
30-Dec-15	19	37	400	385	8.1	170	#N/A	1.7	74	5.0	-	0.25	-	88	0.0030	0.0047	0.13	0.056	*< 7E-06*	*< 7E-06*	0.0062	0.0000030	24	0.00022	0.000048
13-Jan-16	20	39	400	370	8.1	172	#N/A	1.7	78	7.0	-	0.23	-	83	0.0022	0.0050	0.11	0.052	*< 7E-06*	*< 7E-06*	0.0070	*< 3E-06*	23	0.00013	0.000021
27-Jan-16	21	41	400	385	8.0	171	#N/A	2.8	77	6.0	-	0.28	-	84	0.013	0.0051	0.12	0.059	*< 7E-06*	*< 7E-06*	0.0060	0.0000040	23	0.00018	0.000042
10-Feb-16	22	43	400	350	8.1	173	#N/A	2.4	77	7.0	-	0.23	-	80	0.0029	0.0051	0.12	0.057	*< 7E-06*	*< 7E-06*	0.0040	*< 3E-06*	22	0.00014	0.000055
24-Feb-16	23	45	400	380	8.1	178	#N/A	2.1	77	4.0	-	0.25	-	90	0.0015	0.0049	0.12	0.060	*< 7E-06*	*< 7E-06*	0.0030	*< 3E-06*	25	0.00019	0.000038
9-Mar-16	24	47	400	380	8.1	172	#N/A	2.0	74	4.0															

Calculated Loading Rates for Col 11

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	360	8.0	538	#N/A	0.43	12	3.9	1.0	0.014	0.022	13	0.00043	0.00073	0.0059	0.011	0.00000050	0.00000050	0.0014	0.00000022	3.5	0.000019	0.00015
6-May-15	2	3	400	335	8.0	301	#N/A	0.15	3.3	1.7	0.13	0.011	0.010	2.9	0.000097	0.00031	0.0042	0.0016	0.00000023	0.00000023	0.00044	0.00000010	0.78	0.0000020	0.000033
20-May-15	3	5	400	380	8.1	269	#N/A	0.16	3.3	1.4	0.038	0.013	0.011	3.0	0.00015	0.00025	0.0048	0.0016	0.00000027	0.00000027	0.00037	0.00000027	0.82	0.0000087	0.000019
3-Jun-15	4	7	400	275	8.0	242	#N/A	0.12	2.6	0.77	0.028	0.0096	0.0083	2.2	0.00015	0.00019	0.0037	0.0012	0.00000019	0.00000019	0.00039	0.00000019	0.59	0.0000044	0.0000082
17-Jun-15	5	9	500	465	8.1	212	#N/A	0.21	4.0	0.98	0.047	0.015	0.014	3.2	0.00020	0.00031	0.0068	0.0017	0.00000033	0.00000033	0.00053	0.00000070	0.89	0.0000070	0.000010
1-Jul-15	6	11	500	475	8.0	206	#N/A	0.23	4.0	0.76	0.048	0.016	0.014	3.3	0.00019	0.00030	0.0072	0.0019	0.00000033	0.00000033	0.00042	0.00000014	0.88	0.0000076	0.0000067
15-Jul-15	7	13	500	475	8.0	184	#N/A	0.20	4.1	0.67	0.048	0.016	0.014	3.4	0.00019	0.00028	0.0067	0.0021	0.00000033	0.00000033	0.00059	0.00000029	0.88	0.0000076	0.0000064
29-Jul-15	8	15	400	380	8.0	188	#N/A	0.13	3.3	0.46	0.038	0.013	0.011	2.9	0.00016	0.00021	0.0048	0.0016	0.00000027	0.00000027	0.00045	0.00000011	0.78	0.0000057	0.0000035
12-Aug-15	9	17	400	390	8.0	186	#N/A	0.12	3.4	0.39	0.039	0.012	0.012	3.0	0.000098	0.00021	0.0049	0.0018	0.00000027	0.00000027	0.00036	0.00000035	0.82	0.0000062	0.0000028
26-Aug-15	10	19	500	465	7.5	184	0.00	0.14	3.9	0.47	0.047	0.015	0.014	3.5	0.00016	0.00026	0.0060	0.0021	0.00000033	0.00000033	0.00042	0.00000028	0.96	0.0000070	0.0000032
9-Sep-15	11	21	500	475	8.0	175	#N/A	0.14	3.8	0.44	0.048	0.017	0.016	4.1	0.00023	0.00031	0.0072	0.0025	0.00000038	0.00000038	0.00048	0.00000016	1.1	0.0000076	0.0000035
23-Sep-15	12	23	500	470	8.0	176	#N/A	0.11	3.8	0.43	0.00	0.016		4.3	0.00022	0.00031	0.0068	0.0025	0.00000038	0.00000038	0.00043	0.00000022	1.2	0.0000070	0.0000030
7-Oct-15	13	25	400	380	8.0	186	#N/A	0.12	3.4	0.31	0.00	0.012		3.6	0.00017	0.00025	0.0052	0.0020	0.00000031	0.00000031	0.00031	0.00000022	1.00	0.0000052	0.0000021
21-Oct-15	14	27	400	390	8.1	173	#N/A	0.055	3.3	0.31	0.00	0.012		3.4	0.00016	0.00026	0.0057	0.0024	0.00000031	0.00000031	0.00037	0.00000018	0.95	0.0000076	0.0000022
4-Nov-15	15	29	400	390	8.1	177	#N/A	0.090	3.4	0.31	0.00	0.013		3.7	0.00017	0.00022	0.0055	0.0025	0.00000031	0.00000031	0.00025	0.00000031	1.0	0.000013	0.00000018
18-Nov-15	16	31	400	380	8.2	176	#N/A	0.040	3.6	0.31	0.00	0.012		3.4	0.00013	0.00021	0.0056	0.0018	0.00000031	0.00000031	0.00020	0.00000013	0.93	0.0000052	0.0000029
2-Dec-15	17	33	400	380	8.1	178	#N/A	0.076	3.2	0.26	0.00	0.011		3.8	0.00014	0.00022	0.0050	0.0025	0.00000031	0.00000031	0.00027	0.00000013	1.0	0.0000074	0.0000022
16-Dec-15	18	35	400	360	8.1	174	#N/A	0.071	2.8	0.29	0.00	0.011		3.6	0.00013	0.00022	0.0053	0.0024	0.00000029	0.00000029	0.00031	0.00000012	0.98	0.0000058	0.0000022
30-Dec-15	19	37	400	385	8.1	170	#N/A	0.065	2.9	0.22	0.00	0.011		3.9	0.00013	0.00021	0.0057	0.0025	0.00000031	0.00000031	0.00027	0.00000013	1.1	0.0000097	0.0000021
13-Jan-16	20	39	400	370	8.1	172	#N/A	0.062	2.9	0.30	0.00	0.0098		3.5	0.000094	0.00021	0.0046	0.0022	0.00000030	0.00000030	0.00030	0.00000013	0.97	0.0000055	0.00000089
27-Jan-16	21	41	400	385	8.0	171	#N/A	0.11	3.0	0.27	0.00	0.012		3.7	0.00058	0.00023	0.0052	0.0026	0.00000031	0.00000031	0.00027	0.00000018	1.0	0.0000080	0.0000019
10-Feb-16	22	43	400	350	8.1	173	#N/A	0.085	2.7	0.28	0.00	0.0093		3.2	0.00012	0.00021	0.0049	0.0023	0.00000028	0.00000028	0.00016	0.00000012	0.87	0.0000056	0.0000022
24-Feb-16	23	45	400	380	8.1	178	#N/A	0.080	2.9	0.17	0.00	0.011		3.9	0.000066	0.00021	0.0052	0.0026	0.00000031	0.00000031	0.00013	0.00000013	1.1	0.0000083	0.0000017
9-Mar-16	24	47	400	380	8.1	172	#N/A	0.077	2.8	0.17	0.00														

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 11 (Supremo Gneiss Oxide Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	360	0.0030	*< 0.007*	*< 1E-05*	0.018	14	0.041	9.2	0.0074	0.0015	0.019	7.7	0.00079	6.1	0.0000080	39	0.25	19	0.00031	0.00030	*< 5E-05*	0.11	0.00012	0.0020	*< 0.002*
6-May-15	2	3	400	335	0.0013	*< 0.007*	*< 1E-05*	0.0082	7.1	0.013	0.82	0.018	0.00080	0.023	4.9	*< 0.001*	4.8	0.0000050	26	0.11	18	0.00013	*< 1E-05*	0.000070	0.084	0.00010	*< 0.001*	*< 0.002*
20-May-15	3	5	400	380	0.00079	*< 0.007*	*< 1E-05*	0.0062	6.3	0.0014	0.10	0.018	0.00060	0.030	4.5	0.00038	5.2	0.0000050	19	0.098	12	0.00014	0.00016	0.00013	0.070	0.00012	*< 0.001*	*< 0.002*
3-Jun-15	4	7	400	275	0.00076	*< 0.007*	*< 1E-05*	0.0059	6.2	0.00032	0.040	0.018	0.00040	0.028	4.2	0.00020	4.9	0.0000060	16	0.10	9.4	0.00013	0.000040	0.000080	0.063	0.00012	0.0010	*< 0.002*
17-Jun-15	5	9	500	465	0.0016	*< 0.007*	0.00090	0.0046	5.4	0.0015	0.020	0.017	0.00040	0.080	4.2	0.00019	4.5	0.0000080	13	0.090	8.1	0.00014	0.00013	0.00011	0.046	0.000090	0.0040	*< 0.002*
1-Jul-15	6	11	500	475	0.0013	*< 0.007*	*< 1E-05*	0.0044	5.6	0.00051	0.030	0.016	0.00030	0.033	3.7	0.00012	4.5	0.0000060	10	0.093	5.3	0.00014	0.00021	0.000060	0.041	0.00012	*< 0.001*	*< 0.002*
15-Jul-15	7	13	500	475	0.00050	*< 0.007*	*< 1E-05*	0.0042	6.1	0.0026	0.020	0.014	0.00030	0.028	3.4	0.00011	4.6	0.0000050	8.9	0.095	4.7	0.00014	0.000030	0.00012	0.039	0.00013	0.0010	*< 0.002*
29-Jul-15	8	15	400	380	0.00049	*< 0.007*	*< 1E-05*	0.0043	5.9	0.00011	0.010	0.014	0.00020	0.035	3.6	0.000090	4.3	0.0000030	6.6	0.097	4.2	0.00013	0.000010	*< 5E-05*	0.040	0.00012	*< 0.001*	*< 0.002*
12-Aug-15	9	17	400	390	0.00043	*< 0.007*	0.000030	0.0036	6.0	0.00012	*< 0.01*	0.013	0.00020	0.032	3.7	0.000080	4.6	0.000010	5.6	0.098	3.7	0.00013	0.000030	*< 5E-05*	0.035	0.000090	*< 0.001*	*< 0.002*
26-Aug-15	10	19	500	465	0.00045	0.0070	0.000020	0.0034	5.9	0.00017	0.010	0.012	0.00020	0.033	3.7	0.000070	4.3	0.0000070	4.7	0.095	5.1	0.00013	0.000065	0.000050	0.033	0.00011	0.0010	0.0020
9-Sep-15	11	21	500	475	0.00046	*< 0.007*	*< 1E-05*	0.0031	5.8	0.00022	0.010	0.011	0.00020	0.033	3.6	0.000060	4.0	0.0000040	3.9	0.091	6.5	0.00012	0.00010	0.000050	0.030	0.00013	*< 0.001*	*< 0.002*
23-Sep-15	12	23	500	470	0.00040	0.0070	0.000010	0.0029	6.0	0.00027	0.010	0.010	0.00015	0.029	3.5	0.000065	4.0	0.0000040	3.3	0.095	4.7	0.00012	0.000075	0.000050	0.031	0.00011	0.0010	0.0020
7-Oct-15	13	25	400	380	0.00033	*< 0.007*	*< 1E-05*	0.0028	6.1	0.00031	*< 0.01*	0.0088	0.00010	0.024	3.3	0.000070	3.9	0.0000040	2.7	0.100	2.8	0.00011	0.000050	*< 5E-05*	0.031	0.000090	*< 0.001*	*< 0.002*
21-Oct-15	14	27	400	390	0.00062	*< 0.007*	*< 1E-05*	0.0027	5.6	0.00019	*< 0.01*	0.011	0.00020	0.020	3.3	0.000090	4.0	0.0000020	2.2	0.099	3.1	0.00013	0.000070	0.00012	0.030	0.00010	*< 0.001*	*< 0.002*
4-Nov-15	15	29	400	390	0.00054	*< 0.007*	*< 1E-05*	0.0022	6.0	0.00030	*< 0.01*	0.0100	0.00020	0.034	3.4	*< 4E-05*	3.9	*< 2E-06*	2.1	0.095	3.1	0.00013	0.000040	*< 5E-05*	0.029	0.000090	*< 0.001*	*< 0.002*
18-Nov-15	16	31	400	380	0.00027	*< 0.007*	*< 1E-05*	0.0024	6.3	0.00074	*< 0.01*	0.0099	*< 0.0001*	0.031	3.3	0.00013	3.9	*< 2E-06*	1.8	0.10	2.9	0.000097	0.000040	*< 5E-05*	0.025	0.000070	*< 0.001*	*< 0.002*
2-Dec-15	17	33	400	380	0.00058	*< 0.007*	*< 1E-05*	0.0023	7.0	0.0011	*< 0.01*	0.0096	0.00020	0.034	3.6	0.000080	3.7	*< 2E-06*	1.8	0.11	3.1	0.00010	0.000050	*< 5E-05*	0.032	0.000080	*< 0.001*	*< 0.002*
16-Dec-15	18	35	400	360	0.00048	*< 0.007*	*< 1E-05*	0.0025	6.7	0.0017	*< 0.01*	0.0097	0.00010	0.036	3.6	0.000080	4.0	0.0000020	1.6	0.11	2.9	0.00012	0.00011	*< 5E-05*	0.032	0.000070	*< 0.001*	*< 0.002*
30-Dec-15	19	37	400	385	0.00034	*< 0.007*	0.000030	0.0024	6.7	0.0014	0.020	0.0092	0.00010	0.028	3.4	*< 4E-05*	3.7	0.0000020	1.4	0.11	2.8	0.00011	*< 1E-05*	0.000070	0.030	0.000090	*< 0.001*	*< 0.002*
13-Jan-16	20	39	400	370	0.00047	*< 0.007*	0.000040	0.0022	6.2	0.0013	*< 0.01*	0.0083	0.00010	0.032	3.4	0.00020	3.8	0.0000020	1.2	0.098	2.3	0.000071	0.000050	*< 5E-05*	0.027	0.000070	*< 0.001*	*< 0.002*
27-Jan-16	21	41	400	385	0.00031	*< 0.007*	*< 1E-05*	0.0021	6.2	0.00078	*< 0.01*	0.0089	0.00010	0.035	3.3	*< 4E-05*	3.9	*< 2E-06*	1.1	0.11	2.5	0.00011	0.000050	*< 5E-05*	0.030	0.000070	*< 0.001*	*< 0.002*
10-Feb-16	22	43	400	350	0.00054	*< 0.007*	0.000070	0.0020	6.3	0.0020	*< 0.01*	0.0088	0.00010	0.044	3.4	0.000080	3.4	*< 2E-06*	1.1	0.11	2.8	0.00010	0.000060	*< 5E-05*	0.028	0.000090	*< 0.001*	*< 0.002*
24-Feb-16	23	45	400	380	0.00017	*< 0.007*	0.000030	0.0021	6.6	0.00093	*< 0.01*	0.0087	0.00010	0.036	3.4	*< 4E-05*	3.8	*< 2E-06*	0.83	0.11	2.6	0.00011	0.000040	*< 5E-05*	0.029	0.000040	0.0010	*< 0.002*
9-Mar-16	24	47	400	380																								

Calculated Loading Rates for Col 11

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	360	0.00021	0.00050	0.00000072	0.0013	0.99	0.0030	0.66	0.00053	0.00011	0.0014	0.56	0.000057	0.44	0.00000058	2.8	0.018	1.4	0.000022	0.000022	0.0000036	0.0076	0.0000086	0.00014	0.00014
6-May-15	2	3	400	335	0.000043	0.00023	0.00000034	0.00028	0.24	0.00044	0.027	0.00060	0.000027	0.00077	0.16	0.000034	0.16	0.00000017	0.87	0.0037	0.61	0.0000044	0.00000034	0.0000023	0.0028	0.0000034	0.000034	0.000067
20-May-15	3	5	400	380	0.000030	0.00027	0.00000038	0.00024	0.24	0.000052	0.0038	0.00067	0.000023	0.0011	0.17	0.000014	0.20	0.00000019	0.73	0.0037	0.44	0.0000051	0.0000061	0.0000049	0.0027	0.0000046	0.000038	0.000076
3-Jun-15	4	7	400	275	0.000021	0.00019	0.00000028	0.00016	0.17	0.0000088	0.0011	0.00048	0.000011	0.00077	0.12	0.0000055	0.14	0.00000017	0.44	0.0028	0.26	0.0000036	0.0000011	0.0000022	0.0017	0.0000033	0.000028	0.000055
17-Jun-15	5	9	500	465	0.000076	0.00033	0.000042	0.00021	0.25	0.000070	0.00093	0.00078	0.000019	0.0037	0.20	0.0000088	0.21	0.00000037	0.59	0.0042	0.38	0.0000064	0.0000060	0.0000051	0.0022	0.0000042	0.00019	0.000093
1-Jul-15	6	11	500	475	0.000059	0.00033	0.00000048	0.00021	0.27	0.000024	0.0014	0.00074	0.000014	0.0016	0.18	0.0000057	0.21	0.00000029	0.48	0.0044	0.25	0.0000066	0.0000100	0.0000029	0.0020	0.0000057	0.000048	0.000095
15-Jul-15	7	13	500	475	0.000024	0.00033	0.00000048	0.00020	0.29	0.00012	0.00095	0.00067	0.000014	0.0013	0.16	0.0000052	0.22	0.00000024	0.42	0.0045	0.22	0.0000066	0.0000014	0.0000057	0.0019	0.0000062	0.000048	0.000095
29-Jul-15	8	15	400	380	0.000019	0.00027	0.00000038	0.00016	0.22	0.0000042	0.00038	0.00052	0.0000076	0.0013	0.14	0.0000034	0.16	0.00000011	0.25	0.0037	0.16	0.0000049	0.00000038	0.0000019	0.0015	0.0000046	0.000038	0.000076
12-Aug-15	9	17	400	390	0.000017	0.00027	0.0000012	0.00014	0.23	0.0000047	0.00039	0.00051	0.0000078	0.0012	0.14	0.0000031	0.18	0.00000039	0.22	0.0038	0.14	0.0000050	0.0000012	0.0000020	0.0014	0.0000035	0.000039	0.000078
26-Aug-15	10	19	500	465	0.000021	0.00033	0.00000093	0.00016	0.27	0.0000079	0.00047	0.00057	0.0000093	0.0015	0.17	0.0000033	0.20	0.00000033	0.22	0.0044	0.24	0.0000059	0.0000030	0.0000023	0.0015	0.0000051	0.000047	0.000093
9-Sep-15	11	21	500	475	0.000025	0.00038	0.00000055	0.00017	0.32	0.000012	0.00055	0.00062	0.000011	0.0018	0.20	0.0000033	0.22	0.00000022	0.21	0.0050	0.35	0.0000067	0.0000055	0.0000027	0.0016	0.0000071	0.000055	0.00011
23-Sep-15	12	23	500	470	0.000021	0.00038	0.00000054	0.00016	0.32	0.000014	0.00054	0.00055	0.0000081	0.0015	0.19	0.0000035	0.21	0.00000022	0.18	0.0052	0.25	0.0000063	0.0000041	0.0000027	0.0017	0.0000059	0.000054	0.00011
7-Oct-15	13	25	400	380	0.000014	0.00031	0.00000044	0.00012	0.27	0.000014	0.00044	0.00039	0.0000044	0.0010	0.15	0.0000031	0.17	0.00000017	0.12	0.0044	0.12	0.0000049	0.0000022	0.0000022	0.0014	0.0000039	0.000044	0.000087
21-Oct-15	14	27	400	390	0.000028	0.00031	0.00000045	0.00012	0.25	0.0000085	0.00045	0.00049	0.0000090	0.00090	0.15	0.0000040	0.18	0.000000090	0.10	0.0044	0.14	0.0000059	0.0000031	0.0000054	0.0013	0.0000045	0.000045	0.000090
4-Nov-15	15	29	400	390	0.000024	0.00031	0.00000045	0.00010	0.27	0.000013	0.00045	0.00045	0.0000090	0.0015	0.15	0.0000018	0.17	0.000000090	0.094	0.0043	0.14	0.0000057	0.0000018	0.0000022	0.0013	0.0000040	0.000045	0.000090
18-Nov-15	16	31	400	380	0.000012	0.00031	0.00000044	0.00010	0.27	0.000032	0.00044	0.00043	0.0000044	0.0014	0.15	0.0000057	0.17	0.000000087	0.080	0.0044	0.13	0.0000042	0.0000017	0.0000022	0.0011	0.0000031	0.000044	0.000087
2-Dec-15	17	33	400	380	0.000025	0.00031	0.00000044	0.00010	0.31	0.000050	0.00044	0.00042	0.0000087	0.0015	0.16	0.0000035	0.16	0.000000087	0.079	0.0046	0.14	0.0000044	0.0000022	0.0000022	0.0014	0.0000035	0.000044	0.000087
16-Dec-15	18	35	400	360	0.000020	0.00029	0.00000041	0.00010	0.28	0.000072	0.00041	0.00040	0.0000041	0.0015	0.15	0.0000033	0.17	0.000000083	0.065	0.0044	0.12	0.0000051	0.0000046	0.0000021	0.0013	0.0000029	0.000041	0.000083
30-Dec-15	19	37	400	385	0.000015	0.00031	0.0000013	0.00011	0.30	0.000060	0.00089	0.00041	0.0000044	0.0012	0.15	0.0000018	0.16	0.000000089	0.062	0.0046	0.12	0.0000050	0.00000044	0.0000031	0.0013	0.0000040	0.000044	0.000089
13-Jan-16	20	39	400	370	0.000020	0.00030	0.0000017	0.000094	0.26	0.000056	0.00043	0.00035	0.0000043	0.0014	0.14	0.0000085	0.16	0.000000085	0.051	0.0042	0.098	0.0000030	0.0000021	0.0000021	0.0012	0.0000030	0.000043	0.000085
27-Jan-16	21	41	400	385	0.000014	0.00031	0.00000044	0.000092	0.28	0.000035	0.00044	0.00039	0.0000044	0.0015	0.15	0.0000018	0.17	0.000000089	0.048	0.0046	0.11	0.0000050	0.0000022	0.0000022	0.0013	0.0000031	0.000044	0.000089
10-Feb-16	22	43	400	350	0.000022	0.00028	0.0000028	0.000081	0.26	0.000080	0.00040	0.00036	0.0000040	0.0018	0.14	0.0000032	0.14	0.000000080	0.045	0.0042	0.11	0.0000041	0.0000024	0.0000020	0.0011	0.0000036	0.000040	0.000080
24-Feb-16	23	45	400	380	0.0000074	0.00031	0.0000013	0.000092	0.29	0.000041	0.00044	0.00038	0.0000044	0.0016	0.15	0.0000017	0.16	0.000000087	0.036	0.0047	0.11	0.0000047	0.0000017	0.0000022	0.0012	0.0000017	0.000044	0.000087
9-Mar-16	24	47	400	380																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 12 (Supremo Gneiss Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	750	305	7.8	2557	#N/A	11	145	1561	62	0.26	*< 0.3*	1450	0.0033	0.013	0.15	0.011	*< 7E-06*	*< 7E-06*	0.022	0.0000080	385	0.000040	0.011
6-May-15	2	3	400	365	7.6	1465	#N/A	7.5	75	816	22	0.36	*< 0.3*	751	0.0021	0.0087	0.14	0.0042	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	199	*< 3E-05*	0.0026
20-May-15	3	5	400	375	7.8	915	#N/A	6.0	69	393	2.0	0.40	*< 0.3*	405	0.0022	0.0074	0.15	0.0036	*< 7E-06*	*< 7E-06*	0.011	0.0000080	109	0.000040	0.0013
3-Jun-15	4	7	400	260	7.8	704	#N/A	5.9	77	274	*< 1*	0.46	*< 0.3*	323	0.0051	0.0082	0.17	0.0049	*< 7E-06*	*< 7E-06*	0.015	0.0000030	88	0.000040	0.00088
17-Jun-15	5	9	500	485	7.8	555	#N/A	7.0	81	206	*< 1*	0.45	*< 0.3*	245	0.0051	0.0086	0.20	0.0036	*< 7E-06*	*< 7E-06*	0.012	0.0000080	67	0.000050	0.00062
1-Jul-15	6	11	500	485	7.9	395	#N/A	5.7	81	136	*< 1*	0.51	*< 0.3*	184	0.0047	0.0090	0.22	0.0039	*< 7E-06*	*< 7E-06*	0.010	0.000013	48	*< 3E-05*	0.00041
15-Jul-15	7	13	500	490	7.9	339	#N/A	5.4	87	103	*< 1*	0.54	*< 0.3*	162	0.0047	0.0091	0.22	0.0041	*< 7E-06*	*< 7E-06*	0.014	0.000010	42	0.000030	0.00039
29-Jul-15	8	15	400	390	7.9	347	#N/A	3.5	88	88	*< 1*	0.57	*< 0.3*	152	0.0038	0.0093	0.21	0.0042	*< 7E-06*	*< 7E-06*	0.013	0.0000070	40	0.000050	0.00025
12-Aug-15	9	17	400	400	7.9	334	#N/A	4.1	90	77	*< 1*	0.51	*< 0.3*	152	0.0041	0.0093	0.22	0.0043	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	40	*< 3E-05*	0.00018
26-Aug-15	10	19	500	465	7.6	320	#N/A	3.7	89	72	1.0	0.53	0.30	147	0.0060	0.011	0.23	0.0047	0.0000070	0.0000070	0.011	0.0000040	39	0.000045	0.00016
9-Sep-15	11	21	500	470	7.9	307	#N/A	3.3	89	67	*< 1*	0.55	*< 0.3*	141	0.0079	0.013	0.23	0.0050	*< 7E-06*	*< 7E-06*	0.011	0.0000050	38	0.000060	0.00014
23-Sep-15	12	23	500	480	8.0	285	#N/A	3.3	89	57	1.0	0.52	0.30	135	0.0058	0.015	0.23	0.0047	0.0000070	0.0000070	0.0096	0.0000050	36	0.000055	0.00010
7-Oct-15	13	25	400	390	8.0	298	#N/A	3.5	96	54	-	0.49	-	128	0.0037	0.017	0.23	0.0043	*< 7E-06*	*< 7E-06*	0.0081	0.0000050	34	0.000050	0.000059
21-Oct-15	14	27	400	390	8.1	288	#N/A	1.6	92	44	-	0.49	-	128	0.0058	0.020	0.25	0.0049	*< 7E-06*	*< 7E-06*	0.0087	*< 3E-06*	35	*< 3E-05*	0.000075
4-Nov-15	15	29	400	400	8.1	287	#N/A	3.0	97	50	-	0.47	-	138	0.0085	0.022	0.25	0.0050	*< 7E-06*	*< 7E-06*	0.0063	*< 3E-06*	38	0.00011	0.000027
18-Nov-15	16	31	400	380	8.1	288	#N/A	1.1	103	50	-	0.47	-	131	0.0031	0.026	0.26	0.0036	*< 7E-06*	*< 7E-06*	0.0053	0.0000060	35	0.000030	0.000044
2-Dec-15	17	33	400	390	8.1	282	#N/A	2.0	91	46	-	0.46	-	143	0.0041	0.031	0.28	0.0054	*< 7E-06*	*< 7E-06*	0.0070	0.0000030	38	0.000030	0.00017
16-Dec-15	18	35	400	360	8.1	278	#N/A	2.0	85	50	-	0.44	-	138	0.0035	0.035	0.29	0.0054	*< 7E-06*	*< 7E-06*	0.0081	0.0000070	37	0.000090	0.00014
30-Dec-15	19	37	400	390	8.1	269	#N/A	1.8	83	38	-	0.46	-	137	0.0039	0.035	0.29	0.0052	*< 7E-06*	*< 7E-06*	0.0072	*< 3E-06*	37	0.000050	0.00011
13-Jan-16	20	39	400	365	8.1	268	#N/A	1.6	86	47	-	0.41	-	131	0.0034	0.039	0.26	0.0047	*< 7E-06*	*< 7E-06*	0.0080	*< 3E-06*	35	*< 3E-05*	0.000095
27-Jan-16	21	41	400	385	8.0	266	#N/A	3.1	85	46	-	0.44	-	126	0.0067	0.042	0.28	0.0054	*< 7E-06*	*< 7E-06*	0.0060	0.0000040	34	*< 3E-05*	0.000096
10-Feb-16	22	43	400	360	8.1	258	#N/A	2.6	88	42	-	0.40	-	127	0.0038	0.044	0.31	0.0054	*< 7E-06*	*< 7E-06*	0.0050	0.0000030	34	*< 3E-05*	0.000080
24-Feb-16	23	45	400	395	8.1	266	#N/A	2.3	86	42	-	0.36	-	136	0.0017	0.045	0.30	0.0053	*< 7E-06*	*< 7E-06*	0.0040	0.0000040	36	*< 3E-05*	0.00012
9-Mar-16	24	47	400	385	8.1	258	#N/A	2.3	85	34															

Calculated Loading Rates for Col 12

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	750	305	7.8	2557	#N/A	0.78	10	110	4.4	0.018	0.021	102	0.00023	0.00090	0.011	0.00075	0.00000049	0.00000049	0.0015	0.00000056	27	0.0000028	0.00076
6-May-15	2	3	400	365	7.6	1465	#N/A	0.32	3.1	34	0.93	0.015	0.013	32	0.000089	0.00037	0.0060	0.00018	0.00000030	0.00000030	0.00059	0.00000013	8.4	0.0000013	0.00011
20-May-15	3	5	400	375	7.8	915	#N/A	0.26	3.0	17	0.087	0.017	0.013	18	0.000095	0.00032	0.0063	0.00016	0.00000030	0.00000030	0.00047	0.00000035	4.7	0.0000017	0.000056
3-Jun-15	4	7	400	260	7.8	704	#N/A	0.18	2.3	8.2	0.030	0.014	0.0090	9.7	0.00015	0.00025	0.0051	0.00015	0.00000021	0.00000021	0.00045	0.000000090	2.6	0.0000012	0.000026
17-Jun-15	5	9	500	485	7.8	555	#N/A	0.39	4.5	12	0.056	0.025	0.017	14	0.00029	0.00048	0.011	0.00020	0.00000039	0.00000039	0.00068	0.00000045	3.8	0.0000028	0.000035
1-Jul-15	6	11	500	485	7.9	395	#N/A	0.32	4.5	7.6	0.056	0.029	0.017	10	0.00026	0.00050	0.012	0.00022	0.00000039	0.00000039	0.00058	0.00000073	2.7	0.0000017	0.000023
15-Jul-15	7	13	500	490	7.9	339	#N/A	0.31	4.9	5.8	0.057	0.031	0.017	9.2	0.00027	0.00051	0.013	0.00023	0.00000040	0.00000040	0.00076	0.00000057	2.4	0.0000017	0.000022
29-Jul-15	8	15	400	390	7.9	347	#N/A	0.16	3.9	4.0	0.045	0.026	0.014	6.8	0.00017	0.00042	0.0092	0.00019	0.00000032	0.00000032	0.00057	0.00000032	1.8	0.0000023	0.000011
12-Aug-15	9	17	400	400	7.9	334	#N/A	0.19	4.1	3.6	0.046	0.024	0.014	7.0	0.00019	0.00043	0.010	0.00020	0.00000032	0.00000032	0.00048	0.00000014	1.9	0.0000014	0.0000084
26-Aug-15	10	19	500	465	7.6	320	0.00	0.20	4.8	3.9	0.054	0.028	0.016	7.9	0.00032	0.00059	0.012	0.00025	0.00000038	0.00000038	0.00058	0.00000021	2.1	0.0000024	0.0000087
9-Sep-15	11	21	500	470	7.9	307	#N/A	0.18	4.8	3.6	0.054	0.030	0.016	7.6	0.00043	0.00068	0.012	0.00027	0.00000038	0.00000038	0.00059	0.00000027	2.0	0.0000032	0.0000078
23-Sep-15	12	23	500	480	8.0	285	#N/A	0.18	4.9	3.1	0.055	0.029		7.4	0.00032	0.00082	0.013	0.00026	0.00000039	0.00000039	0.00053	0.00000028	2.0	0.0000030	0.0000056
7-Oct-15	13	25	400	390	8.0	298	#N/A	0.16	4.3	2.4	0.00	0.022		5.7	0.00017	0.00078	0.010	0.00019	0.00000031	0.00000031	0.00036	0.00000022	1.5	0.0000022	0.0000026
21-Oct-15	14	27	400	390	8.1	288	#N/A	0.070	4.1	2.0	0.00	0.022		5.7	0.00026	0.00089	0.011	0.00022	0.00000031	0.00000031	0.00039	0.00000013	1.6	0.0000013	0.0000034
4-Nov-15	15	29	400	400	8.1	287	#N/A	0.14	4.5	2.3	0.00	0.022		6.3	0.00039	0.0010	0.011	0.00023	0.00000032	0.00000032	0.00029	0.00000014	1.7	0.0000051	0.0000012
18-Nov-15	16	31	400	380	8.1	288	#N/A	0.050	4.5	2.2	0.00	0.021		5.7	0.00014	0.0011	0.011	0.00016	0.00000031	0.00000031	0.00023	0.00000026	1.5	0.0000013	0.0000019
2-Dec-15	17	33	400	390	8.1	282	#N/A	0.091	4.1	2.1	0.00	0.021		6.4	0.00018	0.0014	0.013	0.00024	0.00000031	0.00000031	0.00031	0.00000013	1.7	0.0000013	0.0000075
16-Dec-15	18	35	400	360	8.1	278	#N/A	0.083	3.5	2.1	0.00	0.018		5.7	0.00014	0.0015	0.012	0.00022	0.00000029	0.00000029	0.00034	0.00000029	1.5	0.0000037	0.0000058
30-Dec-15	19	37	400	390	8.1	269	#N/A	0.082	3.7	1.7	0.00	0.021		6.1	0.00017	0.0016	0.013	0.00023	0.00000031	0.00000031	0.00032	0.00000013	1.6	0.0000022	0.0000047
13-Jan-16	20	39	400	365	8.1	268	#N/A	0.069	3.6	2.0	0.00	0.017		5.5	0.00014	0.0016	0.011	0.00020	0.00000029	0.00000029	0.00034	0.00000013	1.5	0.0000013	0.0000040
27-Jan-16	21	41	400	385	8.0	266	#N/A	0.14	3.8	2.0	0.00	0.019		5.6	0.00030	0.0018	0.012	0.00024	0.00000031	0.00000031	0.00027	0.00000018	1.5	0.0000013	0.0000042
10-Feb-16	22	43	400	360	8.1	258	#N/A	0.11	3.7	1.7	0.00	0.017		5.3	0.00016	0.0018	0.013	0.00022	0.00000029	0.00000029	0.00021	0.00000012	1.4	0.0000012	0.0000033
24-Feb-16	23	45	400	395	8.1	266	#N/A	0.11	3.9	1.9	0.00	0.016		6.2	0.000077	0.0020	0.014	0.00024	0.00000032	0.00000032	0.00018	0.00000018	1.6	0.0000014	0.0000053
9-Mar-16	24	47	400	385	8.1	258	#N/A	0.10	3.8	1.5	0.00														

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 12 (Supremo Gneiss Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	750	305	0.0046	*< 0.007*	*< 1E-05*	0.025	119	0.54	2.2	0.011	0.014	0.030	20	0.011	5.5	0.000089	61	1.8	475	0.00058	0.000080	0.00010	0.64	0.00011	0.0020	*< 0.002*
6-May-15	2	3	400	365	0.0016	*< 0.007*	*< 1E-05*	0.013	62	0.29	0.13	0.016	0.0038	*< 0.003*	13	0.0060	4.0	0.0000040	28	0.89	284	0.00029	*< 1E-05*	0.000070	0.24	0.000070	0.0020	*< 0.002*
20-May-15	3	5	400	375	0.00069	*< 0.007*	0.000050	0.0084	32	0.16	0.010	0.019	0.0018	*< 0.003*	9.7	0.0025	4.1	0.0000040	14	0.49	127	0.00024	0.00013	0.00011	0.15	0.000060	*< 0.001*	*< 0.002*
3-Jun-15	4	7	400	260	0.00072	*< 0.007*	*< 1E-05*	0.0070	25	0.11	*< 0.01*	0.021	0.0014	*< 0.003*	8.5	0.0016	4.1	0.0000050	11	0.41	97	0.00020	0.000040	0.000050	0.12	0.00010	0.0010	*< 0.002*
17-Jun-15	5	9	500	485	0.00072	*< 0.007*	*< 1E-05*	0.0055	19	0.083	*< 0.01*	0.019	0.0011	0.0060	7.1	0.0012	4.0	0.0000040	7.1	0.29	71	0.00019	0.000070	0.000070	0.081	0.000080	0.0010	*< 0.002*
1-Jul-15	6	11	500	485	0.00039	*< 0.007*	*< 1E-05*	0.0048	15	0.057	0.010	0.022	0.00090	*< 0.003*	6.2	0.00077	4.1	0.0000030	4.9	0.23	42	0.00016	0.000060	*< 5E-05*	0.056	0.000090	*< 0.001*	*< 0.002*
15-Jul-15	7	13	500	490	0.00038	*< 0.007*	*< 1E-05*	0.0044	14	0.059	*< 0.01*	0.020	0.00080	0.0040	5.5	0.00054	4.2	0.0000030	3.7	0.21	33	0.00016	0.000030	0.000090	0.047	0.00010	*< 0.001*	*< 0.002*
29-Jul-15	8	15	400	390	0.00032	*< 0.007*	*< 1E-05*	0.0045	13	0.039	*< 0.01*	0.020	0.00060	0.0050	5.5	0.00044	3.7	*< 2E-06*	2.6	0.20	29	0.00014	*< 1E-05*	*< 5E-05*	0.043	0.000070	*< 0.001*	*< 0.002*
12-Aug-15	9	17	400	400	0.00043	*< 0.007*	*< 1E-05*	0.0038	12	0.024	*< 0.01*	0.019	0.00050	0.0040	5.7	0.00040	4.1	0.0000050	2.2	0.19	25	0.00015	0.000060	0.000050	0.038	0.00010	*< 0.001*	*< 0.002*
26-Aug-15	10	19	500	465	0.00042	0.0070	0.000010	0.0036	12	0.023	0.010	0.018	0.00050	0.0040	5.6	0.00036	4.0	0.0000035	1.9	0.18	25	0.00015	0.000055	0.000050	0.033	0.000090	0.0010	0.0020
9-Sep-15	11	21	500	470	0.00040	*< 0.007*	*< 1E-05*	0.0035	11	0.023	*< 0.01*	0.017	0.00050	0.0040	5.4	0.00031	3.8	0.0000020	1.5	0.17	25	0.00014	0.000050	*< 5E-05*	0.029	0.000080	*< 0.001*	*< 0.002*
23-Sep-15	12	23	500	480	0.00044	0.0070	0.000015	0.0032	11	0.015	0.010	0.015	0.00055	0.0035	5.1	0.00028	3.7	0.0000020	1.3	0.16	22	0.00013	0.000080	0.000050	0.026	0.000065	0.0010	0.0020
7-Oct-15	13	25	400	390	0.00047	*< 0.007*	0.000020	0.0029	10	0.0081	*< 0.01*	0.013	0.00060	0.0030	4.8	0.00024	3.5	0.0000020	1.1	0.15	19	0.00011	0.00011	*< 5E-05*	0.024	0.000050	0.0010	*< 0.002*
21-Oct-15	14	27	400	390	0.00049	*< 0.007*	*< 1E-05*	0.0027	9.9	0.015	*< 0.01*	0.016	0.00050	*< 0.003*	4.7	0.00026	3.8	*< 2E-06*	0.98	0.16	19	0.00015	0.000060	0.000060	0.026	0.000080	*< 0.001*	*< 0.002*
4-Nov-15	15	29	400	400	0.00060	*< 0.007*	0.000010	0.0023	11	0.0094	*< 0.01*	0.016	0.00040	0.0050	5.0	0.00024	3.8	*< 2E-06*	0.88	0.15	19	0.00015	0.00028	0.00011	0.026	0.00010	0.0010	*< 0.002*
18-Nov-15	16	31	400	380	0.00017	*< 0.007*	*< 1E-05*	0.0026	11	0.0040	*< 0.01*	0.014	0.00010	*< 0.003*	4.8	0.00032	3.8	*< 2E-06*	0.76	0.15	18	0.00010	0.000020	*< 5E-05*	0.019	0.000080	*< 0.001*	*< 0.002*
2-Dec-15	17	33	400	390	0.00045	*< 0.007*	*< 1E-05*	0.0025	12	0.026	*< 0.01*	0.016	0.00040	0.011	5.3	0.00038	3.9	*< 2E-06*	0.80	0.17	19	0.00013	0.000050	*< 5E-05*	0.026	0.000090	*< 0.001*	*< 0.002*
16-Dec-15	18	35	400	360	0.00053	*< 0.007*	*< 1E-05*	0.0026	11	0.025	*< 0.01*	0.014	0.00040	0.012	5.0	0.00028	4.1	*< 2E-06*	0.69	0.17	18	0.00012	0.00014	*< 5E-05*	0.026	0.000060	*< 0.001*	*< 0.002*
30-Dec-15	19	37	400	390	0.00051	*< 0.007*	*< 1E-05*	0.0026	11	0.021	0.010	0.014	0.00030	0.0030	4.8	0.00024	3.8	*< 2E-06*	0.66	0.16	16	0.00013	*< 1E-05*	0.00010	0.024	0.000080	0.0010	*< 0.002*
13-Jan-16	20	39	400	365	0.00042	*< 0.007*	0.000020	0.0024	11	0.020	*< 0.01*	0.012	0.00030	0.0030	5.0	0.00045	4.0	0.0000020	0.57	0.15	16	0.000084	0.000080	*< 5E-05*	0.021	0.000050	0.0020	*< 0.002*
27-Jan-16	21	41	400	385	0.00044	*< 0.007*	*< 1E-05*	0.0021	10	0.017	*< 0.01*	0.012	0.00030	0.0080	4.7	0.00019	4.0	*< 2E-06*	0.50	0.15	16	0.00014	0.000050	*< 5E-05*	0.022	0.000070	*< 0.001*	*< 0.002*
10-Feb-16	22	43	400	360	0.00024	*< 0.007*	0.000070	0.0021	10	0.013	*< 0.01*	0.012	0.00030	0.0060	4.6	0.00026	3.8	*< 2E-06*	0.50	0.16	15	0.00013	0.000040	0.000080	0.020	0.000070	*< 0.001*	*< 0.002*
24-Feb-16	23	45	400	395	0.00022	*< 0.007*	0.000010	0.0023	11	0.020	0.010	0.012	0.00030	0.013	4.8	0.00025	3.9	*< 2E-06*	0.40	0.16	14	0.00012	0.000020	*< 5E-05*	0.022	0.000070	*< 0.001*	*< 0.002*
9-Mar-16	24	47	400	385																								

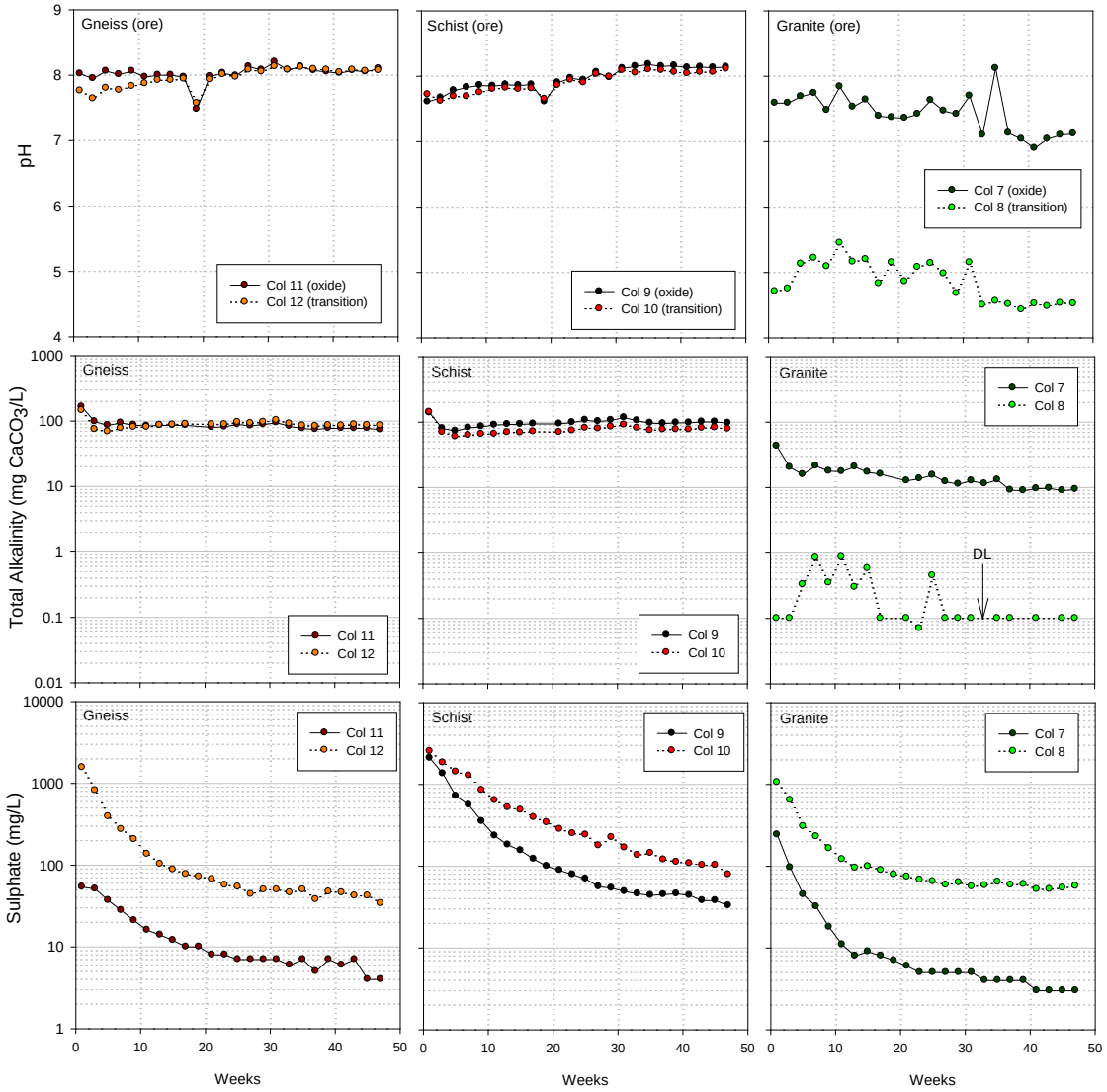
Calculated Loading Rates for Col 12

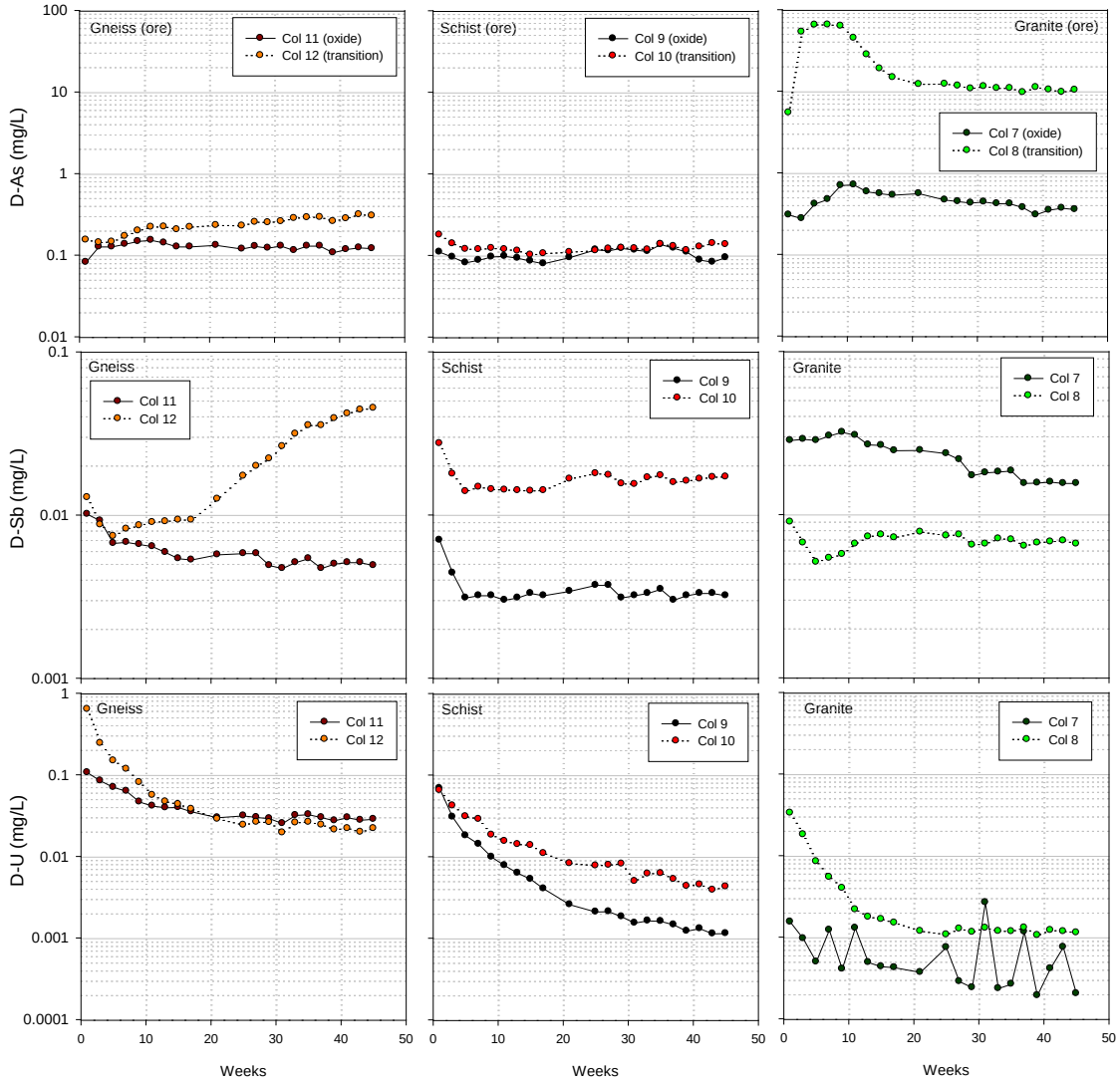
Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	750	305	0.00033	0.00049	0.00000070	0.0018	8.4	0.038	0.16	0.00075	0.0010	0.0021	1.4	0.00078	0.39	0.0000063	4.3	0.13	33	0.000041	0.0000056	0.0000070	0.045	0.0000077	0.00014	0.00014
6-May-15	2	3	400	365	0.000067	0.00030	0.00000042	0.00053	2.6	0.012	0.0055	0.00068	0.00016	0.00013	0.56	0.00025	0.17	0.00000017	1.2	0.038	12	0.000012	0.00000042	0.0000030	0.010	0.0000030	0.000084	0.000084
20-May-15	3	5	400	375	0.000030	0.00030	0.0000022	0.00036	1.4	0.0068	0.00043	0.00081	0.000078	0.00013	0.42	0.00011	0.18	0.00000017	0.62	0.021	5.5	0.000010	0.0000056	0.0000048	0.0064	0.0000026	0.000043	0.000087
3-Jun-15	4	7	400	260	0.000022	0.00021	0.00000030	0.00021	0.76	0.0033	0.00030	0.00062	0.000042	0.000090	0.26	0.000049	0.12	0.00000015	0.32	0.012	2.9	0.0000061	0.0000012	0.0000015	0.0035	0.0000030	0.000030	0.000060
17-Jun-15	5	9	500	485	0.000040	0.00039	0.00000056	0.00031	1.1	0.0047	0.00056	0.0011	0.000062	0.00034	0.40	0.000067	0.23	0.00000022	0.40	0.016	4.0	0.000011	0.0000039	0.0000039	0.0045	0.0000045	0.000056	0.00011
1-Jul-15	6	11	500	485	0.000022	0.00039	0.00000056	0.00027	0.86	0.0032	0.00056	0.0012	0.000050	0.00017	0.35	0.000043	0.23	0.00000017	0.28	0.013	2.3	0.0000090	0.0000034	0.0000028	0.0031	0.0000050	0.000056	0.00011
15-Jul-15	7	13	500	490	0.000022	0.00040	0.00000057	0.00025	0.79	0.0034	0.00057	0.0011	0.000045	0.00023	0.31	0.000031	0.24	0.00000017	0.21	0.012	1.9	0.0000090	0.0000017	0.0000051	0.0026	0.0000057	0.000057	0.00011
29-Jul-15	8	15	400	390	0.000014	0.00032	0.00000045	0.00020	0.56	0.0017	0.00045	0.00088	0.000027	0.00023	0.25	0.000020	0.16	0.000000090	0.12	0.0091	1.3	0.0000063	0.00000045	0.0000023	0.0020	0.0000032	0.000045	0.000090
12-Aug-15	9	17	400	400	0.000020	0.00032	0.00000046	0.00017	0.57	0.0011	0.00046	0.00086	0.000023	0.00018	0.26	0.000018	0.19	0.00000023	0.10	0.0085	1.2	0.0000068	0.0000028	0.0000023	0.0017	0.0000046	0.000046	0.000092
26-Aug-15	10	19	500	465	0.000022	0.00038	0.00000054	0.00019	0.64	0.0012	0.00054	0.00096	0.000027	0.00021	0.30	0.000019	0.21	0.00000019	0.100	0.0096	1.4	0.0000078	0.0000030	0.0000027	0.0018	0.0000048	0.000054	0.00011
9-Sep-15	11	21	500	470	0.000022	0.00038	0.00000054	0.00019	0.61	0.0012	0.00054	0.00092	0.000027	0.00022	0.29	0.000017	0.21	0.00000011	0.083	0.0092	1.4	0.0000078	0.0000027	0.0000027	0.0015	0.0000043	0.000054	0.00011
23-Sep-15	12	23	500	480	0.000024	0.00039	0.00000083	0.00017	0.60	0.00085	0.00055	0.00083	0.000030	0.00019	0.28	0.000015	0.20	0.00000011	0.072	0.0090	1.2	0.0000070	0.0000044	0.0000028	0.0015	0.0000036	0.000055	0.00011
7-Oct-15	13	25	400	390	0.000021	0.00031	0.00000090	0.00013	0.47	0.00036	0.00045	0.00059	0.000027	0.00013	0.22	0.000011	0.16	0.000000090	0.048	0.0069	0.83	0.0000048	0.0000049	0.0000022	0.0011	0.0000022	0.000045	0.000090
21-Oct-15	14	27	400	390	0.000022	0.00031	0.00000045	0.00012	0.44	0.00069	0.00045	0.00073	0.000022	0.00013	0.21	0.000012	0.17	0.000000090	0.044	0.0071	0.84	0.0000068	0.0000027	0.0000027	0.0012	0.0000036	0.000045	0.000090
4-Nov-15	15	29	400	400	0.000028	0.00032	0.00000046	0.00011	0.50	0.00043	0.00046	0.00072	0.000018	0.00023	0.23	0.000011	0.17	0.000000092	0.040	0.0070	0.88	0.0000070	0.000013	0.0000051	0.0012	0.0000046	0.000046	0.000092
18-Nov-15	16	31	400	380	0.0000074	0.00031	0.00000044	0.00011	0.47	0.00018	0.00044	0.00061	0.0000044	0.00013	0.21	0.000014	0.17	0.000000087	0.033	0.0066	0.78	0.0000045	0.00000087	0.0000022	0.00085	0.0000035	0.000044	0.000087
2-Dec-15	17	33	400	390	0.000020	0.00031	0.00000045	0.00011	0.53	0.0012	0.00045	0.00071	0.000018	0.00049	0.24	0.000017	0.18	0.000000090	0.036	0.0074	0.85	0.0000059	0.0000022	0.0000022	0.0012	0.0000040	0.000045	0.000090
16-Dec-15	18	35	400	360	0.000022	0.00029	0.00000041	0.00011	0.45	0.0010	0.00041	0.00059	0.000017	0.00050	0.21	0.000012	0.17	0.000000083	0.029	0.0069	0.73	0.0000048	0.0000058	0.0000021	0.0011	0.0000025	0.000041	0.000083
30-Dec-15	19	37	400	390	0.000023	0.00031	0.00000045	0.00012	0.50	0.00095	0.00045	0.00064	0.000013	0.00013	0.21	0.000011	0.17	0.000000090	0.030	0.0074	0.70	0.0000058	0.00000045	0.0000045	0.0011	0.0000036	0.000045	0.000090
13-Jan-16	20	39	400	365	0.000018	0.00029	0.00000084	0.000099	0.45	0.00085	0.00042	0.00052	0.000013	0.00013	0.21	0.000019	0.17	0.000000084	0.024	0.0062	0.65	0.0000035	0.0000034	0.0000021	0.00089	0.0000021	0.000084	0.000084
27-Jan-16	21	41	400	385	0.000019	0.00031	0.00000044	0.000095	0.45	0.00077	0.00044	0.00054	0.000013	0.00035	0.21	0.0000084	0.18	0.000000089	0.022	0.0068	0.69	0.0000062	0.0000022	0.0000022	0.00097	0.0000031	0.000044	0.000089
10-Feb-16	22	43	400	360	0.0000099	0.00029	0.0000029	0.000087	0.42	0.00054	0.00041	0.00051	0.000012	0.00025	0.19	0.000011	0.16	0.000000083	0.021	0.0065	0.63	0.0000055	0.0000017	0.0000033	0.00082	0.0000029	0.000041	0.000083
24-Feb-16	23	45	400	395	0.0000100	0.00032	0.00000045	0.00010	0.49	0.00090	0.00045	0.00056	0.000014	0.00059	0.22	0.000011	0.18	0.000000091	0.018	0.0070	0.65	0.0000056	0.00000091	0.0000023	0.00099	0.0000032	0.000045	0.000091
9-Mar-16	24	47	400	385																								

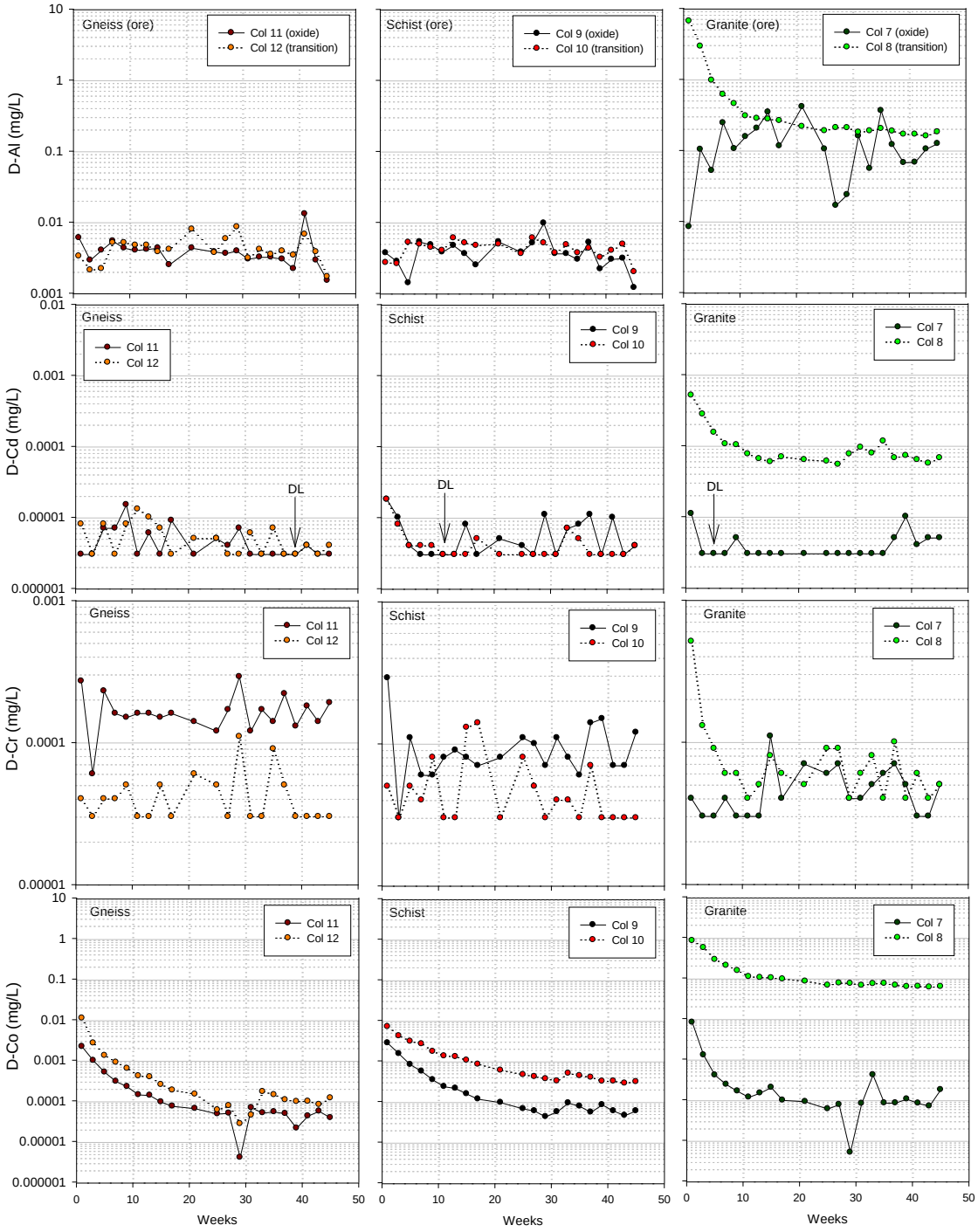
Notes:
Values in grey italics are below the analytical detection limit

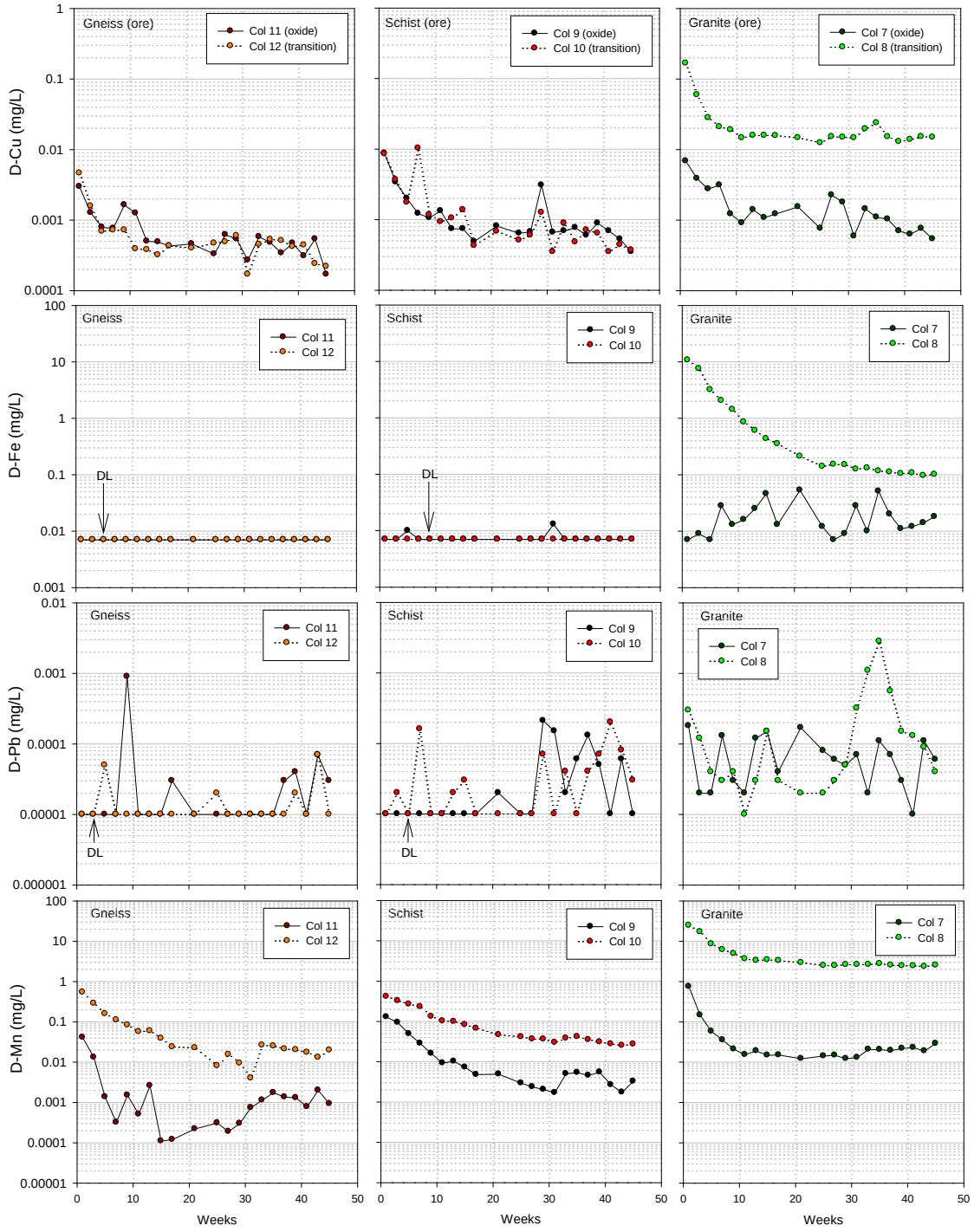
Appendix D.2-4: Time Series Profiles for Ore Kinetic Tests Leachate Concentrations and Loading Rates

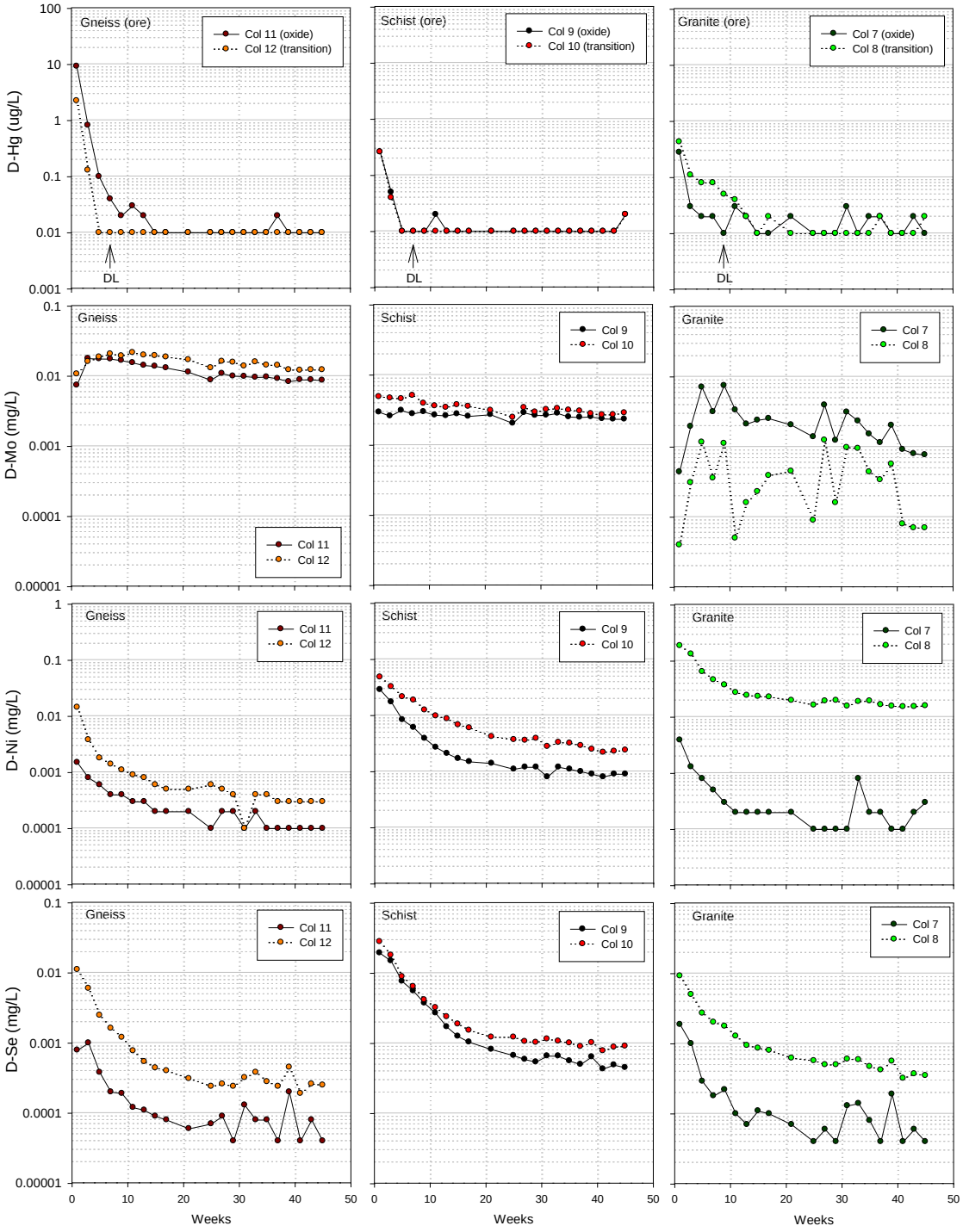
Leachate Concentrations for Ore Unsaturated Columns

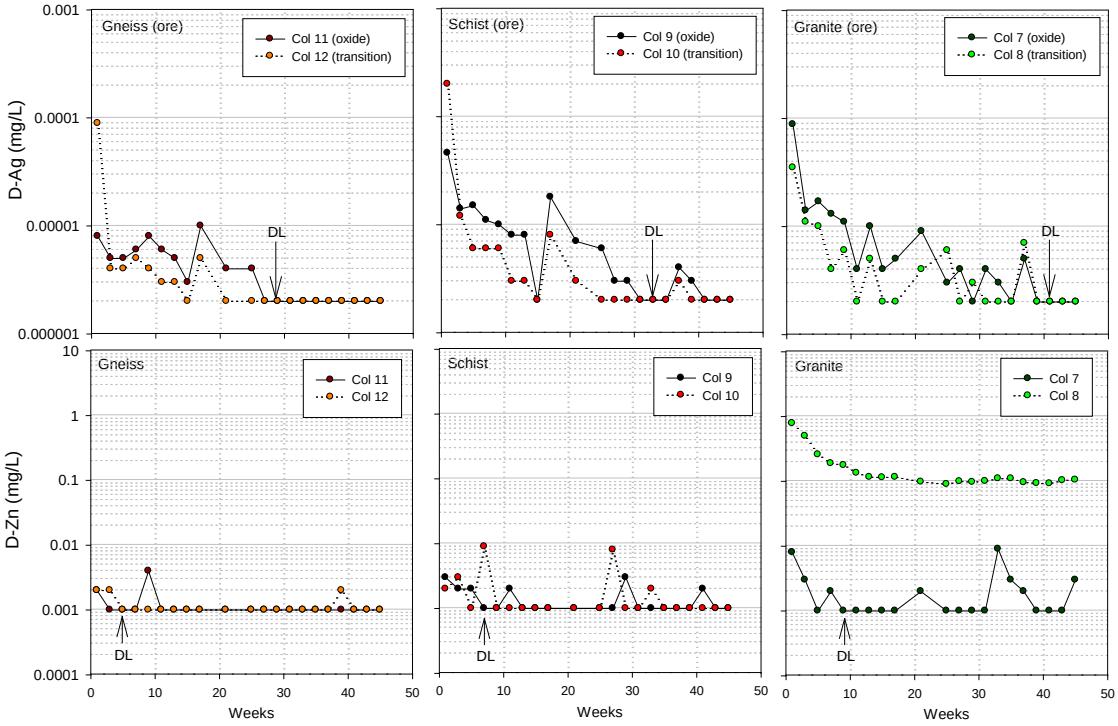



Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
D-As (mg/L)
100
10
1
0.1
0.01
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
D-Sb (mg/L)
0.1
0.01
0.001
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
D-U (mg/L)
1
0.1
0.01
0.001
0.0001
0
10
20
30
40
50
Weeks
Weeks
Weeks

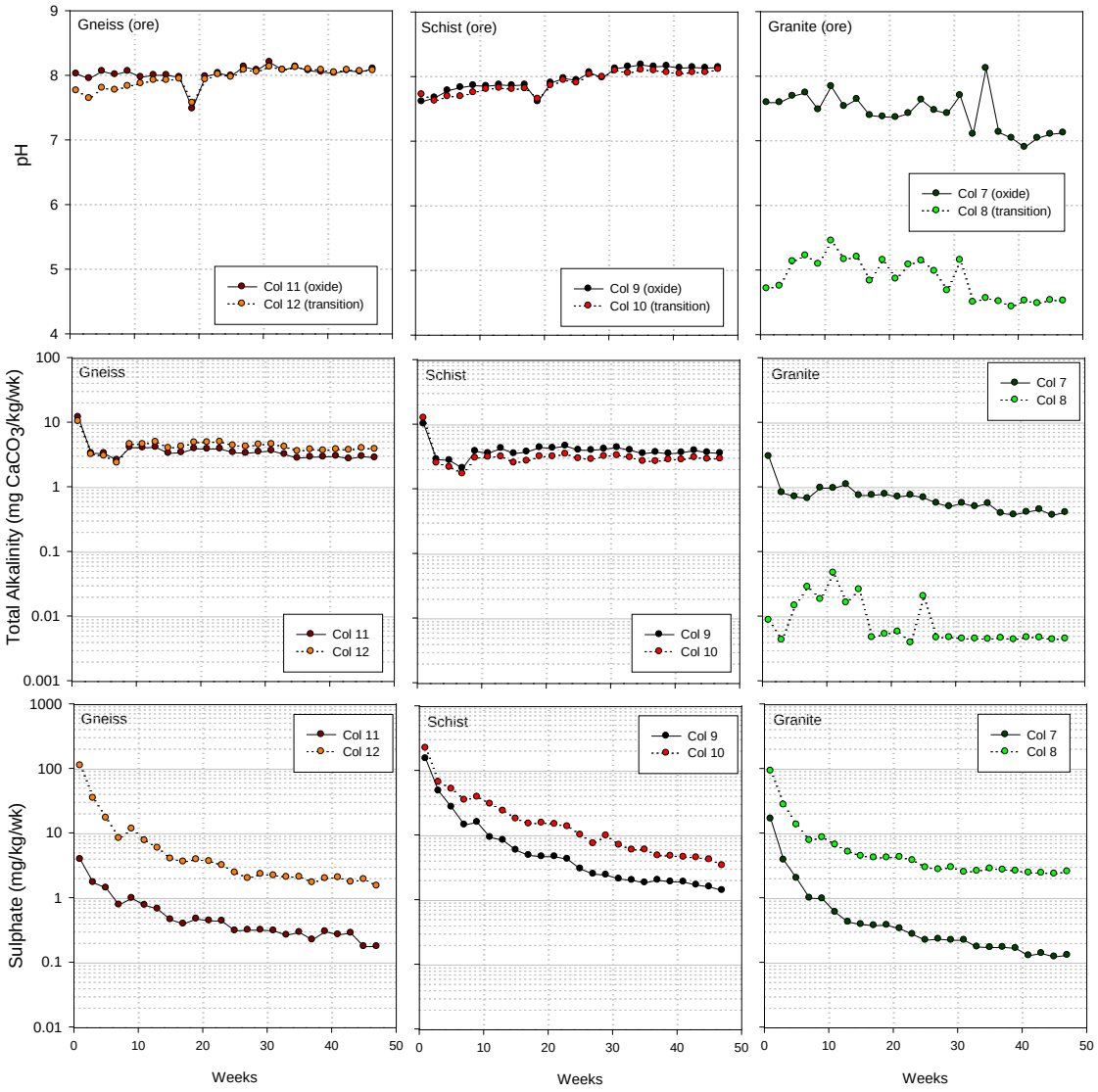

Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
D-Al (mg/L)
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
DL
D-Cd (mg/L)
D-Cr (mg/L)
D-Co (mg/L)
Weeks

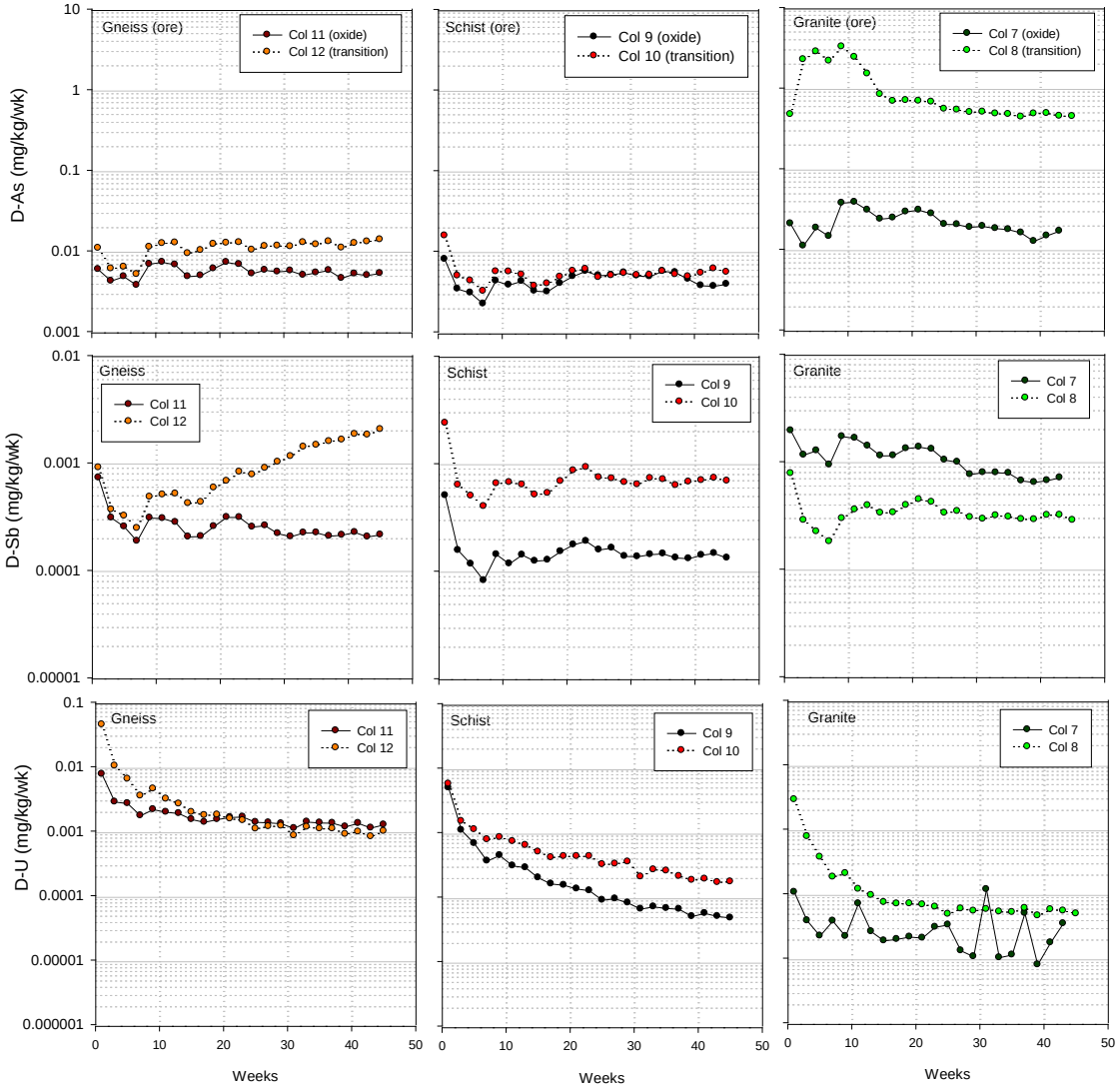

Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
D-Cu (mg/L)
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
DL
D-Fe (mg/L)
D-Pb (mg/L)
D-Mn (mg/L)
Weeks

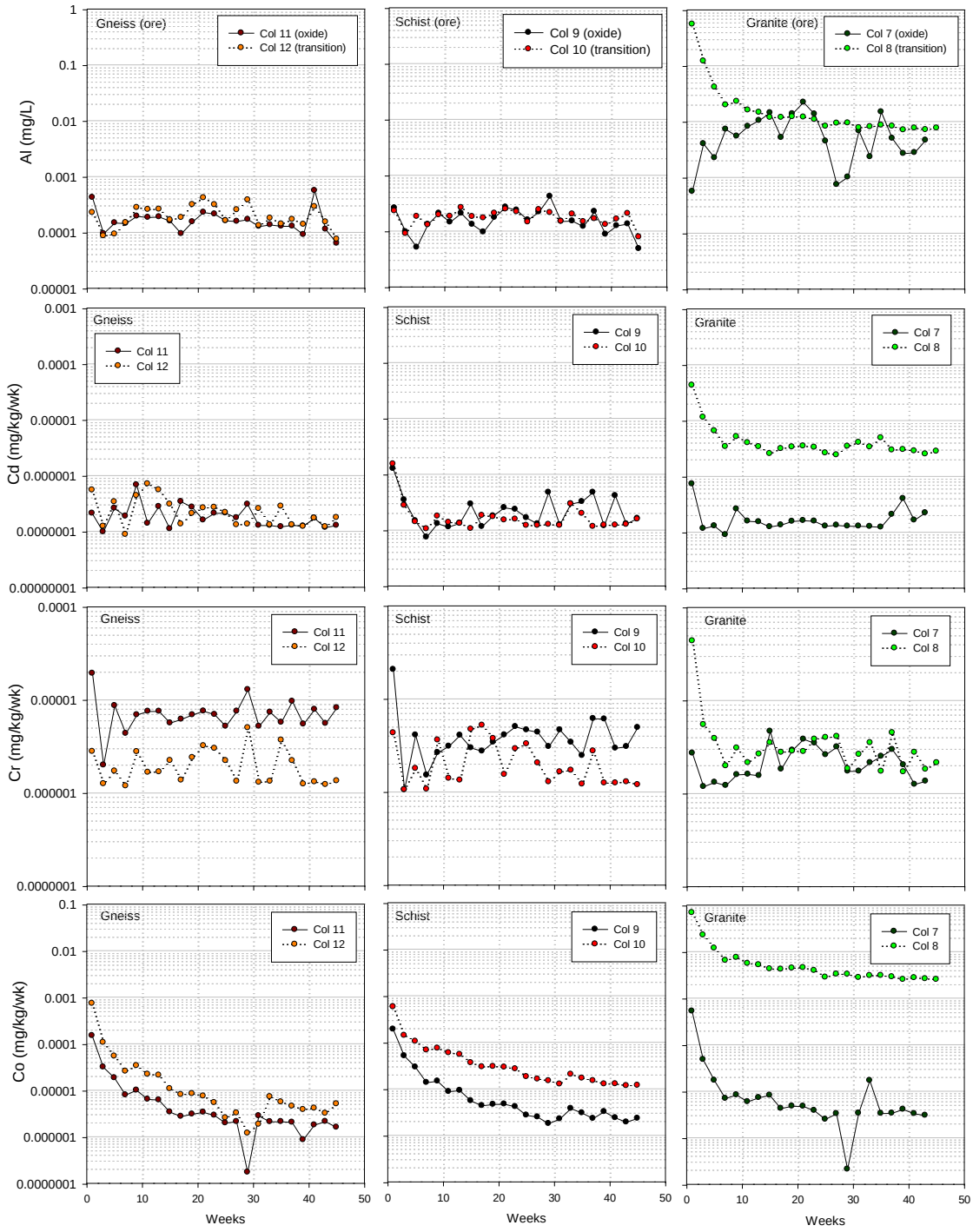

Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
D-Hg (ug/L)
DL
Gneiss
Schist
Granite
Col 11
Col 12
Col 9
Col 10
Col 7
Col 8
D-Mo (mg/L)
D-Ni (mg/L)
D-Se (mg/L)
Weeks

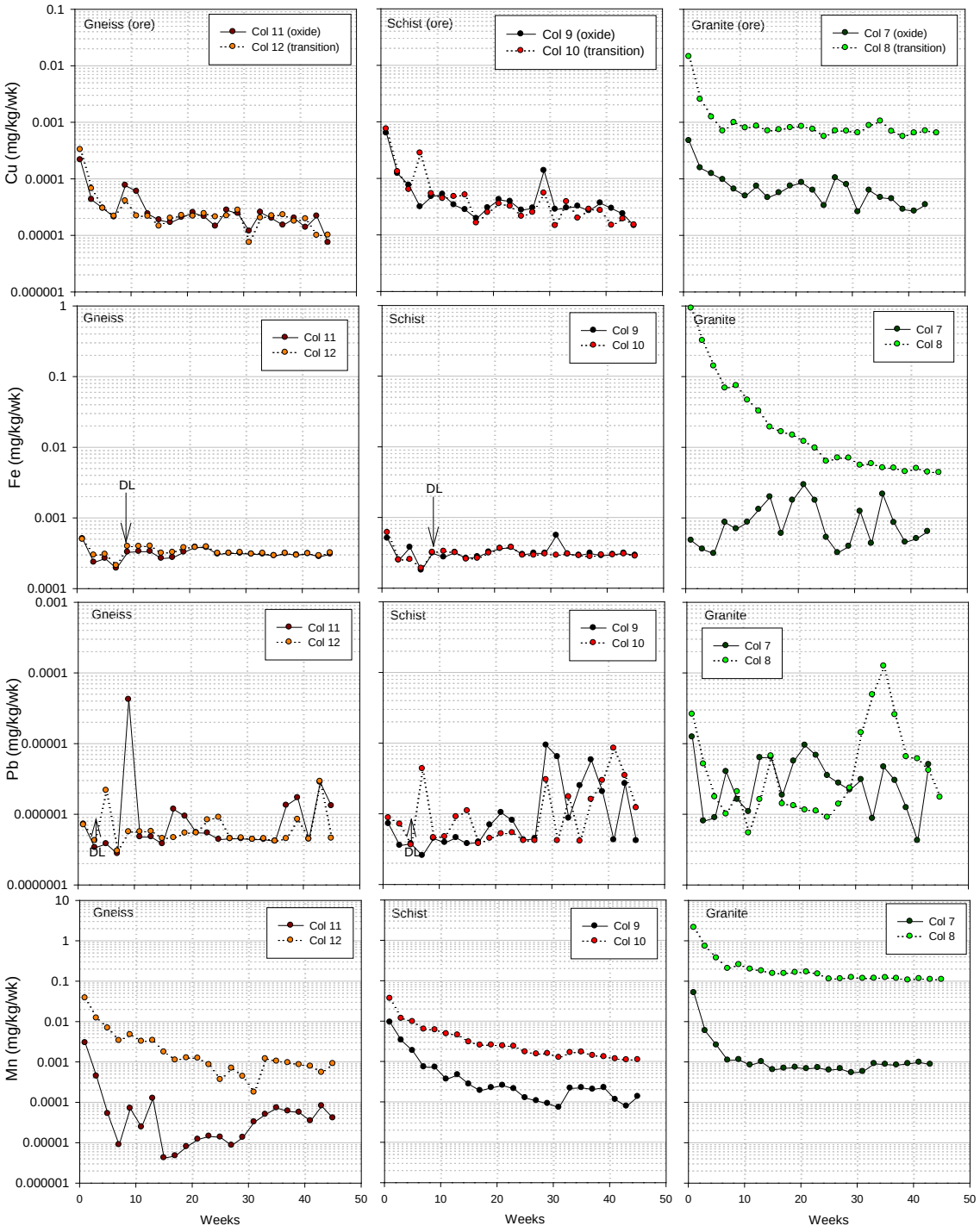

Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
D-Ag (mg/L)
0.001
0.0001
0.00001
0.000001
DL
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
D-Zn (mg/L)
10
1
0.1
0.01
0.001
0.0001
0
10
20
30
40
50
Weeks

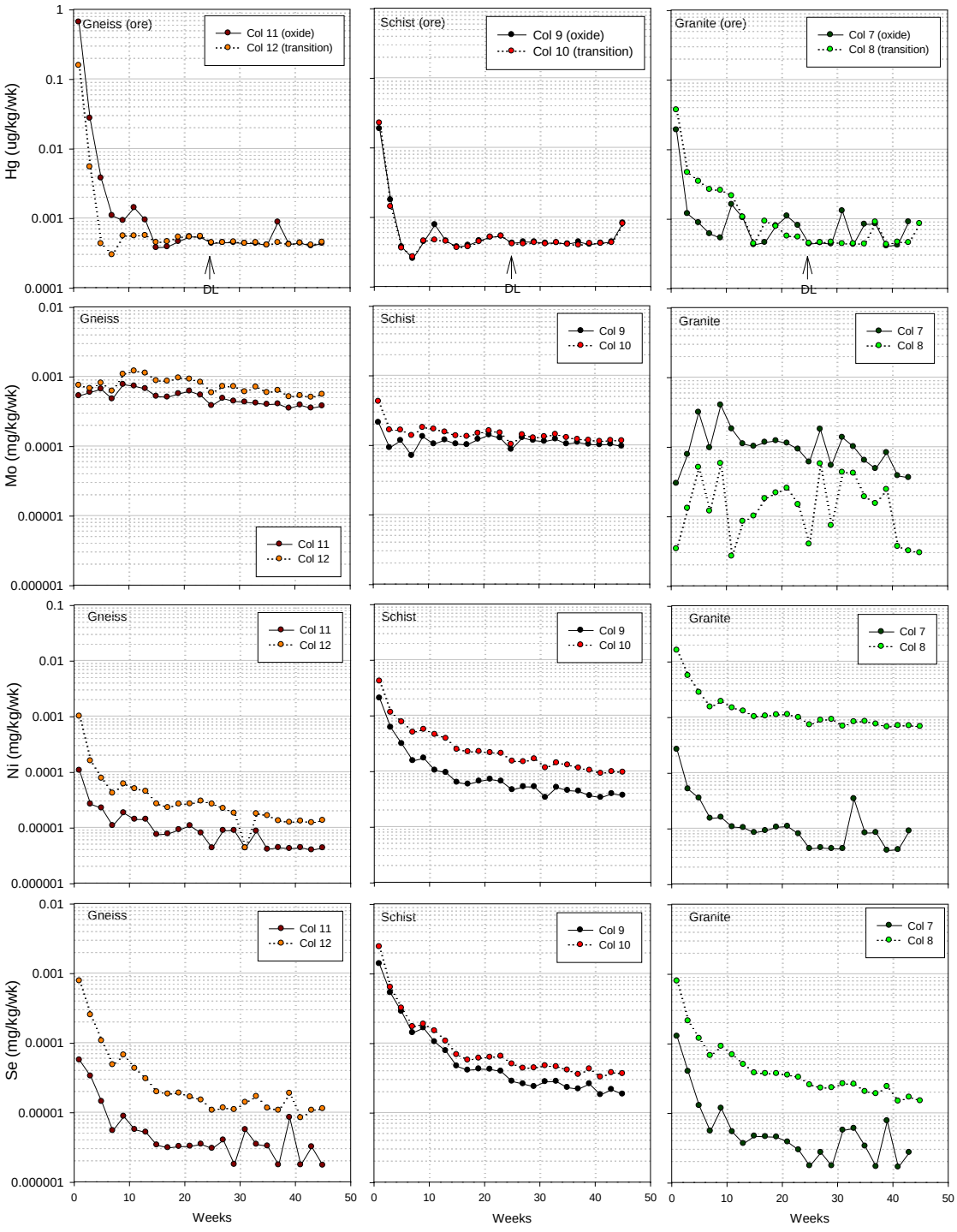
Loading Rates for Ore Unsaturated Columns

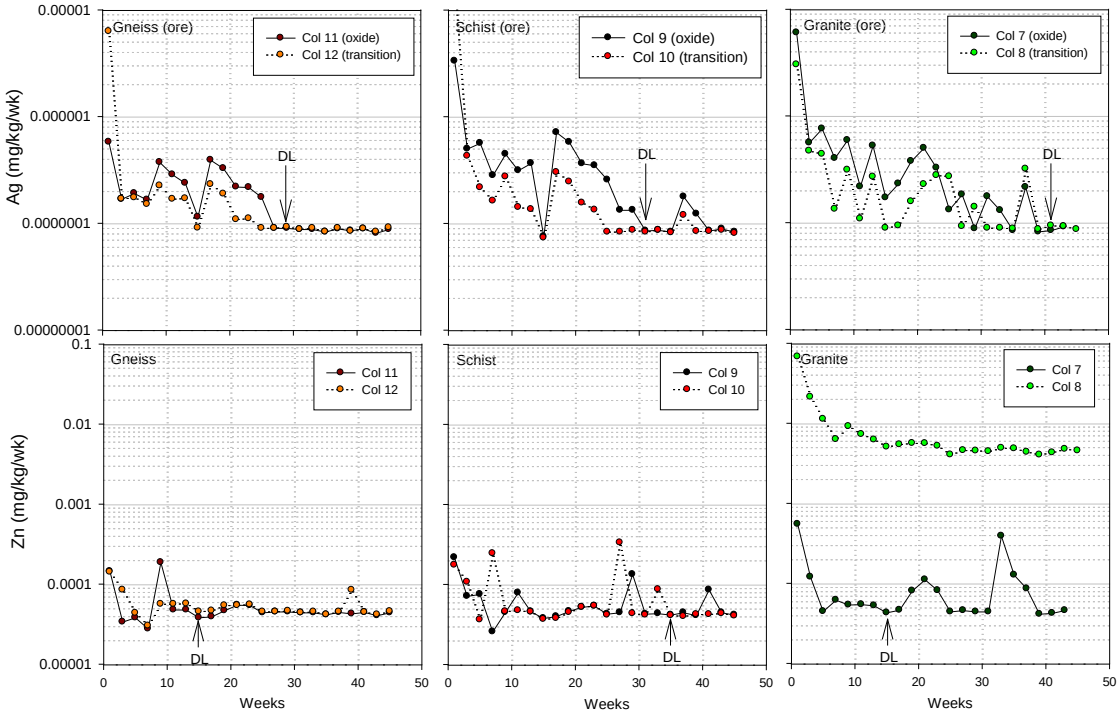



Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
D-As (mg/kg/wk)
10
1
0.1
0.01
0.001
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
D-Sb (mg/kg/wk)
0.01
0.001
0.0001
0.00001
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
D-U (mg/kg/wk)
0.1
0.01
0.001
0.0001
0.00001
0.000001
0
10
20
30
40
50
Weeks
Weeks
Weeks


Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
Al (mg/L)
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
Cd (mg/kg/wk)
Cr (mg/kg/wk)
Co (mg/kg/wk)
Weeks


Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
Cu (mg/kg/wk)
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
DL
Fe (mg/kg/wk)
Pb (mg/kg/wk)
Mn (mg/kg/wk)
Weeks


Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
Hg (ug/kg/wk)
DL
Gneiss
Schist
Granite
Col 9
Col 10
Col 7
Col 8
Mo (mg/kg/wk)
Col 11
Col 12
Ni (mg/kg/wk)
Se (mg/kg/wk)
Weeks


Gneiss (ore)
Col 11 (oxide)
Col 12 (transition)
Schist (ore)
Col 9 (oxide)
Col 10 (transition)
Granite (ore)
Col 7 (oxide)
Col 8 (transition)
DL
Ag (mg/kg/wk)
0.00001
0.000001
0.0000001
0.00000001
Gneiss
Col 11
Col 12
Schist
Col 9
Col 10
Granite
Col 7
Col 8
Zn (mg/kg/wk)
0.1
0.01
0.001
0.0001
0.00001
0
10
20
30
40
50
Weeks

APPENDIX D3: KINETIC TEST RESULTS FOR LEACH TAILINGS

Appendix D.3-1: Overview of Operating Procedures for the Coffee Gold Mine Leach Tailings Kinetic Tests

Test ID	Test Sample Description	Duplicate Tests	Type of Test	Lithology	Weathering Facies	Metallurgical Column ID	Column Dimensions			Dry Wt. of Sample (kg)	Temp (°C)	Operation Procedure	Sampling Frequency	Total Volume of Initial Flushings (mL)	Flushing Rate/ Weekly Input* (mL)	Start Date	Test Status	Cycles/ Weeks	Recirculation Cycles
							Inner Diameter (cm)	Length (cm)	Height (cm)										
Col 1	"A" Bag		Unsaturated Column	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	70340	10.5			10	4°	Trickle Leach	Biweekly	1210	variable	10-Apr-14	active	98	57-89
Col 2	"B" Bag	Col 1	Unsaturated Column	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	70340	10.5			20	4°	Trickle Leach	Biweekly	2355	variable	10-Apr-14	active	98	57-89
Col 15	Latte Composite		Unsaturated Column	Schist	40% Oxide, 60% Transition	20%72162, 20% 72168, 30% 72150, 30% 72156	10.5			5	4°	Trickle Leach	Biweekly	700	variable	3-Jun-15	active	39	-
Col 16	Supremo Composite		Unsaturated Column	Gneiss	80% Oxide, 20% Transition	40% 73028, 40% 73034, 20% 73040	10.5			5	4°	Trickle Leach	Biweekly	700	variable	3-Jun-15	active	39	-
Col 17	Supremo/Kona Composite		Unsaturated Column	90% Gneiss, 10% Granite	80% Oxide, 20% Transition	35% 73028, 35% 73034, 18% 73040, 7% 72174, 3% 72180	10.5			5	4°	Trickle Leach	Biweekly	700	variable	3-Jun-15	active	39	-
FB-LT1		Col 1 & Col 2	Field Bin	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	70340	45.0		80	76.3	site conditions	natural precipitation	3x's / field season	7	natural precipitation	17-Jun-14	active	70	-
FB-LT2			Field Bin	Schist	Oxide	50% 73007 50% 73016	45.0		80	200				15		10-Aug-15	active	10	-
FB-LT3			Field Bin	Gneiss	Oxide	50% 72108 50% 72111	45.0		80	200				19		10-Aug-15	active	10	-

Notes:
Columns and humidity cells are composed of Plexiglas with an acrylic perforated disk & nylon mesh
No sample preparation was conducted prior to leachate sampling for any tests
* generally 400-500 mL for columns, see individual leachate results in Appendix D.3-3 for specific input volumes

APPENDIX D.3-2: X-RAY DIFFRACTION ANALYSES FOR LEACH TAILINGS KINETIC TEST SUB-SAMPLE

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101A/MI4512-APR14*
Batch No.	*1416 Kaminak Coffee Project*
Reporting Date:	*April 29, 2014*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Semi-Quantitative XRD Results
4) XRD Pattern(s)

Bernie C. Yeung, B.Sc.
Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

Report Prepared by: Kim Gibbs

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

SGS

Method Summary

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	70340 A APR4512-01 (wt %)	70340 B APR4512-02 (wt %)
Quartz	56.3	55.7
Phlogopite	3.1	2.8
Dolomite	4.6	2.8
Kaolinite	6.8	9.0
Muscovite	14.8	17.9
Calcite	1.4	1.4
Anorthite	0.0	-
Biotite	0.5	0.7
Orthoclase	1.6	1.3
Chlorite	6.4	5.8
Albite	4.6	2.6
TOTAL	100	100

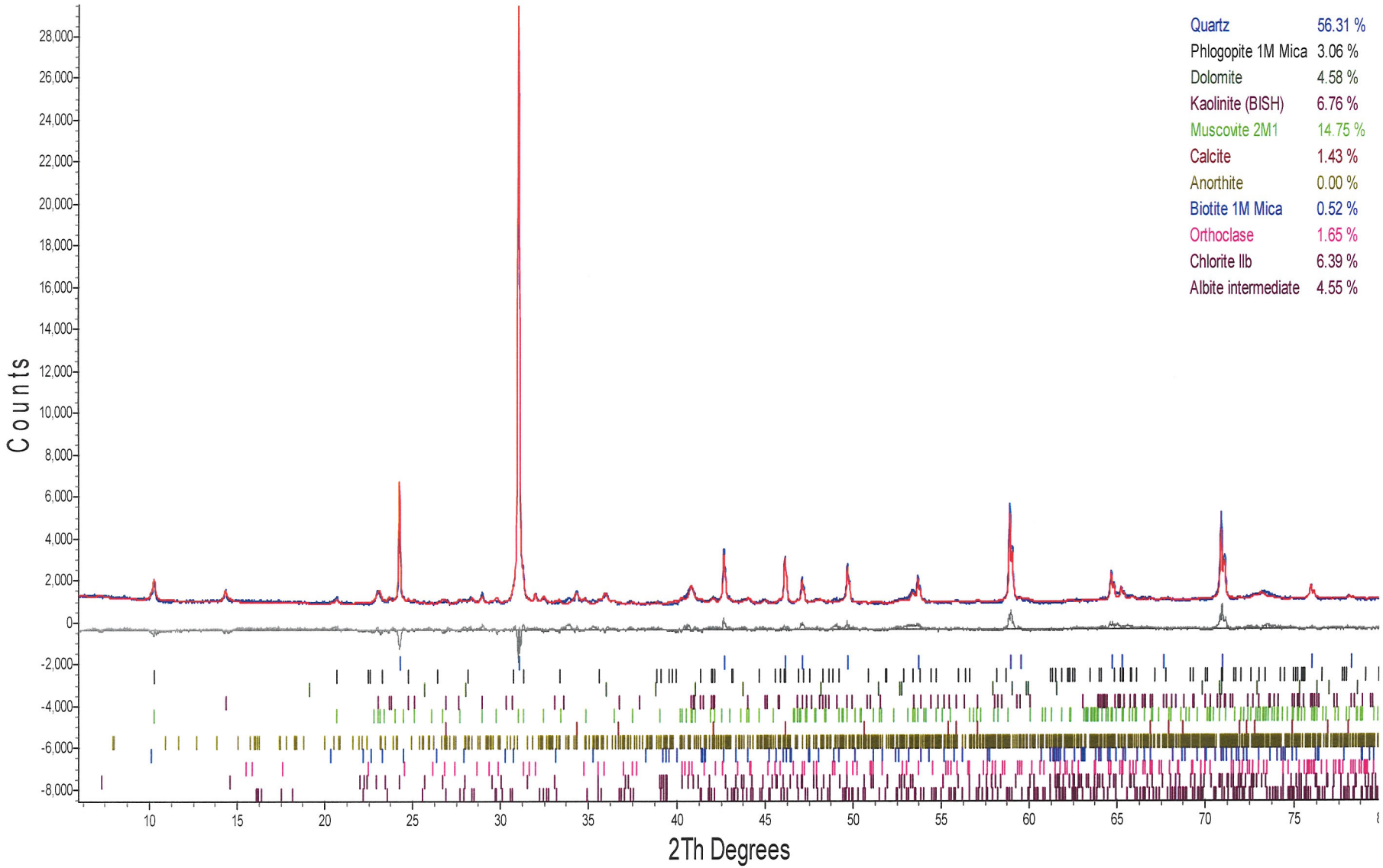
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

Mineral/Compound	Formula
Quartz	SiO_2
Phlogopite	$KMg_3(AlSi_3O_{10})(OH)$
Dolomite	$CaMg(CO_3)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Calcite	$CaCO_3$
Anorthite	$CaAl_2Si_2O_8$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Orthoclase	$KAlSi_3O_8$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Albite	$NaAlSi_3O_8$

SGS Canada Inc
14094-101A/MI4512-APR14
29-Apr-14

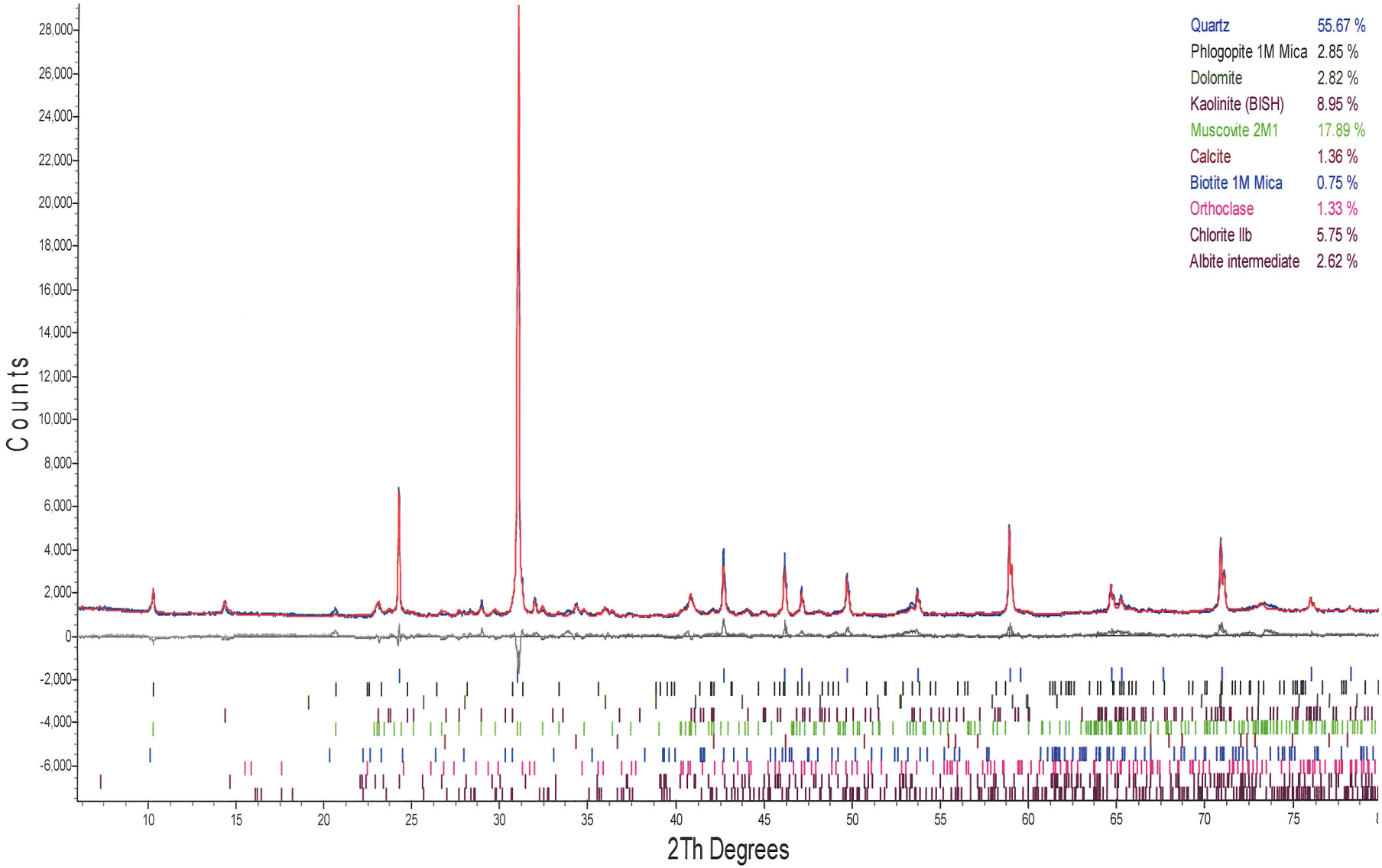
Apr4512-1 re-run.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

SGS Canada Inc
14094-101A/MI4512-APR14
29-Apr-14

Apr4512-2 re-run.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

Appendix D.3-2: Static Test Results for Leach Tailings Kinetic Test Sub-Samples

Acid-Base Accounting Results

Kinetic Tests	Lithology	Weathering Facies	Rinse pH	Paste pH	TIC	CaNP	Total C	Total S	S(SO4)	S(S-2)	Insoluble S	AP	Sobek NP	Siderite NP	Sobek NNP	Siderite NNP	Fizz Test
			s.u.	s.u.	%	kg $CaCO_3$/t	%	%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	
		Method Code	*Sobek*	*Sobek*	*CSB02V*	*Calc.*	*CSA06V*	*CSA06V*	*CSA07V*	*CSA08D*	*Calc.*	*Calc.*	*Sobek*	*Siderite Corr.*	*Calc.*	*Calc.*	*Sobek*
		Limit of Detection	*0.20*	*0.20*	*0.01*	*#N/A*	*0.005*	*0.005*	*0.01*	*0.01*	*#N/A*	*#N/A*	*0.5*	*0.5*	*#N/A*	*#N/A*	*#N/A*
Col 1, Col 2 & FB-LT1	82% Gneiss, 23% Schist	90% Oxide, 10% Transition		8.4	0.56	47	0.60	0.080	0.020	0.040	0.020	1.3	48	47	*ND*	*ND*	Slight
Col 15	Schist	40% Oxide, 60% Transition	9.4	8.8	0.71	59	0.76	0.24	0.020	0.19	0.029	6.0	55	71	49	65	Slight
Col 16	Gneiss	80% Oxide, 20% Transition	9.6	9.2	0.27	23	0.28	0.041	0.012	0.018	0.019	0.56	24	30	24	30	Slight
Col 17	90% Gneiss, 10% Granite	80% Oxide, 20% Transition	9.4	9.0	0.24	20	0.25	0.044	0.012	0.022	0.019	0.68	21	28	21	27	Slight
FB-LT3	Schist	Oxide	9.6	9.1	0.97	81	1.0	0.042	0.020	0.020	0.012	0.63	80	94	80	94	Moderate
FB-LT2	Gneiss	Oxide	9.6	9.3	0.020	1.7	0.041	0.015	*<0.01*	*<0.01*	0.015	0.31	4.2	11	4.2	11	None

Notes:
Values in grey italics are below the analytical detection limit
CaNP = carbonate NP calculated from total inorganic carbon (TIC)
NNP = net neutralization potential, derived by subtracting acid potential (AP) from NP

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Lithology	Weathering Facies	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Lu	Mg	Mn
			ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm
		Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
		Limit of Detection	*0.010*	*0.010*	*1.0*	*10*	*5.0*	*0.10*	*0.020*	*0.010*	*0.010*	*0.050*	*0.10*	*1.0*	*0.050*	*0.50*	*0.010*	*0.10*	*0.10*	*0.050*	*0.010*	*0.020*	*0.010*	*0.10*	*1.0*	*0.010*	*0.010*	*2.0*
Col 1, Col 2 & FB-LT1	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	0.13	0.33	1690	20	201	1.1	0.29	1.6	0.090	46	8.2	123	1.8	15	2.3	1.0	*<0.1*	0.21	0.57	0.020	0.20	26	1.0	0.17	0.34	402
Col 15	Schist	40% Oxide, 60% Transition	0.065	0.53	3543	*<10*	175	0.61	0.24	1.8	0.065	39	5.5	97	1.7	7.9	1.9	1.8	*<0.1*	0.23	1.2	*<0.02*	0.21	20	2.2	0.14	0.43	284
Col 16	Gneiss	80% Oxide, 20% Transition	0.11	0.52	1156	*<10*	214	1.1	0.31	0.90	0.076	61	6.5	108	1.9	6.2	1.9	1.7	*<0.1*	0.16	0.89	*<0.02*	0.27	34	2.0	0.17	0.22	412
Col 17	90% Gneiss, 10% Granite	80% Oxide, 20% Transition	0.099	0.50	1488	*<10*	196	0.98	0.29	0.81	0.072	57	5.9	105	1.8	5.6	1.8	1.6	*<0.1*	0.17	0.91	*<0.02*	0.25	32	1.9	0.16	0.20	376
FB-LT3	Schist	Oxide	0.075	0.65	1350	*<10*	874	0.75	0.66	3.0	0.12	68	14	95	1.9	29	3.3	2.3	*<0.1*	0.13	0.39	0.025	0.29	35	3.0	0.22	0.49	638
FB-LT2	Gneiss	Oxide	0.090	0.63	824	*<10*	242	0.85	0.36	0.17	0.095	48	9.8	115	1.3	9.8	2.4	2.0	*<0.1*	0.18	0.35	0.030	0.23	26	2.5	0.15	0.19	537

Notes:
Values in grey italics are below the analytical detection limit

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Lithology	Weathering Facies	Mo	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
			ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
		Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
		Limit of Detection	*0.050*	*0.010*	*0.050*	*0.50*	*0.0050*	*0.20*	*0.20*	*0.010*	*0.050*	*0.10*	*1.0*	*0.30*	*0.50*	*0.050*	*0.020*	*0.050*	*0.10*	*0.010*	*0.020*	*0.050*	*1.0*	*0.10*	*0.050*	*0.10*	*1.0*	*0.50*
Col 1, Col 2 & FB-LT1	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	4.5	0.030	*<0.05*	14	0.031	15	11	0.080	37	3.8	*<1*	0.30	61	*<0.05*	0.43	0.060	17	*<0.01*	0.59	10	16	0.70	11	1.2	33	7.0
Col 15	Schist	40% Oxide, 60% Transition	4.6	0.038	0.22	23	0.026	16	12	0.24	55	3.6	*<1*	0.41	69	*<0.05*	0.32	*<0.05*	18	*<0.01*	0.74	5.8	16	0.28	8.8	0.91	29	8.0
Col 16	Gneiss	80% Oxide, 20% Transition	5.3	0.036	0.076	16	0.028	13	15	0.038	39	3.2	*<1*	0.92	38	*<0.05*	0.39	*<0.05*	26	*<0.01*	1.0	14	18	0.56	11	1.2	31	5.5
Col 17	90% Gneiss, 10% Granite	80% Oxide, 20% Transition	5.2	0.036	0.098	15	0.026	13	14	0.041	40	3.2	*<1*	0.85	36	*<0.05*	0.36	*<0.05*	25	*<0.01*	0.99	14	17	0.51	11	1.1	28	6.0
FB-LT3	Schist	Oxide	3.7	0.045	0.070	36	0.064	14	14	0.040	95	5.2	*<1*	0.30	76	*<0.05*	0.58	0.075	13	0.010	0.61	1.9	27	0.65	16	1.5	60	4.9
FB-LT2	Gneiss	Oxide	4.8	0.040	0.075	41	0.034	13	13	0.010	41	6.2	*<1*	0.45	19	*<0.05*	0.35	0.14	20	0.010	0.92	13	31	0.40	9.9	1.1	32	7.1

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 1 (LT1, Sample 'A')

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
23-Apr-14	1	1	1210	385	8.4	496	412	9.8	0.50	*< 10*	*< 3*	3.7	4.0	10.0	87	0.70	134	0.062	0.061	0.11	0.058	0.0000070	*< 7E-06*	0.080	0.00016	40	0.089
7-May-14	2	3	400	455	8.5	394	251	4.4	0.22	*< 5*	*< 3*	1.3	1.8	4.2	31	*< 0.3*	46	0.012	0.080	2.0	0.022	0.000014	*< 7E-06*	0.050	0.00033	13	0.040
21-May-14	3	5	450	385	8.6	406	219	2.0	0.070	*< 2*	*< 1*	0.70	0.56	1.2	10	*< 0.3*	33	0.014	0.056	2.0	0.017	0.000079	0.00044	0.041	*< 3E-06*	9.2	0.021
4-Jun-14	4	7	400	325	8.6	396	181	1.4	0.040	*< 2*	*< 1*	0.60	0.21	0.41	3.1	*< 0.3*	29	0.0084	0.052	2.3	0.012	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	8.2	0.012
18-Jun-14	5	9	400	335	8.6	399	95	0.84	0.030	*< 2*	*< 1*	0.50	0.17	0.14	1.6	*< 0.3*	25	0.0095	0.047	2.7	0.012	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	7.0	0.0091
2-Jul-14	6	11	400	340	8.5	411	101	0.65	0.040	*< 2*	*< 1*	0.50	*< 0.06*	0.090	0.90	*< 0.3*	25	0.018	0.052	2.5	0.013	*< 7E-06*	*< 7E-06*	0.018	0.000021	6.9	0.0065
16-Jul-14	7	13	400	340	8.5	374	69	0.44	0.020	*< 2*	*< 1*	0.80	*< 0.06*	0.060	0.60	*< 0.3*	22	0.011	0.051	2.6	0.012	0.000014	0.000013	0.020	*< 3E-06*	6.3	0.0057
30-Jul-14	8	15	400	330	8.5	361	58	0.38	0.020	*< 2*	*< 1*	0.50	*< 0.06*	0.050	0.40	*< 0.3*	18	0.037	0.052	2.9	0.011	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	5.1	0.0049
13-Aug-14	9	17	400	325	8.4	345	51	0.38	0.020	*< 2*	*< 1*	0.50	*< 0.06*	0.040	*< 0.3*	0.40	21	0.011	0.050	2.4	0.013	*< 7E-06*	*< 7E-06*	0.024	*< 3E-06*	5.8	0.0038
27-Aug-14	10	19	400	325	8.4	329	47	0.21	0.010	-	-	0.40	*< 0.06*	0.040	*< 1*	*< 0.3*	20	0.023	0.045	2.3	0.012	*< 7E-06*	*< 7E-06*	0.033	0.0000070	5.7	0.0032
10-Sep-14	11	21	400	315	8.4	317	35	0.23	0.010	-	-	0.30	*< 0.06*	*< 0.03*	*< 0.2*	*< 0.3*	19	0.021	0.042	2.3	0.012	*< 7E-06*	*< 7E-06*	0.027	0.000014	5.2	0.0029
24-Sep-14	12	23	400	340	8.4	319	42	0.19	*< 0.01*	-	-	0.40	*< 0.06*	0.030	*< 1*	*< 0.3*	33	0.0082	0.047	2.2	0.013	*< 7E-06*	*< 7E-06*	0.021	*< 3E-06*	5.1	0.0026
8-Oct-14	13	25	400	305	8.4	284	39	0.17	0.020	-	-	0.70	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	21	0.012	0.038	2.2	0.013	*< 7E-06*	*< 7E-06*	0.018	0.0000030	5.7	0.0025
22-Oct-14	14	27	400	325	8.3	273	33	0.18	0.010	-	-	0.40	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	20	0.019	0.039	2.2	0.015	*< 7E-06*	*< 7E-06*	0.030	0.000013	5.5	0.0022
5-Nov-14	15	29	400	325	-	275	32	0.12	*< 0.01*	-	-	0.30	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	20	0.015	0.038	2.1	0.014	*< 7E-06*	*< 7E-06*	0.024	0.0000050	5.4	0.0020
19-Nov-14	16	31	400	315	8.3	260	30	0.11	0.020	-	-	0.60	*< 0.06*	0.040	*< 1*	*< 0.3*	22	0.0095	0.036	1.9	0.016	*< 7E-06*	*< 7E-06*	0.020	0.000013	5.8	0.0019
3-Dec-14	17	33	400	285	8.4	256	29	0.10	*< 0.01*	-	-	0.40	*< 0.06*	0.030	*< 1*	*< 0.3*	22	0.014	0.034	1.8	0.016	*< 7E-06*	*< 7E-06*	0.019	0.0000080	6.1	0.0017
17-Dec-14	18	35	400	365	8.4	233	23	0.10	*< 0.01*	-	-	1.8	*< 0.06*	0.080	*< 1*	*< 0.3*	21	0.017	0.036	1.7	0.015	*< 7E-06*	*< 7E-06*	0.019	0.0000080	5.4	0.0014
31-Dec-14	19	37	400	335	8.5	273	19	0.080	0.010	-	-	0.50	*< 0.06*	0.060	*< 1*	*< 0.3*	20	0.021	0.034	1.6	0.017	*< 7E-06*	*< 7E-06*	0.018	0.0000030	5.4	0.0013
14-Jan-15	20	39	400	325	8.3	220	20	0.080	*< 0.01*	-	-	0.40	*< 0.06*	0.050	*< 1*	*< 0.3*	23	0.022	0.034	1.6	0.017	*< 7E-06*	*< 7E-06*	0.019	0.000017	6.3	0.0066
28-Jan-15	21	41	400	340	8.3	232	21	0.060	*< 0.01*	-	-	0.40	*< 0.06*	0.11	*< 1*	*< 0.3*	27	0.015	0.030	1.4	0.017	*< 7E-06*	0.000044	0.016	0.0000040	7.4	0.0014
11-Feb-15	22	43	400	325	8.2	206	21	0.050	*< 0.01*	-	-	0.40	*< 0.06*	0.070	*< 1*	*< 0.3*	26	0.012	0.032	1.3	0.018	*< 7E-06*	*< 7E-06*	0.020	0.0000060	7.0	0.0012
25-Feb-15	23	45	400	320	8.2	202	18	0.050	*< 0.01*	-	-	0.40	*< 0.06*	0.080	*< 1*	*< 0.3*	32	0.0038	0.026	0.97	0.022	*< 7E-06*	*< 7E-06*	0.018	0.0000060	8.7	0.0011
11-Mar-15	24	47	400	315	8.2	194	20	0.040	0.010	-	-	0.50	*< 0.06*	0.060	*< 1*	*< 0.3*	36	0.0049	0.025	0.87	0.023	*< 7E-06*	*< 7E-06*	0.017	0.0000050	9.8	0.0011
25-Mar-15	25	49	400	325	8.1	178	13	0.010	*< 0.01*	-	-	0.40	*< 0.06*	0.070	*< 1*	*< 0.3*	41	0.0059	0.025	0.90	0.027	*< 7E-06*	*< 7E-06*	0.016	*< 3E-06*	11	0.0013
8-Apr-15	26	51	400	350	8.1	172	14	0.050	0.010	-	-	0.60	*< 0.06*	0.10	*< 1*	*< 0.3*	45	0.0073	0.028	0.75	0.030	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	12	0.00090
22-Apr-15	27	53	400	320	8.0	158	16	0.030	*< 0.01*	-	-	0.80	*< 0.06*	0.15	*< 1*	*< 0.3*	50	0.0097	0.025	0.70	0.031	*< 7E-06*	*< 7E-06*	0.022	0.000014	13	0.00091
6-May-15	28	55	400	325	8.1	160	13	0.020	*< 0.01*	-	-	0.40	*< 0.06*	0.25	*< 1*	*< 0.3*	55	0.0065	0.021	0.59	0.033	*< 7E-06*	*< 7E-06*	0.018	*< 3E-06*	15	0.00077
20-May-15	29	57	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	30	59	445	380	8.1	144	9.0	0.67	0.020	-	-	0.60	*< 0.06*	*< 0.01*	*< 1*	*< 0.3*	66	0.0089	0.016	0.48	0.041	*< 7E-06*	*< 7E-06*	0.020	0.0000040	18	0.00084
17-Jun-15	31	61	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	32	63	445	385	8.0	140	11	0.020	*< 0.01*	-	-	0.70	0.060	2.0	*< 1*	*< 0.3*	79	0.0051	0.016	0.46	0.049	*< 7E-06*	*< 7E-06*	0.015	0.0000030	21	0.00069
15-Jul-15	33	65	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	34	67	425	355	8.0	131	11	0.020	0.040	-	-	0.80	0.10	5.7	*< 1*	*< 0.3*	97	0.0063	0.014	0.36	0.052	*< 7E-06*	0.000011	0.017	*< 3E-06*	26	0.00075
12-Aug-15	35	69	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	36	71	455	375	8.0	121	9.0	0.020	0.020	-	-	0.90	0.17	13	*< 1*	*< 0.3*	109	0.0050	0.013	0.33	0.061	*< 7E-06*	*< 7E-06*	0.016	0.000028	29	0.00065
9-Sep-15	37	73	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	38	75	445	390	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	39	77	390	320	7.9	121	8.0	0.020	*< 0.01*	-	-	0.50	0.28	21			139	0.0075	0.014	0.28	0.070	*< 7E-06*	*< 7E-06*	0.016	0.0000030	36	0.00060
21-Oct-15	40	79	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	41	81	450	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	42	83	425	360	8.2	132	7.0	0.010	*< 0.01*	-	-	0.20	0.28	17			137	0.0044	0.011	0.29	0.060	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	36	0.00060
2-Dec-15	43	85	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	44	87	450	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	45	89	400	360	8.3	111	9.0	0.020	*< 0.01*	-	-	0.10	0.30	13	-	-	129	0.0035	0.011	0.24	0.060	*< 7E-06*	*< 7E-06*	0.013	*< 3E-06*	34	0.00053
6-Jan-16	46	90	400	340	8.2	112	9.0	0.020	*< 0.01*	-	-	0.20	0.24	12	-	-	134	0.0049	0.012	0.27	0.062	*< 7E-06*	*< 7E-06*	0.013	0.0000030	35	0.00057
20-Jan-16	47	92	400	355	8.2	108	9.0	0.020	*< 0.01*	-	-	*< 0.1*	0.20	8.4	-	-	123	0.0042	0.013	0.32	0.057	*< 7E-06*	*< 7E-06*	0.022	0.0000060	33	0.00060
3-Feb-16	48	94	400	350	8.1	109	9.0	0.010	*< 0.01*	-	-	*< 0.1*	0.13	5.1	-	-	107	0.0035	0.012	0.33	0.054	*< 7E-06*	*< 7E-06*	0.012	*< 3E-06*	28	0.00060
17-Feb-16	49	96	400	330	8.1	116	8.0	0.020	0.040	-	-	*< 0.1*	0.10	3.2	-	-	115	0.0036	0.012	0.34	0.054	*< 7E-06*	*< 7E-06*	0.013	*< 3E-06*	31	0.00067
2-Mar-16	50	98	400	350	8.2	112	9.0	0.010	*< 0.01*	-	-	*< 0.1*	0.060	1.9	-	-	104	0.0016	0.013	0.38	0.051	*< 7E-06*	*< 7E-06*	0.011	0.0000050	27	0.00067

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 1 (LT1, Sample 'A')

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
23-Apr-14	1	1	1210	385	0.32	0.025	2.9	0.00013	0.015	8.1	0.012	7.8	0.22	0.25	0.52	27	0.00060	5.6	0.0062	550	0.17	201	0.00053	0.00078	0.0012	1.1	0.00048	0.0090	< 0.002
7-May-14	2	3	400	455	0.19	0.0079	1.6	0.00013	0.0075	3.4	0.0066	0.65	0.37	0.056	0.43	15	0.0047	5.8	< 2E-06	329	0.062	128	0.00031	0.000050	0.0013	0.99	< 1E-05	0.0030	< 0.002
21-May-14	3	5	450	385	0.092	0.0043	0.82	0.00049	0.0069	2.5	0.0044	0.11	0.14	0.0026	0.42	10	0.0023	4.9	0.000063	294	0.045	78	0.00022	0.000060	0.0015	0.69	0.00010	0.0020	< 0.002
4-Jun-14	4	7	400	325	0.041	0.010	0.47	0.00027	0.0053	2.1	0.0031	0.050	0.14	0.0010	0.44	9.3	0.0013	5.3	0.000014	253	0.038	57	0.00018	0.00018	0.00064	0.56	0.000060	0.0050	< 0.002
18-Jun-14	5	9	400	335	0.029	0.017	0.31	0.000020	0.0052	1.9	0.0021	0.050	0.088	0.00080	0.45	8.4	0.0011	5.3	< 2E-06	221	0.034	43	0.00016	0.000090	0.00045	0.56	0.000080	< 0.001	< 0.002
2-Jul-14	6	11	400	340	0.022	0.0042	0.22	0.000070	0.0050	1.8	0.0016	0.030	0.070	0.00090	0.46	8.3	0.00080	5.6	< 2E-06	206	0.033	37	0.00015	0.00013	0.00043	0.49	0.000060	0.0020	< 0.002
16-Jul-14	7	13	400	340	0.018	0.0017	0.17	0.000030	0.0050	1.6	0.0012	0.020	0.063	0.00060	0.45	7.7	0.00061	5.1	0.000015	190	0.030	29	0.00016	0.00011	0.00032	0.40	0.00020	< 0.001	< 0.002
30-Jul-14	8	15	400	330	0.013	0.0037	0.14	0.000030	0.0047	1.3	0.0012	< 0.01	0.068	0.00050	0.47	6.5	0.00060	4.8	0.0000020	160	0.024	23	0.00013	0.000020	0.00087	0.33	0.00031	< 0.001	< 0.002
13-Aug-14	9	17	400	325	0.011	0.0014	0.075	0.000020	0.0050	1.5	0.00080	< 0.01	0.046	0.00040	0.46	6.6	0.00052	5.1	< 2E-06	169	0.028	20	0.00012	0.000050	0.00029	0.32	0.00012	< 0.001	< 0.002
27-Aug-14	10	19	400	325	0.010	0.0012	0.080	0.000020	0.0048	1.5	0.00090	< 0.01	0.045	0.00040	0.43	6.9	0.00043	5.3	0.0000020	157	0.027	18	0.00014	0.00035	0.00010	0.29	0.00023	< 0.001	< 0.002
10-Sep-14	11	21	400	315	0.0084	0.00098	0.081	0.000020	0.0044	1.4	0.00050	< 0.01	0.040	0.00030	0.44	5.7	0.00049	6.4	< 2E-06	151	0.026	16	0.00012	0.00027	0.000090	0.25	0.00021	< 0.001	< 0.002
24-Sep-14	12	23	400	340	0.0072	0.0012	0.036	0.00013	0.0048	1.4	0.00060	0.010	0.044	0.00040	0.39	6.6	0.00021	5.1	0.000010	128	0.025	13	0.00015	0.00026	0.00026	0.23	0.00019	< 0.001	< 0.002
8-Oct-14	13	25	400	305	0.0071	0.00097	0.061	< 1E-05	0.0056	1.6	0.00028	< 0.01	0.033	0.00030	0.39	5.8	0.00034	5.2	< 2E-06	151	0.029	12	0.00012	0.000040	0.00012	0.23	0.00019	< 0.001	< 0.002
22-Oct-14	14	27	400	325	0.0063	0.00074	0.054	0.000020	0.0057	1.6	0.00064	< 0.01	0.029	0.00020	0.46	5.9	0.00043	5.1	< 2E-06	140	0.026	13	0.00013	0.000030	0.00012	0.20	0.00022	0.0010	< 0.002
5-Nov-14	15	29	400	325	0.0054	0.0010	0.048	0.000070	0.0049	1.6	0.00033	0.010	0.028	0.00020	0.38	5.3	0.00035	5.2	0.0000030	132	0.028	10	0.00011	0.000060	0.00018	0.19	0.00020	< 0.001	< 0.002
19-Nov-14	16	31	400	315	0.0050	0.0014	0.037	0.000030	0.0056	1.8	0.00084	< 0.01	0.024	0.00020	0.37	5.6	0.00027	5.7	0.0000020	132	0.032	9.5	0.00015	0.000060	0.00017	0.18	0.00017	< 0.001	< 0.002
3-Dec-14	17	33	400	285	0.0044	0.020	0.034	0.000020	0.0049	1.6	0.00054	< 0.01	0.021	0.00030	0.34	5.4	0.00027	5.2	< 2E-06	115	0.032	8.8	0.00013	0.000040	0.00015	0.16	0.00018	0.0030	< 0.002
17-Dec-14	18	35	400	365	0.0040	0.0013	0.030	< 1E-05	0.0050	1.8	0.00071	< 0.01	0.019	0.00020	0.34	6.2	0.00030	5.2	< 2E-06	112	0.030	8.3	0.00012	0.000030	0.00016	0.15	0.00019	< 0.001	< 0.002
31-Dec-14	19	37	400	335	0.0036	0.0012	0.031	0.00012	0.0051	1.7	0.00054	< 0.01	0.018	0.00030	0.33	5.4	0.00028	5.5	< 2E-06	103	0.030	7.7	0.00012	0.00014	0.00016	0.15	0.00020	< 0.001	< 0.002
14-Jan-15	20	39	400	325	0.0033	0.00065	0.028	0.00056	0.0051	1.9	0.00062	< 0.01	0.018	0.00020	0.31	5.8	0.00025	5.7	0.0000020	98	0.032	6.9	0.00012	0.000090	0.00019	0.13	0.00018	< 0.001	< 0.002
28-Jan-15	21	41	400	340	0.0028	0.00061	0.025	< 1E-05	0.0049	2.2	0.00055	< 0.01	0.018	0.00020	0.27	6.4	0.00035	5.4	0.0000030	106	0.029	7.2	0.00012	0.00032	0.00018	0.13	0.00021	< 0.001	< 0.002
11-Feb-15	22	43	400	325	0.0027	0.00044	0.046	< 1E-05	0.0059	2.1	0.00060	0.010	0.015	0.00020	0.26	6.2	< 0.001	5.4	< 2E-06	88	0.039	7.0	0.00012	0.00019	0.00012	0.11	0.00018	< 0.001	< 0.002
25-Feb-15	23	45	400	320	0.0027	0.00082	0.016	< 1E-05	0.0063	2.4	0.00028	< 0.01	0.012	0.00010	0.20	6.9	< 0.001	5.5	< 2E-06	80	0.045	6.0	0.00014	0.00015	< 5E-05	0.10	0.00011	< 0.001	< 0.002
11-Mar-15	24	47	400	315	0.0025	0.00084	0.017	< 1E-05	0.0064	2.7	0.00032	< 0.01	0.012	0.00020	0.16	6.6	< 0.001	4.7	0.0000040	69	0.051	6.1	0.00013	0.000080	0.000050	0.094	0.00013	< 0.001	< 0.002
25-Mar-15	25	49	400	325	0.0027	0.0024	0.017	0.000050	0.0064	3.5	0.00042	< 0.01	0.013	0.00020	0.17	7.8	< 0.001	6.0	0.0000030	76	0.061	6.1	0.00016	0.0012	0.00012	0.085	0.00014	0.0010	< 0.002
8-Apr-15	26	51	400	350	0.0020	0.00092	0.012	< 1E-05	0.0066	3.3	0.00061	< 0.01	0.0095	0.00010	0.15	7.8	< 0.001	6.1	0.0000020	56	0.064	5.1	0.00014	0.00014	0.000090	0.076	0.00010	< 0.001	< 0.002
22-Apr-15	27	53	400	320	0.0019	0.00059	0.012	0.00036	0.0065	4.1	0.00073	< 0.01	0.011	0.00010	0.14	8.9	0.00017	5.4	0.000046	54	0.073	5.3	0.00017	0.000080	0.000070	0.071	0.00012	< 0.001	< 0.002
6-May-15	28	55	400	325	0.0018	0.00095	0.013	0.000030	0.0067	4.2	0.00091	0.020	0.0091	0.00010	0.11	8.8	< 0.001	5.8	0.000058	46	0.074	4.9	0.00016	0.000020	0.000080	0.067	0.00014	< 0.001	< 0.002
20-May-15	29	57	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	30	59	445	380	0.0016	0.0038	0.018	0.000070	0.0068	5.3	0.00065	< 0.01	0.012	0.00010	0.092	9.5	0.00017	5.5	0.000012	33	0.093	4.3	0.00016	0.00016	0.000080	0.064	0.00012	0.0010	< 0.002
17-Jun-15	31	61	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	32	63	445	385	0.0016	0.00050	0.011	< 1E-05	0.0069	6.4	0.00083	0.020	0.0066	0.00010	0.089	9.6	0.00016	5.7	0.000020	26	0.12	3.7	0.00019	0.000070	0.000070	0.063	0.00010	< 0.001	< 0.002
15-Jul-15	33	65	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	34	67	425	355	0.0015	0.00070	0.011	0.000010	0.0072	7.5	0.0018	< 0.01	0.0067	0.00010	0.073	9.9	0.00011	5.7	0.0000090	21	0.14	3.6	0.00020	0.000050	< 5E-05	0.063	0.00013	< 0.001	< 0.002
12-Aug-15	35	69	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	36	71	455	375	0.0014	0.0018	0.0080	0.000060	0.0072	8.8	0.00091	< 0.01	0.0069	0.00010	0.054	11	0.00032	5.8	0.00026	19	0.17	3.5	0.00021	0.00011	< 5E-05	0.051	0.00011	< 0.001	< 0.002
9-Sep-15	37	73	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	38	75	445	390	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	39	77	390	320	0.0013	0.00061	0.0080	0.000020	0.0074	12	0.00098	< 0.01	0.0041	0.00020	0.057	12	0.00012	5.3	0.0000070	17	0.20	3.7	0.00021	0.00016	0.00011	0.053	0.00013	< 0.001	< 0.002
21-Oct-15	40	79	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	41	81	450	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	42	83	425	360	0.0014	0.00079	0.014	< 1E-05	0.0061	12	0.0028	< 0.01	0.0048	< 0.0001	0.057	11	0.00021	5.5	0.0000070	14	0.18	3.5	0.00015	0.000070	0.000070	0.046	0.000080	< 0.001	< 0.002
2-Dec-15	43	85	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	44	87	450	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	45	89	400	360	0.0012	0.00046	0.017	0.000020	0.0056	11	0.00042	< 0.01	0.0057	0.00010	0.056	9.3	0.00015	5.3	0.0000090	13	0.15	3.3	0.00012	0.000040	0.00031	0.049	0.000070	< 0.001	< 0.002
6-Jan-16	46	90	400	340	0.0013	0.0010	0.010	< 1E-05	0.0059	11	0.0013	< 0.01	0.0057	0.00010	0.063	10	0.0012	5.6	0.000012	13	0.17	3.2	0.00011	0.00027	< 5E-05	0.047	0.000090	< 0.001	< 0.002
20-Jan-16	47	92	400	355	0.0015	0.00037	0.010	0.000060	0.0057	9.7	0.0011	< 0.01	0.0061	0.00020	0.061	9.0	0.00015	5.9	0.000012	11	0.17	3.6	0.00029	0.000050	0.000050	0.053	0.000070	0.0020	< 0.002
3-Feb-16	48	94	400	350	0.0014	0.0010	0.012	0.000020	0.0053	8.8	0.00060	< 0.01	0.0057	0.00010	0.069	8.7	0.00029	5.4	0.000022	10	0.15	3.7	0.00013	0.000090	< 5E-05	0.051	0.000060	< 0.001	< 0.002
17-Feb-16	49	96	400	330	0.0015	0.00076	0.0080	0.000030	0.0053	9.3	0.00091	< 0.01	0.0060	0.00020	0.068	9.0	0.000090	5.6	< 2E-06	11	0.15	3.4	0.00012	0.00012	< 5E-05	0.051	0.000080	< 0.001	< 0.002
2-Mar-16	50	98	400	350	0.0015	0.00039	0.0080	0.000030	0.0054	9.1	0.0016	< 0.01	0.0062	0.00010	0.070	8.6	0.000080	5.5	0.0000040	9.6	0.14	3.9	0.00012	0.000020	< 5E-05	0.052	0.000040	< 0.001	< 0.002

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 1

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
23-Apr-14	1	1	1210	385	8.4	19	16	0.38	0.019	0.39	0.12	0.14	0.15	0.38	3.3	0.027	5.2	0.0024	0.0024	0.0042	0.0022	0.00000027	0.00000027	0.0031	0.0000060	1.5	0.0034
7-May-14	2	3	400	455	8.5	9.0	5.7	0.100	0.0050	0.11	0.068	0.030	0.040	0.096	0.71	0.0068	1.0	0.00027	0.0018	0.045	0.00051	0.00000032	0.00000016	0.0011	0.0000076	0.29	0.00091
21-May-14	3	5	450	385	8.6	7.8	4.2	0.039	0.0013	0.039	0.019	0.013	0.011	0.023	0.19	0.0058	0.64	0.00028	0.0011	0.038	0.00033	0.0000015	0.0000085	0.00078	0.000000058	0.18	0.00040
4-Jun-14	4	7	400	325	8.6	6.4	2.9	0.022	0.00065	0.033	0.016	0.0098	0.0034	0.0067	0.050	0.0049	0.47	0.00014	0.00084	0.037	0.00020	0.00000011	0.00000011	0.00032	0.000000049	0.13	0.00020
18-Jun-14	5	9	400	335	8.6	6.7	1.6	0.014	0.00050	0.034	0.017	0.0084	0.0028	0.0023	0.027	0.0050	0.42	0.00016	0.00079	0.045	0.00020	0.00000012	0.00000012	0.00033	0.000000050	0.12	0.00015
2-Jul-14	6	11	400	340	8.5	7.0	1.7	0.011	0.00068	0.034	0.017	0.0085	0.0010	0.0015	0.015	0.0051	0.42	0.00031	0.00089	0.043	0.00021	0.00000012	0.00000012	0.00031	0.00000036	0.12	0.00011
16-Jul-14	7	13	400	340	8.5	6.4	1.2	0.0075	0.00034	0.034	0.017	0.014	0.0010	0.0010	0.010	0.0051	0.38	0.00018	0.00087	0.044	0.00020	0.00000024	0.00000022	0.00035	0.000000051	0.11	0.000097
30-Jul-14	8	15	400	330	8.5	5.9	0.96	0.0063	0.00033	0.033	0.017	0.0083	0.00099	0.00083	0.0066	0.0050	0.30	0.00060	0.00086	0.047	0.00018	0.00000012	0.00000012	0.00034	0.000000050	0.084	0.000081
13-Aug-14	9	17	400	325	8.4	5.6	0.83	0.0062	0.00033	0.033	0.016	0.0081	0.00098	0.00065	0.0049	0.0065	0.34	0.00017	0.00081	0.039	0.00021	0.00000011	0.00000011	0.00039	0.000000049	0.095	0.000062
27-Aug-14	10	19	400	325	8.4	5.3	0.76	0.0034	0.00016			0.0065	0.00098	0.00065	0.016	0.0049	0.33	0.00038	0.00073	0.037	0.00019	0.00000011	0.00000011	0.00054	0.00000011	0.093	0.000052
10-Sep-14	11	21	400	315	8.4	5.0	0.55	0.0036	0.00016			0.0047	0.00095	0.00047	0.0032	0.0047	0.29	0.00033	0.00066	0.037	0.00018	0.00000011	0.00000011	0.00042	0.00000022	0.082	0.000046
24-Sep-14	12	23	400	340	8.4	5.4	0.71	0.0032	0.00017			0.0068	0.0010	0.00051	0.017	0.0051	0.55	0.00014	0.00079	0.037	0.00022	0.00000012	0.00000012	0.00036	0.000000051	0.087	0.000044
8-Oct-14	13	25	400	305	8.4	4.3	0.59	0.0026	0.00031			0.011	0.00092	0.00046	0.015	0.0046	0.32	0.00018	0.00058	0.034	0.00020	0.00000011	0.00000011	0.00027	0.000000046	0.086	0.000038
22-Oct-14	14	27	400	325	8.3	4.4	0.54	0.0029	0.00016			0.0065	0.00098	0.00049	0.016	0.0049	0.33	0.00030	0.00063	0.035	0.00024	0.00000011	0.00000011	0.00049	0.00000021	0.090	0.000035
5-Nov-14	15	29	400	325		4.5	0.52	0.0020	0.00016			0.0049	0.00098	0.00049	0.016	0.0049	0.32	0.00024	0.00061	0.033	0.00022	0.00000011	0.00000011	0.00038	0.000000081	0.088	0.000033
19-Nov-14	16	31	400	315	8.3	4.1	0.47	0.0017	0.00032			0.0095	0.00095	0.00063	0.016	0.0047	0.34	0.00015	0.00057	0.030	0.00025	0.00000011	0.00000011	0.00032	0.00000020	0.092	0.000029
3-Dec-14	17	33	400	285	8.4	3.7	0.41	0.0014	0.00014			0.0057	0.00086	0.00043	0.014	0.0043	0.31	0.00020	0.00048	0.026	0.00022	0.000000100	0.000000100	0.00026	0.00000011	0.087	0.000024
17-Dec-14	18	35	400	365	8.4	4.3	0.42	0.0018	0.00018			0.033	0.0011	0.0015	0.018	0.0055	0.38	0.00031	0.00065	0.031	0.00026	0.00000013	0.00000013	0.00035	0.00000015	0.098	0.000026
31-Dec-14	19	37	400	335	8.5	4.6	0.32	0.0013	0.00017			0.0084	0.0010	0.0010	0.017	0.0050	0.34	0.00035	0.00056	0.027	0.00028	0.00000012	0.00000012	0.00030	0.000000050	0.090	0.000022
14-Jan-15	20	39	400	325	8.3	3.6	0.33	0.0013	0.00016			0.0065	0.00098	0.00081	0.016	0.0049	0.38	0.00036	0.00055	0.025	0.00027	0.00000011	0.00000011	0.00031	0.00000028	0.10	0.00011
28-Jan-15	21	41	400	340	8.3	3.9	0.36	0.0010	0.00017			0.0068	0.0010	0.0019	0.017	0.0051	0.46	0.00026	0.00050	0.023	0.00030	0.00000012	0.00000075	0.00027	0.000000068	0.13	0.000023
11-Feb-15	22	43	400	325	8.2	3.4	0.34	0.00081	0.00016			0.0065	0.00098	0.0011	0.016	0.0049	0.43	0.00020	0.00051	0.021	0.00029	0.00000011	0.00000011	0.00033	0.000000098	0.11	0.000019
25-Feb-15	23	45	400	320	8.2	3.2	0.29	0.00080	0.00016			0.0064	0.00096	0.0013	0.016	0.0048	0.51	0.000061	0.00042	0.016	0.00035	0.00000011	0.00000011	0.00029	0.000000096	0.14	0.000018
11-Mar-15	24	47	400	315	8.2	3.1	0.32	0.00063	0.00016			0.0079	0.00095	0.00095	0.016	0.0047	0.56	0.000077	0.00039	0.014	0.00036	0.00000011	0.00000011	0.00027	0.000000079	0.15	0.000017
25-Mar-15	25	49	400	325	8.1	2.9	0.21	0.00016	0.00016			0.0065	0.00098	0.0011	0.016	0.0049	0.67	0.000096	0.00041	0.015	0.00044	0.00000011	0.00000011	0.00025	0.000000049	0.18	0.000021
8-Apr-15	26	51	400	350	8.1	3.0	0.25	0.00088	0.00018			0.011	0.0011	0.0018	0.018	0.0053	0.78	0.00013	0.00049	0.013	0.00052	0.00000012	0.00000012	0.00025	0.000000053	0.22	0.000016
22-Apr-15	27	53	400	320	8.0	2.5	0.26	0.00048	0.00016			0.013	0.00096	0.0024	0.016	0.0048	0.80	0.00016	0.00039	0.011	0.00050	0.00000011	0.00000011	0.00035	0.00000022	0.21	0.000015
6-May-15	28	55	400	325	8.1	2.6	0.21	0.00033	0.00016			0.0065	0.00098	0.0041	0.016	0.0049	0.89	0.00011	0.00034	0.0095	0.00053	0.00000011	0.00000011	0.00030	0.000000049	0.24	0.000013
20-May-15	29	57	500	445																							
3-Jun-15	30	59	445	380	8.1	1.4	0.086	0.0064	0.00019			0.0057	0.00057	0.000095	0.0095	0.0029	0.63	0.000085	0.00015	0.0045	0.00039	0.000000067	0.000000067	0.00019	0.000000038	0.17	0.0000080
17-Jun-15	31	61	500	445																							
1-Jul-15	32	63	445	385	8.0	1.4	0.11	0.00019	0.000096			0.0067	0.00058	0.019	0.0096	0.0029	0.76	0.000049	0.00015	0.0044	0.00048	0.000000067	0.000000067	0.00014	0.000000029	0.20	0.0000066
15-Jul-15	33	65	500	425																							
29-Jul-15	34	67	425	355	8.0	1.2	0.098	0.00018	0.00036			0.0071	0.00089	0.050	0.0089	0.0027	0.86	0.000056	0.00012	0.0032	0.00046	0.000000062	0.000000098	0.00015	0.000000027	0.23	0.0000067
12-Aug-15	35	69	500	455																							
26-Aug-15	36	71	455	375	8.0	1.1	0.084	0.00019	0.00019			0.0084	0.0016	0.12	0.0094	0.0028	1.0	0.000047	0.00012	0.0031	0.00057	0.000000066	0.000000066	0.00015	0.00000026	0.27	0.0000061
9-Sep-15	37	73	500	445																							
23-Sep-15	38	75	445	390																							
7-Oct-15	39	77	390	320	7.9	0.65	0.043	0.00011	0.000053			0.0027	0.0015	0.11	0.00	0.00	0.74	0.000040	0.000072	0.0015	0.00038	0.000000037	0.000000037	0.000084	0.000000016	0.19	0.0000032
21-Oct-15	40	79	500	450																							
4-Nov-15	41	81	450	425																							
18-Nov-15	42	83	425	360	8.2	0.79	0.042	0.000060	0.000060			0.0012	0.0017	0.10	0.00	0.00	0.82	0.000026	0.000067	0.0017	0.00036	0.000000042	0.000000042	0.000064	0.000000018	0.22	0.0000036
2-Dec-15	43	85	500	450																							
16-Dec-15	44	87	450	400																							
30-Dec-15	45	89	400	360	8.3	0.67	0.054	0.00012	0.000060			0.00060	0.0018	0.077			0.77	0.000021	0.000065	0.0014	0.00036	0.000000042	0.000000042	0.000078	0.000000018	0.20	0.0000032
6-Jan-16	46	90	400	340	8.2	3.8	0.31	0.00068	0.00034			0.0068	0.0082	0.40			4.6	0.00017	0.00039	0.0091	0.0021	0.00000024	0.00000024	0.00044	0.00000010	1.2	0.000019
20-Jan-16	47	92	400	355	8.2	1.9	0.16	0.00036	0.00018			0.0018	0.0036	0.15			2.2	0.000075	0.00024	0.0056	0.0010	0.00000012	0.00000012	0.00039	0.00000011	0.59	0.000011
3-Feb-16	48	94	400	350	8.1	1.9	0.16	0.00018	0.00018			0.0018	0.0023	0.090			1.9	0.000061	0.00021	0.0058	0.00095	0.00000012	0.00000012	0.00021	0.000000053	0.50	0.000011
17-Feb-16	49	96	400	330	8.1	1.9	0.13	0.00033	0.00066			0.0017	0.0017	0.052			1.9	0.000059	0.00020	0.0056	0.00089	0.00000012	0.00000012	0.00021	0.000000050	0.50	0.000011
2-Mar-16	50	98	400	350	8.2	2.0	0.16	0.00018	0.00018			0.0018	0.0011	0.033			1.8	0.000028	0.00023	0.0067	0.00089	0.00000012	0.00000012	0.00019	0.000000088	0.47	0.000012

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 1

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
23-Apr-14	1	1	1210	385	0.012	0.00095	0.11	0.0000050	0.00057	0.31	0.00045	0.30	0.0084	0.0096	0.020	1.0	0.000023	0.22	0.00024	21	0.0066	7.7	0.000020	0.000030	0.000046	0.043	0.000018	0.00035	0.000077
7-May-14	2	3	400	455	0.0044	0.00018	0.037	0.0000030	0.00017	0.076	0.00015	0.015	0.0085	0.0013	0.0098	0.33	0.00011	0.13	0.000000046	7.5	0.0014	2.9	0.0000069	0.0000011	0.000030	0.022	0.00000023	0.000068	0.000046
21-May-14	3	5	450	385	0.0018	0.000082	0.016	0.0000094	0.00013	0.048	0.000085	0.0021	0.0027	0.000050	0.0081	0.20	0.000045	0.095	0.0000012	5.7	0.00086	1.5	0.0000043	0.0000012	0.000029	0.013	0.0000019	0.000039	0.000039
4-Jun-14	4	7	400	325	0.00066	0.00016	0.0077	0.0000044	0.000086	0.035	0.000050	0.00081	0.0023	0.000016	0.0072	0.15	0.000020	0.085	0.00000023	4.1	0.00062	0.93	0.0000030	0.0000029	0.000010	0.0091	0.00000098	0.000081	0.000033
18-Jun-14	5	9	400	335	0.00048	0.00028	0.0052	0.00000034	0.000087	0.031	0.000035	0.00084	0.0015	0.000013	0.0076	0.14	0.000018	0.089	0.000000034	3.7	0.00056	0.73	0.0000026	0.0000015	0.0000075	0.0094	0.0000013	0.000017	0.000034
2-Jul-14	6	11	400	340	0.00037	0.000071	0.0037	0.0000012	0.000085	0.031	0.000027	0.00051	0.0012	0.000015	0.0078	0.14	0.000014	0.095	0.000000034	3.5	0.00056	0.63	0.0000025	0.0000022	0.0000073	0.0083	0.0000010	0.000034	0.000034
16-Jul-14	7	13	400	340	0.00031	0.000029	0.0029	0.0000051	0.000084	0.028	0.000020	0.00034	0.0011	0.000010	0.0077	0.13	0.000010	0.086	0.00000026	3.2	0.00050	0.49	0.0000027	0.0000019	0.0000054	0.0067	0.0000034	0.000017	0.000034
30-Jul-14	8	15	400	330	0.00022	0.000060	0.0023	0.00000050	0.000077	0.022	0.000020	0.00017	0.0011	0.00000083	0.0077	0.11	0.0000099	0.079	0.000000033	2.6	0.00040	0.38	0.0000021	0.00000033	0.000014	0.0054	0.0000051	0.000017	0.000033
13-Aug-14	9	17	400	325	0.00017	0.000022	0.0012	0.00000033	0.000081	0.024	0.000013	0.00016	0.00075	0.0000065	0.0075	0.11	0.0000085	0.084	0.000000033	2.7	0.00045	0.33	0.0000020	0.00000081	0.0000047	0.0051	0.0000020	0.000016	0.000033
27-Aug-14	10	19	400	325	0.00016	0.000019	0.0013	0.00000033	0.000077	0.024	0.000015	0.00016	0.00073	0.0000065	0.0069	0.11	0.0000070	0.086	0.000000033	2.6	0.00044	0.29	0.0000022	0.0000057	0.0000016	0.0048	0.0000037	0.000016	0.000033
10-Sep-14	11	21	400	315	0.00013	0.000015	0.0013	0.00000032	0.000069	0.022	0.0000079	0.00016	0.00063	0.0000047	0.0070	0.090	0.0000077	0.10	0.000000032	2.4	0.00041	0.25	0.0000019	0.0000043	0.0000014	0.0039	0.0000033	0.000016	0.000032
24-Sep-14	12	23	400	340	0.00012	0.000020	0.00061	0.0000022	0.000082	0.024	0.000010	0.00017	0.00074	0.0000068	0.0066	0.11	0.0000036	0.086	0.00000017	2.2	0.00042	0.22	0.0000026	0.0000044	0.0000044	0.0039	0.0000032	0.000017	0.000034
8-Oct-14	13	25	400	305	0.00011	0.000015	0.00093	0.00000015	0.000085	0.024	0.0000043	0.00015	0.00051	0.0000046	0.0060	0.088	0.0000052	0.079	0.000000031	2.3	0.00044	0.19	0.0000019	0.00000061	0.0000018	0.0035	0.0000029	0.000015	0.000031
22-Oct-14	14	27	400	325	0.00010	0.000012	0.00088	0.00000033	0.000093	0.026	0.000010	0.00016	0.00046	0.0000033	0.0075	0.095	0.0000070	0.083	0.000000033	2.3	0.00042	0.21	0.0000020	0.00000049	0.0000020	0.0033	0.0000036	0.000016	0.000033
5-Nov-14	15	29	400	325	0.000087	0.000017	0.00078	0.0000011	0.000079	0.026	0.0000054	0.00016	0.00046	0.0000033	0.0062	0.085	0.0000057	0.084	0.000000049	2.1	0.00045	0.16	0.0000019	0.00000098	0.0000029	0.0031	0.0000033	0.000016	0.000033
19-Nov-14	16	31	400	315	0.000079	0.000022	0.00058	0.00000047	0.000088	0.028	0.000013	0.00016	0.00038	0.0000032	0.0059	0.089	0.0000043	0.090	0.000000032	2.1	0.00050	0.15	0.0000023	0.00000095	0.0000027	0.0029	0.0000027	0.000016	0.000032
3-Dec-14	17	33	400	285	0.000062	0.00028	0.00048	0.00000029	0.000070	0.023	0.0000077	0.00014	0.00030	0.0000043	0.0048	0.076	0.0000038	0.074	0.000000029	1.6	0.00045	0.13	0.0000018	0.00000057	0.0000021	0.0022	0.0000026	0.000043	0.000029
17-Dec-14	18	35	400	365	0.000073	0.000023	0.00055	0.00000018	0.000091	0.032	0.000013	0.00018	0.00035	0.0000037	0.0062	0.11	0.0000055	0.095	0.000000037	2.0	0.00055	0.15	0.0000022	0.00000055	0.0000029	0.0027	0.0000035	0.000018	0.000037
31-Dec-14	19	37	400	335	0.000060	0.000021	0.00052	0.0000020	0.000085	0.028	0.0000090	0.00017	0.00031	0.0000050	0.0055	0.091	0.0000047	0.093	0.000000034	1.7	0.00050	0.13	0.0000020	0.0000023	0.0000027	0.0026	0.0000034	0.000017	0.000034
14-Jan-15	20	39	400	325	0.000054	0.000011	0.00046	0.0000091	0.000083	0.030	0.000010	0.00016	0.00029	0.0000033	0.0050	0.094	0.0000041	0.093	0.000000033	1.6	0.00052	0.11	0.0000020	0.0000015	0.0000031	0.0020	0.0000029	0.000016	0.000033
28-Jan-15	21	41	400	340	0.000047	0.000010	0.00043	0.00000017	0.000083	0.037	0.0000094	0.00017	0.00031	0.0000034	0.0046	0.11	0.0000060	0.091	0.000000051	1.8	0.00049	0.12	0.0000020	0.0000054	0.0000031	0.0022	0.0000036	0.000017	0.000034
11-Feb-15	22	43	400	325	0.000045	0.0000072	0.00075	0.00000016	0.000096	0.034	0.0000098	0.00016	0.00024	0.0000033	0.0043	0.100	0.000016	0.088	0.000000033	1.4	0.00063	0.11	0.0000019	0.0000031	0.0000020	0.0017	0.0000029	0.000016	0.000033
25-Feb-15	23	45	400	320	0.000043	0.000013	0.00026	0.00000016	0.00010	0.038	0.0000045	0.00016	0.00020	0.0000016	0.0032	0.11	0.000016	0.088	0.000000032	1.3	0.00072	0.096	0.0000022	0.0000024	0.00000080	0.0016	0.0000018	0.000016	0.000032
11-Mar-15	24	47	400	315	0.000040	0.000013	0.00027	0.00000016	0.00010	0.043	0.0000050	0.00016	0.00019	0.0000032	0.0026	0.10	0.000016	0.075	0.000000063	1.1	0.00080	0.096	0.0000020	0.0000013	0.00000079	0.0015	0.0000020	0.000016	0.000032
25-Mar-15	25	49	400	325	0.000044	0.000040	0.00028	0.00000081	0.00010	0.056	0.0000068	0.00016	0.00022	0.0000033	0.0027	0.13	0.000016	0.098	0.000000049	1.2	0.00099	0.099	0.0000026	0.000019	0.0000020	0.0014	0.0000023	0.000016	0.000033
8-Apr-15	26	51	400	350	0.000035	0.000016	0.00021	0.00000018	0.00012	0.057	0.000011	0.00018	0.00017	0.0000018	0.0026	0.14	0.000018	0.11	0.000000035	0.98	0.0011	0.089	0.0000025	0.0000025	0.0000016	0.0013	0.0000018	0.000018	0.000035
22-Apr-15	27	53	400	320	0.000031	0.0000094	0.00019	0.0000058	0.00010	0.066	0.000012	0.00016	0.00018	0.0000016	0.0023	0.14	0.0000027	0.086	0.00000074	0.86	0.0012	0.085	0.0000027	0.0000013	0.0000011	0.0011	0.0000019	0.000016	0.000032
6-May-15	28	55	400	325	0.000028	0.000015	0.00021	0.00000049	0.00011	0.069	0.000015	0.00033	0.00015	0.0000016	0.0017	0.14	0.000016	0.094	0.00000094	0.75	0.0012	0.080	0.0000026	0.00000033	0.0000013	0.0011	0.0000023	0.000016	0.000033
20-May-15	29	57	500	445																									
3-Jun-15	30	59	445	380	0.000015	0.000036	0.00017	0.00000067	0.000065	0.050	0.0000062	0.000095	0.00012	0.00000095	0.00087	0.090	0.0000016	0.052	0.00000011	0.31	0.00089	0.041	0.0000015	0.0000015	0.00000076	0.00061	0.0000011	0.0000095	0.000019
17-Jun-15	31	61	500	445																									
1-Jul-15	32	63	445	385	0.000015	0.0000048	0.00011	0.000000096	0.000066	0.062	0.0000080	0.00019	0.000064	0.00000096	0.00086	0.092	0.0000015	0.055	0.00000019	0.25	0.0011	0.036	0.0000018	0.00000067	0.00000067	0.00060	0.00000096	0.0000096	0.000019
15-Jul-15	33	65	500	425																									
29-Jul-15	34	67	425	355	0.000013	0.0000062	0.000098	0.000000089	0.000064	0.067	0.000016	0.000089	0.000059	0.00000089	0.00065	0.088	0.00000098	0.050	0.000000080	0.19	0.0013	0.032	0.0000018	0.00000044	0.00000044	0.00056	0.0000012	0.0000089	0.000018
12-Aug-15	35	69	500	455																									
26-Aug-15	36	71	455	375	0.000013	0.000017	0.000075	0.00000056	0.000067	0.082	0.0000085	0.000094	0.000065	0.00000094	0.00051	0.099	0.0000030	0.054	0.0000025	0.17	0.0016	0.033	0.0000020	0.0000010	0.00000047	0.00048	0.0000010	0.0000094	0.000019
9-Sep-15	37	73	500	445																									
23-Sep-15	38	75	445	390																									
7-Oct-15	39	77	390	320	0.0000070	0.0000033	0.000043	0.00000011	0.000040	0.064	0.0000052	0.000053	0.000022	0.0000011	0.00030	0.061	0.00000064	0.028	0.000000037	0.092	0.0011	0.020	0.0000011	0.00000085	0.00000059	0.00028	0.00000069	0.0000053	0.000011
21-Oct-15	40	79	500	450																									
4-Nov-15	41	81	450	425																									
18-Nov-15	42	83	425	360	0.0000086	0.0000047	0.000084	0.000000060	0.000037	0.069	0.000017	0.000060	0.000029	0.00000060	0.00034	0.063	0.0000013	0.033	0.000000042	0.085	0.0011	0.021	0.00000092	0.00000042	0.00000042	0.00027	0.00000048	0.0000060	0.000012
2-Dec-15	43	85	500	450																									
16-Dec-15	44	87	450	400																									
30-Dec-15	45	89	400	360	0.0000073	0.0000028	0.00010	0.00000012	0.000033	0.065	0.0000025	0.000060	0.000034	0.00000060	0.00034	0.056	0.00000090	0.032	0.000000054	0.077	0.00088	0.020	0.00000071	0.00000024	0.0000019	0.00029	0.00000042	0.0000060	0.000012
6-Jan-16	46	90	400	340	0.000043	0.000034	0.00034	0.00000034	0.00020	0.38	0.000043	0.00034	0.00019	0.0000034	0.0021	0.34	0.000041	0.19	0.00000041	0.44	0.0056	0.11	0.0000036	0.0000092	0.0000017	0.0016	0.0000031	0.000034	0.000068
20-Jan-16	47	92	400	355	0.000026	0.0000066	0.00018	0.0000011	0.00010	0.17	0.000019	0.00018	0.00011	0.0000036	0.0011	0.16	0.0000027	0.10	0.00000021	0.20	0.0030	0.064	0.0000051	0.00000089	0.00000089	0.00093	0.0000012	0.000036	0.000036
3-Feb-16	48	94	400	350	0.000024	0.000018	0.00021	0.00000035	0.000093	0.15	0.000011	0.00018	0.000099	0.0000018	0.0012	0.15	0.0000051	0.094	0.00000039	0.18	0.0027	0.065	0.0000023	0.0000016	0.00000088	0.00090	0.0000011	0.000018	0.000035
17-Feb-16	49	96	400	330	0.000025	0.000013	0.00013	0.00000050	0.000088	0.15	0.000015	0.00017	0.000099	0.0000033	0.0011	0.15	0.0000015	0.092	0.000000033	0.18	0.0024	0.056	0.0000020	0.0000020	0.00000083	0.00084	0.0000013	0.000017	0.000033
2-Mar-16	50	98	400	350	0.000025	0.0000068	0.00014	0.00000053	0.000094	0.16	0.000029	0.00018	0.00011	0.0000018	0.0012	0.15	0.0000014	0.096	0.000000070	0.17	0.0025	0.068	0.0000021	0.00000035	0.00000088	0.00091	0.00000070	0.000018	0.000035

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 2 (LT1, Sample 'B')

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
23-Apr-14	1	1	2355	590	8.5	475	598	14	0.50	< 10	< 5	5.2	1.8	12	130	0.80	206	0.027	0.056	0.087	0.080	< 7E-06	< 7E-06	0.082	< 4E-06	63	0.13
7-May-14	2	3	450	340	8.5	424	374	6.7	0.24	< 5	< 3	1.9	2.4	5.9	46	< 0.3	61	0.013	0.079	1.8	0.028	0.000022	< 7E-06	0.054	0.00037	17	0.065
21-May-14	3	5	550	380	8.7	415	291	3.6	0.080	< 2	< 1	1.0	1.0	2.3	18	< 0.3	45	0.28	0.059	1.8	0.019	0.000046	0.00027	0.033	< 3E-06	13	0.031
4-Jun-14	4	7	450	350	8.6	422	274	1.8	0.050	< 2	< 1	1.0	0.50	1.1	7.7	< 0.3	41	0.0097	0.052	2.1	0.016	< 7E-06	< 7E-06	0.021	< 3E-06	12	0.020
18-Jun-14	5	9	450	325	8.6	447	204	1.5	0.030	< 2	< 1	0.70	0.56	0.28	4.6	< 0.3	36	0.017	0.053	2.4	0.016	< 7E-06	< 7E-06	0.025	< 3E-06	10	0.017
2-Jul-14	6	11	450	350	8.6	485	179	1.3	0.040	< 2	< 1	0.80	0.16	0.28	2.5	< 0.3	34	0.012	0.054	2.5	0.014	< 7E-06	< 7E-06	0.019	0.000029	9.4	0.011
16-Jul-14	7	13	450	295	8.6	464	132	0.95	0.020	< 2	< 1	1.0	0.11	0.18	1.6	< 0.3	32	0.0084	0.054	2.6	0.014	0.0000070	0.0000070	0.021	< 3E-06	9.0	0.010
30-Jul-14	8	15	450	340	8.6	504	119	0.84	0.030	< 2	< 1	0.80	0.070	0.12	1.1	< 0.3	28	0.022	0.054	2.7	0.013	< 7E-06	< 7E-06	0.023	< 3E-06	7.9	0.0088
13-Aug-14	9	17	450	350	8.6	448	107	0.98	0.030	< 2	< 1	0.70	< 0.06	0.090	0.80	< 0.3	27	0.012	0.053	2.5	0.013	< 7E-06	< 7E-06	0.023	< 3E-06	7.5	0.0066
27-Aug-14	10	19	450	350	8.6	439	89	0.50	0.020	-	-	0.60	< 0.06	0.070	0.70	< 0.3	27	0.016	0.048	2.5	0.012	< 7E-06	< 7E-06	0.031	0.000015	7.5	0.0056
10-Sep-14	11	21	450	340	8.6	437	70	0.51	0.030	-	-	0.50	< 0.06	0.060	0.50	< 0.3	25	0.012	0.045	2.7	0.012	< 7E-06	< 7E-06	0.026	0.000022	6.9	0.0049
24-Sep-14	12	23	450	305	8.6	442	65	0.49	0.020	-	-	0.50	< 0.06	0.070	< 1	< 0.3	24	0.0073	0.051	2.5	0.012	< 7E-06	< 7E-06	0.021	< 3E-06	6.6	0.0043
8-Oct-14	13	25	450	350	8.6	381	64	0.55	0.020	-	-	0.80	< 0.06	0.050	< 1	< 0.3	24	0.013	0.045	2.7	0.013	< 7E-06	< 7E-06	0.020	0.000017	6.7	0.0041
22-Oct-14	14	27	450	345	8.6	409	57	0.40	0.020	-	-	0.60	< 0.06	0.050	< 1	< 0.3	25	0.011	0.047	2.8	0.013	< 7E-06	< 7E-06	0.029	0.000033	6.8	0.0041
5-Nov-14	15	29	450	335	-	405	53	0.34	0.010	-	-	0.40	< 0.06	0.040	< 1	< 0.3	22	0.012	0.044	2.6	0.012	< 7E-06	< 7E-06	0.022	0.000015	5.9	0.0035
19-Nov-14	16	31	450	340	8.5	397	46	0.33	0.020	-	-	0.50	< 0.06	0.060	< 1	< 0.3	23	0.0072	0.043	2.6	0.014	< 7E-06	< 7E-06	0.024	0.000019	6.2	0.0034
3-Dec-14	17	33	450	350	8.6	377	42	0.28	< 0.01	-	-	0.40	< 0.06	0.050	< 1	< 0.3	23	0.0099	0.044	2.7	0.014	< 7E-06	< 7E-06	0.021	0.000014	6.4	0.0032
17-Dec-14	18	35	450	335	8.6	368	41	0.31	< 0.01	-	-	0.60	< 0.06	0.10	< 1	< 0.3	21	0.0077	0.046	2.6	0.013	< 7E-06	< 7E-06	0.022	0.000014	5.5	0.0030
31-Dec-14	19	37	650	355	8.5	431	36	0.21	0.020	-	-	0.50	< 0.06	0.070	< 1	< 0.3	21	0.014	0.046	2.6	0.014	< 7E-06	< 7E-06	0.021	0.000014	5.5	0.0029
14-Jan-15	20	39	450	335	8.5	319	31	0.14	0.020	-	-	0.50	< 0.06	0.050	< 1	< 0.3	19	0.012	0.047	2.5	0.014	< 7E-06	< 7E-06	0.021	0.000016	5.2	0.0027
28-Jan-15	21	41	450	335	8.5	333	34	0.16	< 0.01	-	-	0.40	< 0.06	0.060	1.0	< 0.3	22	0.013	0.038	2.3	0.015	< 7E-06	0.000021	0.018	0.000011	5.9	0.0026
11-Feb-15	22	43	450	335	8.5	325	33	0.14	< 0.01	-	-	0.40	< 0.06	0.080	1.0	< 0.3	21	0.0093	0.044	2.2	0.016	< 7E-06	< 7E-06	0.023	0.000010	5.6	0.0023
25-Feb-15	23	45	450	345	8.5	340	30	0.12	0.010	-	-	0.40	< 0.06	0.14	< 1	< 0.3	23	0.0080	0.039	1.9	0.017	< 7E-06	< 7E-06	0.023	0.000014	6.3	0.0023
11-Mar-15	24	47	450	330	8.5	337	31	0.12	0.010	-	-	0.40	< 0.06	0.16	< 1	< 0.3	23	0.0086	0.041	2.0	0.016	< 7E-06	< 7E-06	0.020	0.000013	6.2	0.0023
25-Mar-15	25	49	450	355	8.4	309	23	0.11	0.010	-	-	0.40	0.060	0.23	< 1	< 0.3	23	0.011	0.041	2.1	0.017	< 7E-06	< 7E-06	0.020	0.000011	6.1	0.0025
8-Apr-15	26	51	450	370	8.4	310	24	0.11	< 0.01	-	-	0.30	0.21	0.27	< 1	< 0.3	22	0.0075	0.047	2.1	0.018	< 7E-06	0.000010	0.020	< 3E-06	6.1	0.0021
22-Apr-15	27	53	450	330	8.4	303	27	0.10	0.020	-	-	0.50	0.58	0.19	< 1	< 0.3	23	0.0067	0.042	1.9	0.015	< 7E-06	< 7E-06	0.021	0.000038	6.1	0.0021
6-May-15	28	55	450	325	8.4	289	20	0.080	< 0.01	-	-	0.20	1.1	0.060	< 1	< 0.3	22	0.0093	0.039	1.7	0.018	< 7E-06	< 7E-06	0.021	0.0000030	5.8	0.0018
20-May-15	29	57	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	30	59	410	300	8.4	248	17	0.070	0.070	-	-	0.40	2.8	< 0.01	< 1	< 0.3	29	0.0086	0.029	1.4	0.023	< 7E-06	< 7E-06	0.025	0.0000070	8.1	0.0016
17-Jun-15	31	61	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	32	63	410	310	8.3	226	16	0.070	0.010	-	-	0.40	7.9	< 0.03	< 1	< 0.3	27	0.010	0.028	1.4	0.024	< 7E-06	< 7E-06	0.021	0.0000060	7.2	0.0015
15-Jul-15	33	65	500	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	34	67	385	300	8.3	202	14	0.040	0.040	-	-	0.50	17	0.040	< 1	< 0.3	34	0.0057	0.023	1.00	0.027	< 7E-06	< 7E-06	0.021	0.000011	9.5	0.0013
12-Aug-15	35	69	500	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	36	71	385	285	8.3	176	12	0.040	0.010	-	-	0.60	24	0.050	< 1	< 0.3	45	0.0060	0.020	0.74	0.039	< 7E-06	< 7E-06	0.022	0.000015	12	0.0012
9-Sep-15	37	73	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	38	75	495	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	39	77	410	310	8.1	154	11	0.030	< 0.01	-	-	0.20	26	0.030	-	-	66	0.0048	0.019	0.48	0.047	< 7E-06	< 7E-06	0.019	0.0000030	18	0.00097
21-Oct-15	40	79	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	41	81	410	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	42	83	335	255	8.0	160	10	0.020	0.010	-	-	< 0.1	26	< 0.03	-	-	88	0.0041	0.014	0.44	0.047	< 7E-06	< 7E-06	0.016	< 3E-06	23	0.0011
2-Dec-15	43	85	500	415	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	44	87	415	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	45	89	345	285	8.3	135	10	0.030	< 0.01	-	-	< 0.1	22	< 0.03	-	-	98	0.0048	0.014	0.33	0.058	< 7E-06	< 7E-06	0.019	0.0000040	26	0.00096
6-Jan-16	46	90	400	310	8.3	134	12	0.020	< 0.01	-	-	< 0.1	21	< 0.03	-	-	105	0.0053	0.014	0.36	0.064	< 7E-06	< 7E-06	0.018	0.000037	28	0.0011
20-Jan-16	47	92	400	305	8.3	132	9.0	0.020	0.020	-	-	< 0.1	20	< 0.03	-	-	105	0.0040	0.016	0.41	0.066	< 7E-06	< 7E-06	0.019	< 3E-06	28	0.0012
3-Feb-16	48	94	400	285	8.3	133	12	0.020	< 0.01	-	-	< 0.1	18	< 0.03	-	-	97	0.0053	0.014	0.43	0.063	< 7E-06	< 7E-06	0.016	< 3E-06	26	0.0011
17-Feb-16	49	96	400	300	8.2	139	12	0.030	0.040	-	-	< 0.1	14	< 0.03	-	-	99	0.0037	0.014	0.43	0.061	< 7E-06	< 7E-06	0.017	0.000022	27	0.0013
2-Mar-16	50	98	400	320	8.3	142	14	0.030	< 0.01	-	-	0.10	11	< 0.03	-	-	93	0.0020	0.015	0.51	0.057	< 7E-06	< 7E-06	0.016	0.0000030	24	0.0013

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 2 (LT1, Sample 'B')

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
23-Apr-14	1	1	2355	590	0.50	0.024	5.3	0.00083	0.019	12	0.011	7.9	0.20	0.40	0.40	35	0.00070	5.6	0.0082	721	0.26	279	0.00072	0.00023	0.00088	1.4	< 1E-05	0.0080	< 0.002
7-May-14	2	3	450	340	0.27	0.011	2.5	0.00032	0.0090	4.5	0.011	1.2	0.28	0.12	0.42	18	0.0059	6.1	< 2E-06	424	0.083	179	0.00037	0.000060	0.0016	1.2	< 1E-05	0.0040	< 0.002
21-May-14	3	5	550	380	0.15	0.0064	1.4	0.00050	0.0068	3.2	0.0067	0.30	0.19	0.021	0.38	12	0.0031	5.0	0.000066	347	0.059	112	0.00025	0.00027	0.00094	0.82	0.00014	0.0020	< 0.002
4-Jun-14	4	7	450	350	0.079	0.0095	0.89	0.000030	0.0063	2.8	0.0049	0.13	0.15	0.0020	0.42	11	0.0022	5.4	0.0000050	314	0.052	90	0.00022	0.00011	0.00062	0.68	< 1E-05	0.0030	< 0.002
18-Jun-14	5	9	450	325	0.075	0.039	0.66	0.000070	0.0065	2.6	0.0038	0.090	0.18	0.0013	0.42	11	0.0019	5.4	< 2E-06	285	0.047	75	0.00022	< 1E-05	0.00043	0.84	< 1E-05	0.0030	< 0.002
2-Jul-14	6	11	450	350	0.045	0.0036	0.46	0.000030	0.0059	2.5	0.0031	0.070	0.11	0.0011	0.45	10	0.0015	5.5	< 2E-06	264	0.044	63	0.00019	0.00016	0.00055	0.62	< 1E-05	0.0010	< 0.002
16-Jul-14	7	13	450	295	0.040	0.0031	0.39	0.000020	0.0059	2.3	0.0039	0.060	0.12	0.0011	0.47	9.8	0.0013	5.1	0.0000030	254	0.041	51	0.00019	0.00012	0.00048	0.56	0.00015	< 0.001	< 0.002
30-Jul-14	8	15	450	340	0.030	0.0040	0.30	0.000020	0.0064	2.1	0.0025	0.030	0.11	0.00090	0.48	9.0	0.0013	5.1	< 2E-06	238	0.037	42	0.00018	< 1E-05	0.0010	0.50	0.00037	< 0.001	< 0.002
13-Aug-14	9	17	450	350	0.024	0.0023	0.20	0.000020	0.0059	2.0	0.0026	< 0.01	0.089	0.00070	0.48	8.2	0.0015	5.2	< 2E-06	243	0.035	36	0.00016	0.000040	0.00048	0.48	0.000080	< 0.001	< 0.002
27-Aug-14	10	19	450	350	0.022	0.0024	0.20	0.000050	0.0054	2.0	0.0018	< 0.01	0.086	0.00050	0.48	8.7	0.00085	5.5	0.0000020	223	0.035	32	0.00016	0.00038	0.000070	0.45	0.00027	< 0.001	< 0.002
10-Sep-14	11	21	450	340	0.018	0.0014	0.19	< 1E-05	0.0051	1.8	0.00089	0.020	0.077	0.00050	0.49	6.6	0.0011	6.2	< 2E-06	216	0.034	29	0.00015	0.00015	0.000090	0.39	0.00023	< 0.001	< 0.002
24-Sep-14	12	23	450	305	0.015	0.0018	0.092	0.000060	0.0055	1.8	0.0010	0.020	0.071	0.00060	0.46	8.2	0.00089	5.1	0.0000040	219	0.031	23	0.00016	0.000080	0.00045	0.37	0.00021	0.0030	< 0.002
8-Oct-14	13	25	450	350	0.015	0.0019	0.14	0.000040	0.0061	1.8	0.00066	0.030	0.066	0.00040	0.48	6.4	0.00080	5.2	< 2E-06	210	0.033	21	0.00014	0.000080	0.00020	0.35	0.00022	< 0.001	< 0.002
22-Oct-14	14	27	450	345	0.014	0.0011	0.14	0.000020	0.0059	2.0	0.00072	< 0.01	0.062	0.00040	0.57	6.8	0.00077	5.3	< 2E-06	217	0.033	23	0.00014	0.000030	0.00014	0.35	0.00027	< 0.001	< 0.002
5-Nov-14	15	29	450	335	0.012	0.0014	0.12	0.000050	0.0053	1.8	0.00044	0.040	0.058	0.00040	0.47	5.8	0.00074	5.4	< 2E-06	199	0.031	18	0.00014	0.000050	0.00016	0.33	0.00020	< 0.001	< 0.002
19-Nov-14	16	31	450	340	0.011	0.0013	0.097	< 1E-05	0.0060	1.9	0.00073	< 0.01	0.054	0.00030	0.47	6.0	0.00062	5.8	< 2E-06	206	0.034	16	0.00016	0.000040	0.00011	0.32	0.00019	< 0.001	< 0.002
3-Dec-14	17	33	450	350	0.0099	0.0017	0.093	< 1E-05	0.0049	1.7	0.00046	< 0.01	0.050	0.00030	0.47	5.7	0.00070	5.2	< 2E-06	181	0.033	16	0.00014	0.000040	0.00014	0.30	0.00021	0.0010	< 0.002
17-Dec-14	18	35	450	335	0.0094	0.0013	0.079	< 1E-05	0.0056	1.8	0.00056	0.010	0.045	0.00030	0.45	6.4	0.00060	5.2	< 2E-06	182	0.031	14	0.00013	0.000040	0.00014	0.28	0.00019	< 0.001	< 0.002
31-Dec-14	19	37	650	355	0.0087	0.0011	0.084	0.000030	0.0055	1.8	0.00058	< 0.01	0.046	0.00030	0.49	5.9	0.00065	5.7	0.0000020	176	0.031	14	0.00013	0.000090	0.00013	0.28	0.00023	< 0.001	< 0.002
14-Jan-15	20	39	450	335	0.0073	0.0011	0.070	0.000020	0.0048	1.5	0.00073	< 0.01	0.042	0.00030	0.47	5.4	0.00064	5.6	0.0000030	152	0.026	11	0.00013	0.000040	0.00015	0.23	0.00022	< 0.001	< 0.002
28-Jan-15	21	41	450	335	0.0057	0.0013	0.066	< 1E-05	0.0044	1.8	0.00063	< 0.01	0.040	0.00020	0.42	5.8	0.0012	4.8	0.0000020	172	0.024	11	0.00012	0.00022	0.00015	0.22	0.00025	< 0.001	< 0.002
11-Feb-15	22	43	450	335	0.0059	0.0010	0.053	0.000020	0.0053	1.6	0.00053	0.020	0.032	0.00020	0.42	5.5	< 0.001	5.2	0.0000020	149	0.031	10	0.00013	0.00087	0.000090	0.20	0.00022	< 0.001	< 0.002
25-Feb-15	23	45	450	345	0.0062	0.00088	0.053	0.000030	0.0057	1.8	0.00048	< 0.01	0.030	0.00020	0.37	6.2	< 0.001	5.4	< 2E-06	148	0.033	9.4	0.00014	0.00012	0.00011	0.21	0.00016	< 0.001	< 0.002
11-Mar-15	24	47	450	330	0.0059	0.00099	0.048	0.000020	0.0058	1.7	0.00054	< 0.01	0.031	0.00020	0.34	5.6	< 0.001	4.7	0.00010	140	0.032	8.8	0.00012	0.000060	< 5E-05	0.20	0.00016	< 0.001	< 0.002
25-Mar-15	25	49	450	355	0.0063	0.0010	0.056	< 1E-05	0.0056	1.9	0.00062	< 0.01	0.034	0.00020	0.38	6.0	< 0.001	5.8	< 2E-06	159	0.034	9.2	0.00014	0.00052	0.00018	0.18	0.00024	< 0.001	< 0.002
8-Apr-15	26	51	450	370	0.0049	0.0012	0.039	< 1E-05	0.0056	1.7	0.00044	0.010	0.027	0.00020	0.38	5.8	< 0.001	6.1	< 2E-06	132	0.033	8.0	0.00013	0.00018	0.000060	0.17	0.00016	< 0.001	< 0.002
22-Apr-15	27	53	450	330	0.0047	0.0012	0.035	0.00022	0.0050	1.8	0.00050	0.020	0.027	0.00020	0.34	6.2	0.00032	5.3	0.000044	138	0.034	7.8	0.00011	0.00011	0.00014	0.14	0.00022	< 0.001	< 0.002
6-May-15	28	55	450	325	0.0040	0.0015	0.032	0.000020	0.0055	1.7	0.00070	0.010	0.024	0.00020	0.31	6.0	< 0.001	5.5	0.000052	123	0.032	7.3	0.00013	< 1E-05	0.00011	0.15	0.00019	< 0.001	< 0.002
20-May-15	29	57	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	30	59	410	300	0.0034	0.0013	0.024	0.000050	0.0059	2.2	0.00074	< 0.01	0.020	0.00010	0.28	6.4	0.00040	5.6	0.000014	102	0.040	6.3	0.00013	0.000050	0.00011	0.12	0.00018	< 0.001	< 0.002
17-Jun-15	31	61	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	32	63	410	310	0.0031	0.0017	0.022	< 1E-05	0.0064	2.1	0.0012	0.020	0.016	0.00020	0.24	6.0	0.00030	5.6	0.000026	105	0.041	5.1	0.00015	0.00032	0.000090	0.11	0.00017	< 0.001	< 0.002
15-Jul-15	33	65	500	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	34	67	385	300	0.0026	0.00072	0.016	0.000020	0.0076	2.6	0.00047	< 0.01	0.014	0.00010	0.19	6.7	0.00021	5.3	0.000011	101	0.051	4.7	0.00016	0.00012	< 5E-05	0.093	0.00016	< 0.001	< 0.002
12-Aug-15	35	69	500	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	36	71	385	285	0.0022	0.0013	0.011	0.000040	0.0082	3.4	0.0010	0.010	0.028	0.00010	0.14	7.6	0.00025	5.8	0.00012	96	0.066	4.1	0.00019	0.00012	< 5E-05	0.070	0.00013	< 0.001	< 0.002
9-Sep-15	37	73	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	38	75	495	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	39	77	410	310	0.0018	0.00085	0.0080	0.000020	0.0085	5.2	0.00061	< 0.01	0.0064	0.00020	0.10	8.3	0.00017	5.5	0.0000050	77	0.095	3.9	0.00018	0.00016	0.00010	0.057	0.000090	< 0.001	< 0.002
21-Oct-15	40	79	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	41	81	410	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	42	83	335	255	0.0020	0.0016	0.020	0.000090	0.0090	7.3	0.0017	< 0.01	0.0072	< 0.0001	0.089	9.3	0.00027	5.7	0.0000030	67	0.12	4.1	0.00015	0.00015	< 5E-05	0.047	0.00010	0.0010	< 0.002
2-Dec-15	43	85	500	415	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	44	87	415	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	45	89	345	285	0.0017	0.00062	0.013	0.000020	0.0083	8.1	0.0017	< 0.01	0.0067	0.00010	0.092	9.3	0.00019	5.6	0.0000070	56	0.11	4.3	0.00014	0.000030	< 5E-05	0.060	0.000070	< 0.001	< 0.002
6-Jan-16	46	90	400	310	0.0019	0.0014	0.011	0.000090	0.0086	8.7	0.0024	< 0.01	0.0066	0.00010	0.091	10	0.00070	6.0	0.000012	57	0.13	4.5	0.00014	0.00033	< 5E-05	0.058	0.000090	< 0.001	< 0.002
20-Jan-16	47	92	400	305	0.0021	0.00064	0.011	0.000040	0.0088	8.3	0.0022	< 0.01	0.0077	0.00020	0.088	9.5	0.00030	6.3	0.000016	51	0.15	4.5	0.00022	0.000050	< 5E-05	0.069	0.00016	0.0010	< 0.002
3-Feb-16	48	94	400	285	0.0022	0.0017	0.012	0.000050	0.0085	7.9	0.0017	< 0.01	0.0075	0.00020	0.088	9.7	0.00034	5.5	0.000019	49	0.14	4.8	0.00017	0.00011	< 5E-05	0.066	0.00010	< 0.001	< 0.002
17-Feb-16	49	96	400	300	0.0023	0.00091	0.010	0.00011	0.0080	7.9	0.0020	< 0.01	0.0079	0.00020	0.099	9.1	0.00016	5.8	< 2E-06	46	0.13	4.6	0.00016	0.000090	< 5E-05	0.069	0.000090	0.0020	< 0.002
2-Mar-16	50	98	400	320	0.0025	0.00042	0.011	0.000090	0.0082	7.9	0.0059	< 0.01	0.0086	0.00020	0.10	9.2	0.00022	6.0	0.0000030	47	0.13	5.5	0.00016	0.000030	< 5E-05	0.072	0.000050	0.0010	< 0.002

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
23-Apr-14	1	1	2355	590	8.5	14	18	0.40	0.015	0.30	0.15	0.15	0.054	0.35	3.8	0.024	6.1	0.00080	0.0016	0.0026	0.0024	0.00000021	0.00000021	0.0024	0.00000012	1.8	0.0038
7-May-14	2	3	450	340	8.5	3.6	3.2	0.057	0.0020	0.043	0.026	0.016	0.021	0.050	0.39	0.0026	0.52	0.00011	0.00067	0.015	0.00024	0.00000019	0.000000060	0.00046	0.0000032	0.15	0.00055
21-May-14	3	5	550	380	8.7	3.9	2.8	0.034	0.00076	0.019	0.0095	0.0095	0.0095	0.022	0.17	0.0029	0.42	0.0026	0.00056	0.017	0.00018	0.00000044	0.0000026	0.00031	0.000000029	0.12	0.00030
4-Jun-14	4	7	450	350	8.6	3.7	2.4	0.016	0.00044	0.018	0.0088	0.0088	0.0044	0.0096	0.067	0.0026	0.35	0.000085	0.00046	0.018	0.00014	0.000000061	0.000000061	0.00018	0.000000026	0.10	0.00017
18-Jun-14	5	9	450	325	8.6	3.6	1.7	0.012	0.00024	0.016	0.0081	0.0057	0.0046	0.0023	0.037	0.0024	0.29	0.00014	0.00043	0.020	0.00013	0.000000057	0.000000057	0.00020	0.000000024	0.082	0.00014
2-Jul-14	6	11	450	350	8.6	4.2	1.6	0.012	0.00035	0.018	0.0088	0.0070	0.0014	0.0025	0.022	0.0026	0.29	0.00010	0.00047	0.022	0.00012	0.000000061	0.000000061	0.00017	0.00000025	0.082	0.000096
16-Jul-14	7	13	450	295	8.6	3.4	0.97	0.0070	0.00015	0.015	0.0074	0.0074	0.00081	0.0013	0.012	0.0022	0.24	0.000062	0.00040	0.019	0.00010	0.000000052	0.000000052	0.00015	0.000000022	0.066	0.000075
30-Jul-14	8	15	450	340	8.6	4.3	1.0	0.0071	0.00026	0.017	0.0085	0.0068	0.00060	0.0010	0.0094	0.0026	0.24	0.00019	0.00046	0.023	0.00011	0.000000060	0.000000060	0.00019	0.000000026	0.067	0.000075
13-Aug-14	9	17	450	350	8.6	3.9	0.94	0.0086	0.00026	0.018	0.0088	0.0061	0.00053	0.00079	0.0070	0.0026	0.23	0.00011	0.00047	0.022	0.00012	0.000000061	0.000000061	0.00020	0.000000026	0.066	0.000058
27-Aug-14	10	19	450	350	8.6	3.8	0.78	0.0044	0.00018			0.0053	0.00053	0.00061	0.0061	0.0026	0.24	0.00014	0.00042	0.022	0.00010	0.000000061	0.000000061	0.00027	0.00000013	0.066	0.000049
10-Sep-14	11	21	450	340	8.6	3.7	0.60	0.0043	0.00026			0.0043	0.00051	0.00051	0.0043	0.0026	0.21	0.000099	0.00039	0.023	0.00010	0.000000060	0.000000060	0.00022	0.00000019	0.059	0.000042
24-Sep-14	12	23	450	305	8.6	3.4	0.50	0.0037	0.00015			0.0038	0.00046	0.00053	0.0076	0.0023	0.18	0.000056	0.00039	0.019	0.000093	0.000000053	0.000000053	0.00016	0.000000023	0.051	0.000033
8-Oct-14	13	25	450	350	8.6	3.3	0.56	0.0048	0.00018			0.0070	0.00053	0.00044	0.0088	0.0026	0.21	0.00012	0.00040	0.023	0.00011	0.000000061	0.000000061	0.00017	0.00000015	0.059	0.000036
22-Oct-14	14	27	450	345	8.6	3.5	0.49	0.0035	0.00017			0.0052	0.00052	0.00043	0.0086	0.0026	0.22	0.000098	0.00041	0.024	0.00011	0.000000060	0.000000060	0.00025	0.00000028	0.059	0.000035
5-Nov-14	15	29	450	335		3.4	0.44	0.0028	0.000084			0.0034	0.00050	0.00034	0.0084	0.0025	0.19	0.000100	0.00037	0.022	0.00010	0.000000059	0.000000059	0.00018	0.00000013	0.050	0.000029
19-Nov-14	16	31	450	340	8.5	3.4	0.39	0.0028	0.00017			0.0043	0.00051	0.00051	0.0085	0.0026	0.20	0.000061	0.00036	0.022	0.00012	0.000000060	0.000000060	0.00020	0.00000016	0.052	0.000029
3-Dec-14	17	33	450	350	8.6	3.3	0.37	0.0025	0.000088			0.0035	0.00053	0.00044	0.0088	0.0026	0.20	0.000087	0.00038	0.024	0.00013	0.000000061	0.000000061	0.00018	0.00000012	0.056	0.000028
17-Dec-14	18	35	450	335	8.6	3.1	0.34	0.0026	0.000084			0.0050	0.00050	0.00084	0.0084	0.0025	0.18	0.000064	0.00038	0.021	0.00011	0.000000059	0.000000059	0.00019	0.00000012	0.046	0.000025
31-Dec-14	19	37	650	355	8.5	3.8	0.32	0.0019	0.00018			0.0044	0.00053	0.00062	0.0089	0.0027	0.19	0.00012	0.00041	0.023	0.00013	0.000000062	0.000000062	0.00019	0.00000012	0.049	0.000026
14-Jan-15	20	39	450	335	8.5	2.7	0.26	0.0012	0.00017			0.0042	0.00050	0.00042	0.0084	0.0025	0.16	0.000096	0.00040	0.021	0.00011	0.000000059	0.000000059	0.00018	0.00000013	0.044	0.000022
28-Jan-15	21	41	450	335	8.5	2.8	0.28	0.0013	0.000084			0.0034	0.00050	0.00050	0.0084	0.0025	0.18	0.00011	0.00032	0.019	0.00013	0.000000059	0.00000018	0.00015	0.000000092	0.049	0.000022
11-Feb-15	22	43	450	335	8.5	2.7	0.28	0.0012	0.000084			0.0034	0.00050	0.00067	0.0084	0.0025	0.17	0.000078	0.00037	0.019	0.00013	0.000000059	0.000000059	0.00019	0.000000084	0.047	0.000019
25-Feb-15	23	45	450	345	8.5	2.9	0.26	0.0010	0.000086			0.0035	0.00052	0.0012	0.0086	0.0026	0.20	0.000069	0.00034	0.017	0.00014	0.000000060	0.000000060	0.00020	0.00000012	0.054	0.000020
11-Mar-15	24	47	450	330	8.5	2.8	0.26	0.00099	0.000083			0.0033	0.00050	0.0013	0.0083	0.0025	0.19	0.000071	0.00034	0.016	0.00013	0.000000058	0.000000058	0.00017	0.00000011	0.051	0.000019
25-Mar-15	25	49	450	355	8.4	2.7	0.20	0.00098	0.000089			0.0036	0.00053	0.0020	0.0089	0.0027	0.20	0.000099	0.00036	0.018	0.00015	0.000000062	0.000000062	0.00018	0.000000098	0.054	0.000023
8-Apr-15	26	51	450	370	8.4	2.9	0.22	0.0010	0.000093			0.0028	0.0019	0.0025	0.0093	0.0028	0.20	0.000069	0.00044	0.020	0.00016	0.000000065	0.000000093	0.00018	0.000000028	0.056	0.000019
22-Apr-15	27	53	450	330	8.4	2.5	0.22	0.00083	0.00017			0.0041	0.0048	0.0016	0.0083	0.0025	0.19	0.000055	0.00034	0.016	0.00012	0.000000058	0.000000058	0.00017	0.00000031	0.051	0.000018
6-May-15	28	55	450	325	8.4	2.3	0.16	0.00065	0.000081			0.0016	0.0092	0.00049	0.0081	0.0024	0.18	0.000076	0.00031	0.014	0.00015	0.000000057	0.000000057	0.00017	0.000000024	0.047	0.000014
20-May-15	29	57	500	410																							
3-Jun-15	30	59	410	300	8.4	1.9	0.13	0.00053	0.00053			0.0015	0.011	0.000038	0.0038	0.0011	0.11	0.000032	0.00011	0.0054	0.000084	0.000000026	0.000000026	0.000092	0.000000026	0.031	0.0000059
17-Jun-15	31	61	500	410																							
1-Jul-15	32	63	410	310	8.3	1.8	0.12	0.00054	0.000078			0.0016	0.031	0.00012	0.0039	0.0012	0.10	0.000040	0.00011	0.0052	0.000091	0.000000027	0.000000027	0.000079	0.000000023	0.028	0.0000057
15-Jul-15	33	65	500	385																							
29-Jul-15	34	67	385	300	8.3	1.5	0.11	0.00030	0.00030			0.0019	0.064	0.00015	0.0038	0.0011	0.13	0.000021	0.000087	0.0037	0.00010	0.000000026	0.000000026	0.000080	0.000000041	0.036	0.0000048
12-Aug-15	35	69	500	385																							
26-Aug-15	36	71	385	285	8.3	1.3	0.086	0.00029	0.000071			0.0021	0.087	0.00018	0.0036	0.0011	0.16	0.000021	0.000073	0.0026	0.00014	0.000000025	0.000000025	0.000077	0.000000053	0.044	0.0000043
9-Sep-15	37	73	500	495																							
23-Sep-15	38	75	495	410																							
7-Oct-15	39	77	410	310	8.1	1.2	0.085	0.00023	0.000078			0.00078	0.10	0.00012	0.00	0.00	0.25	0.000019	0.000072	0.0019	0.00018	0.000000027	0.000000027	0.000073	0.000000012	0.069	0.0000038
21-Oct-15	40	79	500	410																							
4-Nov-15	41	81	410	335																							
18-Nov-15	42	83	335	255	8.0	1.0	0.064	0.00013	0.000064			0.00032	0.082	0.000096	0.00	0.00	0.28	0.000013	0.000046	0.0014	0.00015	0.000000022	0.000000022	0.000051	0.0000000096	0.074	0.0000034
2-Dec-15	43	85	500	415																							
16-Dec-15	44	87	415	345																							
30-Dec-15	45	89	345	285	8.3	0.96	0.071	0.00021	0.000071			0.00036	0.079	0.00011	0.00	0.00	0.35	0.000017	0.000048	0.0012	0.00021	0.000000025	0.000000025	0.000066	0.000000014	0.092	0.0000034
6-Jan-16	46	90	400	310	8.3	1.0	0.093	0.00016	0.000078			0.00039	0.081	0.00012	0.00	0.00	0.41	0.000021	0.000053	0.0014	0.00025	0.000000027	0.000000027	0.000070	0.00000014	0.11	0.0000041
20-Jan-16	47	92	400	305	8.3	1.0	0.069	0.00015	0.00015			0.00038	0.075	0.00011	0.00	0.00	0.40	0.000015	0.000059	0.0016	0.00025	0.000000027	0.000000027	0.000072	0.0000000011	0.11	0.0000044
3-Feb-16	48	94	400	285	8.3	0.95	0.086	0.00014	0.000071			0.00036	0.062	0.00011	0.00	0.00	0.35	0.000019	0.000051	0.0015	0.00023	0.000000025	0.000000025	0.000057	0.0000000011	0.093	0.0000040
17-Feb-16	49	96	400	300	8.2	1.0	0.090	0.00023	0.00030			0.00038	0.053	0.00011	0.00	0.00	0.37	0.000014	0.000054	0.0016	0.00023	0.000000026	0.000000026	0.000064	0.000000083	0.10	0.0000047
2-Mar-16	50	98	400	320	8.3	1.1	0.11	0.00024	0.000080			0.00040	0.043	0.00012	0.00	0.00	0.37	0.0000080	0.000061	0.0020	0.00023	0.000000028	0.000000028	0.000064	0.000000012	0.097	0.0000054

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
23-Apr-14	1	1	2355	590	0.015	0.00070	0.16	0.000024	0.00056	0.35	0.00032	0.23	0.0060	0.012	0.012	1.0	0.000021	0.17	0.00024	21	0.0077	8.2	0.000021	0.0000068	0.000026	0.040	0.00000030	0.00024	0.000059
7-May-14	2	3	450	340	0.0023	0.000090	0.022	0.0000027	0.000076	0.038	0.000094	0.011	0.0024	0.0010	0.0036	0.15	0.000050	0.052	0.000000017	3.6	0.00070	1.5	0.0000031	0.00000051	0.000013	0.010	0.000000085	0.000034	0.000017
21-May-14	3	5	550	380	0.0015	0.000061	0.013	0.0000048	0.000064	0.030	0.000064	0.0029	0.0018	0.00020	0.0036	0.11	0.000029	0.048	0.00000063	3.3	0.00056	1.1	0.0000024	0.0000026	0.0000089	0.0078	0.0000013	0.000019	0.000019
4-Jun-14	4	7	450	350	0.00069	0.000083	0.0078	0.00000026	0.000055	0.025	0.000043	0.0011	0.0013	0.000018	0.0037	0.100	0.000020	0.048	0.000000044	2.7	0.00046	0.79	0.0000020	0.00000096	0.0000054	0.0060	0.000000088	0.000026	0.000018
18-Jun-14	5	9	450	325	0.00061	0.00032	0.0054	0.00000057	0.000053	0.021	0.000031	0.00073	0.0014	0.000011	0.0034	0.087	0.000015	0.044	0.000000016	2.3	0.00038	0.61	0.0000018	0.000000081	0.0000035	0.0068	0.000000081	0.000024	0.000016
2-Jul-14	6	11	450	350	0.00039	0.000031	0.0041	0.00000026	0.000052	0.021	0.000027	0.00061	0.00099	0.0000096	0.0039	0.090	0.000013	0.048	0.000000018	2.3	0.00038	0.55	0.0000017	0.0000014	0.0000048	0.0055	0.000000088	0.0000088	0.000018
16-Jul-14	7	13	450	295	0.00030	0.000023	0.0029	0.00000015	0.000044	0.017	0.000029	0.00044	0.00086	0.0000081	0.0035	0.072	0.0000096	0.038	0.000000022	1.9	0.00030	0.38	0.0000014	0.00000089	0.0000035	0.0042	0.0000011	0.0000074	0.000015
30-Jul-14	8	15	450	340	0.00025	0.000034	0.0026	0.00000017	0.000055	0.018	0.000021	0.00026	0.00089	0.0000077	0.0041	0.076	0.000011	0.044	0.000000017	2.0	0.00032	0.36	0.0000015	0.000000085	0.0000085	0.0042	0.0000031	0.0000085	0.000017
13-Aug-14	9	17	450	350	0.00021	0.000020	0.0017	0.00000018	0.000052	0.017	0.000023	0.000088	0.00078	0.0000061	0.0042	0.071	0.000013	0.045	0.000000018	2.1	0.00031	0.32	0.0000014	0.00000035	0.0000042	0.0042	0.00000070	0.0000088	0.000018
27-Aug-14	10	19	450	350	0.00019	0.000021	0.0018	0.00000044	0.000047	0.017	0.000016	0.000088	0.00075	0.0000044	0.0042	0.076	0.0000074	0.048	0.000000018	2.0	0.00031	0.28	0.0000014	0.0000033	0.00000061	0.0040	0.0000024	0.0000088	0.000018
10-Sep-14	11	21	450	340	0.00016	0.000012	0.0016	0.000000085	0.000043	0.016	0.0000076	0.00017	0.00065	0.0000043	0.0042	0.056	0.0000089	0.053	0.000000017	1.8	0.00029	0.24	0.0000013	0.0000013	0.00000077	0.0033	0.0000020	0.0000085	0.000017
24-Sep-14	12	23	450	305	0.00012	0.000013	0.00070	0.00000046	0.000042	0.014	0.0000076	0.00015	0.00054	0.0000046	0.0035	0.062	0.0000068	0.039	0.000000031	1.7	0.00024	0.18	0.0000012	0.00000061	0.0000034	0.0028	0.0000016	0.000023	0.000015
8-Oct-14	13	25	450	350	0.00013	0.000017	0.0012	0.00000035	0.000054	0.016	0.0000058	0.00026	0.00058	0.0000035	0.0042	0.056	0.0000070	0.046	0.000000018	1.8	0.00029	0.19	0.0000012	0.00000070	0.0000018	0.0031	0.0000019	0.0000088	0.000018
22-Oct-14	14	27	450	345	0.00012	0.0000097	0.0012	0.00000017	0.000051	0.017	0.0000062	0.000086	0.00053	0.0000035	0.0049	0.059	0.0000066	0.046	0.000000017	1.9	0.00028	0.20	0.0000012	0.00000026	0.0000012	0.0030	0.0000023	0.0000086	0.000017
5-Nov-14	15	29	450	335	0.000097	0.000011	0.0010	0.00000042	0.000044	0.015	0.0000037	0.00034	0.00049	0.0000034	0.0039	0.049	0.0000062	0.045	0.000000017	1.7	0.00026	0.15	0.0000011	0.00000042	0.0000013	0.0027	0.0000017	0.0000084	0.000017
19-Nov-14	16	31	450	340	0.000094	0.000011	0.00082	0.000000085	0.000051	0.016	0.0000062	0.000085	0.00046	0.0000026	0.0040	0.051	0.0000053	0.049	0.000000017	1.8	0.00029	0.14	0.0000014	0.00000034	0.00000094	0.0027	0.0000016	0.0000085	0.000017
3-Dec-14	17	33	450	350	0.000087	0.000015	0.00081	0.000000088	0.000043	0.015	0.0000040	0.000088	0.00043	0.0000026	0.0041	0.050	0.0000061	0.045	0.000000018	1.6	0.00029	0.14	0.0000012	0.00000035	0.0000012	0.0026	0.0000018	0.0000088	0.000018
17-Dec-14	18	35	450	335	0.000079	0.000011	0.00066	0.000000084	0.000047	0.015	0.0000047	0.000084	0.00038	0.0000025	0.0038	0.053	0.0000050	0.044	0.000000017	1.5	0.00026	0.12	0.0000011	0.00000034	0.0000012	0.0023	0.0000016	0.0000084	0.000017
31-Dec-14	19	37	650	355	0.000077	0.0000099	0.00075	0.00000027	0.000048	0.016	0.0000051	0.000089	0.00041	0.0000027	0.0043	0.052	0.0000058	0.051	0.000000018	1.6	0.00028	0.12	0.0000011	0.00000080	0.0000012	0.0025	0.0000020	0.0000089	0.000018
14-Jan-15	20	39	450	335	0.000061	0.0000093	0.00059	0.00000017	0.000040	0.013	0.0000061	0.000084	0.00035	0.0000025	0.0039	0.045	0.0000054	0.047	0.000000025	1.3	0.00022	0.095	0.0000011	0.00000034	0.0000013	0.0019	0.0000018	0.0000084	0.000017
28-Jan-15	21	41	450	335	0.000047	0.000010	0.00055	0.000000084	0.000037	0.015	0.0000053	0.000084	0.00034	0.0000017	0.0035	0.048	0.000010	0.041	0.000000017	1.4	0.00020	0.091	0.00000096	0.0000018	0.0000013	0.0018	0.0000021	0.0000084	0.000017
11-Feb-15	22	43	450	335	0.000049	0.0000084	0.00044	0.00000017	0.000044	0.013	0.0000044	0.00017	0.00027	0.0000017	0.0035	0.046	0.0000084	0.043	0.000000017	1.2	0.00026	0.086	0.0000011	0.0000073	0.00000075	0.0017	0.0000018	0.0000084	0.000017
25-Feb-15	23	45	450	345	0.000053	0.0000076	0.00046	0.00000026	0.000049	0.015	0.0000041	0.000086	0.00026	0.0000017	0.0032	0.053	0.0000086	0.046	0.000000017	1.3	0.00028	0.081	0.0000012	0.0000010	0.00000095	0.0018	0.0000014	0.0000086	0.000017
11-Mar-15	24	47	450	330	0.000048	0.0000082	0.00040	0.00000017	0.000048	0.014	0.0000045	0.000083	0.00026	0.0000017	0.0028	0.046	0.0000083	0.039	0.00000083	1.2	0.00027	0.073	0.00000100	0.00000050	0.00000041	0.0016	0.0000013	0.0000083	0.000017
25-Mar-15	25	49	450	355	0.000056	0.0000092	0.00050	0.000000089	0.000050	0.017	0.0000055	0.000089	0.00030	0.0000018	0.0033	0.053	0.0000089	0.051	0.000000018	1.4	0.00030	0.082	0.0000012	0.0000046	0.0000016	0.0016	0.0000021	0.0000089	0.000018
8-Apr-15	26	51	450	370	0.000046	0.000011	0.00036	0.000000093	0.000052	0.015	0.0000041	0.000093	0.00025	0.0000019	0.0035	0.054	0.0000093	0.056	0.000000019	1.2	0.00030	0.074	0.0000012	0.0000017	0.00000056	0.0016	0.0000015	0.0000093	0.000019
22-Apr-15	27	53	450	330	0.000039	0.000010	0.00029	0.0000018	0.000041	0.015	0.0000041	0.00017	0.00022	0.0000017	0.0028	0.051	0.0000026	0.044	0.00000036	1.1	0.00028	0.064	0.00000092	0.00000091	0.0000012	0.0011	0.0000018	0.0000083	0.000017
6-May-15	28	55	450	325	0.000033	0.000012	0.00026	0.00000016	0.000045	0.014	0.0000057	0.000081	0.00020	0.0000016	0.0025	0.049	0.0000081	0.044	0.00000042	1.00	0.00026	0.059	0.0000010	0.000000081	0.00000089	0.0012	0.0000015	0.0000081	0.000016
20-May-15	29	57	500	410																									
3-Jun-15	30	59	410	300	0.000013	0.0000050	0.000090	0.00000019	0.000022	0.0081	0.0000028	0.000038	0.000074	0.00000038	0.0010	0.024	0.0000015	0.021	0.000000053	0.38	0.00015	0.024	0.00000049	0.00000019	0.00000041	0.00047	0.00000068	0.0000038	0.0000075
17-Jun-15	31	61	500	410																									
1-Jul-15	32	63	410	310	0.000012	0.0000067	0.000085	0.000000039	0.000025	0.0081	0.0000048	0.000078	0.000063	0.00000078	0.00095	0.023	0.0000012	0.022	0.00000010	0.41	0.00016	0.020	0.00000058	0.0000012	0.00000035	0.00042	0.00000066	0.0000039	0.0000078
15-Jul-15	33	65	500	385																									
29-Jul-15	34	67	385	300	0.0000097	0.0000027	0.000060	0.000000075	0.000028	0.0097	0.0000018	0.000038	0.000052	0.00000038	0.00071	0.025	0.00000079	0.020	0.000000041	0.38	0.00019	0.018	0.00000059	0.00000045	0.00000019	0.00035	0.00000060	0.0000038	0.0000075
12-Aug-15	35	69	500	385																									
26-Aug-15	36	71	385	285	0.0000078	0.0000045	0.000039	0.00000014	0.000029	0.012	0.0000036	0.000036	0.000098	0.00000036	0.00050	0.027	0.00000089	0.021	0.00000042	0.34	0.00024	0.015	0.00000068	0.00000043	0.00000018	0.00025	0.00000046	0.0000036	0.0000071
9-Sep-15	37	73	500	495																									
23-Sep-15	38	75	495	410																									
7-Oct-15	39	77	410	310	0.0000069	0.0000033	0.000031	0.000000078	0.000033	0.020	0.0000024	0.000039	0.000025	0.00000078	0.00039	0.032	0.00000066	0.021	0.000000019	0.30	0.00037	0.015	0.00000070	0.00000062	0.00000039	0.00022	0.00000035	0.0000039	0.0000078
21-Oct-15	40	79	500	410																									
4-Nov-15	41	81	410	335																									
18-Nov-15	42	83	335	255	0.0000063	0.0000051	0.000064	0.00000029	0.000029	0.023	0.0000055	0.000032	0.000023	0.00000032	0.00028	0.030	0.00000086	0.018	0.0000000096	0.21	0.00039	0.013	0.00000047	0.00000048	0.00000016	0.00015	0.00000032	0.0000032	0.0000064
2-Dec-15	43	85	500	415																									
16-Dec-15	44	87	415	345																									
30-Dec-15	45	89	345	285	0.0000061	0.0000022	0.000046	0.000000071	0.000029	0.029	0.0000061	0.000036	0.000024	0.00000036	0.00033	0.033	0.00000068	0.020	0.000000025	0.20	0.00040	0.015	0.00000051	0.00000011	0.00000018	0.00021	0.00000025	0.0000036	0.0000071
6-Jan-16	46	90	400	310	0.0000074	0.0000053	0.000043	0.00000035	0.000033	0.034	0.0000094	0.000039	0.000026	0.00000039	0.00035	0.039	0.0000027	0.023	0.000000047	0.22	0.00050	0.017	0.00000054	0.0000013	0.00000019	0.00023	0.00000035	0.0000039	0.0000078
20-Jan-16	47	92	400	305	0.0000082	0.0000024	0.000042	0.00000015	0.000033	0.031	0.0000085	0.000038	0.000029	0.00000076	0.00034	0.036	0.0000011	0.024	0.000000061	0.19	0.00057	0.017	0.00000082	0.00000019	0.00000019	0.00026	0.00000061	0.0000038	0.0000076
3-Feb-16	48	94	400	285	0.0000077	0.0000060	0.000043	0.00000018	0.000030	0.028	0.0000061	0.000036	0.000027	0.00000071	0.00031	0.034	0.0000012	0.020	0.000000068	0.17	0.00051	0.017	0.00000059	0.00000039	0.00000018	0.00023	0.00000036	0.0000036	0.0000071
17-Feb-16	49	96	400	300	0.0000085	0.0000034	0.000038	0.00000041	0.000030	0.030	0.0000074	0.000038	0.000030	0.00000075	0.00037	0.034	0.00000060	0.022	0.0000000075	0.17	0.00047	0.017	0.00000060	0.00000034	0.00000019	0.00026	0.00000034	0.0000075	0.0000075
2-Mar-16	50	98	400	320	0.0000099	0.0000017	0.000044	0.00000036	0.000033	0.031	0.000023	0.000040	0.000034	0.00000080	0.00040	0.037	0.00000088	0.024	0.000000012	0.19	0.00052	0.022	0.00000064	0.00000012	0.00000020	0.00029	0.00000020	0.0000040	0.0000080

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 15 (Latte Composite)

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	350	8.0	141	2258	14	2.6	25	1.7	2.4	3.0	*< 0.06*	44	*< 0.3*	684	0.015	0.065	1.3	0.026	*< 7E-06*	0.000030	0.12	0.000036	213	0.0079
17-Jun-15	2	3	600	565	8.2	156	825	2.9	0.86	5.6	*< 1*	0.70	0.33	0.53	15	*< 0.3*	224	0.0065	0.060	1.5	0.0093	*< 7E-06*	0.00016	0.015	0.0000050	68	0.0013
1-Jul-15	3	5	550	535	8.2	160	433	1.1	0.15	*< 2*	*< 1*	0.40	0.070	0.10	5.0	*< 0.3*	116	0.0068	0.062	1.4	0.0083	*< 7E-06*	*< 7E-06*	0.023	0.0000090	32	0.00049
15-Jul-15	4	7	550	525	8.2	142	262	1.1	0.050	*< 2*	*< 1*	0.20	*< 0.06*	0.030	1.0	*< 0.3*	100	0.0074	0.055	1.2	0.0089	*< 7E-06*	*< 7E-06*	0.064	0.00012	27	0.00028
29-Jul-15	5	9	500	490	8.1	141	229	0.60	0.060	*< 2*	*< 1*	0.20	*< 0.06*	*< 0.03*	1.0	*< 0.3*	110	0.0091	0.048	0.86	0.010	*< 7E-06*	*< 7E-06*	0.021	*< 3E-06*	30	0.00019
12-Aug-15	6	11	500	490	8.2	124	172	0.48	0.030	*< 2*	*< 1*	0.30	*< 0.06*	*< 0.03*	1.0	*< 0.3*	111	0.0054	0.041	0.79	0.011	*< 7E-06*	*< 7E-06*	0.017	0.0000060	29	0.00020
26-Aug-15	7	13	600	560	7.9	155	161	0.40	0.030	2.0	1.0	0.30	0.060	0.030	1.0	0.30	122	0.0054	0.040	0.70	0.013	0.0000070	0.0000070	0.017	0.0000055	32	0.00022
9-Sep-15	8	15	600	580	8.1	118	129	0.31	0.030	*< 2*	*< 1*	0.30	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	132	0.0053	0.038	0.61	0.014	*< 7E-06*	*< 7E-06*	0.017	0.0000050	34	0.00024
23-Sep-15	9	17	600	575	8.1	118	105	0.25	0.025	2.0	1.0	0.25	0.060	0.030	1.0	0.30	136	0.0059	0.035	0.53	0.014	0.0000070	0.0000070	0.017	0.0000045	35	0.00017
7-Oct-15	10	19	500	470	8.1	127	107	0.18	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	139	0.0065	0.033	0.46	0.014	*< 7E-06*	*< 7E-06*	0.016	0.0000040	35	0.000090
21-Oct-15	11	21	500	485	8.1	118	93	0.20	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	143	0.0074	0.033	0.49	0.016	*< 7E-06*	*< 7E-06*	0.018	*< 3E-06*	37	0.00014
4-Nov-15	12	23	500	475	8.2	123	86	0.26	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	157	0.0068	0.028	0.45	0.018	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	40	0.00011
18-Nov-15	13	25	500	485	8.3	130	82	0.18	0.010	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	147	0.0033	0.027	0.45	0.014	0.0000080	*< 7E-06*	0.018	0.000021	36	0.000080
2-Dec-15	14	27	500	475	8.2	116	76	0.16	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	161	0.0040	0.029	0.46	0.019	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	41	0.00014
16-Dec-15	15	29	500	475	8.2	112	71	0.15	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	150	0.012	0.028	0.43	0.021	0.000013	0.000015	0.012	0.00017	37	0.00018
30-Dec-15	16	31	500	490	8.2	105	56	0.14	*< 0.01*	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	155	0.0058	0.027	0.43	0.020	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	38	0.00018
13-Jan-16	17	33	500	450	8.2	107	54	0.13	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	144	0.0042	0.025	0.34	0.019	*< 7E-06*	*< 7E-06*	0.012	*< 3E-06*	35	0.00011
27-Jan-16	18	35	500	460	8.2	106	54	0.13	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	140	0.0039	0.025	0.38	0.020	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	35	0.00012
10-Feb-16	19	37	500	475	8.2	108	49	0.14	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	138	0.0035	0.025	0.41	0.022	*< 7E-06*	*< 7E-06*	0.0080	*< 3E-06*	35	0.00012
24-Feb-16	20	39	500	470	8.2	109	46	0.10	0.010	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	150	0.0021	0.024	0.39	0.023	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	37	0.00016
9-Mar-16	21	41	501	455	8.2	104	39																				

Calculated Loading Rates for Col 15

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	350	8.0	9.8	158	0.95	0.18	1.8	0.12	0.17	0.21	0.0042	3.1	0.021	48	0.0010	0.0045	0.089	0.0018	0.00000049	0.0000021	0.0084	0.0000025	15	0.00055
17-Jun-15	2	3	600	565	8.2	8.8	47	0.17	0.049	0.32	0.057	0.040	0.019	0.030	0.85	0.017	13	0.00037	0.0034	0.085	0.00052	0.00000040	0.0000089	0.00084	0.00000028	3.8	0.000072
1-Jul-15	3	5	550	535	8.2	8.6	23	0.059	0.0080	0.11	0.054	0.021	0.0037	0.0054	0.27	0.016	6.2	0.00036	0.0033	0.076	0.00044	0.00000037	0.00000037	0.0012	0.00000048	1.7	0.000026
15-Jul-15	4	7	550	525	8.2	7.5	14	0.055	0.0026	0.11	0.053	0.011	0.0032	0.0016	0.053	0.016	5.3	0.00039	0.0029	0.060	0.00047	0.00000037	0.00000037	0.0033	0.0000060	1.4	0.000015
29-Jul-15	5	9	500	490	8.1	6.9	11	0.029	0.0029	0.098	0.049	0.0098	0.0029	0.0015	0.049	0.015	5.4	0.00045	0.0023	0.042	0.00049	0.00000034	0.00000034	0.0010	0.00000015	1.5	0.0000093
12-Aug-15	6	11	500	490	8.2	6.1	8.4	0.024	0.0015	0.098	0.049	0.015	0.0029	0.0015	0.049	0.015	5.4	0.00026	0.0020	0.038	0.00052	0.00000034	0.00000034	0.00081	0.00000029	1.4	0.0000098
26-Aug-15	7	13	600	560	7.9	8.7	9.0	0.022	0.0017	0.11	0.056	0.017	0.0034	0.0017	0.056	0.017	6.8	0.00030	0.0022	0.039	0.00070	0.00000039	0.00000039	0.00095	0.00000031	1.8	0.000012
9-Sep-15	8	15	600	580	8.1	6.8	7.5	0.018	0.0017	0.12	0.058	0.017	0.0035	0.0017	0.058	0.017	7.7	0.00031	0.0022	0.035	0.00083	0.00000041	0.00000041	0.0010	0.00000029	2.0	0.000014
23-Sep-15	9	17	600	575	8.1	6.8	6.0	0.014	0.0014	0.12	0.058	0.014	0.0035	0.0017	0.058	0.017	7.8	0.00034	0.0020	0.031	0.00081	0.00000040	0.00000040	0.00095	0.00000026	2.0	0.0000095
7-Oct-15	10	19	500	470	8.1	6.0	5.0	0.0085	0.00094			0.0094	0.0028	0.0014	0.047	0.00	6.5	0.00031	0.0015	0.021	0.00066	0.00000033	0.00000033	0.00074	0.00000019	1.6	0.0000042
21-Oct-15	11	21	500	485	8.1	5.7	4.5	0.0097	0.00097			0.0097	0.0029	0.0015	0.049	0.00	6.9	0.00036	0.0016	0.024	0.00079	0.00000034	0.00000034	0.00087	0.00000015	1.8	0.0000068
4-Nov-15	12	23	500	475	8.2	5.9	4.1	0.012	0.00095			0.0095	0.0029	0.0014	0.048	0.00	7.5	0.00032	0.0013	0.021	0.00085	0.00000033	0.00000033	0.00066	0.00000014	1.9	0.0000052
18-Nov-15	13	25	500	485	8.3	6.3	4.0	0.0087	0.00049			0.0049	0.0029	0.0015	0.049	0.00	7.1	0.00016	0.0013	0.022	0.00069	0.00000039	0.00000034	0.00085	0.0000010	1.7	0.0000039
2-Dec-15	14	27	500	475	8.2	5.5	3.6	0.0076	0.00095			0.0095	0.0029	0.0014	0.048	0.00	7.6	0.00019	0.0014	0.022	0.00091	0.00000033	0.00000033	0.00049	0.00000014	1.9	0.0000067
16-Dec-15	15	29	500	475	8.2	5.3	3.4	0.0071	0.00095			0.0095	0.0029	0.0014	0.048	0.00	7.1	0.00055	0.0013	0.020	0.00097	0.00000062	0.00000071	0.00055	0.0000083	1.7	0.0000086
30-Dec-15	16	31	500	490	8.2	5.1	2.7	0.0069	0.00049			0.0049	0.0029	0.0015	0.049	0.00	7.6	0.00028	0.0013	0.021	0.00098	0.00000034	0.00000034	0.00096	0.00000015	1.9	0.0000088
13-Jan-16	17	33	500	450	8.2	4.8	2.4	0.0059	0.00090			0.0090	0.0027	0.0014	0.045	0.00	6.5	0.00019	0.0011	0.015	0.00086	0.00000032	0.00000032	0.00054	0.00000014	1.6	0.0000050
27-Jan-16	18	35	500	460	8.2	4.9	2.5	0.0060	0.00092			0.0092	0.0028	0.0014	0.046	0.00	6.4	0.00018	0.0012	0.017	0.00093	0.00000032	0.00000032	0.00051	0.00000014	1.6	0.0000055
10-Feb-16	19	37	500	475	8.2	5.1	2.3	0.0067	0.00048			0.0095	0.0029	0.0014	0.048	0.00	6.6	0.00017	0.0012	0.019	0.0010	0.00000033	0.00000033	0.00038	0.00000014	1.6	0.0000057
24-Feb-16	20	39	500	470	8.2	5.1	2.2	0.0047	0.00047			0.0094	0.0028	0.0014	0.047	0.00	7.1	0.000099	0.0011	0.018	0.0011	0.00000033	0.00000033	0.00047	0.00000014	1.7	0.0000075
9-Mar-16	21	41	501	455	8.2	4.7	1.8																				

Leachate Concentrations for Col 16 (Supremo Composite)

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	320	8.9	418	150	3.3	0.25	6.9	*< 1*	1.0	2.2	0.76	19	*< 0.3*	28	0.043	0.064	3.7	0.016	*< 7E-06*	0.000010	0.079	0.000044	8.8	0.0085
17-Jun-15	2	3	600	550	8.8	413	60	1.6	0.070	*< 2*	*< 1*	0.30	0.28	0.34	7.0	*< 0.3*	18	0.085	0.061	4.7	0.0090	*< 7E-06*	0.000080	0.019	0.000028	5.6	0.0029
1-Jul-15	3	5	550	510	8.7	377	28	0.98	0.040	*< 2*	*< 1*	0.20	0.10	0.060	3.0	*< 0.3*	16	0.022	0.057	4.5	0.0099	*< 7E-06*	*< 7E-06*	0.023	0.000015	4.8	0.0014
15-Jul-15	4	7	550	535	8.6	311	18	1.1	0.060	*< 2*	*< 1*	*< 0.1*	0.060	*< 0.03*	1.0	*< 0.3*	12	0.047	0.054	4.3	0.0092	*< 7E-06*	*< 7E-06*	0.040	0.000012	3.5	0.00095
29-Jul-15	5	9	500	465	8.6	318	16	0.48	0.040	*< 2*	*< 1*	0.20	*< 0.06*	*< 0.03*	1.0	*< 0.3*	16	0.030	0.043	3.0	0.012	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	4.7	0.00068
12-Aug-15	6	11	500	490	8.6	298	12	0.46	0.13	*< 2*	*< 1*	0.10	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	14	0.10	0.039	2.7	0.014	*< 7E-06*	*< 7E-06*	0.018	0.0000090	4.3	0.00062
26-Aug-15	7	13	600	565	8.2	308	9.0	0.38	0.080	2.0	1.0	0.10	0.060	0.030	1.0	0.30	14	0.071	0.037	2.5	0.014	0.0000070	0.0000070	0.017	0.0000060	4.3	0.00055
9-Sep-15	8	15	600	560	8.5	224	8.0	0.29	0.030	*< 2*	*< 1*	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	14	0.038	0.036	2.2	0.014	*< 7E-06*	*< 7E-06*	0.016	*< 3E-06*	4.3	0.00048
23-Sep-15	9	17	600	560	8.5	218	7.0	0.21	0.030	2.0	1.0	0.10	0.060	0.030	1.0	0.30	15	0.030	0.032	1.8	0.014	0.0000070	0.0000070	0.014	0.0000030	4.6	0.00042
7-Oct-15	10	19	500	475	8.4	224	5.0	0.12	0.030	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	16	0.021	0.028	1.4	0.015	*< 7E-06*	*< 7E-06*	0.012	0.0000030	4.9	0.00036
21-Oct-15	11	21	500	465	8.5	206	5.0	0.15	0.020	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	18	0.018	0.027	1.4	0.018	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	5.1	0.00046
4-Nov-15	12	23	500	485	8.5	197	6.0	0.16	0.020	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	21	0.024	0.022	1.2	0.021	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	6.2	0.00047
18-Nov-15	13	25	500	460	8.6	204	5.0	0.13	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	21	0.015	0.021	1.1	0.019	0.000015	0.000010	0.012	*< 3E-06*	6.2	0.00040
2-Dec-15	14	27	500	470	8.5	170	4.0	0.10	0.010	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	27	0.022	0.021	0.99	0.027	*< 7E-06*	*< 7E-06*	0.0095	*< 3E-06*	7.8	0.00040
16-Dec-15	15	29	500	460	8.5	157	4.0	0.090	*< 0.01*	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	28	0.013	0.019	0.82	0.030	0.000021	0.000023	0.010	0.000035	8.1	0.00049
30-Dec-15	16	31	500	460	8.4	131	4.0	0.060	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	34	0.027	0.019	0.81	0.035	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	10	0.00046
13-Jan-16	17	33	500	445	8.3	131	4.0	0.060	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	33	0.012	0.016	0.57	0.032	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	9.2	0.00038
27-Jan-16	18	35	500	475	8.3	122	4.0	0.060	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	37	0.0082	0.015	0.57	0.039	*< 7E-06*	*< 7E-06*	0.0090	*< 3E-06*	11	0.00036
10-Feb-16	19	37	500	460	8.3	118	4.0	0.050	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	43	0.0059	0.015	0.52	0.046	*< 7E-06*	*< 7E-06*	0.0070	*< 3E-06*	12	0.00037
24-Feb-16	20	39	500	455	8.3	116	3.0	0.040	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	52	0.0032	0.014	0.46	0.051	*< 7E-06*	*< 7E-06*	0.0070	*< 3E-06*	15	0.00035
9-Mar-16	21	41	501	450	8.3	108	3.0																				

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 15 (Latte Composite)

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	350	0.37	0.079	4.1	0.00024	0.013	37	0.011	0.23	0.044	1.6	0.023	28	0.0080	4.3	0.017	780	1.0	748	0.00040	< 1E-05	0.00019	0.12	0.00033	0.0010	< 0.002
17-Jun-15	2	3	600	565	0.097	0.0074	0.90	< 1E-05	0.0065	13	0.013	0.030	0.020	0.37	0.059	15	0.0038	5.3	0.00066	316	0.36	282	0.00020	0.00040	0.000080	0.036	0.00023	< 0.001	< 0.002
1-Jul-15	3	5	550	535	0.035	0.0024	0.34	< 1E-05	0.0056	8.6	0.013	0.020	0.014	0.068	0.026	10	0.0017	5.3	0.000056	187	0.19	128	0.00015	0.000050	0.000070	0.027	0.00025	< 0.001	< 0.002
15-Jul-15	4	7	550	525	0.020	0.0028	0.25	0.00054	0.0050	8.3	0.011	< 0.01	0.011	0.0089	0.047	9.7	0.00083	5.4	0.000041	139	0.15	98	0.00015	0.00055	0.00013	0.019	0.00024	0.0030	< 0.002
29-Jul-15	5	9	500	490	0.013	0.00098	0.20	< 0.00001	0.0056	8.8	0.0096	< 0.01	0.0089	0.0024	0.0090	9.6	0.00055	4.8	0.000018	105	0.18	78	0.00013	0.000050	< 0.00005	0.018	0.00021	< 0.001	< 0.002
12-Aug-15	6	11	500	490	0.0084	0.00087	0.14	0.000010	0.0045	9.2	0.0087	< 0.01	0.0063	0.0018	0.016	10	0.00060	4.9	0.000012	81	0.17	59	0.00013	0.000050	< 0.00005	0.014	0.00021	< 0.001	< 0.002
26-Aug-15	7	13	600	560	0.0070	0.00094	0.12	0.000010	0.0043	10	0.0090	0.010	0.014	0.0016	0.013	10	0.00078	4.8	0.000050	63	0.19	54	0.00015	0.00012	0.000050	0.013	0.00020	0.0010	0.0020
9-Sep-15	8	15	600	580	0.0057	0.0010	0.092	< 1E-05	0.0041	11	0.0094	< 0.01	0.023	0.0013	0.0090	11	0.00095	4.7	0.000088	45	0.20	49	0.00017	0.00018	< 5E-05	0.011	0.00018	< 0.001	< 0.002
23-Sep-15	9	17	600	575	0.0046	0.00083	0.080	0.000010	0.0040	12	0.0087	0.010	0.014	0.0012	0.0060	10	0.00068	4.5	0.000047	36	0.21	42	0.00015	0.00013	0.000050	0.011	0.00018	0.0010	0.0020
7-Oct-15	10	19	500	470	0.0036	0.00065	0.067	< 1E-05	0.0040	13	0.0080	< 0.01	0.0049	0.0011	< 0.003	9.6	0.00040	4.3	0.0000060	26	0.21	34	0.00012	0.000070	< 5E-05	0.011	0.00017	< 0.001	< 0.002
21-Oct-15	11	21	500	485	0.0040	0.00088	0.082	< 1E-05	0.0039	13	0.0083	< 0.01	0.0056	0.0012	< 0.003	9.3	0.00041	4.7	0.0000070	21	0.22	33	0.00017	0.00016	0.000080	0.011	0.00021	< 0.001	< 0.002
4-Nov-15	12	23	500	475	0.0037	0.0011	0.080	0.000040	0.0035	14	0.0068	< 0.01	0.0045	0.0011	0.0050	10	0.00041	4.5	0.0000040	19	0.22	31	0.00016	0.00020	< 5E-05	0.010	0.00019	< 0.001	< 0.002
18-Nov-15	13	25	500	485	0.0030	0.00055	0.066	0.000070	0.0037	14	0.0064	< 0.01	0.0026	0.00070	0.0030	10	0.0011	4.6	0.000012	16	0.21	32	0.00016	0.00010	< 5E-05	0.0073	0.00017	< 0.001	< 0.002
2-Dec-15	14	27	500	475	0.0028	0.00036	0.064	0.000070	0.0036	15	0.0060	< 0.01	0.0025	0.0010	< 0.003	10	0.00038	4.7	0.0000020	15	0.23	26	0.00013	0.000090	< 5E-05	0.0079	0.00018	< 0.002	< 0.002
16-Dec-15	15	29	500	475	0.0025	0.00080	0.058	0.0026	0.0037	14	0.0064	< 0.01	0.0026	0.0011	0.086	10	0.00041	5.8	0.000021	12	0.23	26	0.00013	0.00016	0.00026	0.0076	0.00021	0.020	< 0.002
30-Dec-15	16	31	500	490	0.0025	0.00078	0.053	0.00017	0.0037	14	0.0055	0.010	0.0033	0.00090	< 0.003	10	0.00036	4.4	0.0000090	11	0.23	23	0.00014	0.000040	0.000070	0.0074	0.00021	< 0.001	< 0.002
13-Jan-16	17	33	500	450	0.0022	0.00075	0.056	0.00014	0.0033	14	0.0049	< 0.01	0.0026	0.00080	< 0.003	9.8	0.0026	4.4	0.0000020	8.6	0.20	20	0.000084	0.000060	< 5E-05	0.0060	0.00014	< 0.001	< 0.002
27-Jan-16	18	35	500	460	0.0021	0.00047	0.045	0.000010	0.0032	13	0.0043	< 0.01	0.0024	0.00070	< 0.003	9.1	0.00029	4.5	< 2E-06	7.1	0.22	20	0.00014	0.000090	< 5E-05	0.0061	0.00015	< 0.001	< 0.002
10-Feb-16	19	37	500	475	0.0019	0.00051	0.035	0.00015	0.0032	13	0.0040	< 0.01	0.0023	0.00080	< 0.003	8.9	0.00038	4.4	< 2E-06	6.2	0.21	17	0.00013	0.000070	< 5E-05	0.0052	0.00016	< 0.001	< 0.002
24-Feb-16	20	39	500	470	0.0021	0.00023	0.047	0.000050	0.0033	14	0.0041	0.040	0.0024	0.00070	0.0040	9.5	0.00034	4.4	< 2E-06	5.4	0.22	17	0.00012	0.000020	< 5E-05	0.0055	0.00014	< 0.001	< 0.002
9-Mar-16	21	41	501	455																									

Calculated Loading Rates for Col 15

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	350	0.026	0.0056	0.29	0.000017	0.00088	2.6	0.00076	0.016	0.0030	0.11	0.0016	2.0	0.00056	0.30	0.0012	55	0.073	52	0.000028	0.00000070	0.000013	0.0084	0.000023	0.000070	0.00014
17-Jun-15	2	3	600	565	0.0055	0.00042	0.051	0.00000057	0.00037	0.75	0.00076	0.0017	0.0011	0.021	0.0033	0.82	0.00022	0.30	0.000037	18	0.020	16	0.000011	0.000023	0.0000045	0.0020	0.000013	0.000057	0.00011
1-Jul-15	3	5	550	535	0.0019	0.00013	0.018	0.00000054	0.00030	0.46	0.00067	0.0011	0.00077	0.0036	0.0014	0.56	0.000090	0.28	0.0000030	10	0.010	6.8	0.0000079	0.0000027	0.0000037	0.0014	0.000013	0.000054	0.00011
15-Jul-15	4	7	550	525	0.0010	0.00014	0.013	0.000028	0.00026	0.44	0.00058	0.00053	0.00056	0.00047	0.0025	0.51	0.000044	0.28	0.0000022	7.3	0.0081	5.1	0.0000080	0.000029	0.0000068	0.0010	0.000013	0.00016	0.00011
29-Jul-15	5	9	500	490	0.00062	0.000048	0.0098	0.00000049	0.00028	0.43	0.00047	0.00049	0.00043	0.00012	0.00044	0.47	0.000027	0.23	0.00000088	5.1	0.0090	3.8	0.0000063	0.0000025	0.0000025	0.00089	0.000010	0.000049	0.000098
12-Aug-15	6	11	500	490	0.00041	0.000043	0.0069	0.00000049	0.00022	0.45	0.00043	0.00049	0.00031	0.000088	0.00078	0.49	0.000029	0.24	0.00000059	3.9	0.0083	2.9	0.0000063	0.0000025	0.0000025	0.00067	0.000010	0.000049	0.000098
26-Aug-15	7	13	600	560	0.00039	0.000052	0.0065	0.00000056	0.00024	0.57	0.00051	0.00056	0.00081	0.000087	0.00070	0.58	0.000043	0.27	0.0000028	3.5	0.010	3.0	0.0000085	0.0000064	0.0000028	0.00070	0.000011	0.000056	0.00011
9-Sep-15	8	15	600	580	0.00033	0.000058	0.0053	0.00000058	0.00024	0.66	0.00054	0.00058	0.0013	0.000075	0.00052	0.62	0.000055	0.27	0.0000051	2.6	0.012	2.8	0.000010	0.000010	0.0000029	0.00066	0.000010	0.000058	0.00012
23-Sep-15	9	17	600	575	0.00027	0.000047	0.0046	0.00000058	0.00023	0.68	0.00050	0.00058	0.00079	0.000069	0.00035	0.58	0.000039	0.26	0.0000027	2.1	0.012	2.4	0.0000085	0.0000072	0.0000029	0.00063	0.000010	0.000058	0.00012
7-Oct-15	10	19	500	470	0.00017	0.000031	0.0031	0.00000047	0.00019	0.59	0.00038	0.00047	0.00023	0.000052	0.00014	0.45	0.000019	0.20	0.00000028	1.2	0.0098	1.6	0.0000057	0.0000033	0.0000024	0.00050	0.0000080	0.000047	0.000094
21-Oct-15	11	21	500	485	0.00020	0.000043	0.0040	0.00000049	0.00019	0.61	0.00040	0.00049	0.00027	0.000058	0.00015	0.45	0.000020	0.23	0.00000034	1.0	0.010	1.6	0.0000081	0.0000078	0.0000039	0.00055	0.000010	0.000049	0.000097
4-Nov-15	12	23	500	475	0.00018	0.000051	0.0038	0.0000019	0.00017	0.66	0.00032	0.00048	0.00021	0.000052	0.00024	0.48	0.000019	0.21	0.00000019	0.90	0.010	1.5	0.0000077	0.0000095	0.0000024	0.00048	0.0000090	0.000048	0.000095
18-Nov-15	13	25	500	485	0.00015	0.000027	0.0032	0.0000034	0.00018	0.68	0.00031	0.00049	0.00013	0.000034	0.00015	0.49	0.000051	0.22	0.00000058	0.79	0.010	1.5	0.0000077	0.0000049	0.0000024	0.00035	0.0000082	0.000049	0.000097
2-Dec-15	14	27	500	475	0.00013	0.000017	0.0030	0.0000033	0.00017	0.69	0.00029	0.00048	0.00012	0.000048	0.00014	0.49	0.000018	0.22	0.000000095	0.70	0.011	1.3	0.0000061	0.0000043	0.0000024	0.00038	0.0000086	0.000095	0.000095
16-Dec-15	15	29	500	475	0.00012	0.000038	0.0028	0.00012	0.00017	0.67	0.00031	0.00048	0.00012	0.000052	0.0041	0.49	0.000019	0.28	0.00000100	0.57	0.011	1.2	0.0000062	0.0000076	0.000012	0.00036	0.0000100	0.00095	0.000095
30-Dec-15	16	31	500	490	0.00012	0.000038	0.0026	0.0000083	0.00018	0.71	0.00027	0.00049	0.00016	0.000044	0.00015	0.49	0.000018	0.22	0.00000044	0.52	0.011	1.1	0.0000070	0.0000020	0.0000034	0.00036	0.000010	0.000049	0.000098
13-Jan-16	17	33	500	450	0.000099	0.000034	0.0025	0.0000063	0.00015	0.62	0.00022	0.00045	0.00012	0.000036	0.00014	0.44	0.00011	0.20	0.000000090	0.39	0.0089	0.88	0.0000038	0.0000027	0.0000023	0.00027	0.0000063	0.000045	0.000090
27-Jan-16	18	35	500	460	0.000096	0.000022	0.0021	0.00000046	0.00014	0.59	0.00020	0.00046	0.00011	0.000032	0.00014	0.42	0.000013	0.21	0.000000092	0.33	0.0099	0.91	0.0000064	0.0000041	0.0000023	0.00028	0.0000069	0.000046	0.000092
10-Feb-16	19	37	500	475	0.000091	0.000024	0.0017	0.0000071	0.00015	0.60	0.00019	0.00048	0.00011	0.000038	0.00014	0.42	0.000018	0.21	0.000000095	0.29	0.010	0.82	0.0000062	0.0000033	0.0000024	0.00025	0.0000076	0.000048	0.000095
24-Feb-16	20	39	500	470	0.000096	0.000011	0.0022	0.0000024	0.00015	0.66	0.00019	0.0019	0.00011	0.000033	0.00019	0.45	0.000016	0.21	0.000000094	0.25	0.010	0.80	0.0000058	0.00000094	0.0000024	0.00026	0.0000066	0.000047	0.000094
9-Mar-16	21	41	501	455																									

Leachate Concentrations for Col 16 (Supremo Composite)

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	320	0.23	0.0042	1.3	0.00029	0.0043	1.5	0.00053	0.65	0.18	0.10	1.1	7.3	0.0020	4.1	0.0013	270	0.029	56	0.00014	< 1E-05	0.00033	2.2	0.00076	0.0020	< 0.002
17-Jun-15	2	3	600	550	0.069	0.0015	0.55	0.0000010	0.0026	0.96	0.0028	0.16	0.084	0.014	1.5	6.0	0.00083	4.9	0.000036	204	0.018	21	0.00014	0.00034	0.00056	1.6	0.00066	< 0.001	< 0.002
1-Jul-15	3	5	550	510	0.029	0.0013	0.33	< 1E-05	0.0027	0.95	0.00041	0.050	0.051	0.0016	1.3	5.5	0.00053	5.0	0.000012	178	0.018	9.6	0.00013	0.00011	0.00029	1.2	0.00056	< 0.001	< 0.002
15-Jul-15	4	7	550	535	0.016	0.0012	0.29	0.000020	0.0025	0.79	0.00070	0.040	0.032	0.00060	1.1	4.6	0.00041	4.6	0.000044	150	0.015	6.9	0.00013	0.000040	0.00038	0.94	0.00062	< 0.001	< 0.002
29-Jul-15	5	9	500	465	0.0095	0.00091	0.18	0.0000010	0.0028	0.91	0.00038	0.020	0.022	0.00020	0.93	4.9	0.00028	4.6	0.000013	136	0.018	5.3	0.00011	0.000050	0.00017	0.69	0.00042	< 0.001	< 0.002
12-Aug-15	6	11	500	490	0.0073	0.00065	0.16	0.000030	0.0025	0.88	0.00070	0.030	0.018	0.00020	0.86	5.3	0.00034	5.1	0.000015	127	0.018	4.1	0.00019	0.000070	0.00056	0.51	0.00057	< 0.001	< 0.002
26-Aug-15	7	13	600	565	0.0059	0.00082	0.12	0.000025	0.0023	0.86	0.00066	0.020	0.016	0.00015	0.77	5.0	0.00030	4.8	0.000024	112	0.017	4.9	0.00016	0.00011	0.00040	0.43	0.00046	0.0010	0.0020
9-Sep-15	8	15	600	560	0.0045	0.00099	0.087	0.000020	0.0022	0.84	0.00062	< 0.01	0.015	< 0.0001	0.68	4.7	0.00026	4.4	0.000033	97	0.017	5.7	0.00012	0.00015	0.00023	0.35	0.00035	< 0.001	< 0.002
23-Sep-15	9	17	600	560	0.0036	0.00070	0.068	0.0000015	0.0023	0.92	0.00040	0.010	0.011	0.00010	0.57	4.8	0.00020	4.3	0.000020	91	0.018	4.0	0.00012	0.00011	0.00023	0.29	0.00031	0.0010	0.0020
7-Oct-15	10	19	500	475	0.0027	0.00041	0.048	< 1E-05	0.0024	0.99	0.00017	< 0.01	0.0068	< 0.0001	0.47	4.8	0.00014	4.2	0.0000070	85	0.020	2.2	0.00011	0.000060	0.00022	0.23	0.00026	< 0.001	< 0.002
21-Oct-15	11	21	500	465	0.0030	0.00054	0.057	< 1E-05	0.0024	1.1	0.00030	< 0.01	0.0073	< 0.0001	0.43	4.9	0.000090	4.6	0.0000050	76	0.021	2.2	0.00012	0.00023	0.000070	0.20	0.00030	< 0.001	< 0.002
4-Nov-15	12	23	500	485	0.0025	0.00052	0.051	< 1E-05	0.0023	1.3	0.00079	< 0.01	0.0063	< 0.0001	0.37	5.4	0.00010	4.4	0.0000030	78	0.023	2.5	0.00014	0.00011	0.000090	0.17	0.00026	< 0.001	< 0.002
18-Nov-15	13	25	500	460	0.0021	0.00067	0.044	0.000060	0.0026	1.4	0.0010	< 0.01	0.0053	< 0.0001	0.39	5.4	0.00062	4.6	0.000010	71	0.025	2.5	0.00016	0.00017	0.000070	0.15	0.00024	< 0.001	< 0.002
2-Dec-15	14	27	500	470	0.0022	0.00042	0.045	< 1E-05	0.0027	1.8	0.0026	< 0.01	0.0049	< 0.0001	0.32	6.3	0.00010	4.6	0.0000040	75	0.032	2.2	0.00012	0.000010	0.00014	0.15	0.00023	< 0.002	< 0.002
16-Dec-15	15	29	500	460	0.0019	0.00064	0.033	0.00027	0.0028	1.9	0.0020	< 0.01	0.0045	< 0.0001	0.27	6.6	0.00018	6.1	0.000021	63	0.033	1.4	0.00015	0.00026	0.00017	0.13	0.00024	0.0010	< 0.002
30-Dec-15	16	31	500	460	0.0016	0.00071	0.033	0.00013	0.0034	2.2	0.0017	0.010	0.0041	< 0.0001	0.26	6.8	0.00014	5.0	0.000061	59	0.040	1.5	0.00021	0.000080	0.00013	0.13	0.00023	< 0.001	< 0.002
13-Jan-16	17	33	500	445	0.0014	0.00086	0.028	0.000040	0.0029	2.3	0.0019	< 0.01	0.0037	< 0.0001	0.20	7.2	0.0014	4.4	< 2E-06	50	0.038	1.6	0.00013	0.000080	< 5E-05	0.096	0.00014	< 0.001	< 0.002
27-Jan-16	18	35	500	475	0.0012	0.00037	0.018	< 1E-05	0.0029	2.5	0.0016	< 0.01	0.0032	< 0.0001	0.19	7.1	< 4E-05	4.8	0.0000020	41	0.046	1.6	0.00017	0.000060	< 5E-05	0.094	0.00014	< 0.001	< 0.002
10-Feb-16	19	37	500	460	0.0011	0.00044	0.013	0.000090	0.0032	3.0	0.0014	< 0.01	0.0029	< 0.0001	0.16	7.4	0.000090	4.6	< 2E-06	36	0.053	1.8	0.00018	0.000070	< 5E-05	0.080	0.00013	< 0.001	< 0.002
24-Feb-16	20	39	500	455	0.0011	0.00021	0.016	0.000020	0.0034	3.7	0.0028	< 0.01	0.0029	< 0.0001	0.16	8.5	0.000050	4.8	< 2E-06	30	0.063	1.7	0.00018	0.000010	< 5E-05	0.082	0.00010	< 0.001	< 0.002
9-Mar-16	21	41	501	450																									

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	320	8.9	27	9.6	0.21	0.016	0.44	0.064	0.064	0.14	0.049	1.2	0.019	1.8	0.0027	0.0041	0.24	0.0010	0.00000045	0.00000064	0.0050	0.0000028	0.56	0.00055
17-Jun-15	2	3	600	550	8.8	23	3.3	0.089	0.0039	0.11	0.055	0.017	0.015	0.019	0.39	0.017	0.99	0.0047	0.0034	0.26	0.00050	0.00000039	0.0000044	0.0010	0.0000015	0.31	0.00016
1-Jul-15	3	5	550	510	8.7	19	1.4	0.050	0.0020	0.10	0.051	0.010	0.0051	0.0031	0.15	0.015	0.81	0.0011	0.0029	0.23	0.00050	0.00000036	0.00000036	0.0012	0.00000077	0.24	0.000069
15-Jul-15	4	7	550	535	8.6	17	0.96	0.061	0.0032	0.11	0.054	0.0054	0.0032	0.0016	0.054	0.016	0.64	0.0025	0.0029	0.23	0.00049	0.00000037	0.00000037	0.0021	0.00000064	0.19	0.000051
29-Jul-15	5	9	500	465	8.6	15	0.74	0.022	0.0019	0.093	0.047	0.0093	0.0028	0.0014	0.047	0.014	0.72	0.0014	0.0020	0.14	0.00055	0.00000033	0.00000033	0.00092	0.00000014	0.22	0.000032
12-Aug-15	6	11	500	490	8.6	15	0.59	0.023	0.0064	0.098	0.049	0.0049	0.0029	0.0015	0.049	0.015	0.70	0.0050	0.0019	0.13	0.00071	0.00000034	0.00000034	0.00088	0.00000044	0.21	0.000030
26-Aug-15	7	13	600	565	8.2	17	0.51	0.021	0.0045	0.11	0.057	0.0057	0.0034	0.0017	0.057	0.017	0.81	0.0040	0.0021	0.14	0.00079	0.00000040	0.00000040	0.00096	0.00000034	0.24	0.000031
9-Sep-15	8	15	600	560	8.5	13	0.45	0.016	0.0017	0.11	0.056	0.0056	0.0034	0.0017	0.056	0.017	0.80	0.0022	0.0020	0.12	0.00076	0.00000039	0.00000039	0.00090	0.00000017	0.24	0.000027
23-Sep-15	9	17	600	560	8.5	12	0.39	0.011	0.0017	0.11	0.056	0.0056	0.0034	0.0017	0.056	0.017	0.86	0.0017	0.0018	0.10	0.00078	0.00000039	0.00000039	0.00080	0.00000017	0.26	0.000024
7-Oct-15	10	19	500	475	8.4	11	0.24	0.0057	0.0014			0.0048	0.0029	0.0014	0.048	0.00	0.78	0.00099	0.0013	0.065	0.00069	0.00000033	0.00000033	0.00059	0.00000014	0.23	0.000017
21-Oct-15	11	21	500	465	8.5	9.6	0.23	0.0070	0.00093			0.0047	0.0028	0.0014	0.047	0.00	0.81	0.00081	0.0013	0.064	0.00084	0.00000033	0.00000033	0.00065	0.00000014	0.24	0.000021
4-Nov-15	12	23	500	485	8.5	9.6	0.29	0.0078	0.00097			0.0049	0.0029	0.0015	0.049	0.00	1.0	0.0011	0.0011	0.057	0.0010	0.00000034	0.00000034	0.00051	0.00000015	0.30	0.000023
18-Nov-15	13	25	500	460	8.6	9.4	0.23	0.0060	0.00046			0.0046	0.0028	0.0014	0.046	0.00	0.97	0.00067	0.00097	0.051	0.00085	0.00000069	0.00000046	0.00056	0.00000014	0.28	0.000018
2-Dec-15	14	27	500	470	8.5	8.0	0.19	0.0047	0.00047			0.0094	0.0028	0.0014	0.047	0.00	1.3	0.0010	0.00098	0.047	0.0013	0.00000033	0.00000033	0.00045	0.00000014	0.36	0.000019
16-Dec-15	15	29	500	460	8.5	7.2	0.18	0.0041	0.00046			0.0046	0.0028	0.0014	0.046	0.00	1.3	0.00058	0.00088	0.038	0.0014	0.00000097	0.0000011	0.00046	0.0000016	0.37	0.000023
30-Dec-15	16	31	500	460	8.4	6.0	0.18	0.0028	0.00046			0.0046	0.0028	0.0014	0.046	0.00	1.6	0.0012	0.00086	0.037	0.0016	0.00000032	0.00000032	0.00051	0.00000014	0.46	0.000021
13-Jan-16	17	33	500	445	8.3	5.8	0.18	0.0027	0.00045			0.0089	0.0027	0.0013	0.045	0.00	1.4	0.00053	0.00071	0.025	0.0014	0.00000031	0.00000031	0.00045	0.00000013	0.41	0.000017
27-Jan-16	18	35	500	475	8.3	5.8	0.19	0.0029	0.00048			0.0095	0.0029	0.0014	0.048	0.00	1.7	0.00039	0.00072	0.027	0.0018	0.00000033	0.00000033	0.00043	0.00000014	0.50	0.000017
10-Feb-16	19	37	500	460	8.3	5.4	0.18	0.0023	0.00046			0.0092	0.0028	0.0014	0.046	0.00	2.0	0.00027	0.00067	0.024	0.0021	0.00000032	0.00000032	0.00032	0.00000014	0.57	0.000017
24-Feb-16	20	39	500	455	8.3	5.3	0.14	0.0018	0.00091			0.0091	0.0027	0.0014	0.046	0.00	2.4	0.00015	0.00062	0.021	0.0023	0.00000032	0.00000032	0.00032	0.00000014	0.67	0.000016
9-Mar-16	21	41	501	450	8.3	4.9	0.14																				

Leachate Concentrations for Col 17 (Supremo/Kone Composite)

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	315	8.9	404	135	4.6	0.26	6.8	*< 1*	0.90	1.4	0.66	17	*< 0.3*	24	0.054	0.11	8.9	0.0084	*< 7E-06*	*< 7E-06*	0.054	0.000033	7.5	0.0064
17-Jun-15	2	3	600	560	8.8	395	60	1.9	0.090	*< 2*	*< 1*	0.30	0.28	0.41	8.0	*< 0.3*	20	0.099	0.089	7.9	0.0065	*< 7E-06*	0.0000070	0.017	0.000022	6.6	0.0020
1-Jul-15	3	5	550	520	8.7	364	32	1.2	0.040	*< 2*	*< 1*	0.20	0.090	0.11	3.0	*< 0.3*	16	0.076	0.082	6.9	0.0061	*< 7E-06*	*< 7E-06*	0.020	0.000014	5.2	0.0010
15-Jul-15	4	7	550	515	8.7	302	23	1.2	0.060	*< 2*	*< 1*	0.10	*< 0.06*	0.030	1.0	*< 0.3*	12	0.20	0.072	5.9	0.0056	0.0000070	*< 7E-06*	0.030	0.0000050	3.6	0.00066
29-Jul-15	5	9	500	475	8.6	297	15	0.52	0.060	*< 2*	*< 1*	0.20	*< 0.06*	*< 0.03*	1.0	*< 0.3*	14	0.13	0.062	4.9	0.0071	0.000012	*< 7E-06*	0.018	*< 3E-06*	4.5	0.00045
12-Aug-15	6	11	500	485	8.6	268	19	0.48	0.040	*< 2*	*< 1*	0.20	*< 0.06*	0.030	1.0	*< 0.3*	14	0.18	0.051	4.0	0.0094	*< 7E-06*	*< 7E-06*	0.016	0.0000040	4.1	0.00051
26-Aug-15	7	13	600	555	8.1	273	13	0.38	0.035	2.0	1.0	0.15	0.060	0.030	1.0	0.30	14	0.12	0.048	3.6	0.0089	0.0000070	0.0000070	0.014	0.0000035	4.2	0.00040
9-Sep-15	8	15	600	570	8.6	214	10	0.28	0.030	*< 2*	*< 1*	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	14	0.062	0.045	3.2	0.0084	*< 7E-06*	*< 7E-06*	0.013	*< 3E-06*	4.2	0.00029
23-Sep-15	9	17	600	560	8.5	201	9.0	0.22	0.025	-	-	0.10	0.060	0.030	1.0	-	15	0.052	0.041	2.7	0.0092	0.0000070	0.0000070	0.012	0.0000030	4.6	0.00027
7-Oct-15	10	19	500	460	8.4	202	7.0	0.16	0.020	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	17	0.043	0.037	2.1	0.0100	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	5.1	0.00025
21-Oct-15	11	21	500	475	8.5	187	8.0	0.17	0.020	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	17	0.018	0.035	2.1	0.012	*< 7E-06*	*< 7E-06*	0.012	*< 3E-06*	5.1	0.00031
4-Nov-15	12	23	500	485	8.5	180	7.0	0.15	0.020	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	20	0.026	0.029	1.8	0.013	*< 7E-06*	*< 7E-06*	0.0086	0.0000080	6.1	0.00033
18-Nov-15	13	25	500	465	8.5	187	6.0	0.10	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	21	0.033	0.027	1.6	0.014	*< 7E-06*	*< 7E-06*	0.0073	0.0000040	6.3	0.00023
2-Dec-15	14	27	500	460	8.4	155	6.0	0.12	0.010	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	28	0.068	0.026	1.4	0.020	*< 7E-06*	*< 7E-06*	0.0081	*< 3E-06*	8.3	0.00023
16-Dec-15	15	29	500	465	8.4	145	6.0	0.10	0.010	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	31	0.017	0.024	1.2	0.023	0.000020	0.000025	0.0085	0.0000040	9.3	0.00031
30-Dec-15	16	31	500	475	8.4	123	5.0	0.070	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	37	0.033	0.026	1.3	0.027	*< 7E-06*	*< 7E-06*	0.011	0.0000070	11	0.00033
13-Jan-16	17	33	500	445	8.3	126	5.0	0.090	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	34	0.012	0.021	0.88	0.022	*< 7E-06*	*< 7E-06*	0.0080	*< 3E-06*	10.0	0.00027
27-Jan-16	18	35	500	455	8.3	120	6.0	0.080	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	39	0.023	0.020	0.86	0.027	*< 7E-06*	*< 7E-06*	0.0080	*< 3E-06*	11	0.00024
10-Feb-16	19	37	500	465	8.2	114	5.0	0.060	*< 0.01*	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	43	0.0079	0.020	0.85	0.029	*< 7E-06*	*< 7E-06*	0.0060	*< 3E-06*	13	0.00023
24-Feb-16	20	39	500	465	8.3	112	4.0	0.050	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	51	0.0052	0.018	0.77	0.033	*< 7E-06*	*< 7E-06*	0.0050	*< 3E-06*	15	0.00027
9-Mar-16	21	41	501	455	8.3	106	4.0																				

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	315	8.9	25	8.5	0.29	0.016	0.43	0.063	0.057	0.088	0.042	1.1	0.019	1.5	0.0034	0.0066	0.56	0.00053	0.00000044	0.00000044	0.0034	0.0000021	0.47	0.00040
17-Jun-15	2	3	600	560	8.8	22	3.4	0.11	0.0050	0.11	0.056	0.017	0.016	0.023	0.45	0.017	1.1	0.0055	0.0050	0.44	0.00036	0.00000039	0.00000039	0.00094	0.0000012	0.37	0.00011
1-Jul-15	3	5	550	520	8.7	19	1.7	0.064	0.0021	0.10	0.052	0.010	0.0047	0.0057	0.16	0.016	0.85	0.0040	0.0043	0.36	0.00032	0.00000036	0.00000036	0.0011	0.00000073	0.27	0.000054
15-Jul-15	4	7	550	515	8.7	16	1.2	0.064	0.0031	0.10	0.052	0.0052	0.0031	0.0015	0.052	0.015	0.61	0.010	0.0037	0.30	0.00029	0.00000036	0.00000036	0.0015	0.00000026	0.19	0.000034
29-Jul-15	5	9	500	475	8.6	14	0.71	0.025	0.0029	0.095	0.048	0.0095	0.0029	0.0014	0.048	0.014	0.68	0.0061	0.0029	0.23	0.00034	0.00000057	0.00000033	0.00086	0.00000014	0.21	0.000021
12-Aug-15	6	11	500	485	8.6	13	0.92	0.023	0.0019	0.097	0.049	0.0097	0.0029	0.0015	0.049	0.015	0.65	0.0086	0.0025	0.20	0.00046	0.00000034	0.00000034	0.00077	0.00000019	0.20	0.000025
26-Aug-15	7	13	600	555	8.1	15	0.72	0.021	0.0019	0.11	0.056	0.0083	0.0033	0.0017	0.056	0.017	0.75	0.0066	0.0027	0.20	0.00050	0.00000039	0.00000039	0.00080	0.00000019	0.23	0.000022
9-Sep-15	8	15	600	570	8.6	12	0.57	0.016	0.0017	0.11	0.057	0.0057	0.0034	0.0017	0.057	0.017	0.78	0.0035	0.0026	0.18	0.00048	0.00000040	0.00000040	0.00075	0.00000017	0.24	0.000017
23-Sep-15	9	17	600	560	8.5	11	0.50	0.012	0.0014			0.0056	0.0034	0.0017	0.056		0.84	0.0029	0.0023	0.15	0.00052	0.00000039	0.00000039	0.00066	0.00000017	0.26	0.000015
7-Oct-15	10	19	500	460	8.4	9.3	0.32	0.0074	0.00092			0.0046	0.0028	0.0014	0.046		0.76	0.0020	0.0017	0.098	0.00046	0.00000032	0.00000032	0.00048	0.00000014	0.23	0.000012
21-Oct-15	11	21	500	475	8.5	8.9	0.38	0.0081	0.00095			0.0048	0.0029	0.0014	0.048		0.80	0.00086	0.0016	0.100	0.00055	0.00000033	0.00000033	0.00055	0.00000014	0.24	0.000015
4-Nov-15	12	23	500	485	8.5	8.7	0.34	0.0073	0.00097			0.0049	0.0029	0.0015	0.049		0.97	0.0013	0.0014	0.087	0.00064	0.00000034	0.00000034	0.00042	0.00000039	0.30	0.000016
18-Nov-15	13	25	500	465	8.5	8.7	0.28	0.0047	0.00047			0.0047	0.0028	0.0014	0.047		0.98	0.0015	0.0012	0.074	0.00065	0.00000033	0.00000033	0.00034	0.00000019	0.29	0.000011
2-Dec-15	14	27	500	460	8.4	7.1	0.28	0.0055	0.00046			0.0092	0.0028	0.0014	0.046		1.3	0.0031	0.0012	0.065	0.00093	0.00000032	0.00000032	0.00037	0.00000014	0.38	0.000011
16-Dec-15	15	29	500	465	8.4	6.7	0.28	0.0047	0.00047			0.0047	0.0028	0.0014	0.047		1.4	0.00079	0.0011	0.057	0.0011	0.00000093	0.0000012	0.00040	0.0000019	0.43	0.000014
30-Dec-15	16	31	500	475	8.4	5.8	0.24	0.0033	0.00048			0.0048	0.0029	0.0014	0.048		1.7	0.0016	0.0012	0.060	0.0013	0.00000033	0.00000033	0.00051	0.00000033	0.51	0.000016
13-Jan-16	17	33	500	445	8.3	5.6	0.22	0.0040	0.00045			0.0089	0.0027	0.0013	0.045		1.5	0.00055	0.00094	0.039	0.00099	0.00000031	0.00000031	0.00036	0.00000013	0.44	0.000012
27-Jan-16	18	35	500	455	8.3	5.5	0.27	0.0036	0.00046			0.0046	0.0027	0.0014	0.046		1.8	0.0011	0.00092	0.039	0.0012	0.00000032	0.00000032	0.00036	0.00000014	0.52	0.000011
10-Feb-16	19	37	500	465	8.2	5.3	0.23	0.0028	0.00047			0.0047	0.0028	0.0014	0.047		2.0	0.00037	0.00092	0.039	0.0014	0.00000033	0.00000033	0.00028	0.00000014	0.60	0.000011
24-Feb-16	20	39	500	465	8.3	5.2	0.19	0.0023	0.00047			0.0093	0.0028	0.0014	0.047		2.4	0.00024	0.00086	0.036	0.0015	0.00000033	0.00000033	0.00023	0.00000014	0.69	0.000013
9-Mar-16	21	41	501	455	8.3	4.8	0.18																				

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	320	0.015	0.00027	0.084	0.000019	0.00028	0.097	0.000034	0.042	0.011	0.0065	0.070	0.46	0.00013	0.26	0.000080	17	0.0018	3.6	0.0000090	0.00000064	0.000021	0.14	0.000049	0.00013	0.00013
17-Jun-15	2	3	600	550	0.0038	0.000085	0.030	0.00000055	0.00014	0.053	0.00016	0.0088	0.0046	0.00077	0.081	0.33	0.000046	0.27	0.0000020	11	0.0010	1.1	0.0000075	0.000019	0.000031	0.087	0.000036	0.000055	0.00011
1-Jul-15	3	5	550	510	0.0015	0.000066	0.017	0.00000051	0.00014	0.048	0.000021	0.0026	0.0026	0.000082	0.064	0.28	0.000027	0.25	0.00000061	9.1	0.00093	0.49	0.0000065	0.0000056	0.000015	0.059	0.000029	0.000051	0.00010
15-Jul-15	4	7	550	535	0.00088	0.000066	0.016	0.0000011	0.00013	0.042	0.000037	0.0021	0.0017	0.000032	0.058	0.25	0.000022	0.25	0.0000024	8.0	0.00081	0.37	0.0000072	0.0000021	0.000020	0.050	0.000033	0.000054	0.00011
29-Jul-15	5	9	500	465	0.00044	0.000042	0.0083	0.00000047	0.00013	0.042	0.000018	0.00093	0.0010	0.0000093	0.043	0.23	0.000013	0.21	0.00000060	6.3	0.00085	0.25	0.0000053	0.0000023	0.0000079	0.032	0.000020	0.000047	0.000093
12-Aug-15	6	11	500	490	0.00036	0.000032	0.0078	0.0000015	0.00012	0.043	0.000034	0.0015	0.00087	0.0000098	0.042	0.26	0.000017	0.25	0.00000074	6.2	0.00089	0.20	0.0000092	0.0000034	0.000027	0.025	0.000028	0.000049	0.000098
26-Aug-15	7	13	600	565	0.00033	0.000046	0.0070	0.0000014	0.00013	0.049	0.000037	0.0011	0.00092	0.0000085	0.043	0.28	0.000017	0.27	0.0000014	6.3	0.00098	0.28	0.0000088	0.0000062	0.000022	0.024	0.000026	0.000057	0.00011
9-Sep-15	8	15	600	560	0.00025	0.000055	0.0049	0.0000011	0.00012	0.047	0.000035	0.00056	0.00082	0.0000056	0.038	0.27	0.000015	0.25	0.0000018	5.4	0.00094	0.32	0.0000069	0.0000084	0.000013	0.019	0.000020	0.000056	0.00011
23-Sep-15	9	17	600	560	0.00020	0.000039	0.0038	0.00000084	0.00013	0.051	0.000022	0.00056	0.00060	0.0000056	0.032	0.27	0.000011	0.24	0.0000011	5.1	0.0010	0.22	0.0000066	0.0000059	0.000013	0.016	0.000017	0.000056	0.00011
7-Oct-15	10	19	500	475	0.00013	0.000019	0.0023	0.00000048	0.00011	0.047	0.0000081	0.00048	0.00032	0.0000048	0.022	0.23	0.0000067	0.20	0.00000033	4.0	0.00093	0.10	0.0000053	0.0000029	0.000010	0.011	0.000012	0.000048	0.000095
21-Oct-15	11	21	500	465	0.00014	0.000025	0.0027	0.00000047	0.00011	0.053	0.000014	0.00047	0.00034	0.0000047	0.020	0.23	0.0000042	0.21	0.00000023	3.5	0.00096	0.10	0.0000057	0.000011	0.0000033	0.0095	0.000014	0.000047	0.000093
4-Nov-15	12	23	500	485	0.00012	0.000025	0.0025	0.00000049	0.00011	0.063	0.000038	0.00049	0.00030	0.0000049	0.018	0.26	0.0000049	0.21	0.00000015	3.8	0.0011	0.12	0.0000066	0.0000053	0.0000044	0.0082	0.000013	0.000049	0.000097
18-Nov-15	13	25	500	460	0.000098	0.000031	0.0020	0.0000028	0.00012	0.063	0.000046	0.00046	0.00024	0.0000046	0.018	0.25	0.000029	0.21	0.00000046	3.3	0.0011	0.12	0.0000075	0.0000078	0.0000032	0.0071	0.000011	0.000046	0.000092
2-Dec-15	14	27	500	470	0.00010	0.000020	0.0021	0.00000047	0.00013	0.085	0.00012	0.00047	0.00023	0.0000047	0.015	0.30	0.0000047	0.22	0.00000019	3.5	0.0015	0.10	0.0000058	0.00000047	0.0000066	0.0068	0.000011	0.000094	0.000094
16-Dec-15	15	29	500	460	0.000087	0.000029	0.0015	0.000012	0.00013	0.087	0.000090	0.00046	0.00020	0.0000046	0.013	0.30	0.0000083	0.28	0.00000097	2.9	0.0015	0.064	0.0000068	0.000012	0.0000078	0.0059	0.000011	0.000046	0.000092
30-Dec-15	16	31	500	460	0.000073	0.000033	0.0015	0.0000060	0.00016	0.10	0.000080	0.00046	0.00019	0.0000046	0.012	0.31	0.0000064	0.23	0.0000028	2.7	0.0018	0.069	0.0000095	0.0000037	0.0000060	0.0058	0.000011	0.000046	0.000092
13-Jan-16	17	33	500	445	0.000061	0.000038	0.0012	0.0000018	0.00013	0.10	0.000083	0.00045	0.00017	0.0000045	0.0089	0.32	0.000062	0.20	0.000000089	2.2	0.0017	0.071	0.0000056	0.0000036	0.0000022	0.0043	0.0000062	0.000045	0.000089
27-Jan-16	18	35	500	475	0.000057	0.000018	0.00086	0.00000048	0.00014	0.12	0.000074	0.00048	0.00015	0.0000048	0.0091	0.34	0.0000019	0.23	0.000000095	2.0	0.0022	0.076	0.0000083	0.0000029	0.0000024	0.0045	0.0000067	0.000048	0.000095
10-Feb-16	19	37	500	460	0.000052	0.000020	0.00060	0.0000041	0.00015	0.14	0.000065	0.00046	0.00013	0.0000046	0.0075	0.34	0.0000041	0.21	0.000000092	1.7	0.0024	0.083	0.0000082	0.0000032	0.0000023	0.0037	0.0000060	0.000046	0.000092
24-Feb-16	20	39	500	455	0.000052	0.0000096	0.00073	0.00000091	0.00016	0.17	0.00013	0.00046	0.00013	0.0000046	0.0071	0.38	0.0000023	0.22	0.000000091	1.4	0.0028	0.077	0.0000080	0.00000046	0.0000023	0.0037	0.0000046	0.000046	0.000091
9-Mar-16	21	41	501	450																									

Leachate Concentrations for Col 17 (Supremo/Kone Composite)

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	315	0.20	0.0055	1.8	0.00026	0.0032	1.2	0.00031	0.54	0.14	0.075	1.4	7.0	0.0010	3.9	0.00076	262	0.023	52	0.00014	*< 1E-05*	0.00031	2.5	0.0011	0.0020	*< 0.002*
17-Jun-15	2	3	600	560	0.072	0.0020	0.69	0.00032	0.0021	0.94	0.0014	0.14	0.076	0.016	1.7	6.1	0.00091	4.5	0.000052	200	0.019	22	0.00016	0.00014	0.00069	1.8	0.00081	*< 0.001*	*< 0.002*
1-Jul-15	3	5	550	520	0.033	0.0012	0.41	*< 1E-05*	0.0021	0.82	0.00083	0.050	0.047	0.0028	1.4	5.3	0.00057	4.7	0.0000080	173	0.017	10	0.00014	0.000080	0.00032	1.3	0.00069	*< 0.001*	*< 0.002*
15-Jul-15	4	7	550	515	0.018	0.0014	0.36	0.000040	0.0019	0.68	0.0011	0.040	0.028	0.00070	1.2	4.7	0.00055	4.7	0.000029	144	0.014	7.9	0.00013	0.000070	0.00083	1.0	0.00081	*< 0.001*	*< 0.002*
29-Jul-15	5	9	500	475	0.011	0.0015	0.22	0.000040	0.0021	0.79	0.00058	0.020	0.021	0.00030	1.0	4.8	0.00032	4.3	0.0000060	130	0.016	6.2	0.00011	0.00023	0.00039	0.77	0.00054	*< 0.001*	*< 0.002*
12-Aug-15	6	11	500	485	0.011	0.00085	0.19	0.000040	0.0019	0.78	0.00080	0.040	0.018	0.00020	0.84	5.4	0.00030	4.7	0.000016	121	0.017	5.9	0.00023	0.000070	0.00069	0.55	0.00069	*< 0.001*	*< 0.002*
26-Aug-15	7	13	600	555	0.0078	0.00091	0.15	0.000030	0.0017	0.77	0.00081	0.025	0.015	0.00015	0.76	5.0	0.00027	4.3	0.000017	106	0.016	6.4	0.00018	0.00013	0.00050	0.47	0.00058	0.0010	0.0020
9-Sep-15	8	15	600	570	0.0049	0.00097	0.10	0.000020	0.0015	0.77	0.00081	*< 0.01*	0.012	*< 0.0001*	0.69	4.6	0.00024	3.9	0.000017	92	0.015	6.8	0.00013	0.00018	0.00031	0.38	0.00047	*< 0.001*	*< 0.002*
23-Sep-15	9	17	600	560	0.0039	0.00074	0.079	0.000015	0.0016	0.85	0.00051	0.010	0.0091	0.00010	0.59	4.7	0.00018	3.9	0.000012	86	0.017	5.0	0.00012	0.00013	0.00027	0.32	0.00038	0.0010	0.0020
7-Oct-15	10	19	500	460	0.0030	0.00051	0.056	0.000010	0.0017	0.92	0.00021	*< 0.01*	0.0064	*< 0.0001*	0.49	4.8	0.00011	3.9	0.0000060	80	0.019	3.2	0.00011	0.000080	0.00023	0.25	0.00028	*< 0.001*	*< 0.002*
21-Oct-15	11	21	500	475	0.0033	0.00066	0.062	*< 1E-05*	0.0017	1.0	0.00012	*< 0.01*	0.0069	*< 0.0001*	0.43	4.7	0.00013	3.9	0.0000020	69	0.019	2.9	0.00015	0.00014	0.000060	0.23	0.00036	*< 0.001*	*< 0.002*
4-Nov-15	12	23	500	485	0.0028	0.00063	0.056	*< 1E-05*	0.0016	1.2	0.00036	*< 0.01*	0.0061	*< 0.0001*	0.39	5.2	0.00013	3.8	0.0000020	71	0.021	3.1	0.00014	0.000090	0.00011	0.19	0.00029	*< 0.001*	*< 0.002*
18-Nov-15	13	25	500	465	0.0023	0.00098	0.049	0.00020	0.0018	1.3	0.0017	*< 0.01*	0.0044	*< 0.0001*	0.37	5.3	0.00035	4.0	0.000015	65	0.024	2.8	0.00015	0.00011	0.00010	0.18	0.00022	*< 0.001*	*< 0.002*
2-Dec-15	14	27	500	460	0.0022	0.00048	0.054	*< 1E-05*	0.0020	1.7	0.0015	0.010	0.0049	0.00010	0.31	6.2	0.00010	4.1	*< 2E-06*	65	0.031	2.8	0.00015	0.000080	0.00017	0.16	0.00024	*< 0.002*	*< 0.002*
16-Dec-15	15	29	500	465	0.0022	0.00055	0.047	0.00025	0.0020	1.9	0.0011	*< 0.01*	0.0048	*< 0.0001*	0.26	6.6	0.00018	5.5	0.000024	57	0.036	2.3	0.00017	0.00027	0.000060	0.14	0.00022	*< 0.001*	*< 0.002*
30-Dec-15	16	31	500	475	0.0020	0.00063	0.039	0.00014	0.0026	2.3	0.0020	0.010	0.0046	*< 0.0001*	0.25	7.4	0.00010	4.3	0.000017	58	0.043	2.1	0.00023	0.000090	*< 5E-05*	0.15	0.00024	*< 0.001*	*< 0.002*
13-Jan-16	17	33	500	445	0.0016	0.00054	0.029	0.000050	0.0021	2.2	0.00070	*< 0.01*	0.0035	*< 0.0001*	0.20	7.2	0.0010	4.1	*< 2E-06*	48	0.038	2.0	0.00013	0.000050	*< 5E-05*	0.11	0.00014	*< 0.001*	*< 0.002*
27-Jan-16	18	35	500	455	0.0015	0.00042	0.024	0.000020	0.0021	2.5	0.00070	*< 0.01*	0.0032	*< 0.0001*	0.19	7.0	*< 4E-05*	4.2	*< 2E-06*	40	0.048	2.2	0.00018	0.000070	*< 5E-05*	0.11	0.00015	*< 0.001*	*< 0.002*
10-Feb-16	19	37	500	465	0.0013	0.00037	0.016	0.00010	0.0022	2.7	0.00079	*< 0.01*	0.0029	*< 0.0001*	0.18	7.2	0.000090	4.0	*< 2E-06*	35	0.052	2.3	0.00019	0.000060	*< 5E-05*	0.094	0.00014	*< 0.001*	*< 0.002*
24-Feb-16	20	39	500	465	0.0013	0.00032	0.021	0.000030	0.0024	3.4	0.00095	0.020	0.0029	*< 0.0001*	0.17	7.9	0.000050	4.2	*< 2E-06*	31	0.058	2.3	0.00019	0.000050	*< 5E-05*	0.100	0.00010	*< 0.001*	*< 0.002*
9-Mar-16	21	41	501	455																									

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	315	0.013	0.00034	0.12	0.000016	0.00020	0.076	0.000020	0.034	0.0089	0.0047	0.091	0.44	0.000063	0.25	0.000048	17	0.0015	3.2	0.0000087	0.00000063	0.000020	0.15	0.000066	0.00013	0.00013
17-Jun-15	2	3	600	560	0.0040	0.00011	0.039	0.000018	0.00011	0.053	0.000077	0.0078	0.0042	0.00087	0.092	0.34	0.000051	0.25	0.0000029	11	0.0011	1.2	0.0000091	0.0000078	0.000039	0.10	0.000045	0.000056	0.00011
1-Jul-15	3	5	550	520	0.0017	0.000063	0.021	0.00000052	0.00011	0.043	0.000043	0.0026	0.0024	0.00015	0.071	0.28	0.000030	0.25	0.00000042	9.0	0.00090	0.54	0.0000074	0.0000042	0.000017	0.068	0.000036	0.000052	0.00010
15-Jul-15	4	7	550	515	0.00093	0.000074	0.018	0.0000021	0.000097	0.035	0.000055	0.0021	0.0014	0.000036	0.059	0.24	0.000028	0.24	0.0000015	7.4	0.00070	0.41	0.0000065	0.0000036	0.000043	0.052	0.000042	0.000052	0.00010
29-Jul-15	5	9	500	475	0.00051	0.000071	0.010	0.0000019	0.00010	0.038	0.000028	0.00095	0.00098	0.0000014	0.048	0.23	0.000015	0.21	0.00000029	6.2	0.00077	0.29	0.0000054	0.000011	0.000019	0.036	0.000026	0.000048	0.000095
12-Aug-15	6	11	500	485	0.00052	0.000041	0.0092	0.0000019	0.000091	0.038	0.000039	0.0019	0.00086	0.0000097	0.041	0.26	0.000015	0.23	0.00000078	5.9	0.00082	0.29	0.000011	0.0000034	0.000033	0.027	0.000033	0.000049	0.000097
26-Aug-15	7	13	600	555	0.00043	0.000051	0.0081	0.0000017	0.000094	0.043	0.000045	0.0014	0.00082	0.0000083	0.042	0.28	0.000015	0.24	0.00000092	5.9	0.00089	0.35	0.0000100	0.0000069	0.000028	0.026	0.000032	0.000056	0.00011
9-Sep-15	8	15	600	570	0.00028	0.000055	0.0058	0.0000011	0.000086	0.044	0.000046	0.00057	0.00067	0.0000057	0.039	0.26	0.000014	0.22	0.00000097	5.2	0.00087	0.39	0.0000073	0.000010	0.000018	0.022	0.000027	0.000057	0.00011
23-Sep-15	9	17	600	560	0.00022	0.000041	0.0044	0.00000084	0.000089	0.047	0.000029	0.00056	0.00051	0.0000056	0.033	0.26	0.0000098	0.22	0.00000064	4.8	0.00095	0.28	0.0000066	0.0000073	0.000015	0.018	0.000021	0.000056	0.00011
7-Oct-15	10	19	500	460	0.00014	0.000023	0.0026	0.00000046	0.000078	0.043	0.0000097	0.00046	0.00029	0.0000046	0.022	0.22	0.0000051	0.18	0.00000028	3.7	0.00086	0.15	0.0000050	0.0000037	0.000011	0.011	0.000013	0.000046	0.000092
21-Oct-15	11	21	500	475	0.00016	0.000031	0.0029	0.00000048	0.000079	0.048	0.0000057	0.00048	0.00033	0.0000048	0.020	0.22	0.0000062	0.19	0.000000095	3.3	0.00092	0.14	0.0000071	0.0000067	0.0000029	0.011	0.0000017	0.000048	0.000095
4-Nov-15	12	23	500	485	0.00013	0.000031	0.0027	0.00000049	0.000076	0.057	0.000017	0.00049	0.00029	0.0000049	0.019	0.25	0.0000063	0.18	0.000000097	3.5	0.0010	0.15	0.0000070	0.0000044	0.0000053	0.0093	0.000014	0.000049	0.000097
18-Nov-15	13	25	500	465	0.00011	0.000046	0.0023	0.0000093	0.000084	0.060	0.000078	0.00047	0.00020	0.0000047	0.017	0.25	0.000016	0.18	0.00000070	3.0	0.0011	0.13	0.0000071	0.0000051	0.0000047	0.0083	0.000010	0.000047	0.000093
2-Dec-15	14	27	500	460	0.00010	0.000022	0.0025	0.00000046	0.000090	0.078	0.000067	0.00046	0.00022	0.0000046	0.014	0.28	0.0000046	0.19	0.000000092	3.0	0.0014	0.13	0.0000070	0.0000037	0.0000078	0.0075	0.000011	0.000092	0.000092
16-Dec-15	15	29	500	465	0.00010	0.000026	0.0022	0.000012	0.000093	0.086	0.000050	0.00047	0.00022	0.0000047	0.012	0.31	0.0000084	0.25	0.0000011	2.6	0.0017	0.11	0.0000079	0.000013	0.0000028	0.0066	0.000010	0.000047	0.000093
30-Dec-15	16	31	500	475	0.000094	0.000030	0.0019	0.0000067	0.00012	0.11	0.000097	0.00048	0.00022	0.0000048	0.012	0.35	0.0000048	0.20	0.00000081	2.8	0.0020	0.100	0.000011	0.0000043	0.0000024	0.0071	0.000011	0.000048	0.000095
13-Jan-16	17	33	500	445	0.000069	0.000024	0.0013	0.0000022	0.000093	0.099	0.000031	0.00045	0.00016	0.0000045	0.0088	0.32	0.000046	0.18	0.000000089	2.1	0.0017	0.089	0.0000056	0.0000022	0.0000022	0.0049	0.0000062	0.000045	0.000089
27-Jan-16	18	35	500	455	0.000066	0.000019	0.0011	0.00000091	0.000096	0.11	0.000032	0.00046	0.00015	0.0000046	0.0088	0.32	0.0000018	0.19	0.000000091	1.8	0.0022	0.10	0.0000080	0.0000032	0.0000023	0.0050	0.0000068	0.000046	0.000091
10-Feb-16	19	37	500	465	0.000059	0.000017	0.00074	0.0000047	0.000100	0.13	0.000037	0.00047	0.00014	0.0000047	0.0081	0.33	0.0000042	0.18	0.000000093	1.6	0.0024	0.11	0.0000087	0.0000028	0.0000023	0.0043	0.0000065	0.000047	0.000093
24-Feb-16	20	39	500	465	0.000062	0.000015	0.00098	0.0000014	0.00011	0.16	0.000044	0.00093	0.00014	0.0000047	0.0077	0.37	0.0000023	0.20	0.000000093	1.4	0.0027	0.11	0.0000088	0.0000023	0.0000023	0.0046	0.0000047	0.000047	0.000093
9-Mar-16	21	41	501	455																									

Notes:
Values in grey italics are below the analytical detection limit

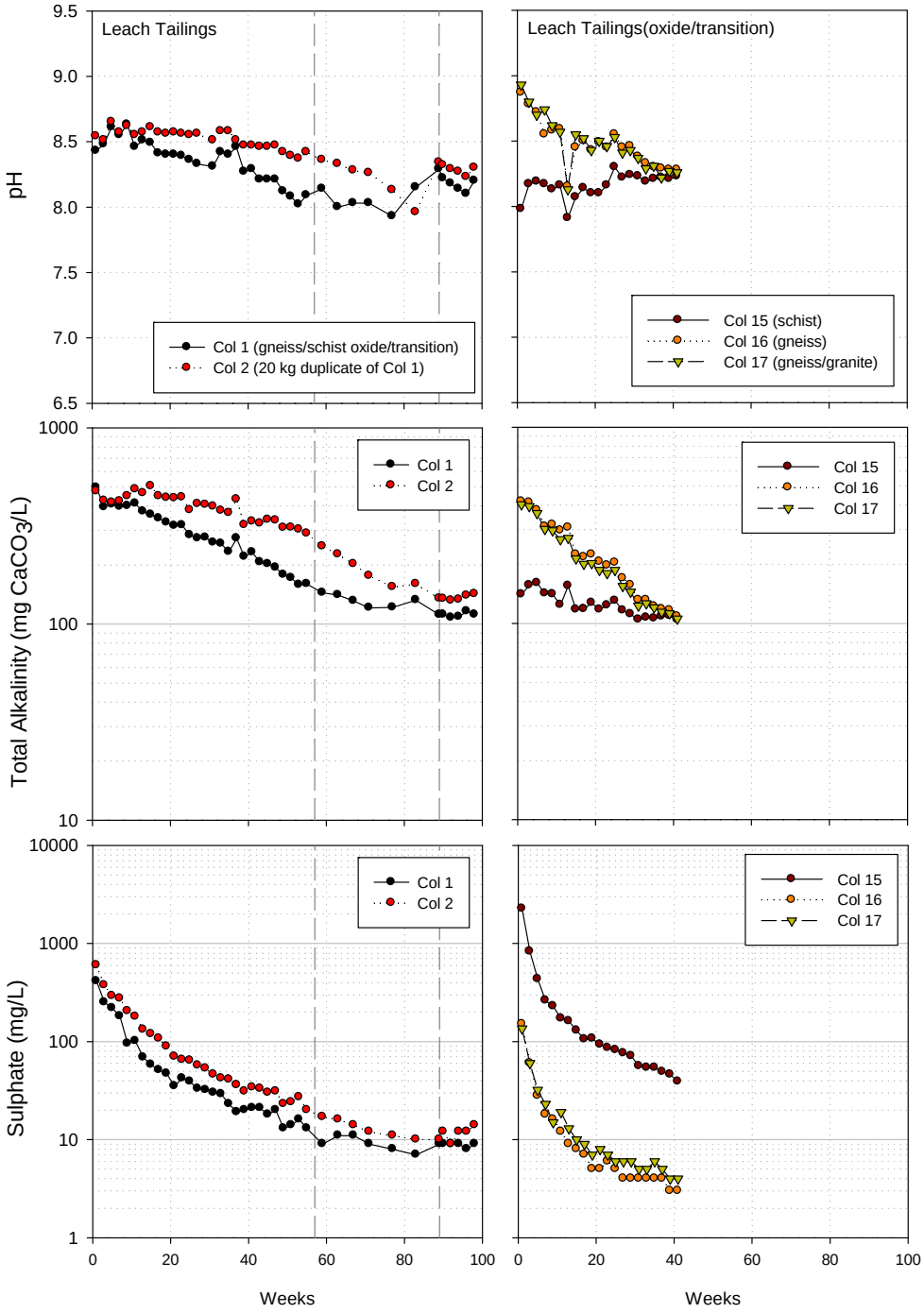
Leachate Concentrations for Leach Tailings Field Kinetic Tests

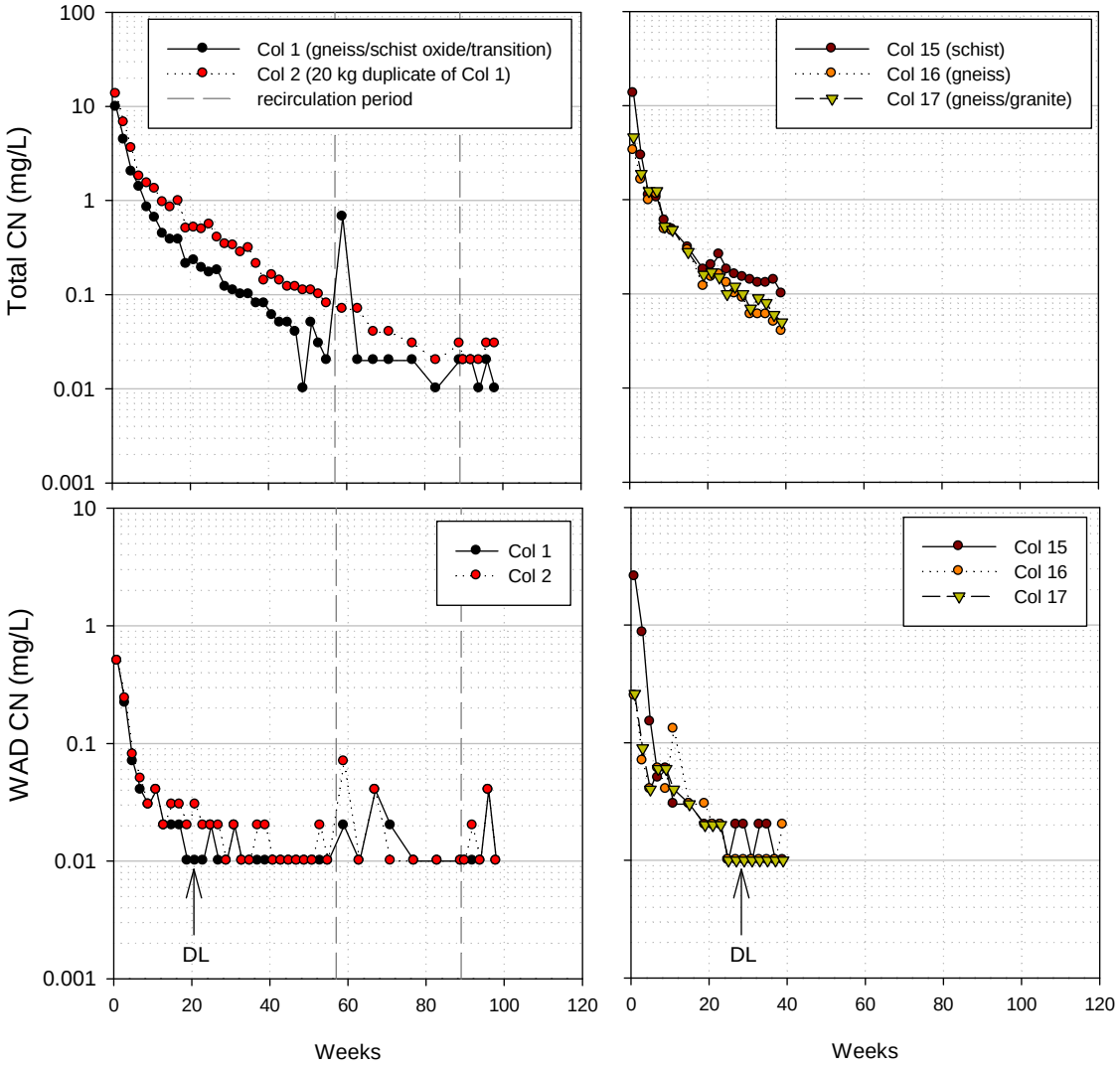
Sample ID		FB-LT1					FB-LT2		FB-LT3	
Date Sampled		17-Jun-14	25-Sep-14	4-Jun-15	10-Aug-15	22-Oct-15	10-Aug-15	22-Oct-15	10-Aug-15	22-Oct-15
Weeks		0.00	14	50	60	70	*0.00*	10	*0.00*	10
Volume	L	5.0	7.0	5.8	2.0	5.0	*0.50*	8.0	*0.50*	8.0
Conductivity	uS/cm	716	991	709	529	692	*595*	490	*780*	734
Hardness (as CaCO3)	mg/L	39	38	17	26	29	*51*	22	*21*	23
pH		8.5	8.5	8.6	8.4	8.5	*8.7*	9.2	*8.9*	8.6
TDS	mg/L	529	669	471	356	429	*953*	985	*680*	1120
Anions and Nutrients										
T-Alkalinity (as CaCO3)	mg/L	227	15	193	-	197	-	254	-	235
T-Ammonia-N	mg/L	0.71	0.29	0.036	-	*< 0.005*	-	5.0	-	1.9
Nitrate-N	mg/L	0.94	4.2	3.9	3.6	5.2	*0.14*	0.16	*< 0.005*	0.85
Nitrite-N	mg/L	2.0	-	0.95	0.34	0.0046	*0.18*	0.080	*< 0.001*	25
Br	mg/L	*< 0.25*	-	*< 0.1*	*< 0.05*	*< 0.25*	*< 0.05*	*< 0.05*	*< 0.25*	*< 0.25*
Cl	mg/L	20	18	8.4	2.1	3.7	*8.3*	6.2	*15*	16
F	mg/L	0.43		0.31	0.36	0.35	*0.35*	0.27	*0.54*	0.60
S(6)	mg/L	119	243	135	88	118	*9.9*	6.2	*18*	24
Cyanides										
WAD Cyanide	mg/L	0.18	0.019	0.34	0.010	0.017	*0.047*	0.052	-	0.17
T-Cyanide	mg/L	1.6	0.34	0.83	0.27	0.38	*1.5*	2.6	-	2.2
Organic / Inorganic Carbon										
DOC	mg/L	9.0	11	-	-	6.0	-	26	-	48
Radioisotopes										
Ra-226	Bq/L	-	-	0.012	0.020	0.012	-	0.42	-	0.030
Dissolved Metals										
Al	mg/L	0.49	0.0080	0.0080	0.0080	0.012	*10*	0.85	*0.30*	1.7
Sb	mg/L	0.046	0.035	0.027	0.030	0.024	*0.11*	0.021	*0.070*	0.057
As	mg/L	1.2	1.8	1.6	1.3	1.4	*1.2*	1.1	*2.3*	3.2
Ba	mg/L	0.048	0.023	0.011	0.029	0.025	*0.19*	0.039	*0.044*	0.080
Be	mg/L	*< 0.0001*	*< 0.001*	*< 0.00002*	*< 0.00002*	*< 0.00002*	*0.0010*	0.000039	*< 0.00002*	0.00010
Bi	mg/L	*< 0.0005*	-	*< 0.00005*	*< 0.00005*	*< 0.00005*	*0.00*	*< 0.00005*	*< 0.00005*	*< 0.00005*
B	mg/L	0.028	*< 0.1*	0.016	0.017	0.016	*0.022*	*< 0.01*	*0.018*	0.019
Cd	mg/L	0.000020	*< 0.00001*	*< 5E-06*	*< 5E-06*	*< 5E-06*	*< 0.00005*	0.0000089	*< 5E-06*	0.0000057
Ca	mg/L	12	11	4.1	7.4	8.1	*17*	8.1	*8.1*	8.3
Cr	mg/L	0.020	0.010	0.0020	0.0030	0.0044	*0.031*	0.015	*0.0020*	0.0050
Co	mg/L	0.077	0.10	0.043	0.021	0.024	*0.57*	0.46	*0.12*	0.20
Cu	mg/L	0.0060	0.0020	0.0020	0.0020	0.0014	*0.016*	0.010	*0.063*	0.042
Fe	mg/L	1.0	0.81	0.24	0.12	0.19	*15*	2.2	*0.32*	2.9
Pb	mg/L	0.00053	*< 0.0005*	*< 0.00005*	0.00010	0.000070	*0.0073*	0.00049	*0.000073*	0.00088
Li	mg/L	0.0050	*< 0.005*	0.0040	0.0040	0.0041	*0.0030*	*< 0.001*	*< 0.001*	*< 0.001*
Mg	mg/L	2.4	2.4	1.6	1.7	2.1	*1.9*	0.28	*0.24*	0.55
Mn	mg/L	0.033	0.0090	0.010	0.013	0.0042	*0.30*	0.022	*0.0080*	0.085
Hg	mg/L	0.00042	0.000052	0.000039	0.000019	0.000018	-	0.00064	-	0.00038
Mo	mg/L	0.054	0.089	0.043	0.058	0.061	*0.22*	0.17	*0.034*	0.048
Ni	mg/L	0.042	*< 0.001*	0.0010	*< 0.0005*	*< 0.0005*	*0.061*	0.016	*0.26*	0.085
P	mg/L	0.24	-	0.23	0.21	0.21	*0.69*	0.53	*0.14*	0.39
K	mg/L	8.5	7.2	4.8	5.3	5.8	*5.0*	1.6	*1.3*	2.2
Se	mg/L	0.0020	0.0020	0.0010	0.0010	0.00082	*0.0020*	0.0017	*0.0030*	0.0024
Si	mg/L	5.2	-	3.2	3.8	3.9	*24*	4.8	*6.3*	8.9
Ag	mg/L	0.00	*< 0.00002*	0.00	*< 0.00001*	*< 0.00001*	*0.00*	0.000033	*0.00*	0.00030
Na	mg/L	138	216	154	108	144	*114*	110	*195*	150
Sr	mg/L	0.052	-	0.024	0.039	0.041	*0.043*	0.016	*0.017*	0.023
Tl	mg/L	0.00	0.00	0.00	0.00	0.00010	*0.0010*	0.00021	*0.00*	0.00038
Sn	mg/L	*< 0.0001*	*< 0.0005*	*< 0.0001*	*< 0.0001*	*< 0.0001*	*0.0010*	*< 0.0001*	*0.00*	0.00035
Ti	mg/L	*< 0.01*	*< 0.01*	*< 0.0003*	*< 0.0003*	*< 0.0003*	*0.17*	0.013	*0.0010*	0.017
U	mg/L	0.21	0.36	0.23	0.16	0.21	*0.46*	0.67	*0.036*	0.027
V	mg/L	*< 0.001*	*< 0.001*	*< 0.0005*	*< 0.0005*	*< 0.0005*	*0.023*	0.0029	*0.0020*	0.0041
Zn	mg/L	0.0020	0.019	0.0070	0.047	0.021	*0.019*	0.0019	*< 0.001*	0.0066
Total Metals										
Al	mg/L	-	0.13	-	-	-	-	-	-	-
Sb	mg/L	-	0.037	-	-	-	-	-	-	-
As	mg/L	-	1.8	-	-	-	-	-	-	-
Ba	mg/L	-	0.025	-	-	-	-	-	-	-
Be	mg/L	-	*< 0.001*	-	-	-	-	-	-	-
B	mg/L	-	*< 0.1*	-	-	-	-	-	-	-
Cd	mg/L	-	*< 0.00001*	-	-	-	-	-	-	-
Ca	mg/L	-	11	-	-	-	-	-	-	-
Cr	mg/L	-	0.0098	-	-	-	-	-	-	-
Co	mg/L	-	0.11	-	-	-	-	-	-	-
Cu	mg/L	-	0.0025	-	-	-	-	-	-	-
Fe	mg/L	-	0.99	-	-	-	-	-	-	-
Pb	mg/L	-	*< 0.0005*	-	-	-	-	-	-	-
Li	mg/L	-	*< 0.005*	-	-	-	-	-	-	-
Mg	mg/L	-	2.4	-	-	-	-	-	-	-
Mn	mg/L	-	0.014	-	-	-	-	-	-	-
Hg	mg/L	0.0096	0.000062	-	-	-	-	-	-	-
Mo	mg/L	-	0.092	-	-	-	-	-	-	-
Ni	mg/L	-	0.0011	-	-	-	-	-	-	-
K	mg/L	-	7.2	-	-	-	-	-	-	-
Se	mg/L	-	0.0020	-	-	-	-	-	-	-
Ag	mg/L	-	*< 0.00002*	-	-	-	-	-	-	-
Na	mg/L	-	216	-	-	-	-	-	-	-
Tl	mg/L	-	0.00021	-	-	-	-	-	-	-
Sn	mg/L	-	*< 0.0005*	-	-	-	-	-	-	-
Ti	mg/L	-	*< 0.01*	-	-	-	-	-	-	-
U	mg/L	-	0.36	-	-	-	-	-	-	-
V	mg/L	-	*< 0.001*	-	-	-	-	-	-	-
Zn	mg/L	-	0.028	-	-	-	-	-	-	-

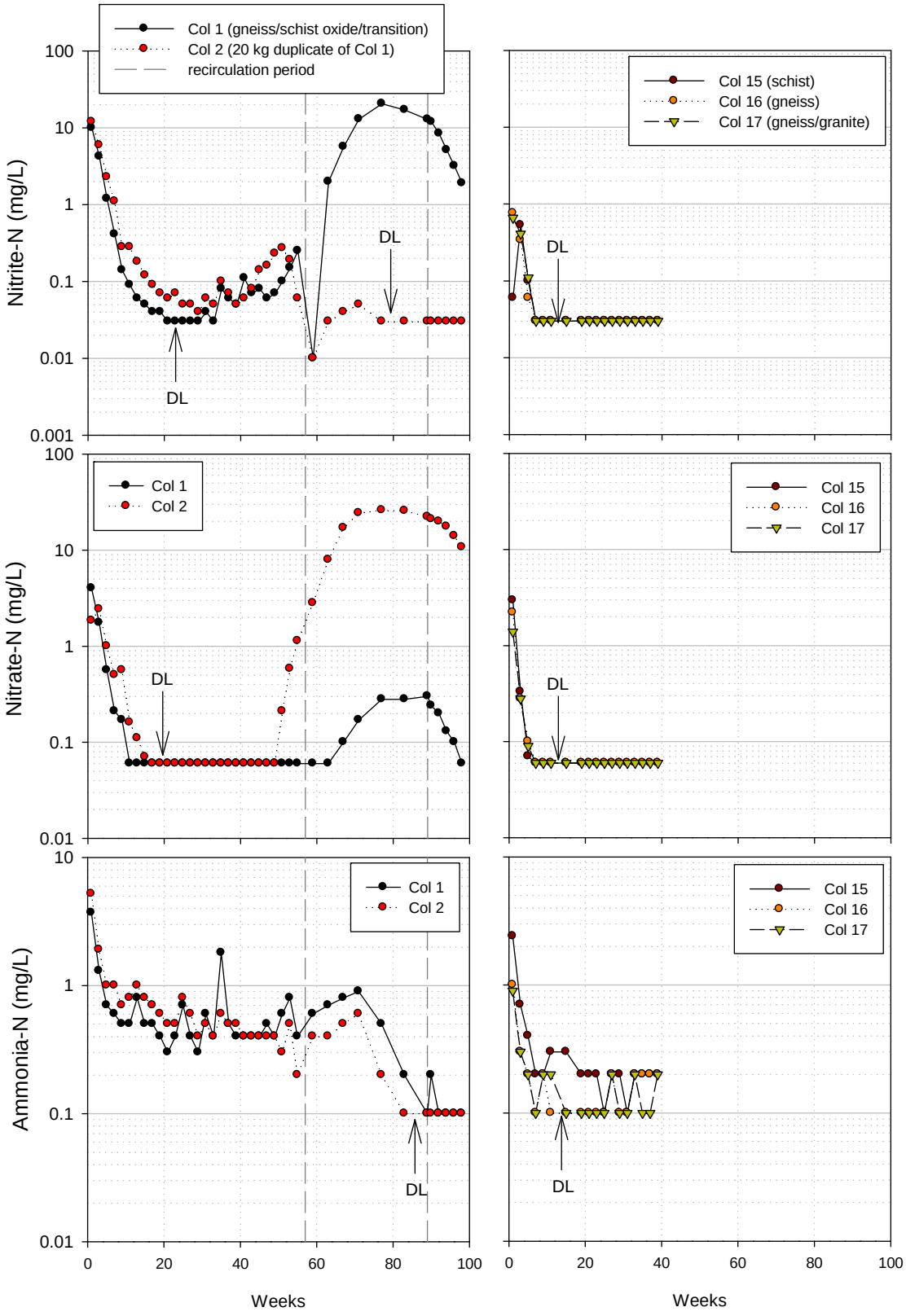
Notes:
Values in grey italics are below the analytical detection limit

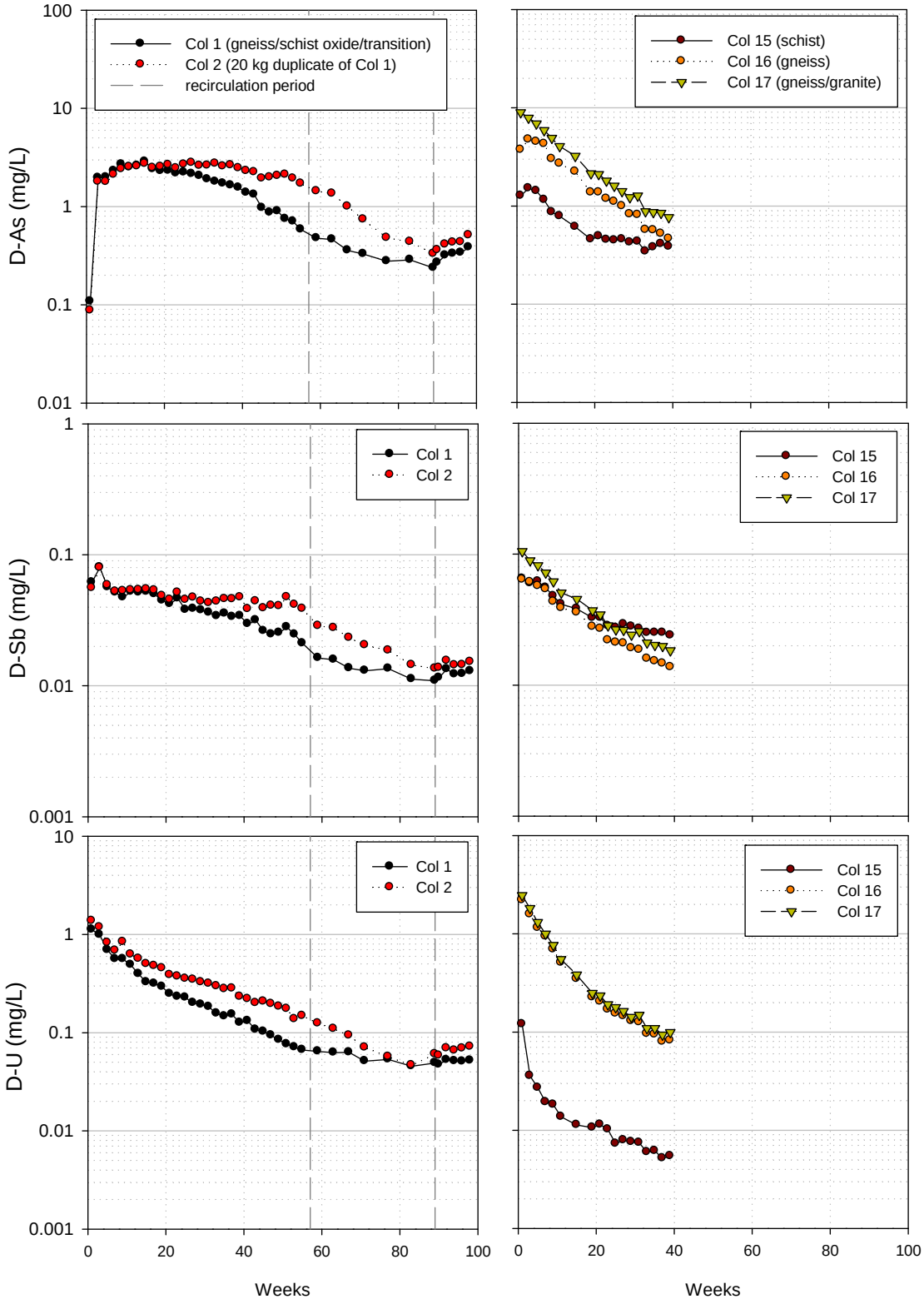
Appendix D.3-4: Time Series Profiles for Leach Tailings Kinetic Tests

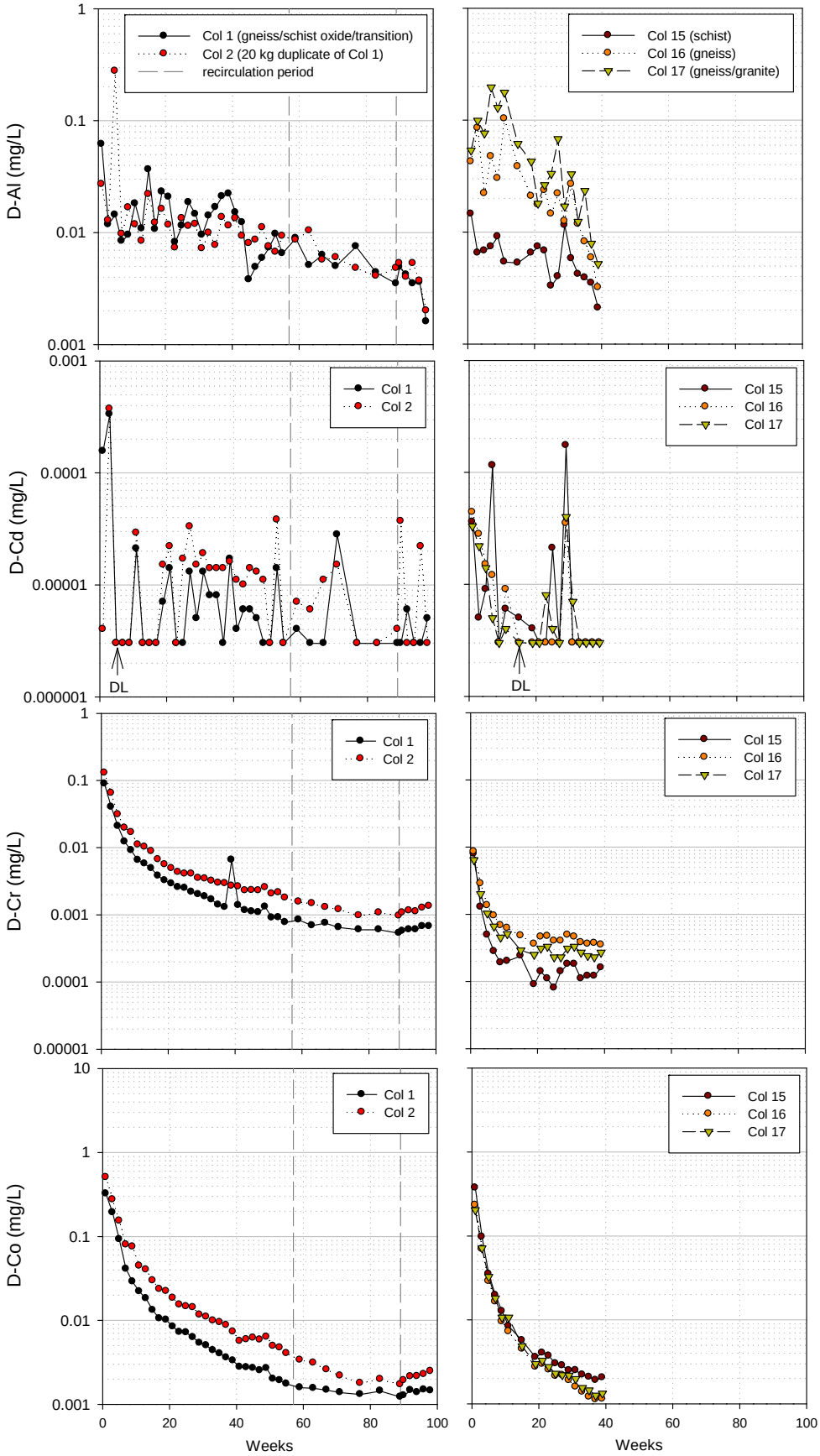
Leachate Concentrations for Leach Tailings Unsaturated Columns

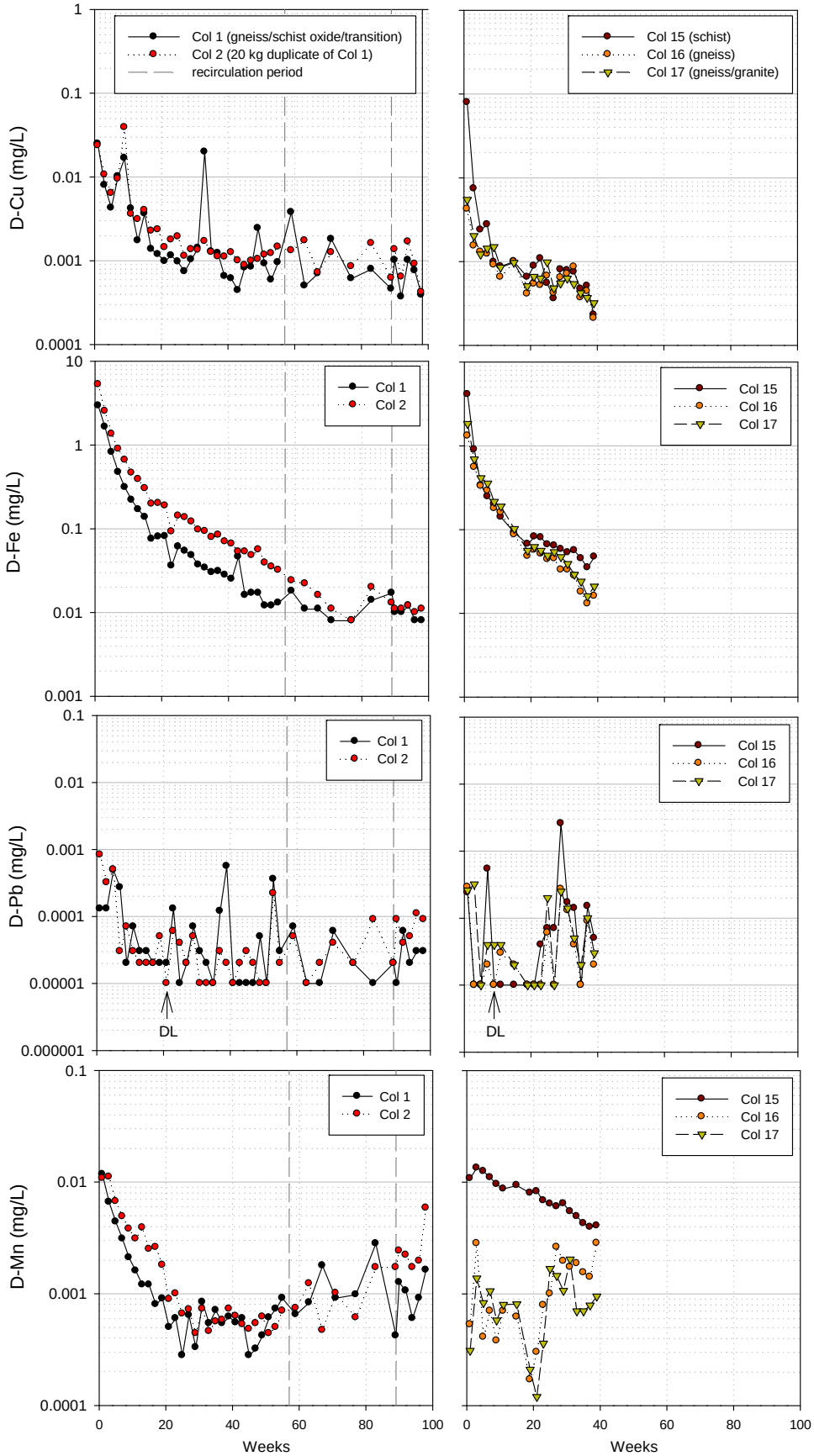


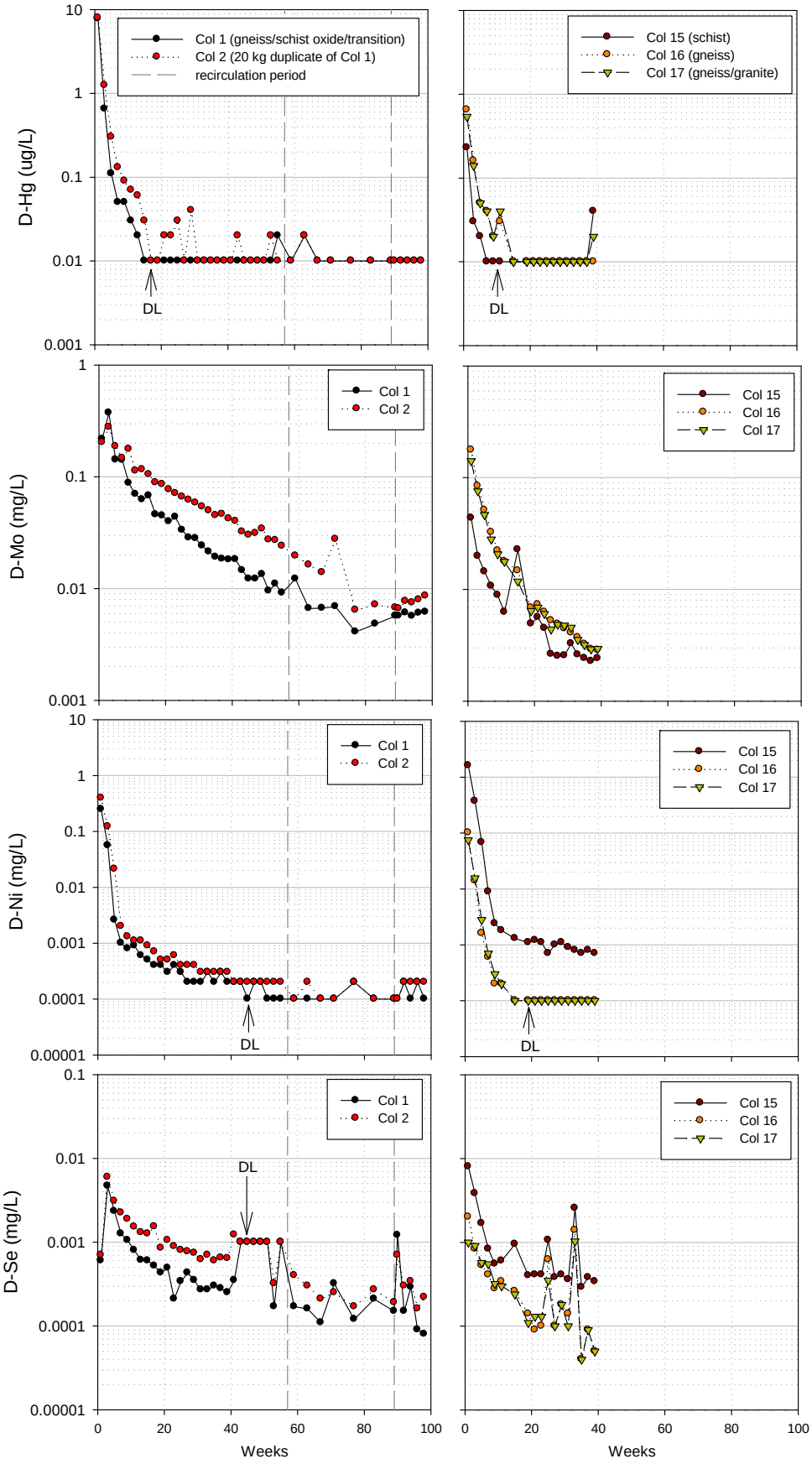

Total CN (mg/L)
WAD CN (mg/L)
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Col 1
Col 2
Col 15
Col 16
Col 17
DL
DL
Weeks
Weeks

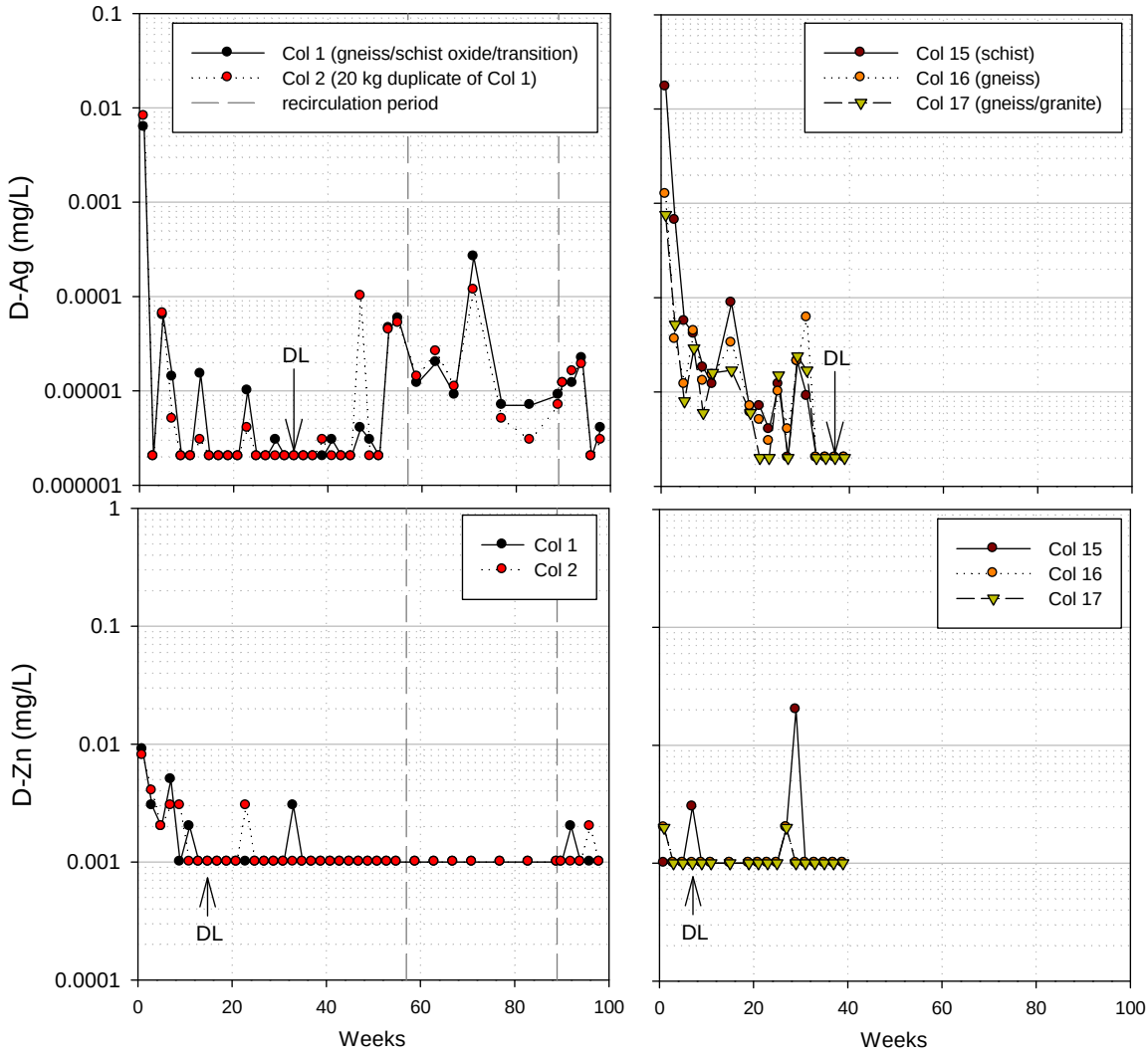

Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Nitrite-N (mg/L)
Nitrate-N (mg/L)
Ammonia-N (mg/L)
DL
Col 1
Col 2
Col 15
Col 16
Col 17
100
10
1
0.1
0.01
0.001
0
20
40
60
80
100
Weeks


D-As (mg/L)
D-Sb (mg/L)
D-U (mg/L)
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Col 1
Col 2
Col 15
Col 16
Col 17
Weeks
Weeks

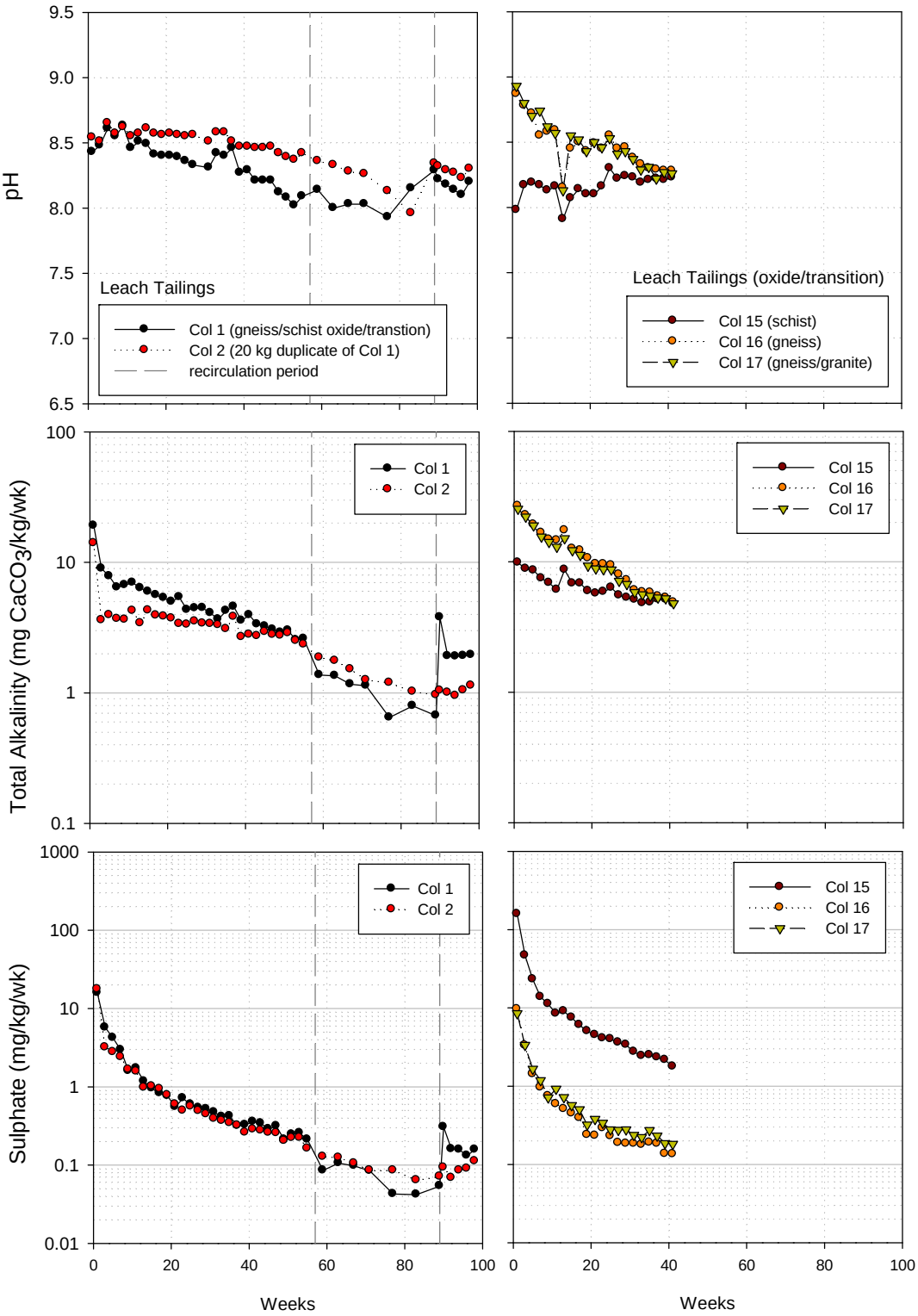

Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
D-Al (mg/L)
D-Cd (mg/L)
D-Cr (mg/L)
D-Co (mg/L)
Col 1
Col 2
Col 15
Col 16
Col 17
DL
Weeks

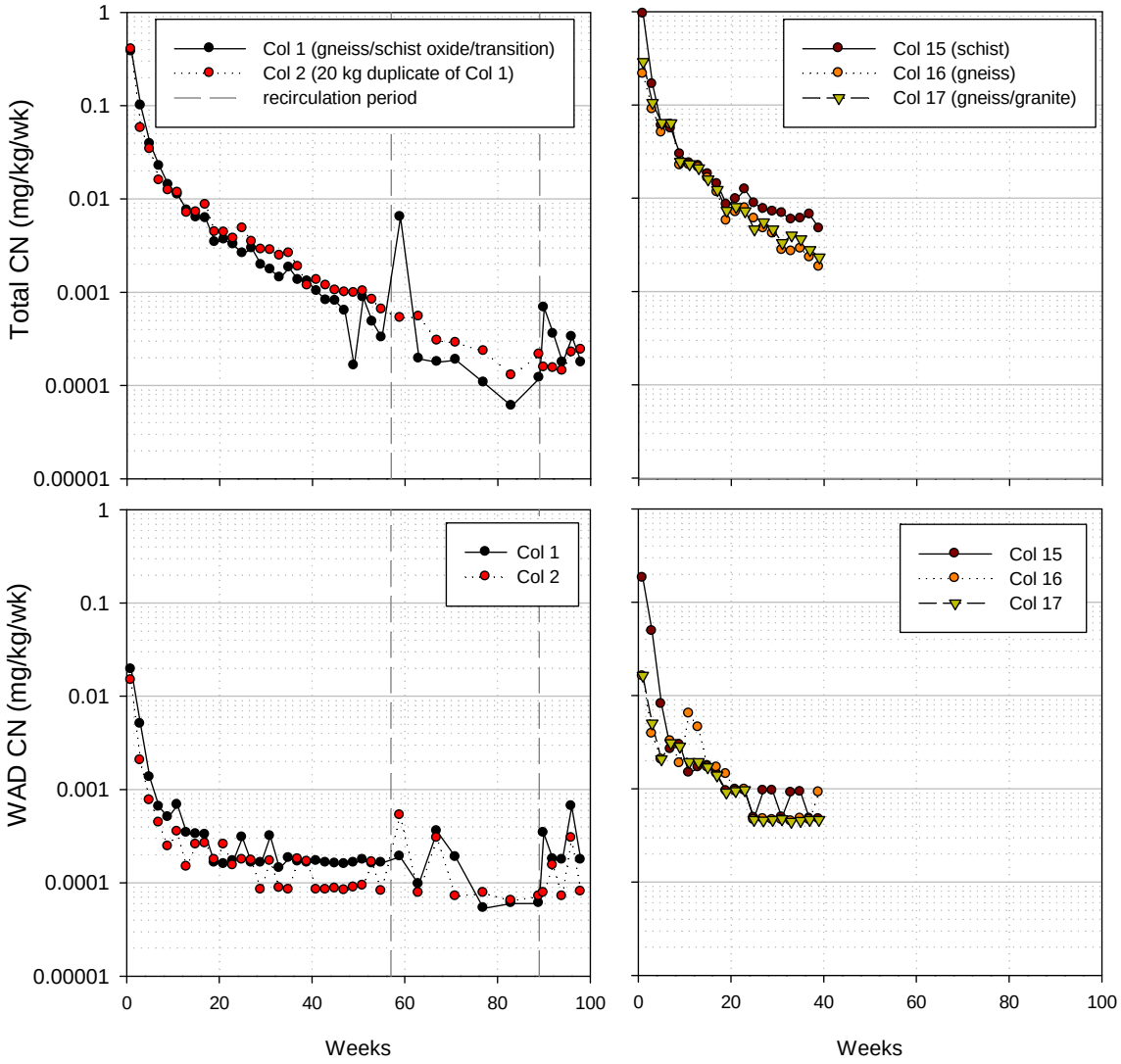

D-Cu (mg/L)
D-Fe (mg/L)
D-Pb (mg/L)
D-Mn (mg/L)
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Col 1
Col 2
Col 15
Col 16
Col 17
DL
Weeks

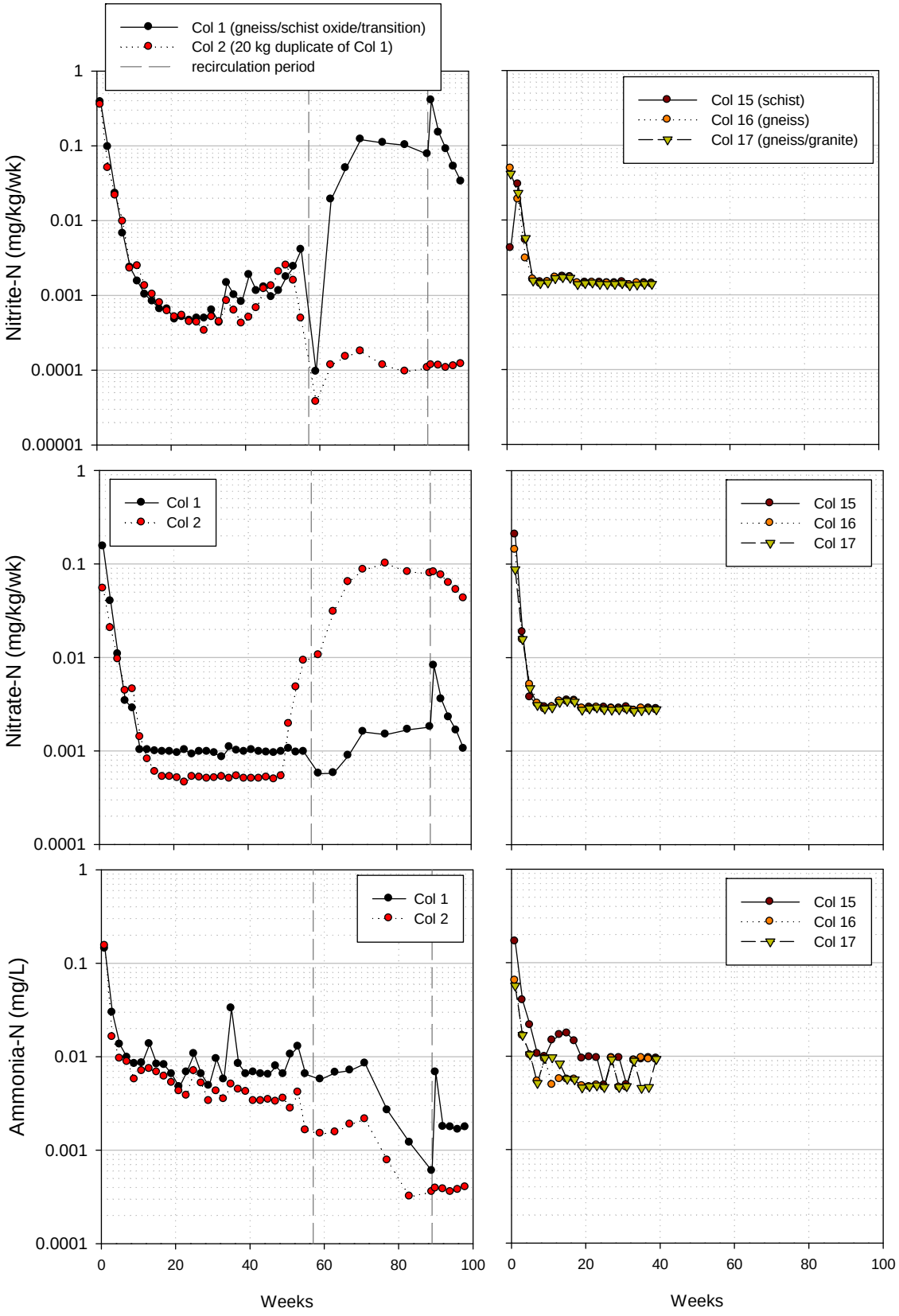

D-Hg (ug/L)
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
DL
D-Mo (mg/L)
Col 1
Col 2
Col 15
Col 16
Col 17
D-Ni (mg/L)
D-Se (mg/L)
Weeks

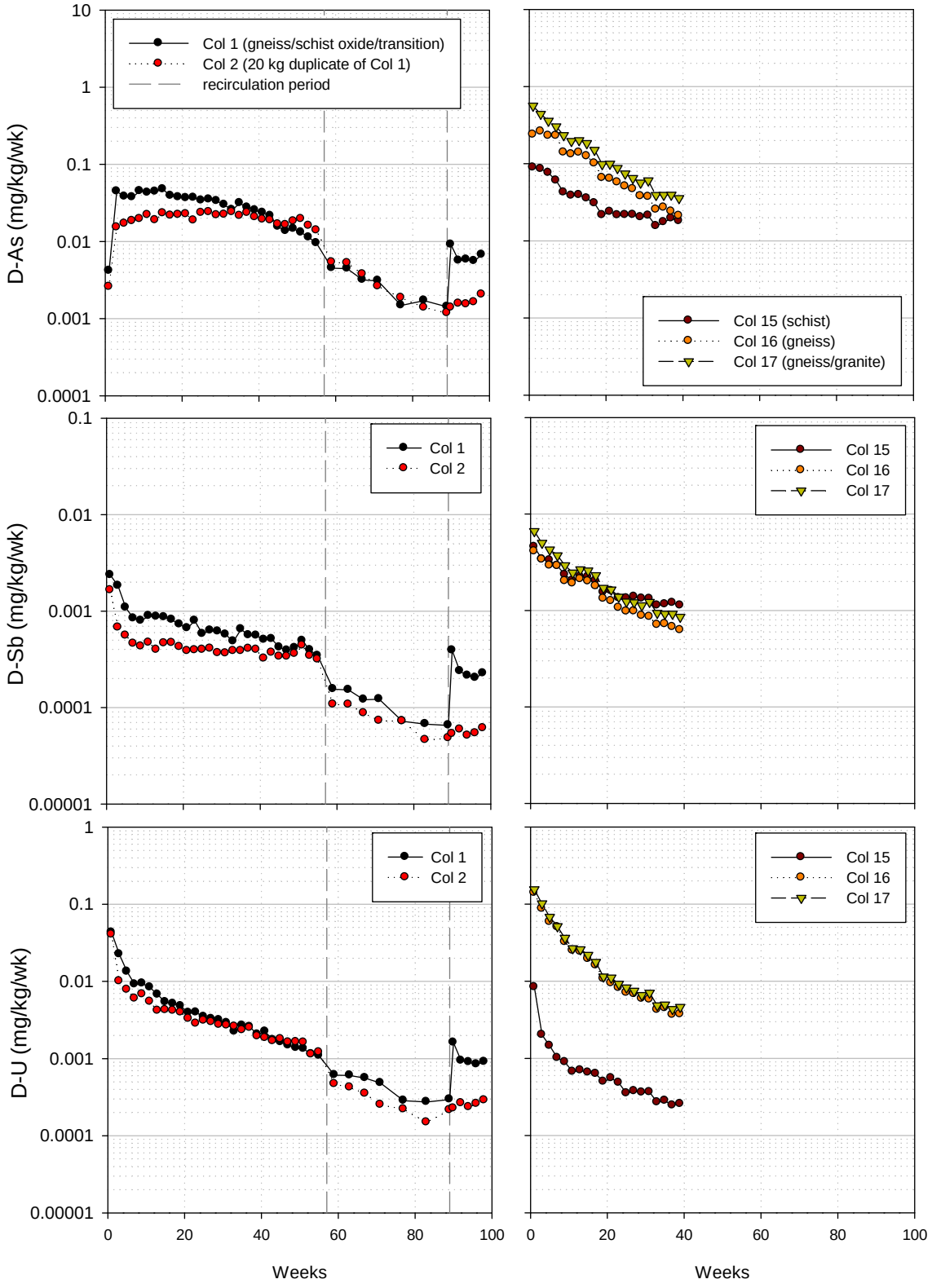

D-Ag (mg/L)
0.1
0.01
0.001
0.0001
0.00001
0.000001
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
DL
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
DL
D-Zn (mg/L)
1
0.1
0.01
0.001
0.0001
Col 1
Col 2
DL
Col 15
Col 16
Col 17
DL
0
20
40
60
80
100
Weeks
0
20
40
60
80
100
Weeks

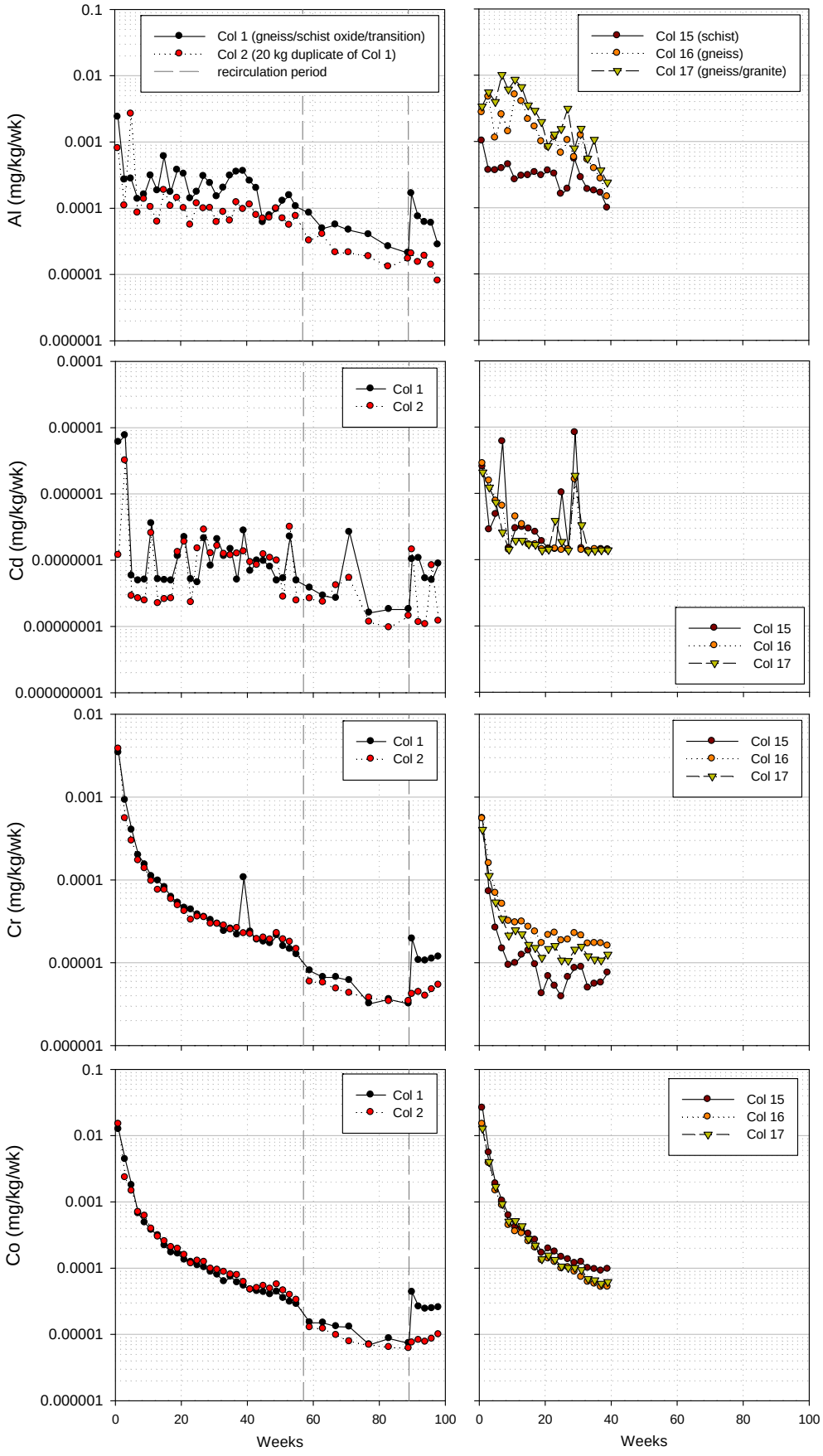
Loading Rates for Leach Tailings Unsaturated Columns

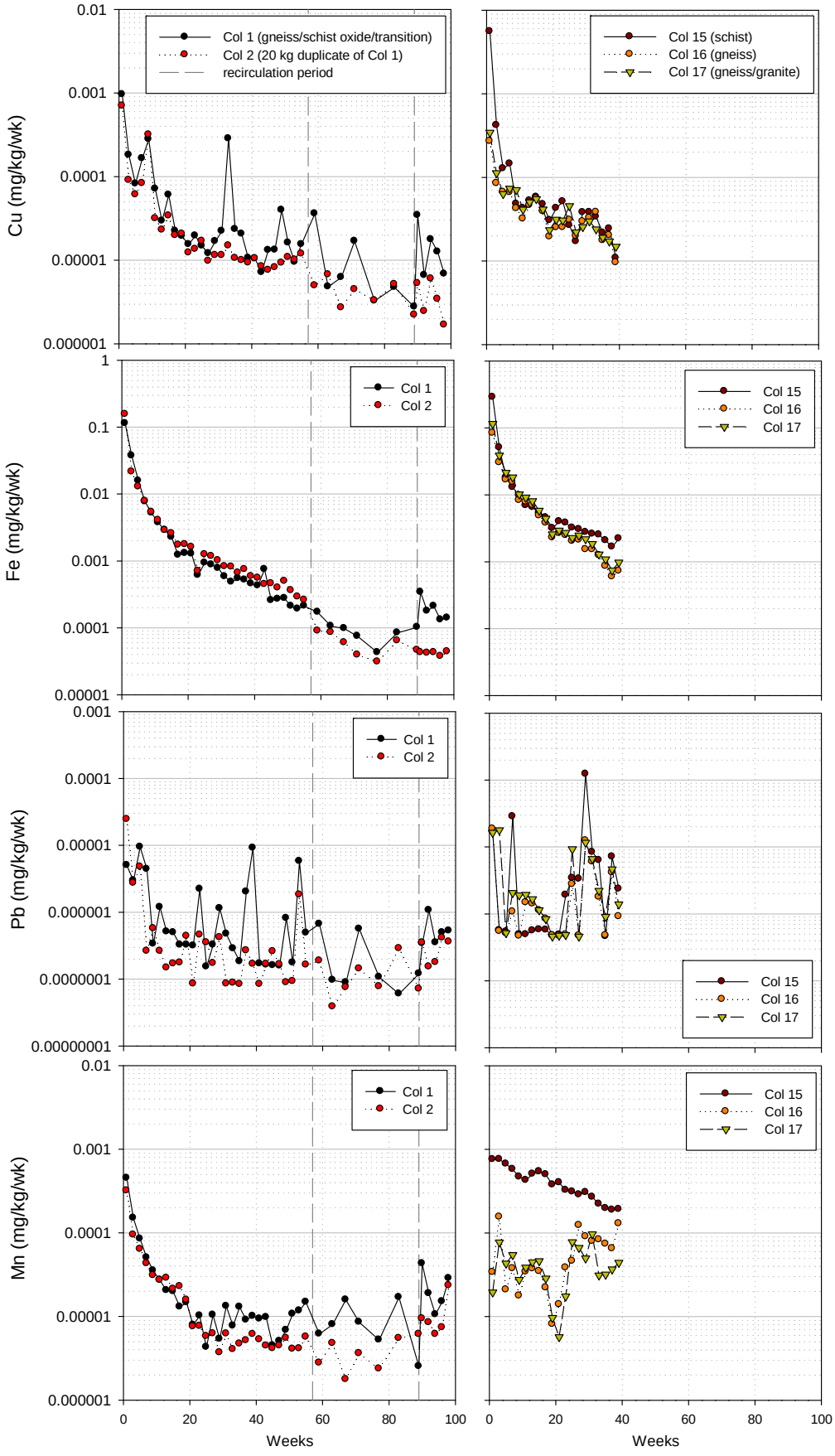


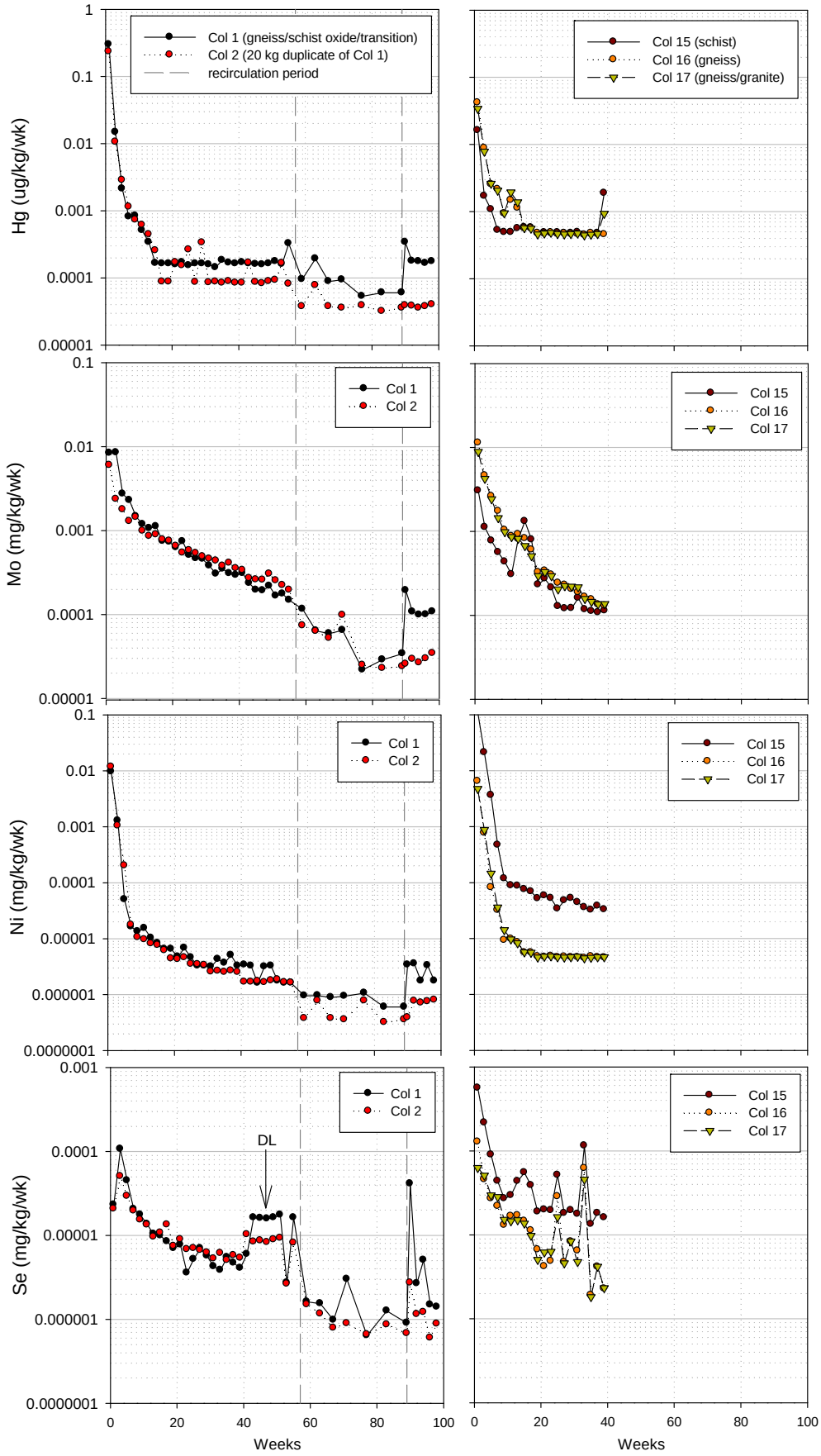

Total CN (mg/kg/wk)
WAD CN (mg/kg/wk)
1
0.1
0.01
0.001
0.0001
0.00001
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Col 1
Col 2
Col 15
Col 16
Col 17
0
20
40
60
80
100
Weeks

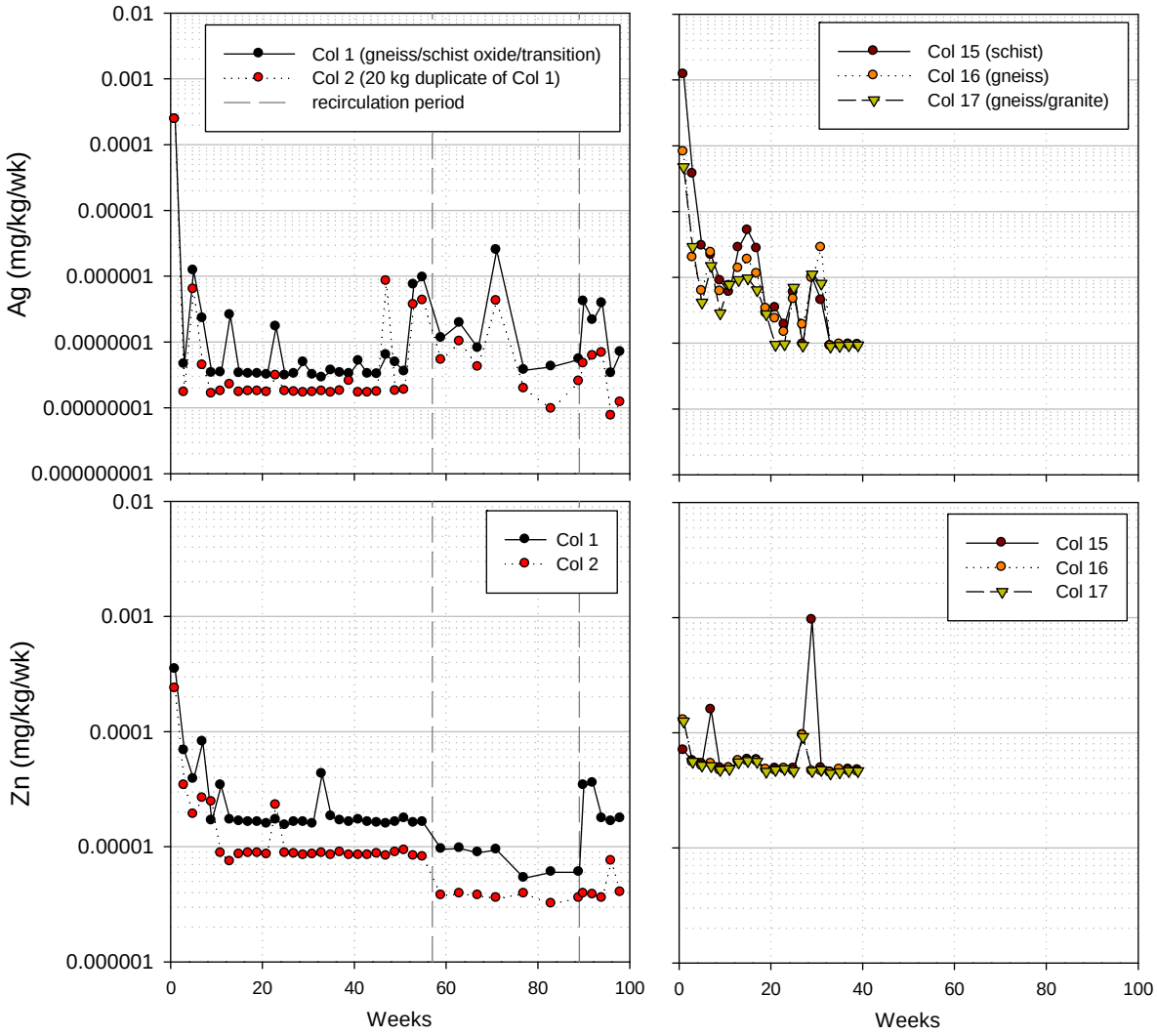

Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Nitrite-N (mg/kg/wk)
Nitrate-N (mg/kg/wk)
Ammonia-N (mg/L)
Col 1
Col 2
Col 15
Col 16
Col 17
1
0.1
0.01
0.001
0.0001
0.00001
0
20
40
60
80
100
Weeks


D-As (mg/kg/wk)
D-Sb (mg/kg/wk)
D-U (mg/kg/wk)
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Col 1
Col 2
Col 15
Col 16
Col 17
Weeks
Weeks


Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Al (mg/kg/wk)
Cd (mg/kg/wk)
Cr (mg/kg/wk)
Co (mg/kg/wk)
Col 1
Col 2
Col 15
Col 16
Col 17
Weeks
Weeks


Cu (mg/kg/wk)
Fe (mg/kg/wk)
Pb (mg/kg/wk)
Mn (mg/kg/wk)
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Col 1
Col 2
Col 15
Col 16
Col 17
Weeks
Weeks


Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Hg (ug/kg/wk)
Mo (mg/kg/wk)
Ni (mg/kg/wk)
Se (mg/kg/wk)
Col 1
Col 2
Col 15
Col 16
Col 17
DL
Weeks


Ag (mg/kg/wk)
0.01
0.001
0.0001
0.00001
0.000001
0.0000001
0.00000001
0.000000001
Col 1 (gneiss/schist oxide/transition)
Col 2 (20 kg duplicate of Col 1)
recirculation period
Col 15 (schist)
Col 16 (gneiss)
Col 17 (gneiss/granite)
Zn (mg/kg/wk)
Col 1
Col 2
Col 15
Col 16
Col 17
0
20
40
60
80
100
Weeks

Appendix E: Additional Data to Support Source Term Predictions

Appendix E.1: Nitrogen Loadings

Appendix E.2: PHREEQC Geochemical Modelling Input

Appendix E.3: Geochemical Source Terms

Appendix E.4: Bench-Scale Testwork for HLF Water Treatment System (INOTEC Report)

GOLDCORP

APPENDIX E.1: NITROGEN LOADINGS

Appendix E.1: Nitrogen Loadings

1. Overview

Explosive residue and associated combustion products on blasted rock surfaces are the primary sources of ammonia (NH_3 and NH_4^+), nitrate (NO_3^-), and nitrite (NO_2^-) associated with runoff from active mining and blasting operations (Pommen, 1983). The export of nitrogen (N) from blasting is therefore linked to the quantity and types of explosives used, in addition to the detonation efficiency.

Ammonium nitrate fuel oil (ANFO) is the primary component of explosives used in mining and blasting related operations. Ideally the explosive reaction converts nitrogen species, in this case ammonia and nitrate, to nitrogen gas. In practice, the detonation efficiency, and thus conversion of nitrogen species to nitrogen gas, are dictated by the handling procedures of the explosives and the blasting conditions (Forsyth *et al.,* 1995; Revey, 1996). Wet blasting conditions may result in the leaching of N from explosives prior to detonation. Wet conditions may also result in inefficient or incomplete detonation and/or misfires, which in turn yields excess N residue available for leaching (Mueller *et al,* 2015). Nitrogen compounds in explosive mixtures are readily water soluble, with solubility rates varying from minutes for ANFO to weeks for water resistant ANFO emulsion mixtures as described by Revy (1996). Emulsion products continue to be developed to mitigate the effects of wet-blasting conditions on N leaching and overall blasting efficiency. The application of emulsion products continues to be more common as their costs decrease and their benefits to overall operational efficiency are realized.

The primary pathway of nitrogen associated with blasting residue is via seepage from excavated waste rock, which is deposited in waste rock storage facilities. The release of nitrogen compounds is directly related to the volume of blasted rock and the rate of water infiltration into the waste rock facilities. Water percolation rates through waste rock piles is variable and leads to a time lag between rock deposition and observed release of nitrogen at significant concentrations (Bailey, 2013; Mueller *et al,* 2015). Preferential flow paths develop within a rock pile leading to partial and gradual wetting from the outer to the inner portions of the pile. The nitrogen available for leaching is limited to the wetted areas of the pile and over time newly wetted areas will release stored nitrogen, therefore nitrogen release from a large rock pile can persist for years or decades after rock placement. Microbial activity along the flow paths can mediate nitrification reactions which act to oxidize ammonia and nitrite to nitrate. For open pit mining operations, which are typically

oxidizing environments, the export of nitrogen to the receiving environment has been observed to be predominantly in the form of nitrate, and to a lesser extent, nitrite and ammonia (Ferguson and Leask, 1988).

The export of aqueous nitrogen species can also occur via mine pit water, particularly during dewatering of active pit development (Cameron, 2007). Infiltration of water into loaded blast patterns can lead to nitrogen release prior to blasting from explosives loaded into boreholes or from explosives spilled on the pit floor. Subsequent to blasting, infiltration water in contact with blasted rock on the pit floor can mobilize residual nitrogen species. There is limited storage of nitrogen within the pit as the majority of explosives residuals are excavated with the blasted rock. As a result, the export of nitrogen from mine pit contact water is typically associated with operations.

The processes that result in the distribution of water soluble N species are not immediately quantifiable, nor are they predictable, as each blast is unique with respect to detonation efficiency, residue amount and type, as well as microbial activity. Consequently, empirical methods have been developed to predict N loadings from mining activity and are based on explosive type, explosive quantity, and pit dewatering conditions (*e.g.*, wet versus dry) as presented in Mueller *et al*. (2015). Model assumptions and methodologies for the derivation of nitrogen species source terms are presented in the sections below. Source terms are derived for application in the water quality model for the Project and are used to predict Project effects on surface and groundwater quality.

2. Assumptions

Nitrogen source terms were derived for contact water associated with pit wall runoff and waste rock seepage. Source terms were calculated based on projected explosive use and waste rock deposition plans. Source term loadings are estimated as a percentage of the total explosives used for blasting over a specified time period and incorporate the following assumptions:

- Mining, explosive use, waste rock production and placement will proceed as per the mine plan;
- Explosive types to be used are ANFO (34% N) and Emulsion (27.5% N; Orica Fortis® or Fortan® products);
- Best explosive use and blasting practices will be implemented to maximize explosive consumption and minimize explosive residue as a result of blasting;
- Over the operational mine life, 15% of blast holes were assumed to be wet, were used as a proxy for less efficient detonation, and are assumed to apply to approximately 15% of the total explosives used;

- Nitrogen is exported to the aqueous downstream receiving environment in species that are proportional to average distributions observed by Ferguson and Leask (1988) when T-N is greater than 3 mg/L, with nitrate, ammonia and nitrite respectively representing 95%, 4% and 1% of the total nitrogen release, respectively;
- The observations of nitrogen loadings from pit walls and waste rock at the Aitik Mine, Thompson Creek Mine, and Minto Mine are reasonably representative examples of open pit mining and blasting conditions that will be encountered at the Project; and,
- For the purpose of source term derivation, the baseline levels for nitrate, ammonia and nitrite are assumed to be zero.

3. Methodology

A desktop review of the Aitik, Thompson Creek, and Minto mines was conducted to document N loading associated with well-managed open pit mining operations. Mine development, waste rock production rates, and/or climatic settings for these projects are relatively similar to the proposed Coffee Creek Mine and are considered reasonable analogs for comparison to the Coffee Gold Mine. Associated N loading rates observed from these analog sites are therefore used to constrain nitrogen source terms for the Project.

Boliden's Aitik Mine is an open pit hard-rock mine in northern Sweden. Production began in the 1960s and is currently operating with an annual ore production rate of approximately 39 Mtonnes (2014). Climatic conditions at Aitik are similar to the Coffee Gold Mine. Sources of N loading at Aitik include pit walls and waste rock dumps.

The Thompson Creek Mine (TCM) is an open pit molybdenum mine located in Idaho, United States of America. The Thompson Creek Mine is owned and operated by the Thompson Creek Metals Company Inc. and operated from 1983 to 2014. Production at Thompson Creek reached up to 9 Mtonnes per year. While not at a northern latitude, the Thompson Creek mine is located at in the Rocky Mountains at a high elevation (2,200 masl) and experiences extreme, continental conditions not dissimilar from Coffee. Further, the open pit blasting conditions at TCM are relatively dry and are considered a reasonable proxy for the relatively dry conditions expected at Coffee, where open pits development is predominantly above the water table. With decades of water quality data with nitrogen species measurements associated with the waste rock seepage and pit wall contact water seepage, TCM is an ideal site for comparison to Coffee.

Capstone Mining Corporation's Minto Mine is an open pit copper mine located north of Whitehorse in central Yukon, Canada. Yearly production reached nearly 17 Mt in 2015,

with approximately 7 years of operations remaining. The Minto site, like Aitik, is within a region of similar conditions to the Project. and has been collecting operational water quality data that includes pit wall and waste rock seepage sampling. The benefits of Minto as an analogue for N species source term loadings are two-fold: site climate conditions are expected to be reasonably similar to the Project; and Minto is a relatively modern, operating, open-pit mine with a supporting, up to date monitoring plan and water quality database.

3.1 Source Term Development

Methods used to develop N source terms for waste rock seepage, pit wall runoff, and draindown quality from the heap leach facility are described below.

3.1.1 Waste Rock Seepage

Annual waste rock deposition schedules are not available for the Project. Therefore, an annual accumulation and release of residual nitrogen from waste rock facilities cannot be calculated as per the Ferguson and Leask (1988) approach. Rather, the range of N concentrations that may be produced from mine waste facilities is taken from observations at analogue sites, which include Aitik, Thompson Creek, and the Minto Mine. Observations from analogue sites function as proxies for expected N concentrations from active, well managed mine sites and are applied as capping terms for the N source terms.

Water quality datasets were developed for each analogue and included NH_3, NO_3^-, and NO_2^- concentrations. Median and 90th percentile or maximum N species concentrations were calculated for each of the analogue waste rock dumps (Table 1). A Base Case estimate and an Upper estimate for NH_3, NO_3^- and NO_2^- concentrations were developed. Median and 90th percentile or maximum values were considered from each facility for the Base Case and Upper estimate, respectively. The highest value was selected for each term. In this case, the median and 90th percentile values from the Minto Mine were consistently highest from the analogue sites and were selected as the Base Case and Upper Estimate N source terms for waste rock seepage (Table 1). The final N source terms are based on the Base Case and Upper Estimate concentrations presented in (Table 1) for all waste rock storage facilities at the Project.

Table 1:
Median, 90th Percentile, and maximum nitrate, nitrite, and ammonia concentrations for seepages associated with waste rock dumps from each of Aitik Mine, Thompson Creek Mine, and Minto Mine

Location	Rock Mass	NO_3-N (mg/L)			NO_2-N (mg/L)			NH_3-N (mg/L)		
	(MT)	Median	P90 or Max*	n	Median	P90 or Max*	n	Median	P90 or Max*	n
Aitik (WRD T6)	225	30	43	3	-	-	-	0.003	0.006	3
Thompson Creek (Buck C)	310	7	15	45	<0.010	0.11	42	<0.050	<0.050	23
Thompson Creek (PH Toe)	45	8.5	10	32	0.01	0.01	31	0.05	0.05	31
Minto (Southwest Dump)	21	30	45	42	0.1	0.3	42	0.06	0.2	42
Source Term		Base Case Estimate	Upper Estimate		Base Case Estimate	Upper Estimate		Base Case Estimate	Upper Estimate	
		30	45		0.1	0.3		0.06	0.2	

Note: *P90 values calculated for samples with N>10; max values calculated for samples with N<10.

3.1.2 Pit Wall Seepage

Pit water quality from analogue sites was used as a proxy for N pit wall seepage source terms and include pit lakes at Aitik and Thompson Creek mine sites. Similar to the waste rock seepage capping terms, median and 90th percentile or maximum N species concentrations were calculated for each analogue pit lake (Table 2). Maximum concentrations were selected for populations <10, and 90th percentile concentrations were calculated for populations >10. Base Case and Upper Estimate source terms for NH3, NO3-, and NO2- were derived (Table 2). The higher median value was selected for the Base Case estimate. Similarly, the higher 90th percentile or maximum value was selected for the Upper Estimate.

Table 2:
Median, 90th Percentile, and maximum nitrate, nitrite, and ammonia concentrations for seepages associated with pit wall from each of Aitik Mine, Thompson Creek Mine, and Minto Mine.

Location	NO_3-N (mg/L)			NO_2-N (mg/L)			NH_3-N (mg/L)		
	Median	**P90 or Max***	**n**	**Median**	**P90 or Max***	**n**	**Median**	**P90 or Max***	**n**
Aitik	5.6	8.4	28	0.007	0.03	28	0.3	1.6	28
Thompson Creek	5.6	29	26	0.01	0.52	6	0.19	5.7	6
Source Term	Base Case Estimate	Upper Estimate		Base Case Estimate	Upper Estimate		Base Case Estimate	Upper Estimate	
	5.6	29		0.01	0.52		0.3	5.7	

Note: *P90 values calculated for samples with N>10; max values calculated for samples with N<10.

3.1.3 Heap Leach Facility

Following operations, heap leach facility (HLF) drainage will be treated with an electro bioreactor (EBR) system before being discharged. This facility will treat a variety of chemical species, including NO_3^-. The efficacy of the EBR system at treating HLF drainage was demonstrated with bench scale testing, as described in Appendix E.4. During the EBR bench scale test work, nutrients such as ammonia and phosphate were added to stimulate microbial growth. The duration of the experiment was not sufficient to optimize nutrient addition rates, resulting in excess nutrient addition which in turn induced artificially high effluent concentrations of N parameters. The bio-treatment process is designed to denitrify the influent and as a result, effluent nitrogen concentrations are expected to be low. As a conservative assumption, NH_3 concentrations in EBR effluent were assumed to be equal to NO_3^-. Source term concentrations of NO_3^- and NO_2^- were set to observed concentrations in EBR bench test effluent (median and 75th percentile) for Base Case and Upper estimate source terms, respectively (Table 3).

Elevated concentrations of nitrogen species are expected to be present in HLF drainage in post closure. Unlike other sources of nitrogen loading at the minesite, the primary source of nitrogen species in the HLF is from degradation of CN. Hence, nitrogen concentrations cannot be calculated based on an estimate of explosive use as is it is for waste rock storage facilities. Nitrogen loadings in the HLF will depend in large part on the rate of CN degradation during mine life and the effectiveness of rinsing closed sections of the heap during progressive reclamation. For the purposes of source term prediction, nitrogen concentrations produced at the closed heap leach facility at an analogue mine site, Brewery

Creek are applied. The median and 90th percentile concentrations observed 1 to 10 years after closure are used as the Base Case and Upper source term concentrations for nitrogen species (Table 3).

In the Base Case scenario, it is assumed that in-situ degradation of nitrogen species will be partially successful, and that nitrogen species will be degraded within the HLF (Table 3). The In-situ treatment of nitrogen species within the HLF is described in the Conceptual Reclamation and Closure of Mine Facilities (Appendix 31-R)

Table 3:
Nitrogen source term estimates for the Heap Leach Facility during Closure (treated EBR effluent) and Post Closure.

Parameter	Units	Closure		Post Closure		
		Base Case Estimate	Upper Estimate	Base Case Estimate (no in-situ treatment)	Base Case Estimate (in situ treatment)	Upper Estimate
NH_3-N	mg/L	0.13	0.25	0.050	0.050	9.0
NO_3-N	mg/L	0.13	0.25	317	50	375
NO_2-N	mg/L	0.025	0.050	5.3	0.20	6.7

References

Bailey, B. L., L. J. D. Smith, D. W. Blowes, C. J. Ptacek, L. Smith, and D. C. Sego. 2013. The Diavik Waste Rock Project: Persistence of contaminants from blasting agents in waste rock effluent. Applied Geochemistry, 36(9): 256-270.

Cameron, A., Corkery, D., MacDonald, G., Forsyth, B. and Gong, T. 2007. An investigation of ammonium nitrate loss to mine discharge water at Diavik Diamond Mines, in Proceedings EXPLO 2007 Blasting: Techniques and Technology, 3–4 September 2007, Wollongong, Australia: 21−33.

Forsyth, B., Cameron, A. and Miller, S. 1995. Explosives and water quality, in Proceedings Sudbury ’95 Mining and the Environment, Sudbury, Canada, May 28 to June 1, 1995, volume II: 795-803.

Ferguson, K. and Leask, S.M. 1988. The export of nutrients from surface coal mines, Regional Program Report: 87−12, Environmental Protection, Conservation and Protection, Pacific and Yukon Region, Environment Canada, West Vancouver, BC, Canada, 127 pp.

Gerardi, M.H. 2002. Nitrification and denitrification in the activated sludge process, A John Wiley & Sons, Inc., 193 pp.

Morin, K.A. and Hutt, N.M. 2008. Leaching of nitrogen species during underground mining, viewed November 16, 2012 http://www.mdag.com/case_studies/cs29.html).

Mueller, P., Stockwell, J., and Martin, A.J. 2015. The influence of explosive use on nitrogen loading and speciation in an underground mine in British Columbia. Proceedings of Mine Water Solutions in Extreme Environments. April 12-15, 2015. 449 – 458.

Pommen, L.W. 1983. The effect on water quality of explosives use in surface mining – Volume 1: Nitrogen sources, water quality and prediction and management of impacts, Ministry of the Environment, Water Management Branch, Victoria, BC, Canada, 149 pp.

Revy, G.F. 1996. Practical methods to control explosives losses and reduce ammonia and nitrate levels in mine water, Mining Engineering, 48(7): 61−64.

Wiber, M.R., Connel, B., Michelutti, B., Bell, D., Joyce, K. and Luinstra, W. 1991. Environmental aspects of explosives use, Northwest Mining Association Short Course, Spokane, WA, USA.

APPENDIX E.2: PHREEQC GEOCHEMICAL MODELLING INPUT

Appendix E.2: PHREEQC Geochemical Modelling Input

Alkalinity at Calcite Equilibrium as a Function of CO_2 (g), High TDS and High Temperature

SELECTED_OUTPUT 1		
-file selected_output_1.sel		
-pH true		
-alkalinity true		
-molalities CO_3^{-2}		
-saturation_indices CO_2(g)		
Solution		
Temp	10	
pH	7	
redox pe		
units mg/L		
density 1		
S(6)	2000.0	
Ca	338.0	
Mg	167.6	
Na	868.0	
-water 1 # kg		
save solution 1		
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
CO_2(g)	-3.5	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
CO_2(g)	-3.45	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
CO_2(g)	-3.4	
end		
Use Solution 1		

SELECTED_OUTPUT 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.35	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.3	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.25	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.2	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.15	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.1	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.05	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.95	
end		
Use Solution 1		

SELECTED_OUTPUT 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.9	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.85	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.8	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.75	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.7	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.65	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.6	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.55	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.5	
end		
Use Solution 1		

SELECTED_OUTPUT 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.4	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.3	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	$-2._2$	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.1	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2	
end		

Alkalinity at Calcite Equilibrium as a Function of CO_2 (g), Low TDS and Low Temperature

SELECTED_OUTPUT 1			
-file selected_output_1.sel			
-pH true			
-alkalinity true			
-charge_balance true			
-molalities CO_3^{-2}			
-saturation_indices calcite CO_2(g)			
Solution			
Temp	0.1		
pH	7		
redox pe			
units mg/L			
density 1			
S(6)	500.0		
Ca	84.5		
Mg	41.9		
Na	217.0		
-water 1 # kg			
save solution 1			
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
CO_2(g)	-3.5		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
CO_2(g)	-3.45		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
CO_2(g)	-3.4		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
CO_2(g)	-3.35		
end			

SELECTED_OUTPUT 1			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.3		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.25		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.2		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.15		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.1		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.05		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.95		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.9		

SELECTED_OUTPUT 1			
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.85		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.8		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.75		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.7		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.65		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.6		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.55		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.5		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	

SELECTED_OUTPUT 1			
$CO_2(g)$	-2.4		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.3		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.2		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.1		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2		
end			

Barium Concentration at Barite Saturation Indices (SI) 0.55

SELECTED_OUTPUT		
-totals Ba		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	40	
Ca	12.5	
Mg	2.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	50	
Ca	15.625	
Mg	3.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	60	
Ca	18.75	
Mg	3.75	

SELECTED_OUTPUT		
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	70	
Ca	21.875	
Mg	4.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	80	
Ca	25	
Mg	5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	90	

SELECTED_OUTPUT		
Ca	28.125	
Mg	5.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	100	
Ca	31.25	
Mg	6.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	110	
Ca	34.375	
Mg	6.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	

SELECTED_OUTPUT		
S(6)	120	
Ca	37.5	
Mg	7.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	130	
Ca	40.625	
Mg	8.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	135	
Ca	42.1875	
Mg	8.4375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		

SELECTED_OUTPUT		
density 1		
Alkalinity	100	
S(6)	140	
Ca	43.75	
Mg	8.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	145	
Ca	45.3125	
Mg	9.0625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	155	
Ca	48.4375	
Mg	9.6875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	

SELECTED_OUTPUT		
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	165	
Ca	51.5625	
Mg	10.3125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	175	
Ca	54.6875	
Mg	10.9375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	185	
Ca	57.8125	
Mg	11.5625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	

SELECTED_OUTPUT		
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	195	
Ca	60.9375	
Mg	12.1875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	205	
Ca	64.0625	
Mg	12.8125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	215	
Ca	67.1875	
Mg	13.4375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		

SELECTED_OUTPUT		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	225	
Ca	70.3125	
Mg	14.0625	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	235	
Ca	73.4375	
Mg	14.6875	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	245	
Ca	76.5625	
Mg	15.3125	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		

SELECTED_OUTPUT		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	255	
Ca	79.6875	
Mg	15.9375	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	265	
Ca	82.8125	
Mg	16.5625	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	275	
Ca	85.9375	
Mg	17.1875	
Ba	0.1	barite 0.55

SELECTED_OUTPUT		
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	285	
Ca	89.0625	
Mg	17.8125	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	290	
Ca	90.625	
Mg	18.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	295	
Ca	92.1875	

SELECTED_OUTPUT		
Mg	18.4375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	300	
Ca	93.75	
Mg	18.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	310	
Ca	96.875	
Mg	19.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	

SELECTED_OUTPUT		
S(6)	320	
Ca	100	
Mg	20	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	330	
Ca	103.125	
Mg	20.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	340	
Ca	106.25	
Mg	21.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		

SELECTED_OUTPUT		
density 1		
Alkalinity	100	
S(6)	350	
Ca	109.375	
Mg	21.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	360	
Ca	112.5	
Mg	22.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	410	
Ca	128.125	
Mg	25.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	

SELECTED_OUTPUT		
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	460	
Ca	143.75	
Mg	28.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	510	
Ca	159.375	
Mg	31.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	560	
Ca	175	
Mg	35	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	

SELECTED_OUTPUT		
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	610	
Ca	190.625	
Mg	38.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	660	
Ca	206.25	
Mg	41.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	710	
Ca	221.875	
Mg	44.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		

SELECTED_OUTPUT		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	760	
Ca	237.5	
Mg	47.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	810	
Ca	253.125	
Mg	50.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	860	
Ca	268.75	
Mg	53.75	
Ba	0.1	barite 0.55
-water 1 # kg		

SELECTED_OUTPUT		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	910	
Ca	284.375	
Mg	56.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	960	
Ca	300	
Mg	60	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1010	
Ca	315.625	
Mg	63.125	
Ba	0.1	barite 0.55

SELECTED_OUTPUT		
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1060	
Ca	331.25	
Mg	66.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1110	
Ca	346.875	
Mg	69.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1160	
Ca	362.5	
Mg	72.5	

SELECTED_OUTPUT		
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1210	
Ca	378.125	
Mg	75.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1260	
Ca	393.75	
Mg	78.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1310	

SELECTED_OUTPUT		
Ca	409.375	
Mg	81.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1360	
Ca	425	
Mg	85	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1410	
Ca	440.625	
Mg	88.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	

SELECTED_OUTPUT		
S(6)	1460	
Ca	456.25	
Mg	91.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1510	
Ca	471.875	
Mg	94.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1560	
Ca	487.5	
Mg	97.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		

SELECTED_OUTPUT		
density 1		
Alkalinity	100	
S(6)	1610	
Ca	503.125	
Mg	100.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1660	
Ca	518.75	
Mg	103.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1710	
Ca	534.375	
Mg	106.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	

SELECTED_OUTPUT		
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1760	
Ca	550	
Mg	110	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1810	
Ca	565.625	
Mg	113.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1860	
Ca	581.25	
Mg	116.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	

SELECTED_OUTPUT		
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1910	
Ca	596.875	
Mg	119.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1960	
Ca	612.5	
Mg	122.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	2010	
Ca	628.125	
Mg	125.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		

Mount Nansen Field Bin and Waste Rock Seep Saturation Indices

SELECTED_OUTPUT 1		
-file selected_output_1.sel		
-saturation_indices Gypsum Calcite		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.3	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	515	
Alkalinity	46	
Ca	185	
Mg	41.6	
Cl	0.63	
K	3.1	
Na	2.6	
Sr	0.423	
Si	2.6	
N(5)	0.32	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.91	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	863	
Alkalinity	54	
Ca	313	
Mg	86.1	
Cl	3.7	
K	3.6	

Na	4.3	
Sr	0.854	
Si	3.36	
N(5)	0.55	
N(3)	0.01	
N(-3)	0.1	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	8.13	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1150	
Alkalinity	51	
Ca	367	
Mg	88.2	
Cl	0.17	
K	3.8	
Na	4.8	
Sr	0.911	
Si	2.95	
N(5)	0.01	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.82	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1120	
Alkalinity	64	
Ca	353	

Mg	82.9	
Cl	0.07	
K	3.8	
Na	4.6	
Sr	0.874	
Si	3.42	
N(5)	0.06	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.89	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1290	
Alkalinity	59	
Ca	407	
Mg	93.6	
Cl	0.17	
K	0	
Na	4.4	
Sr	1.13	
Si	3.35	
N(5)	0.01	
N(3)	0.04	
N(-3)	0.1	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.88	
pe 4		
redox pe		
units mg/L		
density 1		

S(6)	1300	
Alkalinity	63	
Ca	463	
Mg	121	
Cl	0.36	
K	5.2	
Na	5.7	
Sr	1.21	
Si	3.73	
N(5)	0.01	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.72	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1070	
Alkalinity	58	
Ca	373	
Mg	92.7	
Cl	0.11	
K	3.8	
Na	4.6	
Sr	0.814	
Si	2.75	
N(5)	0.14	
N(3)	0.05	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.75	
pe 4		

redox pe		
units mg/L		
density 1		
S(6)	1040	
Alkalinity	62	
Ca	343	
Mg	86.8	
Cl	0.11	
K	3.3	
Na	4.2	
Sr	0.826	
Si	2.89	
N(5)	0.31	
N(3)	0.04	
N(-3)	0.08	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.57	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	887	
Alkalinity	44	
Ca	201	
Mg	49.8	
Cl	0.48	
K	3	
Na	2.2	
Sr	0.673	
Si	2.52	
N(5)	0.48	
N(3)	0.08	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01

temp 25		
pH	7.63	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	883	
Alkalinity	47	
Ca	359	
Mg	75.2	
Cl	0.35	
K	3.6	
Na	3.7	
Sr	0.939	
Si	3.55	
N(5)	0.4	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.54	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	820	
Alkalinity	47	
Ca	294	
Mg	70	
Cl	0.32	
K	2	
Na	2	
Sr	0.647	
Si	3.5	
N(5)	0.49	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		

end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.96	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1120	
Alkalinity	58	
Ca	346	
Mg	125	
Cl	0.53	
K	2	
Na	8.8	
Sr	0.92	
Si	4.44	
N(5)	8.19	
N(3)	0.03	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.7	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1690	
Alkalinity	41	
Ca	371	
Mg	90.5	
Cl	0.83	
K	1.5	
Na	10.1	
Sr	0.972	
Si	4.43	
N(5)	9.96	

N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.66	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1740	
Alkalinity	38	
Ca	370	
Mg	203	
Cl	1.1	
K	0	
Na	9.9	
Sr	0.963	
Si	5.09	
N(5)	9.13	
N(3)	0.02	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.62	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1450	
Alkalinity	41	
Ca	377	
Mg	194	
Cl	1.25	
K	1.9	
Na	12.9	

Sr	1.11	
Si	6.31	
N(5)	9.86	
N(3)	0.04	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.66	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1450	
Alkalinity	36	
Ca	385	
Mg	182	
Cl	1.38	
K	1.6	
Na	11.5	
Sr	0.892	
Si	5.92	
N(5)	9.55	
N(3)	0.06	
N(-3)	0.2	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.62	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1610	
Alkalinity	31	
Ca	395	
Mg	201	

Cl	1.03	
K	1.1	
Na	7.3	
Sr	0.951	
Si	4.1	
N(5)	8.16	
N(3)	0.06	
N(-3)	0.36	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.49	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1680	
Alkalinity	28	
Ca	420	
Mg	219	
Cl	0.91	
K	1.9	
Na	8.8	
Sr	0.958	
Si	4.22	
N(5)	8.09	
N(3)	0.08	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.86	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1330	

Alkalinity	54	
Ca	368	
Mg	173	
Cl	1.04	
K	1	
Na	11	
Sr	0.884	
Si	5.4	
N(5)	6.35	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	6.29	
S(6)	1890	
N(-3)	0.005	
N(5)	0.5	
N(3)	0.1	
Mg	191	
Ca	337	
Mn	1.79	
Na	2	
Sr	0.799	
Cl		
F	0.152	
-water 1 # kg		
end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		

density 1		
pH	7.43	
S(6)	1710	
N(-3)	0.044	
N(5)	0.75	
N(3)	0.32	
Mg	139	
Ca	355	
Mn	0.242	
Na	2	
Sr	0.546	
Cl		
F	0.167	
Alkalinity	39.6	
-water 1 # kg		
end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	6.47	
S(6)	1360	
N(-3)	0.0079	
N(5)	6.24	
N(3)	0.05	
Mg	110	
Ca	416	
Mn	0.0669	
Na	0.8	
Sr	0.615	
Cl		
F	0.165	
Alkalinity	34	
-water 1 # kg		
end		
SOLUTION # Field Bin		

temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	7.35	
S(6)	1280	
N(-3)	0.01	
N(5)	0.15	
N(3)	0.01	
Mg	159	
Ca	496	
Mn	0.167	
Na	1	
Sr	0.705	
Cl	0.45	
F		
Alkalinity	16	
-water 1 # kg		
end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	5.21	
S(6)	1410	
N(-3)	0.01	
N(5)	0.1	
N(3)	0.1	
Mg	250	
Ca	446	
Mn	0.0538	
Na	2	
Sr	0.936	
Cl	2.3	
F		
Alkalinity	24	
-water 1 # kg		

end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	7.3	
S(6)	1870	
N(-3)	0.01	
N(5)	0.01	
N(3)	0.01	
Mg	212	
Ca	542	
Mn	0.119	
Na	1.8	
Sr	0.74	
Cl	0.58	
F		
Alkalinity	47	
-water 1 # kg		
end		
SOLUTION # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	6.5	
S(6)	1690	
N(-3)	0.01	
N(5)	0.11	
N(3)	0.01	
Mg	265	
Ca	446	
Mn	0.075	
Na	6	
Sr	0.76	
Cl	0.52	
F		
Alkalinity	47	
-water 1 # kg		
end		

APPENDIX E3: GEOCHEMICAL SOURCE TERMS

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Waste Rock Facilities

		SO4	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr	Cu	Fe
Upper Case		**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Alpha Dump	mg/L	2091.2	0.050	0	0.014958694	5.6615E-05	0.028160118	390.9132182	3.5251E-05	0.001651238	0.004278068	0.005805372	0.03355218
Kona Backfill	mg/L	401.3	0.078	0	0.020954087	2.64439E-05	0.595158603	92.58863484	0.000105599	0.027041502	0.000621828	0.000874274	0.019852145
in Pit Latte	mg/L	1103.9	0.050	0	0.014544095	2.90632E-05	0.031079887	207.1123022	1.84624E-05	0.000819286	0.002271572	0.00305103	0.031984318
in Pit Supremo	mg/L	1212.5	0.050	0	0.014544095	3.19224E-05	0.031079887	227.4878768	2.02787E-05	0.000899886	0.002495048	0.003351188	0.031984318
in Pit Double Double	mg/L	1081.2	0.050	0	0.014544095	2.84653E-05	0.031079887	202.8517515	1.80826E-05	0.000802432	0.002224843	0.002988266	0.031984318
Alpha Under Drain	mg/m/yr	439478.1	40.064	0	9.545812723	0.011897884	28.59983113	82152.08323	0.007408155	0.347014638	0.899054172	1.220023767	17.11447871
Base Case													
Alpha Dump	mg/L	1429.8	0.025	0	0.007931028	3.87082E-05	0.006309529	267.2712253	2.41015E-05	0.001128967	0.002924957	0.00396919	0.021483066
Kona Backfill	mg/L	274.3	0.027	0	0.014326516	1.808E-05	0.011367883	63.30376342	7.21989E-05	0.018488542	0.00042515	0.00059775	0.013573107
in Pit Latte	mg/L	754.8	0.025	0	0.007925593	1.98708E-05	0.007023385	141.604725	1.26229E-05	0.000560154	0.001553096	0.002086019	0.02141737
in Pit Supremo	mg/L	829.0	0.025	0	0.007925593	2.18257E-05	0.007023385	155.5357065	1.38648E-05	0.000615261	0.001705889	0.00229124	0.02141737
in Pit Double Double	mg/L	739.2	0.025	0	0.007925593	1.9462E-05	0.007023385	138.6917445	1.23633E-05	0.000548631	0.001521147	0.002043107	0.02141737
Alpha Under Drain	mg/m/yr	439478.1	40.064	0	9.545812723	0.011897884	28.59983113	82152.08323	0.007408155	0.347014638	0.899054172	1.220023767	17.11447871

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Waste Rock Facilities

		Hg	Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
Upper Case		**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**Bq/L**
Alpha Dump	mg/L	2.44545E-05	236.3178529	0.026333133	0.19936325	0.009311543	0.001110593	0.033511708	0.003007408	0.000592658	0.768802979	0.131336918	0.019458122
Kona Backfill	mg/L	4.22151E-06	17.71184274	10.24834406	0.006387923	0.007276152	0.000310914	0.006337664	0.000179391	0.000211464	0.2538	0.092088334	0.091868435
in Pit Latte	mg/L	1.19937E-05	124.2728387	0.009462993	0.115349487	0.003390183	0.00054362	0.016634375	0.001331929	0.00030723	0.8601	0.06088923	0.029531715
in Pit Supremo	mg/L	1.31736E-05	136.4987203	0.010393956	0.126697495	0.003723707	0.000597101	0.018270854	0.001462964	0.000337455	0.8601	0.066879473	0.028246982
in Pit Double Double	mg/L	1.17469E-05	121.716396	0.009268328	0.112976608	0.003320442	0.000532437	0.016292186	0.00130453	0.00030091	0.8601	0.059636665	0.029824113
Alpha Under Drain	mg/m/yr	0.005139219	49663.20662	5.534020424	41.89703895	1.956860602	0.233395855	7.04262873	0.632019597	0.12454954	244.9084392	27.60101451	18.2469385
Base Case													
Alpha Dump	mg/L	6.15571E-06	161.5728483	0.018004223	0.136306622	0.006366394	0.000759323	0.022912286	0.002056194	0.000405206	0.3322803	0.089796347	0.011430937
Kona Backfill	mg/L	2.88629E-06	12.10976168	7.006893979	0.004367486	0.004974777	0.000212575	0.004333123	0.000122651	0.00014458	0.1316	0.062961703	0.06293025
in Pit Latte	mg/L	6.19083E-06	84.96656627	0.006469942	0.078865583	0.002317901	0.000371678	0.011373086	0.000910653	0.000210056	0.376	0.041630567	0.017430422
in Pit Supremo	mg/L	6.19083E-06	93.32552223	0.00710645	0.086624328	0.002545935	0.000408244	0.012491963	0.001000243	0.000230721	0.376	0.045726156	0.016672138
in Pit Double Double	mg/L	6.19083E-06	83.21870116	0.006336847	0.077243222	0.002270219	0.000364032	0.011139128	0.00089192	0.000205735	0.376	0.040774176	0.017603003
Alpha Under Drain	mg/m/yr	0.005139219	49663.20662	5.534020424	41.89703895	1.956860602	0.233395855	7.04262873	0.632019597	0.12454954	244.9084392	27.60101451	18.2469385

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Pit Walls

		Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr	Cu	Fe	Hg
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
BASE CASE														
	No Lake, end of mine life	39.5	0.022		0.007579785	2.67503E-05	0.0218188	119.8747943	4.27048E-05	0.000233268	0.000470768	0.001032277	0.01354255	9.71543E-06
SU4 NORTH DRAINAGE	Lake at Spillway	39.2	0.021		0.007553	2.83741E-05	0.016925249	124.3338875	4.51458E-05	0.000240817	0.000487968	0.001027645	0.01349781	8.96182E-06
	No Lake, end of mine life	33.8	0.025		0.007254123	2.28453E-05	0.030761285	106.1695308	3.67724E-05	0.000207336	0.000460916	0.001046771	0.01304087	1.05856E-05
SU4 South Drainage	Lake at Spillway	34.8	0.023		0.007276872	2.39643E-05	0.028033791	109.7152072	3.84626E-05	0.000214108	0.000469496	0.001046055	0.0130645	1.01505E-05
	No Lake, end of mine life	32.5	0.024		0.007206479	2.02657E-05	0.027662804	97.38669749	3.33154E-05	0.000188369	0.000407477	0.001017084	0.01239871	1.06777E-05
SU3-SU5	Lake at Spillway	32.6	0.020		0.007121952	2.04886E-05	0.021461531	97.23526494	3.38659E-05	0.000186802	0.000394704	0.000997096	0.01193362	9.86321E-06
	No Lake, end of mine life	34.8	0.017		0.0069612	1.83991E-05	0.019931562	90.45877204	3.09495E-05	0.000174593	0.000349478	0.000967061	0.01128195	9.73437E-06
SU1-SU2	Lake at Spillway	34.8	0.017		0.006970164	1.99328E-05	0.018311175	95.1082941	3.31196E-05	0.000183336	0.000372962	0.000970429	0.01149204	9.41358E-06
	No Lake, end of mine life	124.0	0.013		0.009498723	2.72829E-05	0.046935134	171.5623593	4.25431E-05	0.000772375	0.000578783	0.001218503	0.01501509	1.09331E-05
LA	Lake at Spillway	73.9	0.014		0.009069345	3.06462E-05	0.018338371	165.4825758	4.78974E-05	0.000712404	0.000671474	0.001162373	0.01396896	7.7216E-06
UPPER CASE														
	No Lake, end of mine life	41.1	0.034		0.006679299	2.71523E-05	0.03908585	133.5414043	4.63571E-05	0.000299127	0.000499808	0.001128243	0.01376482	1.00419E-05
SU4 NORTH DRAINAGE	Lake at Spillway	40.7	0.033		0.006389203	2.87929E-05	0.030176418	138.7227773	4.8736E-05	0.000309754	0.000515611	0.00111851	0.01371032	9.27255E-06
	No Lake, end of mine life	35.2	0.035		0.006702487	2.3219E-05	0.047779356	117.8325752	4.03828E-05	0.00026302	0.000502879	0.001158838	0.01333661	1.10217E-05
SU4 South Drainage	Lake at Spillway	36.2	0.034		0.006605632	2.43486E-05	0.042994886	121.9352495	4.20644E-05	0.000272779	0.000510951	0.001153503	0.01335095	1.05713E-05
	No Lake, end of mine life	33.9	0.033		0.006819829	2.06263E-05	0.046550415	107.755702	3.71711E-05	0.000237446	0.000442466	0.001135147	0.01268598	1.11012E-05
SU3-SU5	Lake at Spillway	34.0	0.030		0.006616528	2.08586E-05	0.036464621	107.6838099	3.77996E-05	0.000236515	0.000427189	0.001111001	0.01220973	1.02672E-05
	No Lake, end of mine life	36.7	0.026		0.006724836	1.87595E-05	0.036257204	100.020386	3.4991E-05	0.000221687	0.000381894	0.001080895	0.01154371	1.01149E-05
SU1-SU2	Lake at Spillway	36.5	0.027		0.006537048	2.03051E-05	0.033123576	105.3740252	3.70351E-05	0.000233333	0.000405004	0.001081005	0.01174557	9.78242E-06
	No Lake, end of mine life	183.6	0.023		0.007489689	2.79199E-05	0.092292251	188.5271773	6.46309E-05	0.00095657	0.000866042	0.001442626	0.01529846	1.23118E-05
LA	Lake at Spillway	104.4	0.026		0.006146484	3.13333E-05	0.03752014	178.8204119	7.31469E-05	0.000890581	0.001004133	0.001335457	0.01419015	9.2014E-06

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Pit Walls

		Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
BASE CASE												
	No Lake, end of mine life	41.21473248	0.108042224	0.024756661	0.001508038	0.000137072	0.012374961	0.000759226	0.000175483	0.061476085	0.013370523	0.019898998
SU4 NORTH DRAINAGE	Lake at Spillway	42.81880431	0.114915327	0.024455768	0.001581627	0.000145292	0.011385813	0.000792029	0.00017027	0.060874474	0.014182761	0.019139064
	No Lake, end of mine life	36.31296642	0.089958078	0.024141059	0.001306363	0.000118975	0.010833936	0.000658812	0.000167911	0.06457882	0.011418889	0.023664288
SU4 South Drainage	Lake at Spillway	37.56812092	0.095157079	0.024105996	0.001363745	0.000124607	0.010906124	0.000686957	0.000165739	0.064045589	0.011978742	0.022717963
	No Lake, end of mine life	33.87882088	0.0787191	0.02497052	0.001197192	0.000105277	0.010854165	0.000597287	0.000170343	0.063985095	0.010127734	0.023116159
SU3-SU5	Lake at Spillway	34.18352572	0.080143691	0.025054885	0.001218556	0.000106323	0.010501085	0.000602658	0.00016413	0.062824583	0.010239402	0.021453189
	No Lake, end of mine life	32.22143643	0.072580151	0.025206824	0.001154918	9.57599E-05	0.011949623	0.000571932	0.000160723	0.059619437	0.009194365	0.018991411
SU1-SU2	Lake at Spillway	33.69244127	0.078885791	0.024781908	0.001220407	0.000103519	0.011221928	0.000603943	0.000158906	0.059098994	0.009961312	0.018897304
	No Lake, end of mine life	52.9721605	0.171852255	0.010536621	0.007181217	0.000152065	0.034478896	0.00161127	0.000159953	0.00783896	0.013618984	0.00054742
LA	Lake at Spillway	52.89728217	0.182029823	0.011114635	0.00686225	0.000166411	0.031625875	0.001353312	0.000125651	0.008093155	0.01530365	0.000562541
UPPER CASE												
	No Lake, end of mine life	44.87257517	0.122094167	0.028987995	0.001581606	0.000277882	0.015679025	0.000777102	0.00022251	0.158274806	0.013550946	0.062767209
SU4 NORTH DRAINAGE	Lake at Spillway	46.65357393	0.129805945	0.028700814	0.001645598	0.000294148	0.014510892	0.000787375	0.000218385	0.161188362	0.014370689	0.062752664
	No Lake, end of mine life	39.50069382	0.101741261	0.027935404	0.001388938	0.000241428	0.013515833	0.000738935	0.000209805	0.147281855	0.01158685	0.066473643
SU4 South Drainage	Lake at Spillway	40.88422951	0.107584717	0.027968401	0.001441931	0.000252376	0.013686779	0.000752708	0.000208706	0.149188648	0.01215177	0.065630589
	No Lake, end of mine life	36.77893446	0.089067327	0.02884185	0.001277826	0.000215253	0.013380132	0.000751223	0.000208374	0.153417538	0.010284571	0.065138244
SU3-SU5	Lake at Spillway	37.10504353	0.090635792	0.028999469	0.001289324	0.000217262	0.012978291	0.000775772	0.000201188	0.158008795	0.01039832	0.063155702
	No Lake, end of mine life	34.9102509	0.082121873	0.029254767	0.00123142	0.00019628	0.014802821	0.000785842	0.000195011	0.155052279	0.009343595	0.057483364
SU1-SU2	Lake at Spillway	36.54997811	0.089216516	0.028810114	0.001293637	0.000211743	0.013948139	0.00077961	0.000194916	0.154663365	0.010116482	0.058013927
	No Lake, end of mine life	62.59136004	0.198158138	0.013001839	0.008876746	0.00045016	0.025012242	0.001294683	0.000227635	0.035632282	0.013925996	0.004151265
LA	Lake at Spillway	62.45485766	0.209739341	0.013885277	0.008487134	0.000491538	0.020302083	0.000952132	0.000187434	0.038045137	0.01557562	0.002792895

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Treated Heap Leach Facility Drainage

	Ammonia	NO3	NO2	Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Base Case	0.125	0.125	0.025	67	0.188	0.0069	0.0198	0.000059	0.0134	37.4	0.00001	0.0941	0.00056
Upper Case	0.25	0.25	0.05	73	0.197	0.0104	0.0257	0.000074	0.0155	38.9	0.00001	0.0974	0.0007

	Cu	Fe	Hg	Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	0.0023	0.288	0.000037	12.9	0.159	0.00017	0.0011	0.0001	0.00021	0.00176	0.00002	0.000914	0.0295	0.023
Upper Case	0.0026	0.305	0.0000405	13.6	0.198	0.00051	0.0012	0.00016	0.00023	0.00228	0.00002	0.00119	0.0456	0.032

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Heap Leach Facility Drainage at Closure

Solution	T-CN	Ammonia	NO3	NO2	Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Base Case	mg/L	0.05	316.5	5.3	562.2	0.227	0.09685	0.0084	0.000162522	0.292817364	171.1679146	8.50018E-05	0.05995	0.00651
Upper Case	mg/L	9.02	375.4	6.68	1914.5	0.244	0.2	0.1288	0.00074925	0.691268883	460.6481141	0.000268486	0.101	0.0195
Base Case (Passive Discharge)														
	Cu	Fe	Hg	Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	0.002335	0.522	0.00004565	52.23898228	0.03293246	0.254461526	0.005859489	0.000369563	0.03275	0.006591223	0.002255966	0.291774839	0.015872223	0.020897299
Upper Case	0.0064	1.01	0.000423	140.301542	0.100733031	0.900113335	0.019799156	0.001623678	0.0802	0.019829836	0.005938213	0.68162509	0.044042277	0.029774847
Base Case (Passive Discharge)														

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Plantsite Area

Solution	Ammonia	NO3	NO2	Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Base Case	0.005	0.0025	0.001	0.25	0.025	0	0.0169	0.000025	0.0023	0.94	0.000025	0.00059	0.00294	
Upper Case	0.01	0.0089	0.0017	0.855	0.025	0	0.0479	0.0000605	0.00335	1.415	0.00005	0.000915	0.003485	
	Cu	Fe	Hg	Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	0.0052	0.03	0.000025	0.351	0.0535	0.00108	0.00221	0.0007	0.00025	0.00025	0.00005	0.00159	0.005	0.011951644
Upper Case	0.00735	0.044	0.00005	0.514	0.0812	0.001535	0.003085	0.00107	0.00027	0.0005	0.0001	0.002435	0.01	0.018187508

Appendix E.3: Geochemical Source Terms
Geochemical Source Terms for Nitrogen Species

	Ammonia	NO3	NO2
	mg/L	mg/L	mg/L
BASE CASE			
Alpha	0.06	30.00	0.10
Kona in-pit Dump	0.06	30.00	0.10
In-pit Latte WRSF	0.06	30.00	0.10
In-pit Supremo WRSF	0.06	30.00	0.10
In-pit Double Double WRSF	0.06	30.00	0.10
PIT WALLS Active	1.8	17	0.030
PIT WALLS Inactive	0.00	0.00	0.00
UPPER CASE			
Alpha	0.20	45.00	0.30
Kona- In Pit Dump	0.20	45.00	0.30
North Dump	0.20	45.00	0.30
In-pit Latte WRSF	0.20	45.00	0.30
In-pit Supremo WRSF	0.20	45.00	0.30
In-pit Double Double WRSF	0.20	45.00	0.30
PIT WALLS Active	5.5	34	3.6
PIT WALLS Inactive	0.00	0.00	0.00

APPENDIX E4: BENCH-SCALE TESTWORK FOR HLF WATER TREATMENT SYSTEM (INOTEC REPORT)

LORAX ENVIRONMENTAL

COFFEE GOLD PROJECT

Bench-Scale EBR Testing: Nitrate, Arsenic, and Uranium Removal from the Coffee Gold Mine Leach Waters

Final Report

April, 2016

Lorax Environmental Services

David Flather, M.Sc.
Principal and Senior Environmental Geoscientist
Tel. (604) 688-7173
Email: David.Flather@lorax.ca

INOTEC
2712 S. 3600 W., Suite A
Salt Lake City, UT 84119
(801) 966-9694
www.inotec.us

Table of Contents

1. Executive Summary 2
2. Introduction 2
    2.1. Coffee Gold Project Description 2
    2.2. Electro-Biochemical Reactor (EBR) 2
    2.3. Test Goals 3
3. Experimental Design and Procedures 4
    3.1. Microbial Screening 4
    3.2. EBR Bench-Scale Testing 4
    3.3. Sampling and Analysis 5
4. Results 6
    4.1. Chemistry and Treatability Assessment 6
    4.2. Microbial Screening and Assessment 6
    4.3. Removal of Contaminants of Interest (NO_3, As, U) 8
    4.4. Removal of Other Contaminants 10
5. Conclusions 11

Appendix A. Analytical Data Tables 12

1. Executive Summary

The Coffee Gold project is located in the west-central Yukon Territory, approximately 130 km south of Dawson City. Lorax Environmental Services (Lorax) has contracted with Inotec LLC (Inotec) to perform treatability studies. This report summarizes results of preliminary bench-scale laboratory evaluations of contaminant removal efficiency using Electro-Biochemical Reactor (EBR) technology.

A microbial population was screened and selected that is expected to exhibit stable nitrate, uranium, and arsenic removal characteristics within the Coffee Gold leach waters and indigenous microbial population. Optimized EBR system achieved 99.9%, 98.8%, and 99.1% removals for nitrate-N, arsenic, and uranium, respectively. Additionally, sixteen other metals as well as total and WAD cyanide were removed by the EBR treatment.

The preliminary bench-scale testing successfully validated the EBR technology as a treatment option for the Coffee Gold leach waters.

2. Introduction

2.1. Coffee Gold Project Description

The Coffee Gold project is located in the west-central Yukon Territory, approximately 130 km south of Dawson City. Exploration drilling has led to the discovery of gold mineralization in 19 areas.

Lorax Environmental Services (Lorax) has contracted with Inotec LLC (Inotec) to perform treatability studies. This report summarizes results of preliminary bench-scale laboratory evaluations of contaminant removal efficiency using Electro-Biochemical Reactor technology.

2.2. Electro-Biochemical Reactor (EBR)

Microbes mediate the removal of metal and inorganic contaminants through electron transfer (redox processes). For example, nitrate reduction can be described by the following redox reaction:

$$NO_3^- + 5e^- + 6H^+ \rightarrow \frac{1}{2}N_2 + 3H_2O \quad (1)$$

The biotransformation shown in reaction 1 occurs under anaerobic, reductive conditions, and thus requires low dissolved oxygen (DO) levels and a negative ORP environment. Five electrons are needed to reduce one molecule of nitrate to nitrogen gas. Other co-contaminants, such as arsenate, uranium, etc., would add to the electron demand. One molecule of glucose, often used as a cost-effective nutrient in the form of molasses, can provide up to 24 electrons under optimal conditions and complete glucose metabolism (usually measured in hours). In environmental applications, this efficiency or the amount of electrons actually realized is usually considerably less; only a few of these electrons are available within 4 to 6 hours time.

In conventional biological treatment systems, electrons are supplied from excess nutrients added to the system. Excess nutrients/chemicals are typically required to compensate for inefficient and variable electron availability needed to adjust the reactor chemistry, microbial growth, contaminant removal, and to compensate for system sensitivity. However, these excess nutrients lead to additional capital and operational expenses, due to higher nutrient consumption and excessive biomass production.

The Electro-Biochemical Reactor (EBR) technology overcomes these shortcomings by directly supplying needed electrons to the reactor and microbes, using a low applied potential across the reactor cell (1-3 V). For a comparison with a conventional nutrient electron donor, the current of 1 mA provides 6.2×10^{15} electrons per second. These electrons replace and supplement the electrons normally supplied to the reactor/microbial system by excess nutrients, at a considerable monetary savings and reactor, microbial, and environmental benefits. The directly supplied electrons are readily available to the microbes in a consistent controllable manner without metabolic energy expenditure. The excess electron provision in the EBR systems allows for a better control of the ORP conditions, without the need to add chemicals, such as bisulfide to adjust the ORP. Moreover, those "free electrons", from the microbes' metabolic standpoint, make the EBR bioreactors more robust and less sensitive to wide fluctuations in water chemistries than the past generations of biotreatments.

2.3. Test Goals

The Coffee Gold treatability tests consisted of the following tasks:

- Task 1 – Spent Ore Column Leaching Tests. Task 1 was used to generate leach waters for Tasks 2 through 4.
- Task 2 – Microbial Screening and Treatability Assessment. The goal of Task 2 was to develop microbial consortia for Tasks 3 and 4.
- Task 3 – EBR Validation Testing. The goal of Task 3 was to provide preliminary evaluation of the EBR technology for treatment of the Coffee Gold leach waters.
- Task 4 – In Situ Testing. The goal of Task 4 was to evaluate microbial in situ treatment of the Coffee Gold spent ore materials.

This report focuses on results obtained during Tasks 2 and 3 of testing. The main goal of the EBR bench-study was to provide a preliminary assessment and validation of the Electro-Biochemical Reactor Technology for arsenic, uranium, and nitrate removal from the Coffee Gold leach waters. Nitrate-N removal is important because it is a co-contaminant and a preferred electron acceptor that needs to be reduced or removed before other metals can be effectively targeted. Treatability assessment, microbial assessment and bench-scale testing was performed on Coffee Gold waters, generated in the lab via Coffee Gold spent ore leaching.

3. Experimental Design and Procedures

3.1. Microbial Screening

Microbial isolation and screening tests were conducted on solutions received and initial column materials at 5ºC and 20 ºC. Microbes isolated from the Coffee Gold waters and spent ore materials were tested for their ability to remove arsenic, uranium, and nitrate from solution. These isolates were tested in direct comparative screening tests alongside Inotec's repository microbes in order to select a site-specific inoculum for removal of contaminants of interest.

These tests provided the microbes for the EBR treatability assessment. A microbial population screened to be effective at removing arsenic, uranium, and nitrate were grown into an inoculum for the EBR testing.

3.2. EBR Bench-Scale Testing

The process flow diagram for the bench-scale EBR testing is shown in Figure 1. The bench-scale setup consisted of a two-stage, up-flow, fixed bed EBR system. The tests were conducted under continuous flow conditions, i.e., the water was treated 24 hours per day. The system was operated using a total hydraulic retention time of 44 hours.

The EBR column tests were conducted continuously for two months for process assessment and validation testing. The goal of validation testing was to generate sufficient compliance data (i.e., nitrate, arsenic, and uranium concentrations in the EBR treatment effluent below desired levels). The EBR system initially treated leach waters pumped twice through the Coffee Gold spent ore columns. However, since uranium concentrations have decreased after the second pass through the spent ore columns, it was decided for the EBR to treat first pass leach solutions instead.

Prior to the EBR treatment, cyanide destruction in the leachate solutions was performed using hydrogen peroxide treatment; nitrate-N was readjusted to at least 150 mg/L, and pH of the water was dropped to about 6.5.

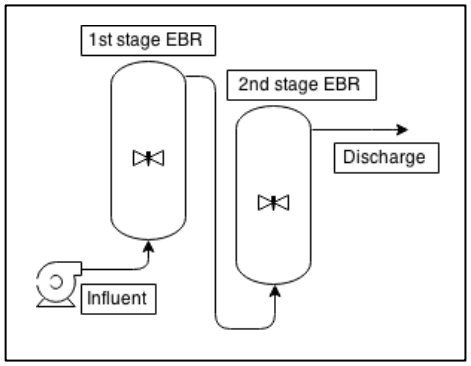


Figure 1. Process flow diagram of a bench-scale EBR system.

3.3. Sampling and Analysis

Daily Inotec in-house measurements included flowrate, pH, ORP, DO, temperature, nutrient addition, conductivity, and nitrate-N. Influent and EBR effluent samples were collected in 5-day intervals and sent out to ALS Vancouver for a complete suite analysis (Table 1).

Table 1. Analytes and analytical methods used in the EBR bench-scale tests.

Analyte	Method	Method Number
Hardness	EDTA Titration	APHA 2340B
pH	Automated pH meter	APHA 4500-H pH Value
TDS	Gravimetric	APHA 2540 C
Alkalinity	Titration	APHA 2320 Alkalinity
Bromide	Ion Chromatography (IC)	EPA 300.1
Chloride	Ion Chromatography (IC)	EPA 300.1
Fluoride	Ion Chromatography (IC)	EPA 300.1
Total Nitrogen	Colorimetric	APHA Method 4500-P (J) / NEMI 5735
Ammonia-Nitrogen	Fluorescence	J. ENVIRON. MONIT., 2005
Nitrite-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Nitrate-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Total Phosphorus	Colorimetric	APHA 4500-P Phosphorus
Orthophosphate	Colorimetric	APHA 4500-P Phosphorus
Sulfate	Ion Chromatography (IC)	EPA 300.1
Total Cyanide	Continuous Flow Analyzer (CFA)	ISO 14403:2002
WAD Cyanide	Continuous Flow Analyzer (CFA)	APHA 4500-CN CYANIDE
Total Metals	Collision/Reaction Cell – Inductively Coupled Plasma (CRC-ICP)	EPA 200.2/6020A
Total Mercury	Cold Vapor Atomic Absorption Spectrophotometry (CVAAS)	EPA 1631E

4. Results

4.1. Chemistry and Treatability Assessment

The leachate solution chemistry treated by the EBR system is shown in Table 2. Nitrate as well as arsenic (1.1 mg/L) and uranium (144 μg/L) concentrations were well within the EBR treatability range. Compounds that often compete with nitrate, arsenic, and uranium for electrons during biotreatments, e.g., nitrite, and other metal oxyanions, such as selenate or chromate, were not present at concentrations that would impact EBR performance.

Inorganic parameters that often have an inhibitory effect on microbial metabolism, such as chlorides, were present at low levels. Total and WAD cyanides were elevated and needed to be destroyed prior to EBR treatment. Due to the nature of the spent ore, the generated leach solutions had pH of about 8.7 and needed to be adjusted to 6.5 for optimal denitrification and As/U removal.

Water chemistry assessment strongly suggests that the EBR technology will be effective at removing the contaminants of concern. Additionally, the EBR technology should also reduce the concentration of some other metals, such as aluminum, antimony, cadmium, chromium, copper, mercury, molybdenum, nickel, and tin.

4.2. Microbial Screening and Assessment Results

Nitrate-, arsenic-, and uranium-reducing microorganisms were isolated from the Coffee Gold waters and spent ore materials received and screened with Inotec's repository strains to examine their bioremediation potential in the site waters at 5°C and 20°C. The microbial screening is used to 1) determine whether a given contaminant is easy or difficult to remove in a given water chemistry using the EBR technology; 2) identify a best performing microbial population in the given water chemistry (contaminant transformation, temperature dependence, performance robustness); 3) selection of an adjusted/enhanced microbial consortium that is the most compatible with the unadjusted native population; and 4) condition the selected microbial consortia for optimal EBR performance.

With an evaluation of the obtained wastewater chemistry, good positive denitrification and microbial arsenic/uranium reduction screening results were obtained. Selected microbes were further screened and characterized to develop the inocula for EBR tests. From the various consortia tested in the Coffee Gold waters, the best inoculum for the bench-scale tests was selected based on:

- Nitrate/As/U reduction potential at low and high temperatures.
- Robustness in the Coffee Gold waters at low and high temperatures.
- Compatibility with indigenous microbes present in the Coffee Gold waters.
- The ability to maintain an integrated biofilm with desired contaminant removal characteristics.

Table 2. Water chemistry of Coffee Gold leach solutions.

Parameter	Concentration
Metals	
Aluminum	1.5 mg/L
Antimony	30.8 µg/L
Arsenic	1.1 mg/L
Barium	70.5 µg/L
Cadmium	3.7 µg/L
Calcium	37.5 mg/L
Chromium	10.3 µg/L
Cobalt	239 µg/L
Copper	0.5 mg/L
Iron	0.5 mg/L
Lead	1.1 µg/L
Magnesium	5.9 mg/L
Manganese	32 µg/L
Mercury	3.7 µg/L
Molybdenum	75 µg/L
Nickel	118 µg/L
Potassium	83 mg/L
Selenium	2.1 µg/L
Silver	5.2 µg/L
Sodium	234 mg/L
Strontium	186 µg/L
Thallium	0.88 µg/L
Tin	7.7 µg/L
Titanium	9.3 µg/L
Uranium	144 µg/L
Vanadium	1.2 µg/L
Zinc	187 µg/L
Inorganics	
pH	8.7
Hardness, Total (as $CaCO_3$)	118 mg/L
Alkalinity, Total (as $CaCO_3$)	188 mg/L
Ammonia as N	13 mg/L
Chloride	6.8 mg/L
Fluoride	0.35 mg/L
Cyanide, Total	24 mg/L
Cyanide, WAD	25 mg/L
Nitrate as N	105 mg/L
Nitrite as N	0.3 mg/L
Total N	130 mg/L
Sulfate	160 mg/L
Dissolved Orthophosphate	0.13 mg/L

4.3. Removal of Contaminants of Interest

The bench-scale testing validated the EBR technology for removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Figures 2 and 3 show removal of nitrate-N and nitrite-N by the bench-scale EBR system. Nitrate-N concentrations were adjusted to a minimum of 150 mg/L in the influent waters and averaged 188 mg/L during the 2-month test period. The EBR system consistently removed both nitrate-N and nitrite-N to below detection limits (0.19 mg/L and 0.04 mg/L, respectively).

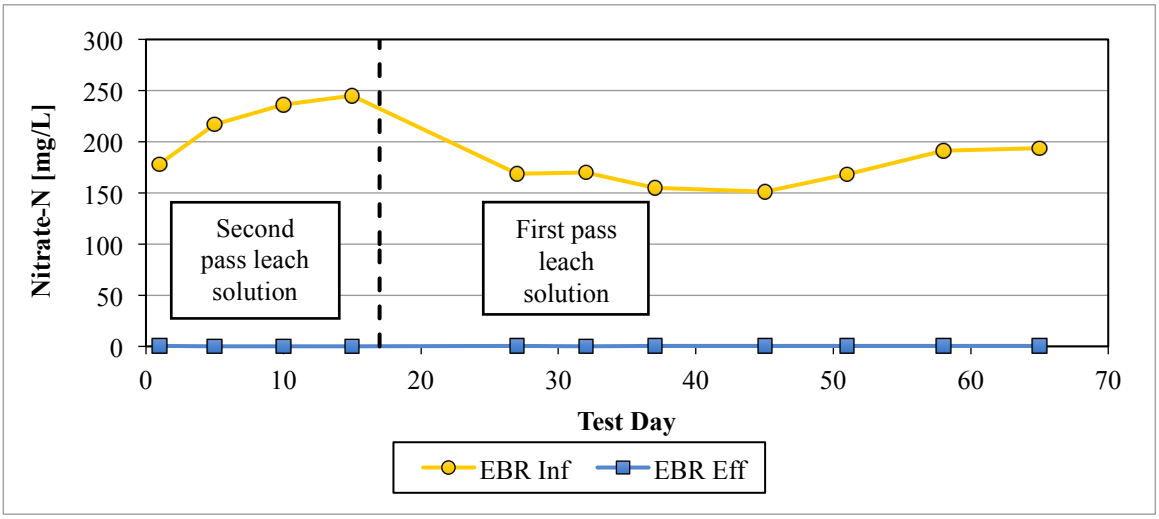


Figure 2. EBR nitrate-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

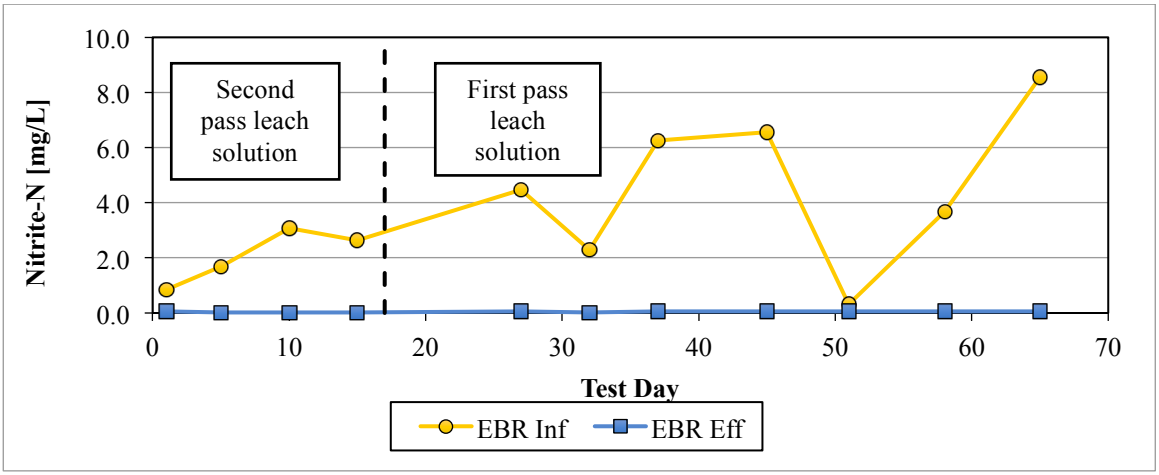


Figure 3. EBR nitrite-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Arsenic removal by the EBR Coffee Gold system for the initial two weeks averaged 60% (Figure 4). Process and bioreactor operation were adjusted to improve the EBR performance. After system modifications were implemented, the EBR As removal increased to an average of 98.8%. Total arsenic was removed from the average of 1,113 µg/L in the leach waters to average of 12.9 µg/L in the EBR system effluent.

Uranium removal averaged 99.1%, with the EBR system effluent concentrations averaging 0.8 µg/L (Figure 5). Influent uranium levels varied between 34 µg/L and 154 µg/L, with the average concentrations of 92.5 µg/L. Table 3 summarizes EBR performance.

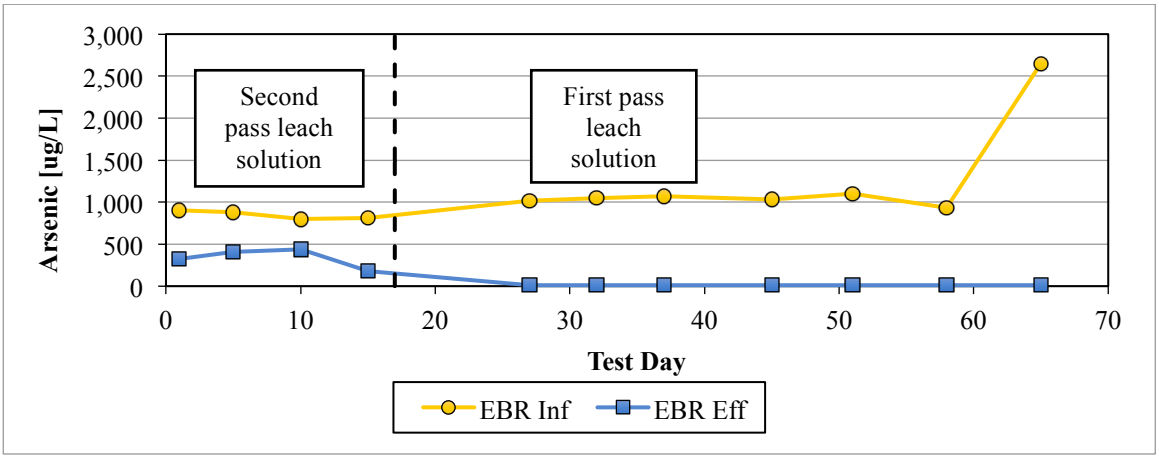


Figure 4. EBR arsenic removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

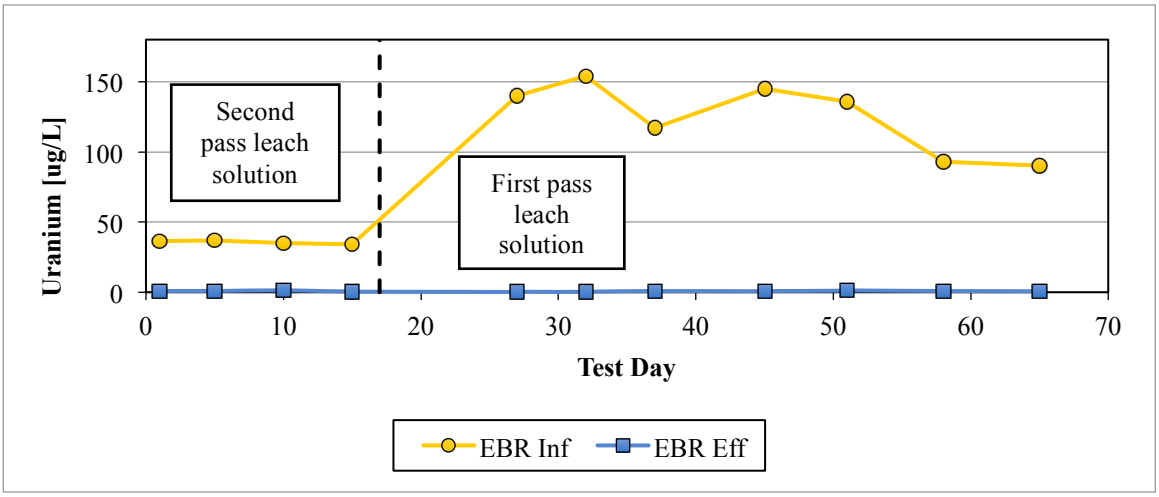


Figure 5. EBR uranium removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Table 3. Average EBR treatment performance.

Parameter	Average EBR Influent	Average EBR Effluent	% Removal
Nitrate-N [mg/L]	188	< 0.19	> 99.9%
Nitrite-N [mg/L]	3.7	< 0.04	> 98.9%
As [µg/L]	1,113	12.9*	98.8%
U [µg/L]	92.5	0.8	99.1%
Al [µg/L]	737	< 35.8	> 95.1%
Sb [µg/L]	33.2	< 0.35	> 98.9%
Cd [µg/L]	1.3	< 0.02	> 98.5%
Cr [µg/L]	10.7	< 0.66	> 93.8%
Co [µg/L]	269	122	54.6%
Cu [µg/L]	267	< 2.4	> 99.1%
Fe [µg/L]	2.2	0.23	89.5%
Pb [µg/L]	1.9	< 0.17	> 91.0%
Hg [µg/L]	1.6	0.03	98.1%
Mo [µg/L]	59.5	< 6.9	> 88.4%
Ni [µg/L]	75.1	< 2.3	> 96.9%
Se [µg/L]	2.9	1.2	58.6%
Ag [µg/L]	3.9	< 0.06	> 98.5%
Tl [µg/L]	0.8	< 0.03	> 96.2%
Sn [µg/L]	32.5	0.8	97.5%
Zn [µg/L]	76.1	38.1	49.9%
WAD Cyanide [mg/L]	0.03	< 0.007	> 76.7%
Total Cyanide [mg/L]	0.48	0.16	66.7%
Ammonia-N [mg/L]	15.3	208	NA
Orthophosphate [mg/L]	0.2	47.1	NA

*after process adjustment

NA – not applicable

4.4. Removal of Other Contaminants

Beside arsenic and uranium, the EBR system removed other metals to various degrees as well (Table 3). Over 90% average removal efficiencies were achieved for Al, Sb, Cd, Cr, Cu, Pb, Hg, Ni, Sn, Ag, and Tl. Total and WAD cyanide were still present in the leach waters after peroxide cyanide destruction, albeit at much lower concentrations (0.48 mg/L and 0.03 mg/L, respectively). The EBR system degraded WAD cyanide to below the detection limit of 0.007 mg/L and total cyanide to average levels of 0.16 mg/L (Table 3). Complete analytical data tables are given in Appendix A.

As expected in this preliminary treatability evaluation, nutrient levels (e.g., ammonia-N and orthophosphate) were elevated in the EBR system effluent. The scope of work for this project

was focused on the initial validation of the EBR process for removal of contaminants of interest and not on process optimization. In field applications, minimum nutrient additions to the EBR system are established and balanced, often resulting in minimal (if any) increases in the system effluent. However, if ultra-low levels of ammonia or BOD are required in the system effluent, a conventional aerobic bioreactor polishing step can be used. Aerobic bioreactors are a well-established technology for nutrient removal from municipal wastewaters, where they have been successfully implemented for over a century.

5. Conclusions

The preliminary bench-scale testing successfully validated EBR technology for removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Nitrate-N was removed from an average of 188 mg/L to below detection limit of 0.19 mg/L. After process adjustments, average removals of 98.8% and 99.1% were achieved for arsenic and uranium, respectively. Furthermore, sixteen other metals as well as total and WAD cyanides were removed by the EBR system.

In order to develop process requirements and design parameters for a Coffee Gold site-specific EBR system, additional bench-scale and/or pilot-scale testing is required. Testing duration of a minimum of 14-16 weeks is required for process assessment and to develop validation data, nutrient and hydraulic retention time requirements, as well as evaluation of post-treatment needs, if any.

Thank you for your consideration of INOTEC's EBR technology for evaluation.

Sincerely,

INOTEC, INC.

Jack Adams, Ph.D.
President, INOTEC

Ola Opara, Ph.D.
Vice President, INOTEC

Appendix A.

Analytical Data Tables

	Hardness [mg/L as CaCO3]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	95.5	145	135	282	111
5		148	141	176	122
10		135	151	147	114
15	77.4	136	152	177	109
27	110			107	154
32	108			114	149
37	106			130	147
45	110			115	148
51	109			101	128
58	121			116	150
65	145			146	144

	pH				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	8.64	8.31	8.3	6.55	7.98
5		8.36	8.32	7.38	8.08
10		8.34	8.33	6.78	8.06
15	8.78	8.30	8.38	7.27	8.01
27	8.29			7.16	7.91
32	8.34			6.62	7.93
37	8.32			6.46	7.88
45	8.29			6.24	7.73
51	8.31			6.65	7.83
58	8.31			6.49	7.87
65	8.16			6.25	7.97

	TDS [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	1390	1450	1330	1680	3190
5		1480	1560	1830	2400
10		1560	1650	1840	2170
15	1620	1560	1670	2000	1910
27	1110			1280	1980
32	1160			1630	2040
37	1160			1560	2090
45	1160			1540	2600
51	1170			1690	2130
58	1290			1730	2230
65	1320			1780	2280

	Alkalinity [mg/L as CaCO3]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	140	182	168	43.8	1890
5		190	174	64.8	1530
10		187	190	32.1	1410
15	131	165	200	47.5	1260
27	157			106	852
32	158			65.4	775
37	164			41.8	772
45	167			44.9	739
51	179			70.9	680
58	176			65.9	689
65	166			57.1	682

	Ammonia-N [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	17.1	9.5	10.1	9.91	314
5		9.3	10.7	9.38	192
10		10.4	12.4	10.5	149
15	19.4	12.2	14.3	12.0	144
27	18.2			21.8	178
32	18.5			21.5	206
37	19.6			21.1	218
45	19.0			20.6	210
51	19.9			20.7	215
58	12.4			13.0	234
65	8.97			7.94	231

	Chloride [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<10	6.7	6.9	215	733
5		<10	6.7	127	488
10		<10	<10	142	424
15	<10	6.3	<10	158	433
27	6.3			177	1020
32	7.0			114	1010
37	6.5			184	1060
45	6.5			160	1060
51	6.8			89	1060
58	7.0			92	1180
65	6.8			100	1160

	Nitrate-N [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	206	159	161	178	<0.25
5		194	180	217	<0.1
10		205	195	236	<0.1
15	178	184	197	245	<0.1
27	94.6			169	<0.25
32	103			170	<0.1
37	101			155	<0.25
45	100			151	<0.25
51	98.1			168	<0.25
58	125			191	<0.25
65	127			194	<0.25

	Nitrite-N [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.328	1.82	0.94	0.84	<0.05
5		2.26	3.49	1.68	<0.02
10		0.899	6.64	3.07	<0.02
15	0.319	0.571	16.4	2.64	<0.02
27	0.281			4.46	<0.05
32	0.300			2.28	<0.02
37	0.325			6.25	<0.05
45	0.303			6.56	<0.05
51	0.298			0.30	<0.05
58	4.1			3.68	<0.05
65	8.73			8.55	<0.05

	Total N [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	216	178	165	186	346
5		190	181	223	205
10		199	209	239	166
15	192	203	216	248	149
27	122			259	195
32	124			190	210
37	118			177	224
45	120			171	223
51	120			185	216
58	147			213	247
65	141			212	243

	Orthophosphate-P [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.074	0.08	0.07	0.368	78.3
5		0.071	0.087	0.198	51.7
10		0.076	0.0862	0.138	50
15	0.032	0.062	0.112	0.193	41.6
27	0.141			0.266	41
32	0.131			0.184	44
37	0.124			0.197	42.1
45	0.128			0.188	44.3
51	0.117			0.169	39.6
58	0.128			0.184	43.9
65	0.150			0.193	42.1

	Sulfate [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	160	163	167	223	<15
5		171	158	166	<6
10		158	144	144	<6
15	152	151	154	178	<6
27	143			168	<15
32	156			155	50.2
37	147			158	39
45	150			159	67
51	149			150	57
58	166			166	73
65	165			163	69

	Sulfide-S [mg/L]		
Test Day	**Leach Columns Influent**	**EBR Influent**	**EBR Effluent**
27	<0.0015	<0.0015	0.611
32	<0.0015	<0.0015	3.48
37	<0.0015	<0.0015	1.96
45	0.0026	<0.0015	3.99
51	<0.0015	<0.006	3.36
58	<0.0015	<0.0015	2.42
65	<0.0015	<0.0015	4.42

	Cyanide WAD [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	11.3	0.0201	0.054	0.0188	<0.005
5		0.0193	0.0232	0.0143	<0.005
10		0.0155	0.0136	0.0087	<0.005
15	9.7	0.0245	0.0208	0.0161	0.0084
27	6.71			0.0479	0.013
32	6.62			0.0908	0.0098
37	5.76			0.0083	0.0104
45	4.09			0.0623	0.0067
51	2.21			0.0085	0.0069
58	0.73			<0.005	0.0051
65	0.364			0.0302	0.0077

	Cyanide Total [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	11.7	0.529	0.505	0.558	0.374
5		0.448	0.37	0.452	0.355
10		0.518	0.342	0.355	0.24
15	10.4	0.493	0.334	0.353	0.0997
27	7.04			0.696	0.0975
32	7.4			0.693	0.11
37	6.18			0.0979	0.0964
45	4.73			0.521	0.0959
51	2.92			0.779	0.104
58	1.37			0.376	0.0811
65	0.749			0.363	0.0816

	Aluminum [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	32.2	19.6	8.8	51.1	74.3
5		<6	6.6	61.8	62.9
10		<6	<6	9.9	59.8
15	81.9	<6	7.4	15.7	46
27	114			214	<15
32	131			128	<30
37	97.5			84.7	17.2
45	93.1			50.9	19.5
51	382			163	23.2
58	260			356	25.7
65	6430			6970	19.8

	Antimony [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	28.7	31.3	32.2	35	0.38
5		32.8	33.8	32.7	<0.2
10		36.9	33.5	32.7	<0.2
15	29.1	30.9	31.2	30.7	<0.5
27	30.5			28.9	<0.5
32	30.3			31	<1
37	25.5			29.7	0.23
45	29			28.4	<0.2
51	31.1			28.9	0.22
58	32.1			32.1	<0.2
65	65.3			54.9	0.21

	Arsenic [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	1040	864	866	903	321
5		916	869	877	405
10		875	786	800	440
15	951	891	767	813	179
27	1060			1020	10.1
32	1080			1050	13.2
37	1090			1070	11.7
45	1100			1030	12.2
51	1170			1100	13.4
58	942			934	14.3
65	2620			2650	15.5

	Barium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	51.8	52.1	40.2	60.7	188
5		47.0	40.9	51.2	498
10		41.7	42.0	42.6	350
15	34.1	41.2	49.6	47.6	207
27	61.7			60.5	550
32	61			64	351
37	63.1			68.6	423
45	63.5			63.4	426
51	69.7			67.1	384
58	52.8			52.2	332
65	254			268	350

	Beryllium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<0.04	<0.04	<0.04	<0.04	<0.04
5		<0.04	<0.04	<0.04	<0.04
10		<0.04	<0.04	<0.04	<0.04
15	<0.02	<0.04	<0.04	<0.04	<0.01
27	<0.02			<0.04	<0.1
32	<0.02			<0.02	<0.02
37	<0.02			<0.02	<0.04
45	<0.02			<0.02	<0.04
51	0.021			<0.02	<0.04
58	0.02			0.041	<0.04
65	1.26			1.13	<0.04

	Bismuth [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<0.1	<0.1	<0.1	<0.1	<0.1
5		<0.1	<0.1	<0.1	<0.1
10		<0.1	<0.1	<0.1	<0.1
15	<0.05	<0.1	<0.1	<0.1	<0.25
27	<0.05			<0.1	<0.25
32	<0.05			<0.05	<0.05
37	<0.05			<0.05	<0.1
45	<0.05			<0.05	<0.1
51	<0.05			<0.05	<0.1
58	<0.05			<0.05	<0.1
65	0.425			0.376	<0.1

	Boron [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.028	0.023	0.025	0.050	0.231
5		0.024	0.026	0.030	0.279
10		0.022	0.020	0.022	0.272
15	0.022	0.023	0.024	0.028	0.237
27	0.022			0.022	0.144
32	0.023			0.025	0.170
37	0.019			0.027	0.149
45	0.021			0.024	0.135
51	0.024			0.023	0.131
58	0.022			0.021	0.107
65	0.027			0.025	0.096

	Cadmium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	2.06	0.044	0.046	0.157	<0.01
5		0.021	0.03	0.103	<0.01
10		0.015	0.012	0.041	0.014
15	1.64	0.016	0.011	0.072	<0.025
27	1.2			1.29	<0.025
32	0.939			0.964	<0.05
37	0.521			0.888	<0.01
45	0.300			0.589	<0.01
51	0.370			0.544	<0.01
58	0.333			0.505	<0.01
65	9.06			9.38	<0.01

	Calcium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	29.1	41.4	37.4	98.1	29.6
5		41.4	38.5	53.7	30.1
10		37.4	40.0	41.6	28.9
15	21.6	37.5	39.3	53.5	26.0
27	34.6			33.5	37.7
32	33.9			36.3	35.7
37	33.4			42.8	36.6
45	34.3			37.0	37.8
51	33.9			31.5	32.7
58	35.3			34.0	38.9
65	40.8			41.6	37.4

	Chromium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	10.3	7.25	6.54	5.4	0.93
5		7.14	6.6	6.87	0.76
10		6.69	6.57	6.19	0.60
15	10.3	6.99	6.07	6.24	0.71
27	9.39			9.11	<0.5
32	10.5			8.59	<1
37	10.2			8.38	0.46
45	10.6			7.95	0.51
51	11.7			11.0	<0.7
58	6.89			8.82	0.57
65	39.8			39.2	0.56

	Cobalt [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	261	285	289	350	194
5		285	285	284	173
10		268	272	258	147
15	255	277	273	266	153
27	248			244	95.8
32	266			239	112
37	259			254	89.1
45	266			248	92.5
51	279			260	96.8
58	265			270	97.4
65	281			282	94.1

	Copper [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	607	9.2	10	58.4	2.3
5		4.8	4.3	40.7	<1.0
10		3.4	3.7	5.8	1.5
15	579	3.1	6.4	6.7	<2.5
27	561			497	<2.5
32	631			446	<5.0
37	606			403	2.6
45	631			387	2.0
51	671			523	2.3
58	162			179	2.3
65	444			389	2.5

	Iron [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.258	0.259	0.191	0.338	0.158
5		0.241	0.198	0.389	0.202
10		0.244	0.194	0.202	0.177
15	0.288	0.257	0.203	0.203	0.194
27	0.33			0.404	0.242
32	0.357			0.278	0.173
37	0.337			0.214	0.242
45	0.355			0.192	0.282
51	0.544			0.445	0.288
58	0.475			0.788	0.305
65	21.7			21	0.291

	Lead [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<0.1	<0.1	<0.1	<0.1	<0.1
5		<0.1	<0.1	<0.25	<0.1
10		<0.1	<0.1	<0.1	<0.1
15	0.052	<0.1	<0.1	<0.1	<0.25
27	0.075			0.22	<0.25
32	0.113			0.117	<0.5
37	0.07			0.079	<0.1
45	0.065			0.058	<0.1
51	0.245			0.23	<0.1
58	0.270			0.595	0.16
65	20.9			19.1	0.14

	Lithium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	3.8	7.3	7.5	7.3	26.1
5		7.4	8.1	7.0	20.6
10		5.9	9.2	7.6	34.7
15	4.9	8.1	9.4	7.7	93.1
27	4.5			4.2	55.1
32	4.5			4.4	45.0
37	4.0			4.6	27.2
45	4.7			4.6	28.0
51	5.0			5.0	26.3
58	6.5			6.1	22.9
65	7.0			6.4	19.7

	Magnesium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	5.52	10.2	9.98	9.04	8.99
5		10.8	10.9	10.1	11.4
10		10.2	12.3	10.5	10.1
15	5.68	10.3	13.1	10.6	10.8
27	5.82			5.59	14.6
32	5.77			5.6	14.5
37	5.61			5.49	13.6
45	5.90			5.54	13.1
51	5.87			5.47	11.3
58	7.93			7.59	12.9
65	10.4			10.3	12.4

	Manganese [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	4.88	32.1	12.9	176	36.1
5		20	12.9	70.7	31
10		16.9	12.6	28.3	38.9
15	4.74	19.7	12.7	68	106
27	14.2			20.3	108
32	16.2			24.6	133
37	15.8			44.2	148
45	17.0			26.6	146
51	21.8			21.8	159
58	22.7			32.7	177
65	628			668	198

	Mercury [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.591	0.0746	0.0378	0.201	0.033
5		0.0312	0.0241	0.117	<0.025
10		0.0248	0.0185	0.0309	0.0263
15	0.505	0.0142	0.0295	0.0268	0.0087
27	0.588			0.708	0.0462
32	0.564			0.607	0.0409
37	0.489			0.637	0.0405
45	0.651			0.602	0.0325
51	0.657			0.497	0.0352
58	1.12			1.27	0.039
65	12.8			13.4	0.037

	Molybdenum [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	78	40.4	46	52.6	18.3
5		40.4	42	42.5	23.5
10		43.8	38.5	38.5	23.1
15	77.2	34.2	34.6	36.6	8.68
27	81.6			75	<0.25
32	80.5			80.4	<0.5
37	68.2			79.6	0.51
45	78.8			77.0	0.20
51	81.6			75.1	0.13
58	64.1			60.6	0.14
65	44.5			37.0	0.17

	Nickel [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	131	3.6	4.8	62.6	4.0
5		2.6	2.1	23.3	2.7
10		2.2	1.7	3.0	2.6
15	122	2.2	1.7	4.1	2.9
27	120			115	<2.5
32	127			113	<5.0
37	125			120	1.2
45	127			111	1.1
51	132			117	1.2
58	62.6			53.1	1.1
65	121			104	1.0

	Phosphorus [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.051	<0.05	<0.05	0.363	72
5		<0.05	<0.05	0.204	49.1
10		<0.05	<0.05	0.095	49.2
15	<0.05	<0.05	<0.05	0.140	43.3
27	0.097			0.219	42.7
32	0.095			0.22	45.1
37	0.09			0.216	43.1
45	0.095			0.198	43.5
51	0.151			0.241	35.3
58	0.061			0.187	41.2
65	0.349			0.470	43.0

	Potassium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	314	54.8	68.2	228	455
5		61.3	76	204	351
10		63.8	87.5	191	308
15	267	68.8	91.9	189	232
27	79.3			473	272
32	81.6			269	275
37	76.4			240	320
45	81.9			231	340
51	77.6			250	312
58	72.7			235	343
65	75.8			242	336

	Selenium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	2.95	2.15	2.12	3.79	0.5
5		2.18	2.17	3.11	0.28
10		2.25	2.24	2.47	0.34
15	2.51	2.20	2.05	3.67	<0.25
27	2.39			2.83	0.88
32	2.65			2.89	2.46
37	2.36			3.28	1.21
45	2.48			2.82	1.76
51	2.54			2.41	1.56
58	2.32			2.15	2.28
65	2.54			2.47	2.25

	Silicon [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	4.76	5.06	5.47	5.68	25.5
5		5.43	5.71	5.51	23
10		5.27	5.62	5.24	26.5
15	5.12	5.59	6.18	5.22	41.5
27	5.42			5.4	25.5
32	5.34			5.18	22.7
37	5.11			5.06	17.3
45	5.31			5.00	18.4
51	5.83			5.07	17.6
58	5.82			5.73	18.5
65	18.7			19.5	18.3

	Silver [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	7.07	0.027	0.111	1.04	0.086
5		<0.020	0.037	0.811	0.031
10		<0.020	0.030	0.094	0.026
15	7.76	<0.020	0.023	0.100	<0.05
27	7.75			7.21	<0.05
32	8.35			6.22	<0.1
37	6.63			6.22	0.054
45	7.81			4.74	0.048
51	8.93			7.81	0.066
58	2.16			4.03	0.059
65	5.63			4.83	0.074

	Sodium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	264	350	335	260	587
5		377	376	343	467
10		354	371	338	423
15	261	365	384	367	433
27	251			239	367
32	266			240	453
37	271			273	435
45	264			250	438
51	269			254	439
58	272			260	451
65	274			276	485

	Strontium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.177	0.275	0.253	0.388	0.23
5		0.287	0.269	0.299	0.218
10		0.309	0.293	0.282	0.211
15	0.168	0.262	0.299	0.306	0.162
27	0.197			0.185	0.165
32	0.196			0.207	0.207
37	0.162			0.212	0.204
45	0.190			0.196	0.209
51	0.202			0.188	0.213
58	0.231			0.220	0.245
65	0.248			0.219	0.249

	Sulfur [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	46.7	51.4	50.7	69.4	5.5
5		54.5	52.4	54.6	0.81
10		53.5	53.3	52.6	0.61
15	49.9	53.3	52.0	54.9	1.54
27	50.8			49.1	8.06
32	48.1			48.8	18.2
37	50.1			52.6	15.5
45	52.3			52.2	24.4
51	51.6			48.3	20.6
58	51.0			48.9	23.2
65	53.8			53.1	23.5

	Thallium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.787	0.685	0.678	0.409	<0.02
5		0.707	0.711	0.698	<0.02
10		0.804	0.761	0.694	<0.02
15	0.786	0.707	0.790	0.657	<0.05
27	0.869			0.86	<0.05
32	0.833			0.851	<0.10
37	0.711			0.824	<0.02
45	0.829			0.773	<0.02
51	0.902			0.791	<0.02
58	0.729			0.655	<0.02
65	1.96			1.46	<0.02

	Tin [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	2.45	0.29	18	22.9	1.02
5		0.23	14.7	31.9	0.8
10		<0.20	12.0	18.0	0.87
15	3.01	0.22	23.4	8.66	0.53
27	3.91			50.7	0.93
32	3.53			40.7	1.1
37	2.28			28.5	0.97
45	2.67			27.0	0.75
51	3.96			46.5	0.62
58	5.50			54.1	0.45
65	9.69			29.0	0.46

	Titanium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<0.6	<0.6	<0.6	<1.2	<0.6
5		<0.6	<0.6	<1.5	<0.6
10		<0.6	<0.6	<0.6	<0.6
15	<0.99	<0.6	<0.6	<0.6	<1.5
27	<1.2			<2.4	<1.5
32	<1.5			0.83	<3
37	<1.2			<0.9	<0.6
45	0.75			<0.9	<0.6
51	<3.0			1.61	<0.6
58	<6.0			4.3	<0.6
65	77.3			81.6	<0.6

	Uranium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	137	41.4	29.4	36.4	1.02
5		45.9	29.4	37.1	0.983
10		66.4	34.9	34.9	1.40
15	132	60.3	36.5	34.0	0.601
27	158			140	0.23
32	150			154	0.41
37	124			117	0.935
45	147			145	0.741
51	154			136	1.19
58	97.3			92.9	0.914
65	103			90.3	0.741

	Vanadium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	1.4	<1.0	<1.0	0.5	<1.0
5		<1.0	<1.0	<1.0	<1.0
10		<1.0	<1.0	<1.0	<1.0
15	0.8	<1.0	<1.0	<1.0	2.5
27	0.5			<1.0	2.5
32	0.6			0.55	5.0
37	0.5			0.53	<1.0
45	0.5			0.5	<1.0
51	0.8			0.66	<1.0
58	0.6			1.01	<1.0
65	23.0			23.1	<1.0

	Zinc [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	185	<6	<6	14.0	43.2
5		<6	<6	9.1	48.9
10		<6	<6	<6	30.5
15	171	<6	<6	<6	69.0
27	161			153.0	28.0
32	159			130.0	45.0
37	142			111.0	21.9
45	92.1			107.0	36.0
51	53.7			78.7	29.5
58	15.1			26.9	22.0
65	184			196.0	45.6

Appendix C: Saturated Column Report

Newmont™ COFFEE

1 Introduction and Objectives

This appendix describes sample collection, methods and results of saturated column experiments conducted as a component of the geochemical characterization program of the Coffee Gold Mine (the Project). Saturated column results have been initiated to provide information on the geochemical behaviour of geologic material which may become flooded as a result of mining activities. Specifically, wall rock and waste rock backfill below mine pit spillway elevations may become flooded once pit lakes form. Understanding how saturated conditions will affect the release and attenuation of metals will help inform mine waste management plans and water quality predictions. A summary of saturated column tests which have been initiated for the Project is provided in Table 1-1.

In this report, the methods and sample selection are described in Chapter 2. The results and discussion are presented in Chapter 3. This section includes both static test characterization of column material, visual observations of secondary precipitates forming within columns, and column effluent results. Finally, a summary of the most salient results of the column experiment are provided in Chapter 4.

Table 1-1:
Summary of Saturated Column Tests Initiated for the Coffee Gold Mine

Test ID	Sample Source	Material	Lithology	Weathering Facies	Start Date	Termination Date
Saturated Columns						
Kona 1	Col 13,14 and 8 Residue	Waste rock/ore	Granite	Tran./Fresh	07-Jul-17	24-May-19
Kona 2	Col 13,14 and 7 Residue	Waste rock/ore	Granite	Oxide/Tran./Fresh	07-Jul-17	24-May-19
Kona 3	Col 13 Residue	Waste Rock	Granite	Transition	07-Jul-17	24-May-19
Kona 4	Col 14 Residue	Waste Rock	Granite	Fresh	07-Jul-17	24-May-19
Sat-GO	FB-GO Residue	Waste Rock	Gneiss	Oxide	29-Sept-17	24-May-19
Sat-GT	FB-GT Residue	Waste Rock	Gneiss	Transition	29-Sept-17	24-May-19
Sat-GS	FB-GS Residue	Waste Rock	Gneiss	Fresh	29-Sept-17	24-May-19
Sat-SO	FB-SO Residue	Waste Rock	Schist	Oxide	29-Sept-17	24-May-19
Sat-ST	FB-ST Residue	Waste Rock	Schist	Transition	29-Sept-17	24-May-19
Sat-SS	FB-SS Residue	Waste Rock	Schist	Fresh	29-Sept-17	24-May-19

2 Laboratory and Analytical Methodology

2.1 *Sample Collection*

Rock samples for the saturated column experiments were collected from field bins and unsaturated column residues. Collecting saturated column test samples from unsaturated kinetic test residues is preferred over fresh drill core, as it reflects a period of unsaturated weathering which mined materials will experience prior to submergence by pit lakes which only form after mining operations in a pit are terminated. These unsaturated kinetic tests were initiated between June 2014 and May 2015 as part of the geochemical characterization program for the Project. A complete discussion regarding setup and operation of unsaturated kinetic tests can be found in *Coffee Gold Project: Metal Leaching and Acid Rock Drainage Characterization* (Lorax, 2017). A summary of kinetic tests from which residue samples were collected is provided in Table 2-1.

Waste rock samples were selected which where representative of the three major lithologies (granite, gneiss and schist) and a range of weathering facies (oxide, transition, and fresh). Granite ore samples were also selected for saturated column studies. This ore sample only represents a small percentage of the overall mine waste that will be produced (<1%); however, the transition granite ore has an in-situ mildly acidic pH and elevated metal leaching potential. Its behaviour under flooded conditions is of particular interest as flooding this material type is a potential strategy to mitigate acid rock drainage potential.

Granite samples for Kona 1-4 columns were sourced from unsaturated column residues, while gneiss and schist samples for GS/GT/GO/SS/ST/SO columns were sourced from field bin residues. The unsaturated column were being conducted at SGS Burnaby Laboratories. The unsaturated column tests were terminated and the residues homogenized to generate saturated column samples. The field bin samples were collected from a depth of 20cm within field bin to avoid surface weathering effects.

Appendix C
Saturated Column Report

Table 2-1: Summary of unsaturated kinetic tests from which residue samples were collected for saturated column construction.

Test ID	Ore/Waste	Lithology	Weathering	Mass (kg)	Start Date	Residue Collected
Col 13	Waste	Granite	Transition	10.0	20-May-15	19-Apr-17
Col 14	Waste	Granite	Fresh	10.0	20-May-15	19-Apr-17
Col 7	Ore	Granite	Oxide	4.4	22-Apr-15	19-Apr-17
Col 8	Ore	Granite	Transition	4.4	22-Apr-15	19-Apr-17
FB-GS	Waste	Gneiss	Fresh	190.1	17-Jun-14	23-Aug-17
FB-GT	Waste	Gneiss	Transition	229.4	17-Jun-14	23-Aug-17
FB-GO	Waste	Gneiss	Oxide	183.1	17-Jun-14	23-Aug-17
FB-SS	Waste	Schist	Fresh	201.5	17-Jun-14	23-Aug-17
FB-ST	Waste	Schist	Transition	164.8	17-Jun-14	23-Aug-17
FB-SO	Waste	Schist	Oxide	171.3	17-Jun-14	23-Aug-17

Note: *FB – Field bin; Col xx – Unsaturated Column*

2.2 *Column Design and Operation*

2.2.1 Column Construction

Saturated columns were constructed from Plexiglass cylinders (15.0 cm inside diameter, 20.0 cm length). The initial stage of column construction included washing of all parts prior to assembly with deionized water. Before the addition of any column substrates, the bottom of the column was lined with a dispersion plate (perforated disk), a sheet of non-reactive mesh fabric, and a layer of silica sand (200-600 g) to allow for the even distribution of water over the surface area of the column bottom before contacting the ore and waste rock samples.

Each column was equipped with an inlet at the base of the column and one port at the top of the column for sampling. Note that the experiment was designed so that influent entered from the bottom of the column and flowed upward. In other words, the bottom of the column is effectively upgradient and the top of the column is downgradient. This is a standard measure to ensure even flow through the column materials and minimize the risk of uncontrolled gravity-driven drainage and development of preferential flow paths (Jurjovec *et al.,* 2002; Petrunic *et al.,* 2005; Al *et al.,* 2006).

Granite (Kona 1-4) columns were constructed on June 15th, 2017 and allowed to settle for one week before being sealed on June 22nd, 2017. Approximately 12 weeks later, gneiss and schist (GS, GT, GO, SS, ST, SO) columns were constructed and sealed on September 18th and 19th, 2017. Column materials were coned and quartered to collect 6-8 kg of dry weight for construction. Saturated column material, mass and initiation dates are shown in Table 2-2. Materials were

made into a slurry with the influent for the experiment before being added to the columns in ~3 cm layers to produce a homogeneous mixture. Columns were filled with as much material available to reduce headspace. Due to limited amounts of kinetic tests residues, some headspace (up to 3 cm) is present in the granite columns. Minimal headspace (< 1 cm) is present in the gneiss and schist columns.

Table 2-2: Characteristics of column materials and initiation of saturated column testwork.

Column	Column Composition	Lithology	Weathering	Ore/Waste	Mass (kg)	Sample Source	Sealed	Start
Kona 1	Top Half	Granite	50% Fresh, 50% Transition	Waste	2.60	Col 13 and Col 14 Residue	22-Jun-17	07-Jul-17
	Bottom Half	Granite	Transition	Ore	2.60	Col 8 Residue		
Kona 2	Top Half	Granite	50% Fresh, 50% Transition	Waste	2.48	Col 13 and Col 14 Residue	22-Jun-17	07-Jul-17
	Bottom Half	Granite	Oxide	Ore	2.60	Col 7 Residue		
Kona 3	Whole column	Granite	Transition	Waste	5.99	Col 13 Residue	22-Jun-17	07-Jul-17
Kona 4	Whole column	Granite	Fresh	Waste	6.04	Col 14 Residue	22-Jun-17	07-Jul-17
GS	Whole column	Gneiss	Fresh	Waste	7.27	FB-GS Residue	18-Sep-17	29-Sep-17
GT	Whole column	Gneiss	Transition	Waste	6.13	FB-GT Residue	18-Sep-17	29-Sep-17
GO	Whole column	Gneiss	Oxide	Waste	6.63	FB-GO Residue	19-Sep-17	29-Sep-17
SS	Whole column	Schist	Fresh	Waste	7.17	FB-SS Residue	19-Sep-17	29-Sep-17
ST	Whole column	Schist	Transition	Waste	7.19	FB-ST Residue	19-Sep-17	29-Sep-17
SO	Whole column	Schist	Oxide	Waste	8.20	FB-SO Residue	19-Sep-17	29-Sep-17

Note: *FB – Field bin; Col xx – Unsaturated Column*

2.2.2 Column Operation

Influent chemistry consisted of deionized (DI) water amended with a small amount of Na-lactate to provide an organic carbon supply. Dissolved organic carbon (DOC) was added to achieve similar concentrations as observed in ambient groundwater at the Project site (~10 mg/L) and to stimulate microbial activity and redox reactions in the columns. Sodium-lactate was chosen as the DOC source for this work since lactate has been cited as a suitable electron donor to stimulate microbial growth compared to other organic carbon sources such as ethanol, acetic acid, propionate and acetate (Nagpal *et al.*, 2000). Influent was made by adding 51.8 mg/L of 60% w/w Na-lactate in large batches (5 gallons) to ensure minimal variability in solution chemistry.

Flow to the granite columns was initiated on July 4th, 2017 and the first effluent sample was collected on July 7th, 2017. Similarly, flow to the gneiss and schist columns was initiated on

Appendix C
Saturated Column Report

September 27th, 2017 and the first effluent sample was collected on September 29th, 2017. Frequency of sample collection was identical between all columns, with the second effluent sample being collected four weeks later, and subsequent sampling occurring biweekly for the rest of the experimental period. Approximately 200-250 mL of effluent were collected over 24 hours for each sampling event. To collect a sample representative of porewater conditions in granite columns, ~350 mL was removed from the headspace prior to collecting an effluent sample.

Leachate was collected from the top port of the columns and passed through a 0.45 µm cellulose acetate filter before being collected in high-density polyethylene sample bottles. To preserve redox speciation and minimize the potential for oxidation artifacts, sample bottles were purged with nitrogen gas to displace oxygen from the bottles prior to sampling. Following collection, samples were preserved and submitted to ALS Laboratories for analysis.

Monthly flow rates from each column are provided in Table 2-3. The increase to monthly flow rates in the end of December 2018 across all columns was to ensure pore volume (PV) replacement following the introduction of $CaSO_4$ in column influent during Phase 3 of the experiment, as described below. Replacement of 15-22 PVs occurred throughout the experimental period for granite, gneiss, and schist columns.

Table 2-3: Monthly flow rates of saturated columns (up to end of April 2019)

Month-year	Kona 1	Kona 2	Kona 3	Kona 4	GS	GT	GO	SS	ST	SO
					mL/month					
Jul-17	561	526	583	524						
Aug-17	1777	1780	1741	1764						
Sep-17	1246	1201	1198	1235	421	415	326	416	441	433
Oct-17	994	973	981	775	264	259	262	262	262	258
Nov-17	1165	1123	1120	1129	566	563	571	533	592	553
Dec-17	1273	1241	1211	1129	528	488	514	537	525	530
Jan-18	1026	1059	1076	973	520	522	523	533	583	523
Feb-18	1104	1083	1104	1058	562	538	549	566	563	564
Mar-18	1520	1506	1495	1471	803	809	804	839	816	810
Apr-18	1129	1094	1133	1128	519	515	496	543	512	519
May-18	1097	1048	1058	1047	530	527	521	550	533	534
Jun-18	999	982	904	985	558	670	389	601	616	560
Jul-18	1009	998	992	975	553	467	411	557	579	537
Aug-18	1538	1511	1547	1467	833	1074	604	836	821	782
Sep-18	1060	1015	1113	1046	637	699	429	649	650	614
Oct-18	1037	995	1052	1038	419	681	391	421	416	402
Nov-18	1074	1010	1079	1071	632	709	420	636	627	599
Dec-18	1370	1298	1444	1394	705	894	622	713	702	662
Jan-19	2337	2458	2402	2376	1261	1655	1028	1312	1145	1092
Feb-19	1480	1421	1555	1470	887	1131	730	928	874	824

Mar-19	1453	1272	1502	1422	893	1150	714	935	832	838
Apr-19	1463	1423	1342	1437	814	1117	710	800	844	794
Cumulative Volume Removed from Column (mL)	27712	27017	27632	26914	12905	14883	11014	13167	12933	12428
Pore volume (mL)	1510	1635	1252	1565	837	677	720	732	704	742
Pore volumes replaced	18.4	16.5	22.1	17.2	15.4	22.0	15.3	18.0	18.4	16.7

Note: *Pore volume was estimated by the volume of influent added to turn dry materials into a slurry in addition to the volume of influent used to fill the column. This may be an overestimation for Kona 1, Kona 2, Kona 3, and Kona 4, which had headspace in the columns.*

2.2.3 **Experimental Phases**

The column experiment was conducted in three phases that are depicted in Figure 2-1 and summarized as follows:

- Standard operation (*Phase 1*): Columns receive DOC amended DI water as influent and effluent is sampled or discarded. This phase of the experiment characterizes the range of metal leaching potential of individual material types under mildly reducing conditions.
- Column sequencing (*Phase 2*): Effluent of columns with elevated As are used as influent for columns with low As. This phase of the experiment provides information on how sequential deposition of different rock types can impact metal mobility.
- Calcium sulphate addition (*Phase 3*): Influent is spiked with calcium and sulphate and columns continued to operate in sequence. This phase of the experiment provides data on how elevated SO_4 and Ca generated from subaerial portions of backfilled waste dumps may impact metal mobility and release in saturated sections of the backfill dump.

.

Appendix C
Saturated Column Report

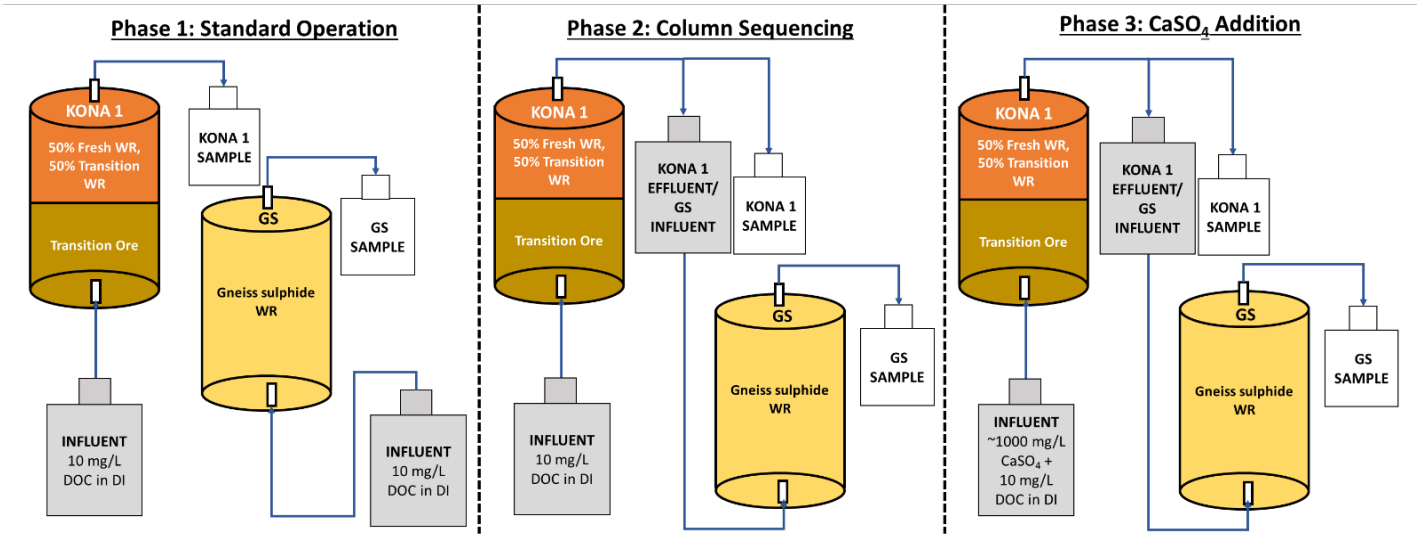


Figure 2-1: Schematic of column configuration during the three phases of column operation, using the Kona 1 and GS columns to demonstrate changes in influent, effluent, and sample collection. Arrows indicate flow direction.

Columns were initially operated independently (i.e., no sequencing) from July 2017 to June 2018 to assess leachate chemistry and metal mobility of the varying individual lithologies under suboxic conditions. Initial standard operation is depicted in Phase 1 of the schematic (Figure 2-1).

Column sequencing was introduced in June 2018 to evaluate the geochemistry of leachate produced from layering of different lithologies, particularly in the context of As and U attenuation. Column sequencing is depicted in Phase 2 of the schematic (Figure 2-1) for Kona 1 and GS columns, with the notable change being influent for the GS columns while influent for the Kona 1 column remained unchanged (10 mg/L DOC in deionized water). Sequencing pairs are listed below:

Primary Column → Secondary Column

1. Kona 1 Effluent→ Influent for GS
2. Kona 2 Effluent→ Influent for ST
3. Kona 3 Effluent→ Influent for SS
4. Kona 4 Effluent→ Influent for SO
5. GT Effluent→ Influent for GO

Phase 3 of column operation was initiated in December 2018 to assess the effect of infiltration water containing elevated levels of calcium and sulphate on the release and attenuation of metals from mixed lithologies. As depicted in Figure 2-1, influent used for primary columns was altered in Phase 3 to contain 10 mg/L DOC + 1000 mg/L SO_4 and 413 mg/L Ca. This change affected

leachate chemistry produced by primary columns, and by extension the influent used for secondary columns. In this phase of the experiment, flow rates were increased up to 50% to ensure pore volume replacement within two cycles. This is reflected in increased monthly flow rates from December 2018 to January 2019 (Table 2-3). For the granite columns, 750 mL was collected as part of effluent collection for sequencing and sampling. For the gneiss and schist columns, 500 mL is collected for sequencing and sampling from column GT, while 400 mL is collected from columns GS, GO, SS, ST, and SO.

Initiation of gneiss and schist columns commenced 12 weeks following initiation of granite columns. While the experimental period for Phase 1 differs between columns, sequencing during Phase 2 and 3 requires a parallel discussion of primary and secondary columns. For the purposes of this report, specific terminology will be used to describe Phase 1 through 3, which correspond to the overall experimental period (Table 2-4). Time periods prior to sequencing will be referred to as Week *xx* (pre-seq.), while time periods following sequencing will be referred to as Week *xx* (post-seq.).

Effluent results up to April 25th, 2019 or Week 46 (post-seq.) are included in this report. This time period corresponds to overall column operation of 94 weeks for granite columns and 82 weeks for gneiss and schist columns.

Table 2-4: Overall experimental periods and corresponding experimental periods as referenced in the report for operation Phases 1 through 3 for granite, gneiss and schist columns.

Experimental Phases	Overall Experimental Period		Experimental Period as Referenced in Report	
	Granite Columns	Gneiss and Schist Columns	Granite Columns	Gneiss and Schist Columns
Phase 1: Standard Operation	Week 0 to 46	Week 0 to 34	Week 0 to 46 (pre-seq.)	Week 0 to 34 (pre-seq.)
Phase 2: Column Sequencing	Week 48 to 74	Week 36 to 62	Week 0 to 26 (post-seq.)	
Phase 3: $CaSO_4$ Addition	Week 76 to 94	Week 64 to 82	Week 28 to 46 (post-seq.)	

2.3 *Analytical Methods*

2.3.1 Solid Phase Characterization

Static were conducted on a subsample of materials used for column construction and saturated column residues upon completion of testwork. The testing consisted of acid base accounting (ABA), shake flask extractions (SFE) and metals by aqua regia digestion and ICP-MS analysis as

per MEND (2009). Acid-base accounting consists of a series of tests to determine the paste pH, sulphur species and carbonate content. Total elemental abundance was determined by aqua-regia digestion and analysis by ICP-MS. Shake flask extractions were conducted using a 24-hour NanoPure water leach extraction test at a 3:1 liquid to solid ratio and leachates were submitted for analysis.

Mineralogic characterization was conducted using QEMSCAN. Samples analyzed by QEMSCAN included both residue samples used in saturated column tests, and cuts of test samples collected prior to unsaturated testing. Materials were stage pulverized to 80% passing of 106 microns prior to analysis. Samples were then micro-riffled with subsamples taken for graphite impregnated polished section preparation and submitted for QEMSCAN using Particle Mineral Analysis (PMA) and Specific Mineral Search (SMS) analyses.

2.3.2 **Water Quality**

Saturated column leachates and influent samples were sent to ALS Environmental Laboratories (ALS) in Vancouver for the following analyses:

- Nitrate, nitrite, sulfate, chloride, bromide, fluoride;
- Dissolved organic carbon (DOC), phosphorus, ammonia;
- Dissolved sulfide; and
- Dissolved metals.

Alkalinity, pH and conductivity were measured in-house at the Lorax laboratory. All water quality results are reported in Appendix A.

2.4 *Quality Assurance and Quality Control*

Quality control (QC) measures for column testwork include method and experimental blanks collected at the Lorax laboratory, and ALS specific method blanks, sample duplicates and certified reference materials.

For the method blank analysis, a ‘blank column’ is constructed using the same material (*i.e.* Plexiglass) as the experimental columns and is filled with DI water. This column is then sampled and tested monthly, using the same procedure outlined above for the saturated columns. Results for method blank analysis during the period of column operation (July 2017 to April 2019) are reported in Appendix B. Overall, the results indicate good contamination control for most parameters with exception to minor detectable levels of P, Al, Ba, Cu, and Zn. Concentrations of P and Zn in column leachates are on average 11x and 6x greater, respectively, than concentrations observed in the method blank. This demonstrates that any potential leaching from column

materials does not have significant bearing on experimental results. Average concentrations of Al, Ba, and Cu in column effluents are similar in magnitude to maximum concentrations found in the method blank, indicating some potential for experimental artifacts.

Experimental or 'bottle' blanks of deionized water were tested weekly for dissolved metals and anions to evaluate potential sources of contamination during sample preservation. This test also served to monitor the quality of deionized water used to make the column influent. Across all parameters, only 1.7% of values were above the MDL, indicating excellent contamination control. Complete results for bottle blank analysis during the column operating period can be found in Appendix B.

For submissions to ALS, hold time targets were met and QC results demonstrated conformity to data quality objectives, indicating good precision, accuracy and contamination control in test procedures. Examples where data quality objectives fell out of the acceptable range include 1) exceedances of the method blank resulting in adjustment of the limits of reporting for applicable parameters; and 2) inaccurate matrix spike recovery due to elevated background analyte concentrations.

2.5 *Geochemical Equilibrium Modelling*

Saturation indices (SIs) were calculated using the USGS geochemical modeling program PHREEQC coupled to the Lawrence Livermore National Laboratory database (llnl.dat) (Parkhurst and Apello, 1999). An SI of 0 indicates that a mineral is in equilibrium with the solution; a mineral may be dissolving or precipitating to achieve equilibrium. A positive SI denotes that a mineral is oversaturated and therefore may be precipitated from solution. A negative SI denotes that a mineral is unsaturated; if the solid phase is present it will dissolve until equilibrium is reached. Saturation indices are based on the thermodynamics of mineral formation/dissolution and do not account for kinetic limitations that affect mineral formation and dissolution.

3 Results and Discussion

3.1 *Visual Observations*

Columns were regularly inspected throughout the duration of the experiment to evaluate changes to column materials. Column photos from throughout Phases 1 to 3 can be found in Appendix D.

Granite, gneiss and schist columns showed minimal alteration in Phases 1 and 2. The only exception to this is Kona 1, where black precipitate was observed above the sand layer in Week 11 (post-seq.). Following addition of $CaSO_4$ to influent, significant changes were observed in most columns. Discoloration of column materials was observed in Kona 1, Kona 3, Kona 4, GS, GT, and SO columns. Photographs of selected columns are presented in Figure 3-1 and Figure 3-2.

Dark staining of column materials occurred throughout the vertical profile of Kona 3, GS and SO columns which may be indicative of precipitate formation (Figure 3-2). In contrast, discoloration mainly occurred in the bottom 5 cm of the Kona 1 and Kona 4 columns. Staining also occurred at the top of column materials in Kona 1, Kona 3, Kona 4, GS, GT, SO, SS, and ST columns (Figure xx). The formation of an orange-black crust is visible in the Kona 1, Kona 3 and Kona 4 columns, while dark-brown pigmentation occurred in the GS, GT, SO, SS and ST columns. Photographs of the tops of selected columns are presented in Figure 3-3.

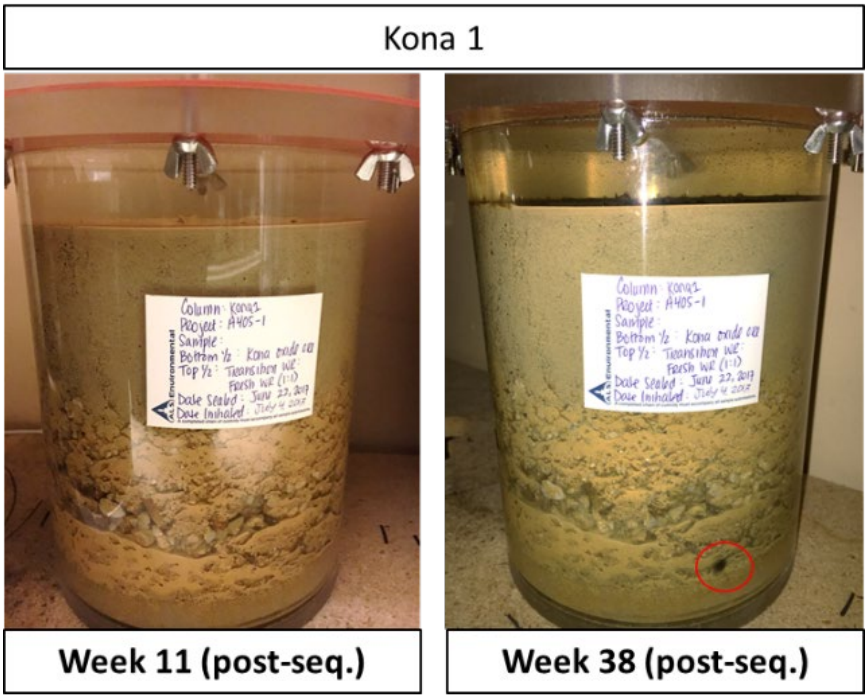


Figure 3-1: Photographs of Kona 1 column from Phase 1 (Week 12 pre-seq.) and from Phase 2 (Week 11 post-seq.).

Appendix C
Saturated Column Report

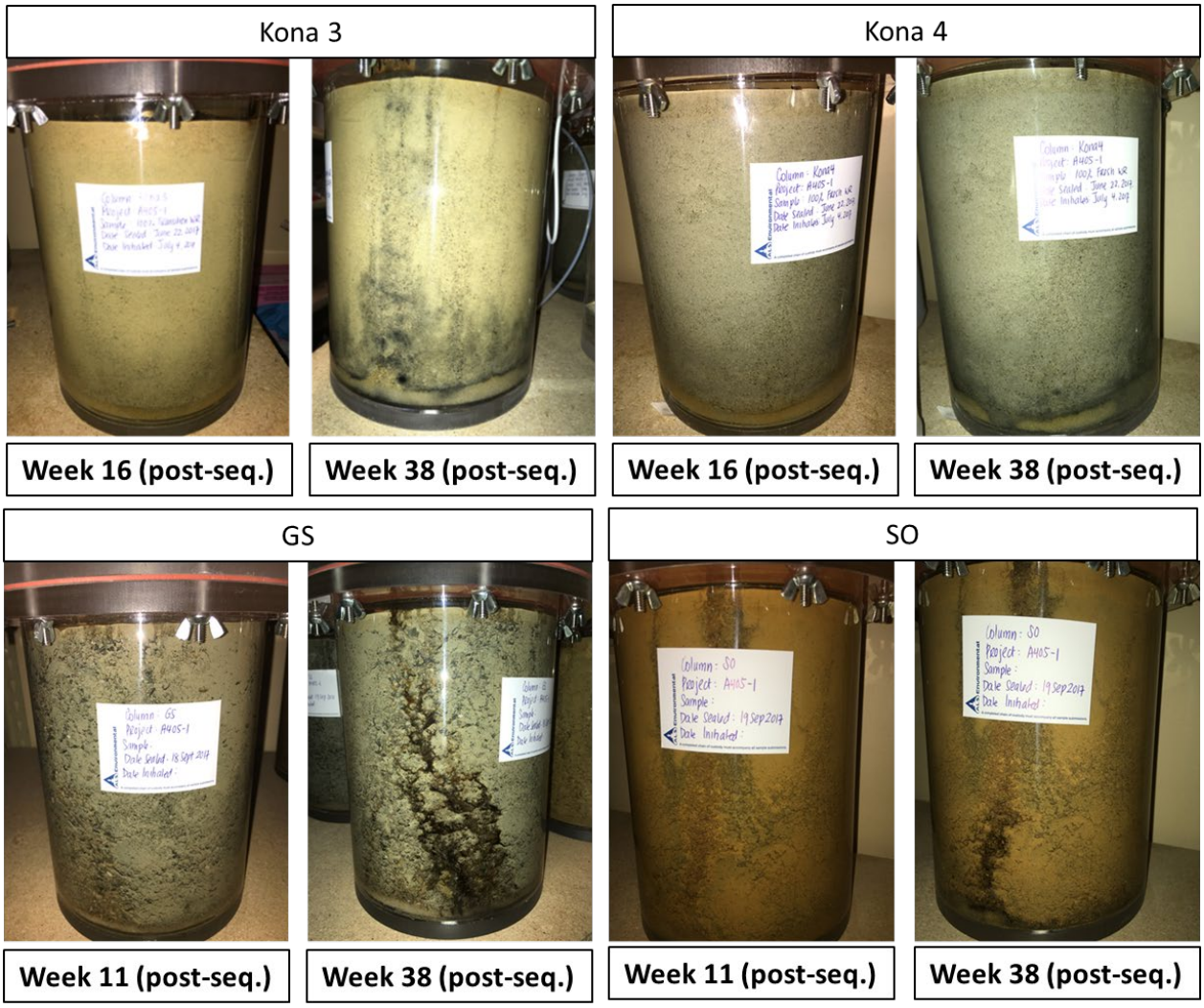


Figure 3-2: Photographs of selected columns from Phase 2 (Week 11 and 16 post-seq.) (left image) are compared to those from Phase 3 (Week 38 post-seq.) (right image).

Appendix C
Saturated Column Report

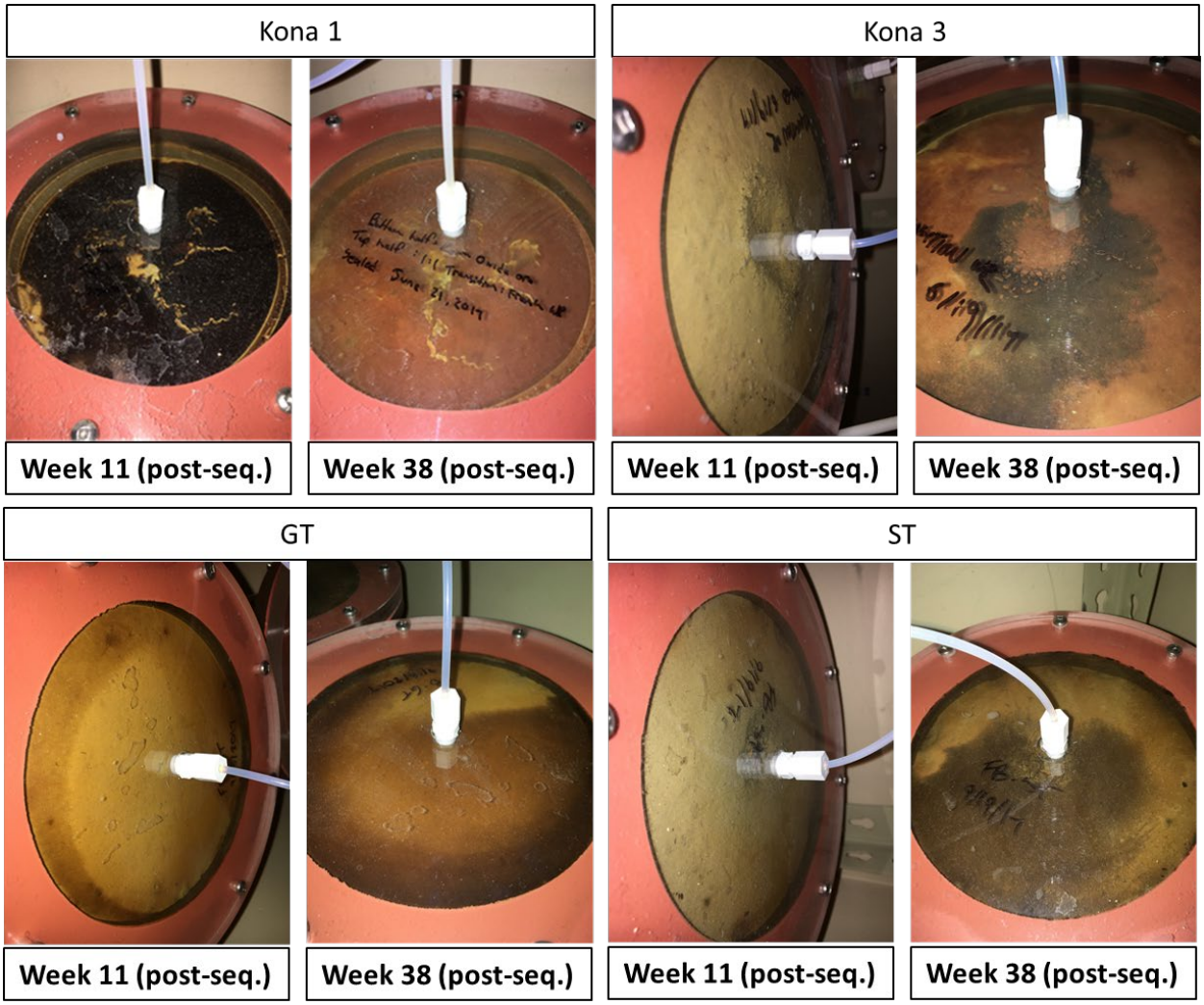


Figure 3-3: Photographs of the tops of selected columns from Phase 2 (Week 11 post-seq.) (left image) are compared to those from Phase 3 (Week 38 post-seq.) (right image).

3.2 *Solid Phase Characterization*

3.2.1 Static Test Results

3.2.1.1 Acid Base Accounting

Acid base accounting (ABA) results summarized in Table 3-2 for the column materials are primarily differentiated by lithology and secondarily by weathering facies. Complete ABA results are presented in Appendix C. Paste pH is near neutral to alkaline (7.4 to 8.3) for all WR samples across lithologies and is slightly acidic (5.5 to 6.6) in granite transition and oxide ores (Col 7 and

8 residues). Carbonate NP is consistently highest in schist WR (FB-SS, FB-ST, and FB-SO residues), moderate in gneiss WR (FB-GS, FB-GT, and FB-GO residues), and lowest in granite samples (Col 7, 8, 13, and 14 residues). Carbonate NP and sulphur content generally increases with increasing oxidation.

Across all lithologies, results for total S range from 0.017 to 0.41%, and is highest in schist WR residues and relatively comparable in gneiss and granite residue samples. Sulfur concentrations consistently decrease with increased weathering of ore and WR. Notably, sulphate measurements from the hydrochloric acid leach were either below or slightly above detection limit (< 0.01%) for all samples, affirming that most sulphur are present as sulphide. Results for total C are consistent with total S as increased weathering is associated with acidification and leaching of carbonate minerals from WR and ore.

Table 3-1: ABA results of kinetic test residues used in column experiments

Parameter	Unit	Col 13 Residue	Col 14 Residue	Col 7 Residue	Col 8 Residue	FB-GS Residue	FB-GT Residue	FB-GO Residue	FB-SS Residue	FB-ST Residue	FB-SO Residue
Paste pH	units	7.40	8.26	6.62	5.49	7.86	7.88	8.01	8.15	8.28	8.04
CaNP	$tCaCO_3/1000t$	*<0.8*	8.3	0.8	*<0.8*	48.3	35.0	20.0	178.3	120.8	75.0
Total S	wt.%	0.017	0.031	0.022	0.154	0.177	0.084	0.012	0.414	0.088	0.035
SO_4-S	wt.%	*<0.01*	*<0.01*	*<0.01*	0.01	0.02	0.01	*<0.01*	0.02	0.01	0.01
Sulfide S	wt.%	0.01	0.03	*<0.01*	0.11	0.16	0.07	0.01	0.35	0.06	0.02
Total Carbon	wt.%	0.014	0.111	0.018	0.027	0.569	0.419	0.237	2.18	1.46	0.921

Note: NPR calculated from CaNP and AP values (i.e. NPR = CaNP/AP)

3.2.1.2 Metal Content

Metal results from aqua regia digestion are summarized in Table 3-2 and complete results are presented in Appendix C. Overall, the results showed some variation in metal concentrations with weathering zone, lithology and ore vs waste. Divalent metal cations such as Zn, Cu and Pg are highest in schist WR. These metals are commonly associated with sulphide minerals. The elevated concentrations of these metals in schist is consistent with this rock type containing the highest sulphide content.

Arsenic concentrations ranged from 23 to 6310 mg/kg across lithologies and tended to have greater accumulation in oxidized samples (oxide > transition > fresh) in granite, gneiss and schist WR. However, As content in granite transition ore (Col 8 residue) is nearly double the As content in the granite oxide ore (Col 7 residue). Uranium content ranged from 2.78 to 11 mg/kg and is consistently higher in granite and gneiss relative to schist samples. There is no consistent trend for weathering state and U content.

Appendix C
Saturated Column Report

The highest As and U concentrations are present in the two grnite ore samples (Col 7 and 8 residue). These samples had As concentrations which were up to 100x that which was observed in granite waste samples. The difference in U concentrations between waste rock and ore was significantly lower, with ore containing U concentrations which are only up to 1.8x that observed in waste.

Table 3-2: Aqua regia metal results of kinetic test residues used in column experiments

Parameter	Unit	Col 13 Residue	Col 14 Residue	Col 7 Residue	Col 8 Residue	FB-GS Residue	FB-GT Residue	FB-GO Residue	FB-SS Residue	FB-ST Residue	FB-SO Residue
Al	**wt.%**	0.05	*<0.01*	0.1	0.07	1.02	0.53	0.48	1.19	1.15	0.47
Ca	**wt.%**	0.04	0.09	0.05	0.03	1.54	0.91	0.7	5.86	5	2.46
Fe	**wt.%**	0.84	1.09	1.47	1.38	1.85	1.22	1.27	2.5	2.1	2.66
K	**wt.%**	0.15	0.19	0.13	0.14	0.49	0.18	0.17	0.77	0.69	0.15
Mg	**wt.%**	0.06	0.11	0.02	0.01	0.69	0.33	0.19	1.39	1.01	0.4
Na	**wt.%**	0.01	0.02	*<0.01*	*<0.01*	0.03	0.02	0.01	0.04	0.04	0.01
As	**ppm**	265	53	3240	6310	59	167	168	23	42	348
Ba	**ppm**	49	60	67	46	135	202	92	357	350	358
Cd	**ppm**	0.08	0.04	0.25	0.03	0.01	0.03	0.03	0.08	0.05	0.14
Co	**ppm**	1.5	1.7	1.7	1.6	7.8	3.7	4.5	12.4	11	11.7
Cr	**ppm**	126	122	106	116	89	77	84	107	137	79
Cu	**ppm**	4	4.2	6.5	4.1	8.4	8.7	10.5	18.6	15.9	31.1
Hg	**ppm**	0.15	0.07	0.82	4.67	0.08	0.23	0.15	0.12	0.08	0.45
Li	**ppm**	6	8	2	2	6	1	1	12	14	1
Mn	**ppm**	334	679	187	201	350	278	278	666	572	535
Mo	**ppm**	3.3	3.29	3.41	3.75	2.85	3.26	2.1	2.43	2.76	1.8
Ni	**ppm**	2.9	2.4	3.1	2.6	13.9	5.6	9.1	54.3	40.4	29.9
P	**ppm**	0.01	0.02	0.01	0.01	0.04	0.02	0.03	0.06	0.04	0.05
Pb	**ppm**	19.3	10.2	36.5	17	5.2	7.7	9.7	13.2	7.8	19.7
Sb	**ppm**	1.75	0.57	38.7	162	1.88	7.52	8.7	2.25	1.73	37.6
Se	**ppm**	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
Sn	**ppm**	0.6	0.8	0.4	0.3	1.1	0.9	0.8	1.3	1.3	0.6
Sr	**ppm**	7.4	3.7	16.2	16.9	60.2	38.4	21.7	202	689	65.5
Tl	**ppm**	0.21	0.3	0.66	1.53	0.3	0.26	0.24	0.33	0.43	0.4
U	**ppm**	7.12	5.96	11	9	5.63	7.14	5.15	3.07	3.21	2.78
V	**ppm**	5	7	9	9	24	9	14	43	38	33
W	**ppm**	*<0.1*	*<0.1*	0.3	0.1	0.2	0.2	1	2.4	0.7	0.3
Zn	**ppm**	31	31	44	15	21	19	19	54	39	45

3.2.1.3 Shake Flask Extractions

Shake flask extractions (SFE) results are summarized in Table 3-3 and complete SFE results are presented in Appendix C. Solution pH across lithologies ranged from 4.8 to 8.2, being near neutral to alkaline in granite, gneiss and schist waste rock. The acidic solution pH of the granite transition ore (Col 8 residue) is consistent with its rinse-pH result (Table 3-2). Alkalinity is notably greater in gneiss and schist samples relative to granite WR and ore, which may be attributed to greater carbonate content compared to granite samples.

Major ion concentrations and conductivity tended to be greater in gneiss and schist WR compared to granite. Calcium and Mg ranged from 14 to 38 mg/L and 4 to 15 mg/L, respectively, relative to much lower concentrations of Ca (0.49 to 3.4 mg/L) and Mg (0.15 to 0.63 mg/L) leached from granite samples. Other major cations, Na and K were also leached in greater concentrations in gneiss and schist samples relative to granite (Col 7, 8, 13, and 14 residues). Sulphate content ranged from 5 to 145 mg/L across lithologies and was highest in gneiss followed by schist and granite. In gneiss and schist WR, sulphate concentrations were greater in fresh (GS and SS) relative to oxidized samples (GO and SO), likely reflecting the relative solid-phase sulphur content. There is minimal leachable sulphate in granite WR and ore (Col 7, 8, 13, and 14 residues).

Arsenic and uranium concentrations varied with lithology and weathering. The highest As concentrations are associated with the granite ore samples (2.47 mg/L to 0.47 mg/L), with intermediate concentrations found in granite waste (0.037 mg/L to 0.14 mg/L) and gneiss waste (0.023 to 0.065 mg/L), and the lowest concentrations found in schist waste (0.0071 to 0.025 mg/L). Arsenic also showed an association with weathering state, with highest concentrations generally associated with more oxidized samples of a given lithology. Uranium concentrations were greatest in gneiss waste (0.012 mg/L to 0.027 mg/L), with similarly low concentrations in schist waste (0.00089 mg/L to 0.0058 mg/L) and granite samples (0.00029 to 0.0015 mg/L). Uranium concentrations tended be lowest in the most weathered rock types.

Table 3-3: SFE results of kinetic test residues used in column experiments

Parameter	Unit	Col 13 Residue	Col 14 Residue	Col 7 Residue	Col 8 Residue	FB-GS Residue	FB-GT Residue	FB-GO Residue	FB-SS Residue	FB-ST Residue	FB-SO Residue
pH		7.14	7.22	7.53	4.80	8.21	7.98	8.20	8.14	8.13	8.00
Conductivity	**uS/cm**	25	39	11	25	111	211	110	258	165	126
Total Acidity	**mg CaCO3/L**	4.5	4.0	4.5	8.3	2.6	3.6	2.7	3.0	2.8	3.1
Alkalinity	**mg CaCO3/L**	6.4	15.1	6.6	0.1	39.8	34.1	40.3	47.4	41.4	46.3
Sulphate	**mg/L**	6	6	5	5	145	64	13	79	39	13
Dissolved Metals											

Appendix C
Saturated Column Report

D-Al	**mg/L**	0.003	*<0.001*	0.005	*<0.001*	0.030	0.051	0.068	0.033	0.056	0.025
D-Sb	**mg/L**	0.0040	0.0020	0.0203	0.0175	0.0059	0.0039	0.0026	0.0096	0.0009	0.0070
D-As	**mg/L**	0.135	0.0369	0.469	2.47	0.0229	0.0609	0.0647	0.0071	0.0098	0.0247
D-Ba	**mg/L**	0.00121	0.00439	0.00147	0.00028	0.0172	0.0414	0.0206	0.0406	0.0409	0.0604
D-Be	**mg/L**	0.000016	0.000018	0.000019	0.000113	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*
D-Bi	**mg/L**	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*
D-B	**mg/L**	0.031	0.031	0.025	0.016	0.009	0.020	0.015	0.009	0.011	0.020
D-Cd	**mg/L**	0.000004	0.000004	0.000003	0.000017	0.000013	0.000038	0.000013	0.000009	0.000006	*<0.0000 03*
D-Ca	**mg/L**	0.49	3.40	0.64	0.88	38.8	22.6	9.63	27.4	20.0	13.7
D-Cr	**mg/L**	*<0.0000 3*	0.00011	0.00008	0.00009	*<0.0000 3*	0.00006	0.00035	0.00006	0.00021	0.00083
D-Co	**mg/L**	0.000176	0.000179	0.000065	0.00384	0.000014	0.000014	0.000025	0.000017	0.000021	0.000018
D-Cu	**mg/L**	0.00041	0.00037	0.00086	0.00294	0.00096	0.00092	0.00129	0.00066	0.00098	0.00080
D-Fe	**mg/L**	0.083	0.129	0.120	0.112	*<0.007*	*<0.007*	0.027	*<0.007*	0.022	0.009
D-Pb	**mg/L**	0.00178	0.00048	0.00028	0.00008	0.00016	0.00046	0.00006	0.00002	0.00005	0.00001
D-Li	**mg/L**	0.0019	0.0018	0.0004	0.0004	0.0022	0.0012	0.0011	0.0030	0.0028	0.0017
D-Mg	**mg/L**	0.150	0.630	0.210	0.238	15.4	6.97	2.61	12.6	5.67	3.94
D-Mn	**mg/L**	0.0284	0.0754	0.670	0.105	0.00522	0.00203	0.00110	0.00433	0.00158	0.00021
D-Hg	**mg/L**	*<0.01*	*<0.01*	0.04	0.02	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
D-Mo	**mg/L**	0.00156	0.00063	0.00035	0.00004	0.00941	0.0111	0.0109	0.00221	0.00556	0.00340
D-Ni	**mg/L**	*<0.0001*	*<0.0001*	*<0.0001*	0.0012	0.0002	*<0.0001*	0.0002	0.0004	0.0002	*<0.0001*
D-P	**mg/L**	0.015	*<0.003*	0.018	0.014	*<0.003*	0.010	0.034	*<0.003*	*<0.003*	*<0.003*
D-K	**mg/L**	3.35	3.04	1.11	0.984	7.27	5.38	3.62	9.46	6.32	3.08
D-Se	**mg/L**	0.00008	0.00007	0.00004	0.00009	0.00013	0.00014	0.00008	0.00009	0.00022	0.00008
D-Si	**mg/L**	5.09	4.86	2.14	0.78	1.78	2.35	3.34	0.86	2.36	2.44
D-Ag	**mg/L**	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*
D-Na	**mg/L**	1.66	1.72	0.71	0.32	6.33	3.07	6.00	4.01	4.52	4.83
D-Sr	**mg/L**	0.00240	0.00964	0.00448	0.00415	0.245	0.111	0.0483	1.33	1.43	0.0852
D-S	**mg/L**	1.5	1.0	0.4	2.0	46.7	21.1	4.1	24.1	12.1	4.6
D-Tl	**mg/L**	0.000034	0.000045	0.000039	0.000211	0.000031	0.000151	0.000020	0.000027	*<0.0000 05*	0.000036
D-Sn	**mg/L**	0.00007	0.00010	0.00007	0.00005	*<0.0000 1*	0.00010	0.00003	0.00002	0.00002	*<0.0000 1*
D-Ti	**mg/L**	0.00285	0.00440	0.00576	0.00014	0.00010	0.00017	0.00059	0.00011	0.00095	0.00011
D-U	**mg/L**	0.000310	0.001519	0.000292	0.000766	0.0267	0.0266	0.0124	0.00584	0.00338	0.000894
D-V	**mg/L**	0.00027	0.00066	0.00038	0.00014	0.00059	0.00025	0.00052	0.00034	0.00131	0.00019
D-Zn	**mg/L**	*<0.002*	*<0.002*	*<0.002*	0.012	*<0.002*	0.005	*<0.002*	*<0.002*	*<0.002*	*<0.002*
D-Zr	**mg/L**	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*

3.2.2 QEMSCAN Results

Selective QEMSCAN results are presented in Table 3-4. Complete QEMSCAN results can be found in Appendix C. Samples submitted for QEMSCAN analysis included both kinetic test residue samples (used in saturated column experiments) and splits collected during initial setup of the unsaturated kinetic tests in 2014/2015. A comparison of mineral abundance for GS (FB-GS-Residue & GS-2) and SS (FB-SS-Residue & SS) was done to examine how sample mineralogy evolves during unsaturated kinetic testing. In general, bulk mineral alteration from several 2 to 3 years of weathering during kinetic testing is expected to be minimal. The average relative percent difference (RPD) between pre-test and residual samples was 29% for GS and 41% for SS. For dominant minerals (quartz, feldspar, clays, and other silicates) that account for 82 to 94% of mineral abundance, RPD ranged from <1 to 16% for GS and from 1 to 28% for SS. The variability in these relatively inert minerals can largely be attributed to sample heterogeneity and analytical precision. RPD of carbonate minerals, which make up 5-16% of mineral abundance, was 6 to 14% for GS and 9 to 13% for SS. This given that this is within the range of RPD found for relatively inert minerals, it is assumed that the carbonate content is essentially unchanged during several years of field bin exposure.

As depicted in Figure 3-4, the dominant mineral groups present across granite, gneiss, and schist materials include quartz, feldspar, micas, chlorite, clays, amphiboles, and other silicates. They account for 82% to 88% of schist samples (FB-SS residue, SS, ST, SO), and 94 to 99 % of granite and gneiss samples (Col 7, 8, 13, and 14 residues; FB-GS residue, GS-2, GT, and GO-3). Carbonate minerals present in the lithologies include calcite, dolomite and ankerite, all of which were present in greater proportions in schist (8% to 16%) and gneiss (2% to 5%) relative to granite (< 1%). Oxide mineral abundance (Fe-oxides, goethite, As-Fe oxyhydroxide, Fe-Sb oxide, other oxide) ranged from 0.34% to 3.8%, with the highest values observed in gneiss oxide and schist oxide. Sulfur minerals present ranged from 0.02 to 0.93 % across lithologies, and were highest in the schist sulphide WR (FB-SS residue and SS), followed by the gneiss sulphide WR (FB-GS residue and GS-2) and the granite transition ore (Col 8 residue). Pyrite, arsenopyrite, other (unidentified) sulphides, and sulphates make up the majority of sulfur minerals present, while chalcopyrite, galena, sphalerite and stibnite were present in much smaller fractions. Phosphate minerals (apatite with trace monazite) ranged from 0.02 to 0.45 %, being highest in schist followed by gneiss and granite.

Appendix C
Saturated Column Report

Table 3-4: QEMSCAN results for relative mineral abundance in kinetic test residues and fresh samples

Mineral Mass (wt. %)	Col 13 Residue	Col 14 Residue	Col 7 Residue	Col 8 Residue	FB-GS-Residue	GS-2	GT	GO-3	FB-SS-Residue	SS	ST	SO
Pyrite	0.17	0.050	0.010	0.18	0.25	0.55	0.22	0.010	0.72	0.80	0.14	0.00
Arsenopyrite	0.040	0.020	0.020	0.18	0.030	0.010	0.010	0.00	0.00	0.010	0.00	0.00
Chalcopyrite	0.00070	0.00060	0.00	0.0011	0.0025	0.0021	0.00020	0.0011	0.0021	0.0024	0.0025	0.0010
Galena	0.00080	0.00010	0.00020	0.00020	0.00040	0.00050	0.00010	0.00040	0.00060	0.018	0.00020	0.00
Sphalerite	0.0011	0.00070	0.00	0.00060	0.00050	0.0014	0.00	0.00	0.0017	0.0040	0.0020	0.0011
Stibnite	0.00089	0.00020	0.00	0.00	0.0013	0.0016	0.00033	0.00039	0.0014	0.0024	0.0024	0.00
Other Sulphides	0.010	0.00	0.00	0.00	0.010	0.010	0.00	0.00	0.010	0.030	0.010	0.00
Quartz /Feldspar	89.7	87.5	65.6	67.1	67.2	65.8	71.9	74.6	50.6	49.9	57.7	56.2
Mica	3.62	5.74	18.5	20.4	17.0	17.4	11.3	11.3	22.1	21.1	16.1	16.6
Chlorite	0.20	0.25	0.65	0.56	1.1	1.0	0.33	0.43	1.8	2.1	3.1	0.74
Clays	4.58	5.20	12.6	7.92	6.81	6.77	9.86	8.94	4.17	5.01	1.90	11.5
Amphibole	0.010	0.00	0.00	0.00	0.25	0.29	0.30	0.040	0.73	0.97	3.0	0.37
Other Silicates	0.50	0.60	1.39	1.12	2.07	2.42	1.36	1.15	2.48	2.97	5.30	2.57
Fe-Oxides	0.050	0.073	0.12	0.044	0.036	0.040	0.043	0.15	0.024	0.023	0.10	0.51
Goethite	0.53	0.24	0.63	0.68	0.15	0.24	0.36	0.79	0.28	0.26	0.32	2.84
Other Oxides	0.33	0.18	0.24	0.33	0.15	0.17	0.13	0.18	0.36	0.19	0.27	0.44
Calcite	0.030	0.020	0.010	0.010	2.28	2.51	0.75	1.23	10.5	9.53	11.1	4.36
Dolomite	0.00	0.00	0.00	0.00	0.97	0.91	1.49	0.45	3.54	4.05	0.51	1.29
Ankerite	0.060	0.00	0.00	0.020	1.45	1.67	1.91	0.51	2.29	2.62	0.31	2.20
As-Fe Oxyhydroxide	0.00	0.010	0.24	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apatite	0.16	0.050	0.00	0.010	0.15	0.20	0.11	0.15	0.45	0.41	0.17	0.25
Monazite	0.00	0.020	0.020	0.010	0.010	0.010	0.00	0.040	0.00	0.00	0.00	0.010
Sulphates	0.010	0.010	0.00	0.00	0.050	0.010	0.010	0.010	0.070	0.060	0.010	0.15
Fe-Sb Oxide	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.020	0.010	0.030	0.00	0.00	0.00	0.00	0.010	0.010	0.00	0.00
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Appendix C
Saturated Column Report

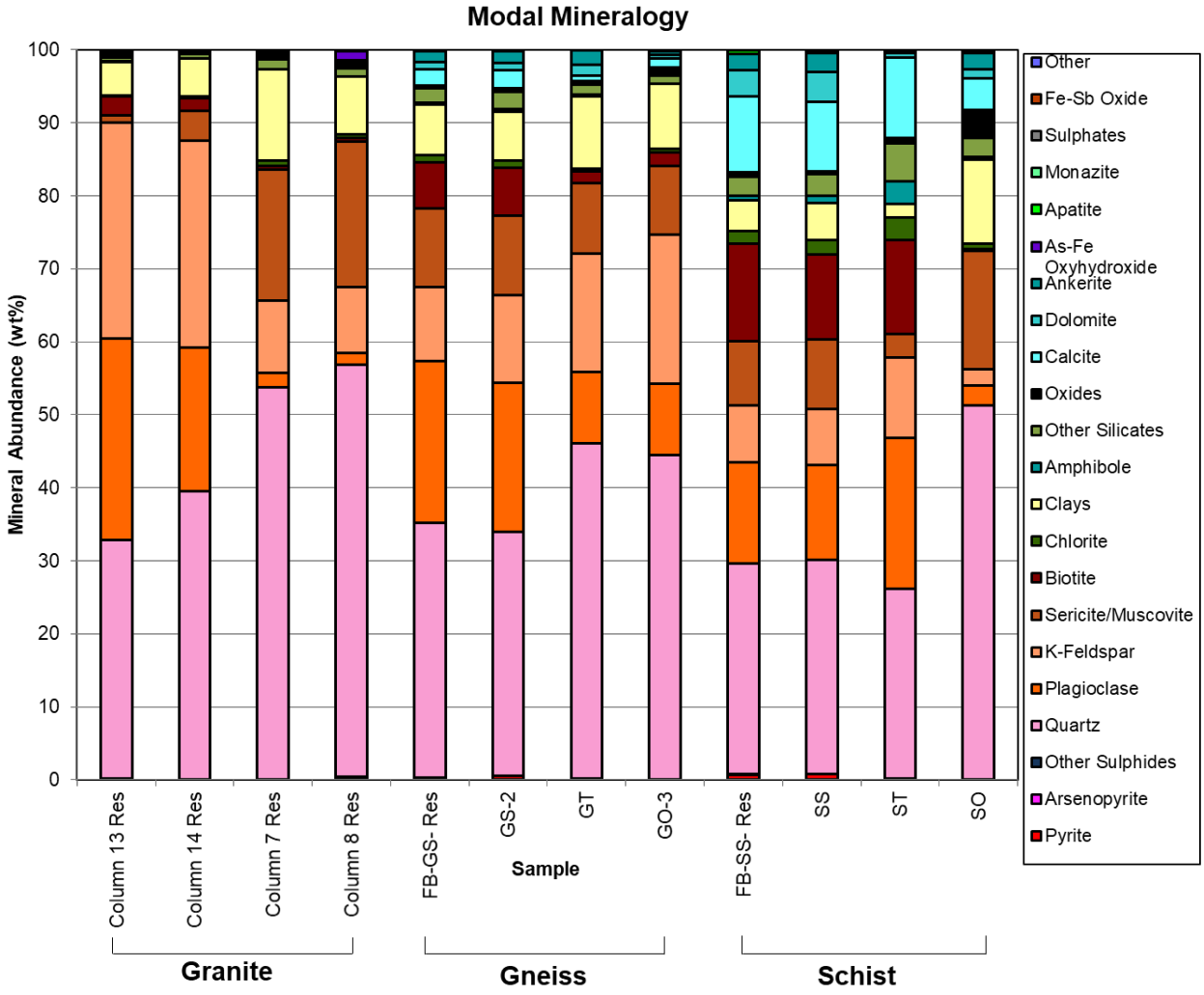


Figure 3-4: Relative mineral abundance in kinetic test residues and fresh samples

Appendix C
Saturated Column Report

Iron deportment in granite, gneiss, and schist lithologies are shown in Figure 3-5. In most cases, the majority of Fe present (51% to 76 %) is associated with rock forming silicate minerals such as mica, chlorite and amphibole. As expected, proportions of Fe associated with oxides were higher in oxidized samples. Across lithologies, 0.05% to 11% of Fe is associated with sulphide minerals, predominantly as pyrite. Iron associated with carbonate minerals is only significant for gneiss and schist samples, comprising 2% to 24% of total Fe.

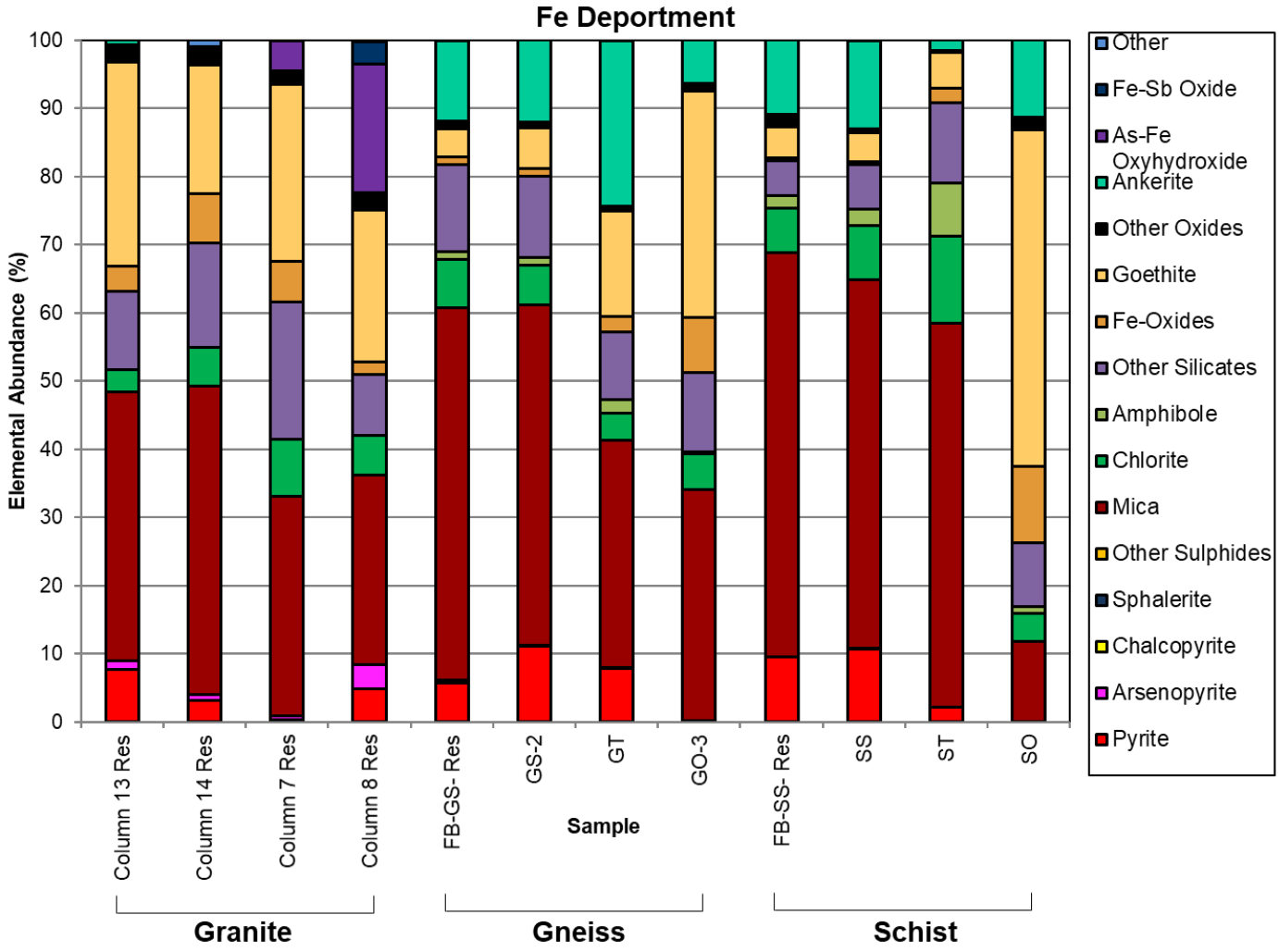


Figure 3-5: Relative elemental abundance of Fe in minerals present in kinetic test residues and fresh samples

Appendix C
Saturated Column Report

Arsenic deportment is shown in Figure 3-6. For granite ore (Col 7 and 8 residues), As-Fe oxyhydroxide accounts for the majority of As present (80%), while a smaller fraction is associated with arsenopyrite (10 to 15%) and oxides (2 to 10%). For fresh gneiss WR (FB-GS residue and GS-2), arsenopyrite is the dominant mineral form of As (96 to 98%), followed by a combination of As-Fe oxyhydroxide and Fe-Sb oxide (2 to 4%). In the schist oxide WR (SO), the majority of As is associated with oxides (97%), while no As minerals were characterized in the gneiss oxide WR (GO-3), likely due to low elemental abundance.

There is a notable discrepancy in As abundance in pre-test and residual fresh schist samples (FB-GS Residue & SS). In the residual SS sample, As is predominantly associated with As-Fe oxyhydroxide (74%) and Fe-Sb oxide (26%); while in the pre-test sample, As is mainly found as arsenopyrite (91%) and present in smaller fractions as As-Fe oxyhydroxide (4%) and Fe-Sb oxide (4%). This discrepancy in results may be due to both weathering of primary arsenopyrite and sample heterogeneity. Note that similar values of arsnopyrite are found in GS and FB-GS residue.

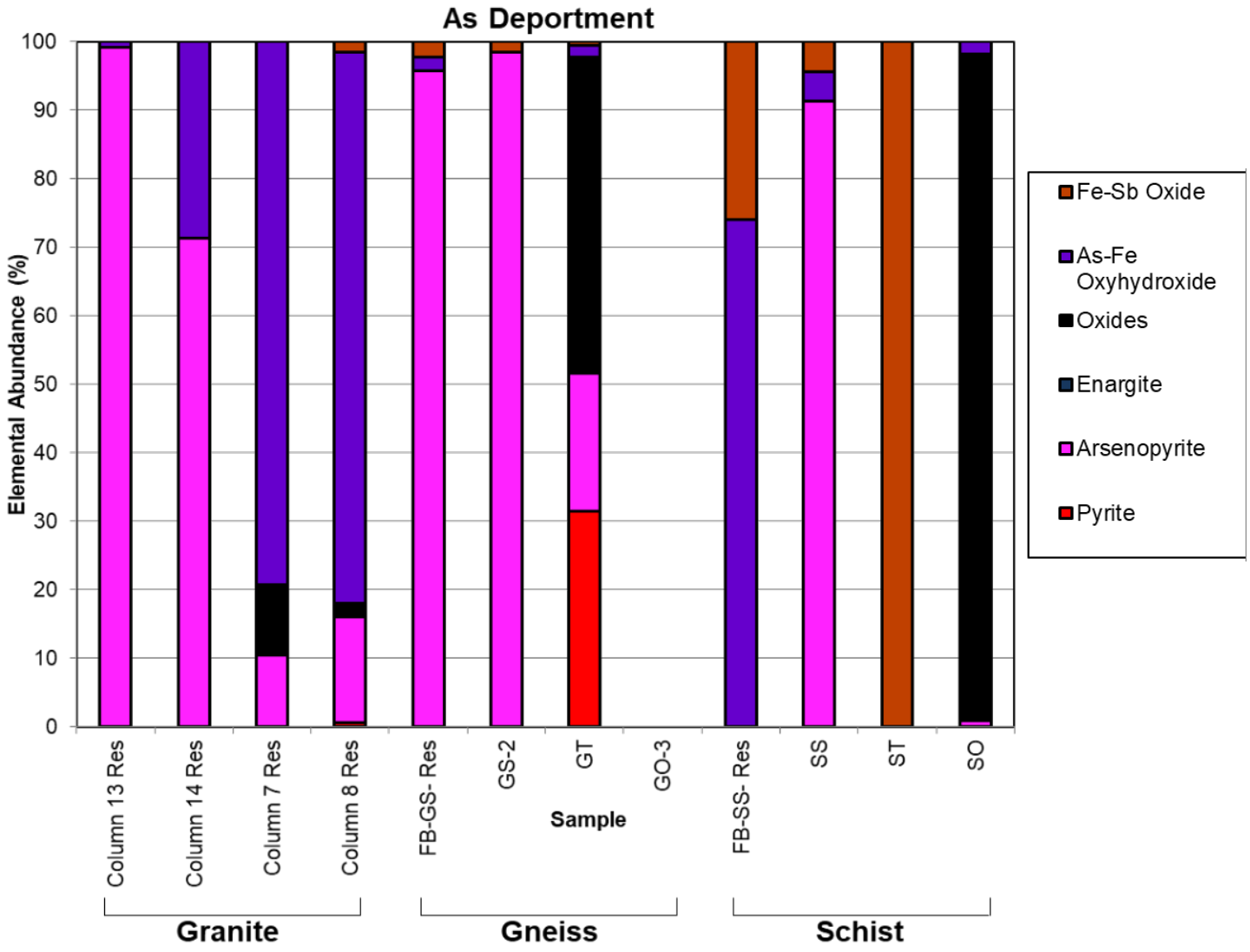


Figure 3-6: Relative elemental abundance of As in minerals present in kinetic test residues and fresh samples

3.3 *Column Influent*

Column influent in Phase 1 and Phase 2 of the experiment consisted of DI water amended with 51.8 mg/L of Na-lactate. The influent was analyzed in order to confirm that target concentrations had been achieved and confirm that the solution was trace metal free. The results show that the target DOC concentration (10 mg/L) was achieved in this phase of the experiment and that trace amounts of Ba, Pb and Al were present in the influent (Figure 3-5). Regular monitoring of DOC indicated relatively little variability throughout the entire course of the experiment with DOC concentrations ranging from 9.46 mg/L to 11.4 mg/L and a mean value of 10.3 mg/L (Appendix A).

In phase 3 of the experiment, $CaSO_4$ was introduced to column influent in addition to Na-lactate. Phase 3 influent was analyzed for a full suite of parameters each time a new batch of influent was made-up in addition to monitoring DOC, dissolved metal, and anion concentrations every 4 weeks (Appendix A). The first batch of Phase 3 influent was only used during the Week 28 (post-seq.) sampling event as the SO_4 concentration was 700 mg/L. The following two batches of column influent had SO_4 concentrations of 1010 mg/L and 1030 mg/L, respectively, and were used successively through the final phase of the experiment. Increases in many of the trace element concentrations in the Phase 3 influent are suspected to have been contributions from impurities in the $CaSO_4$ powder used to spike the influent. Parameters that were elevated to concentrations similar in magnitude to those of column effluent include Al, Ba, Cu, Fe, Pb, Mn, and Sr.

Appendix C
Saturated Column Report

Table 3-5: Composition of Column Influent

Parameter	Unit	Phase 1 and 2	Phase 3			
		17-Aug-17	11-Dec-18	05-Jan-18	14-Feb-18	Mean Value*
T-Alk	mg/L	13	23	21	24	22
pH	s.u.	5.86	6.43	6.43	6.38	6.41
Conductivity	uS/cm	24.82	1234	1619	1625	1622
DOC	mg/L	10.8	10.5	10.2	10.4	10.3
NH_3	mg/L	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.05*
NO_3-N	mg/L	*<0.005*	*<0.025*	*<0.025*	*<0.05*	*<0.05*
NO_2-N	mg/L	*<0.001*	*<0.005*	*<0.005*	*<0.01*	*<0.01*
T-PO_4	mg/L	*<0.002*	0.0051	0.0099	0.0119	0.011
SO_4	mg/L	*<0.3*	699	1010	1030	1020
D-Na	mg/L	6.79	6.36	5.96	7.03	6.50
D-Ca	mg/L	*<0.02*	271	386	395	391
D-K	mg/L	*<0.05*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
D-Cl	mg/L	*<0.5*	*<2.5*	*<2.5*	*<5*	*<5*
D-Mg	mg/L	*<0.005*	0.328	0.485	0.712	0.599
D-Si	mg/L	*<0.05*	0.17	0.27	0.42	0.35
D-F	mg/L	*<0.02*	*<0.1*	*<0.1*	*<0.2*	*<0.2*
D-Al	mg/L	0.00056	0.0728	0.114	0.181	0.148
D-Sb	mg/L	*<0.00002*	*<0.00004*	*<0.00004*	*<0.00004*	*<0.00004*
D-As	mg/L	*<0.00002*	0.000059	0.000096	0.000066	0.000081
D-Ba	mg/L	0.000047	0.00225	0.00694	0.01150	0.0092
D-Cd	mg/L	*<0.000005*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
D-Cr	mg/L	*<0.0001*	*<0.0002*	*<0.0002*	0.00028	0.00024
D-Co	mg/L	*<0.000005*	0.000054	0.000058	0.000105	0.000082
D-Cu	mg/L	*<0.0001*	0.00070	0.00144	0.00253	0.00199
D-Fe	mg/L	*<0.001*	0.0253	0.0397	0.0708	0.0553
D-Pb	mg/L	0.0000071	0.000070	0.000104	0.000133	0.000119
D-Li	mg/L	*<0.0005*	*<0.001*	0.0013	0.0014	0.0014
D-Mn	mg/L	*<0.005*	0.00330	0.00746	0.01540	0.0114
D-Hg	mg/L	*<0.00005*	*ND*	*ND*	*ND*	*ND*
D-Mo	mg/L	*<0.00005*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
D-Ni	mg/L	*<0.00005*	0.00012	*<0.0001*	0.0002	0.0002
D-Se	mg/L	*<0.00004*	*<0.00008*	*<0.00008*	*<0.00008*	*<0.00008*
D-Ag	mg/L	*<0.000005*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
D-Sr	mg/L	*<0.0001*	0.737	1.63	2.29	1.96
D-Tl	mg/L	*<0.000002*	*<0.000004*	*<0.000004*	*<0.000004*	*<0.000004*

D-V	mg/L	*<0.00005*	0.00018	0.00023	0.00037	0.00030
D-Zn	mg/L	*<0.0005*	*<0.002*	*<0.002*	*<0.002*	*<0.002*

Note: Mean value determined from January 5, 2018 and February 14, 2018 influent samples.

3.4 *Column Effluent*

3.4.1 **Phase 1**

3.4.1.1 pH and Major Ions

Column effluent pH remained steady throughout phase 1 of the experiment. Gneiss and schist columns produced slightly higher pH (median pH of 8.02) than the granite columns (median pH of 6.92) (Figure 3-7 and Figure 3-8). The granite column Kona 4 produced significantly higher alkalinity compared to other granite columns, with all values generally declining in the first 15 week before stabilizing (Figure 3-7). Conversely, gneiss and schist column alkalinity increases for the first 10 weeks before stabilizing. The highest alkalinity values were generally observed in fresh weathering types (Kona 4, SS and GS).

Most major ions reach peak concentrations in the first four weeks and then decline for the duration of Phase 1. The fresh weathering types generally produce higher major ion concentrations than more oxidized samples. Columns GS and SS (fresh) consistently produced significantly higher major ion concentrations (*e.g.* Ca, K, Mg, Na, and SO_4), particularly in the first ~15 weeks, compared to columns GO and SO (oxide) and columns GT and ST (transition weathered).

Calcium concentrations in the columns decrease over time, most notably in the GS column where concentrations decline to roughly half of the initial porewater concentrations (~160 mg/L to ~80 mg/L) by Week 15 (Figure 3-9 and Figure 3-10). The declines in Ca concentrations are driven by much lower values can be related to calcite ($CaCO_3$) solubility. Saturation indices (SI) calculated in PHREEQC suggest that calcite is saturated in all gneiss and schist columns (SI = 0.11 – 0.78). Conversely, SI for granite columns indicate $CaCO_3$ is undersaturated and is not likely to control Ca concentrations, with the exception of Kona 4 which is near calcite equilibrium in the first 14 weeks.

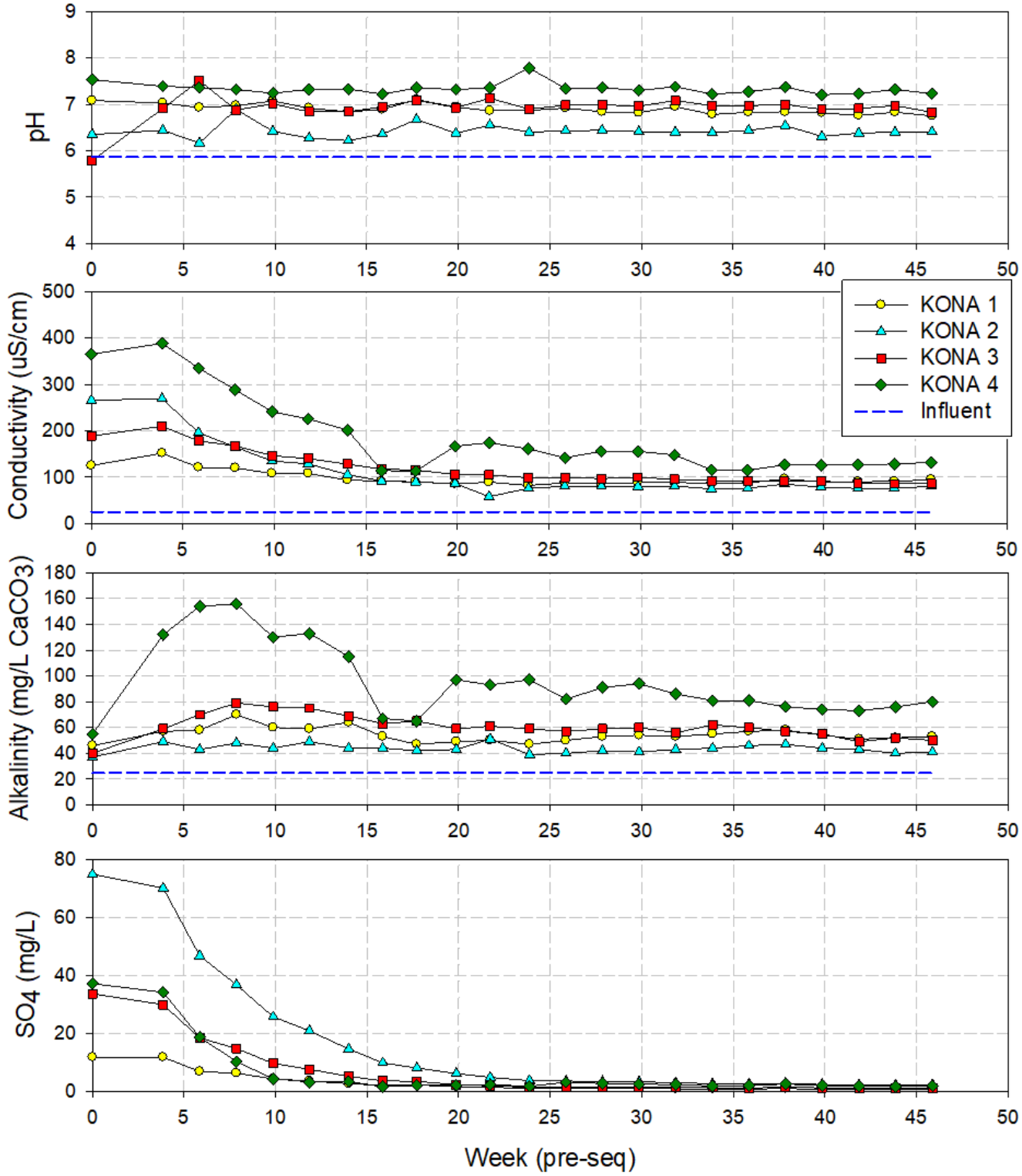


Figure 3-7: Time series profiles of pH, Conductivity, Total Alkalinity, and SO_4 in granite column effluent in Phase 1.

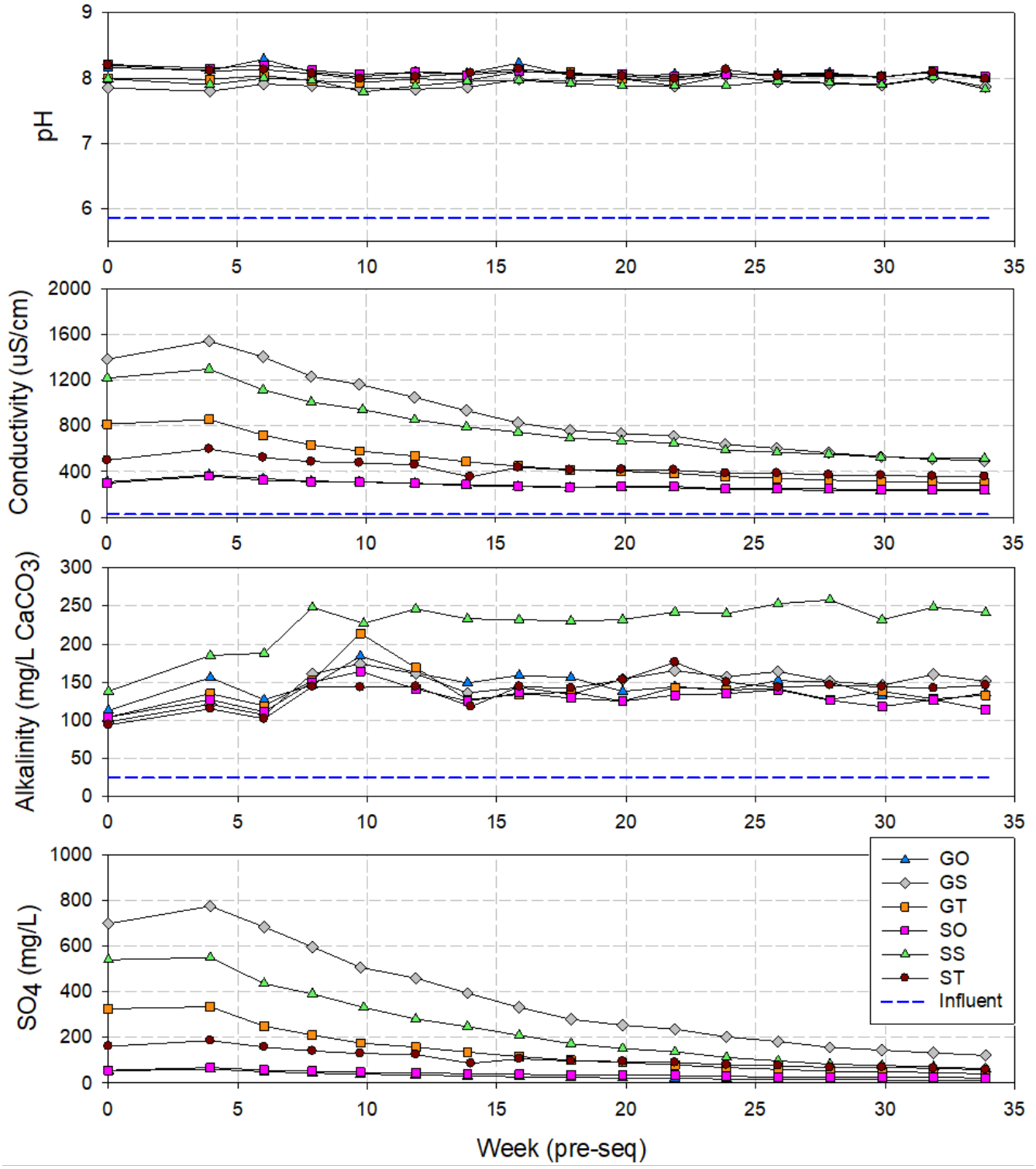


Figure 3-8: Time series profiles of pH, Conductivity, Total Alkalinity, and SO_4 in gneiss and schist column effluent in Phase 1.

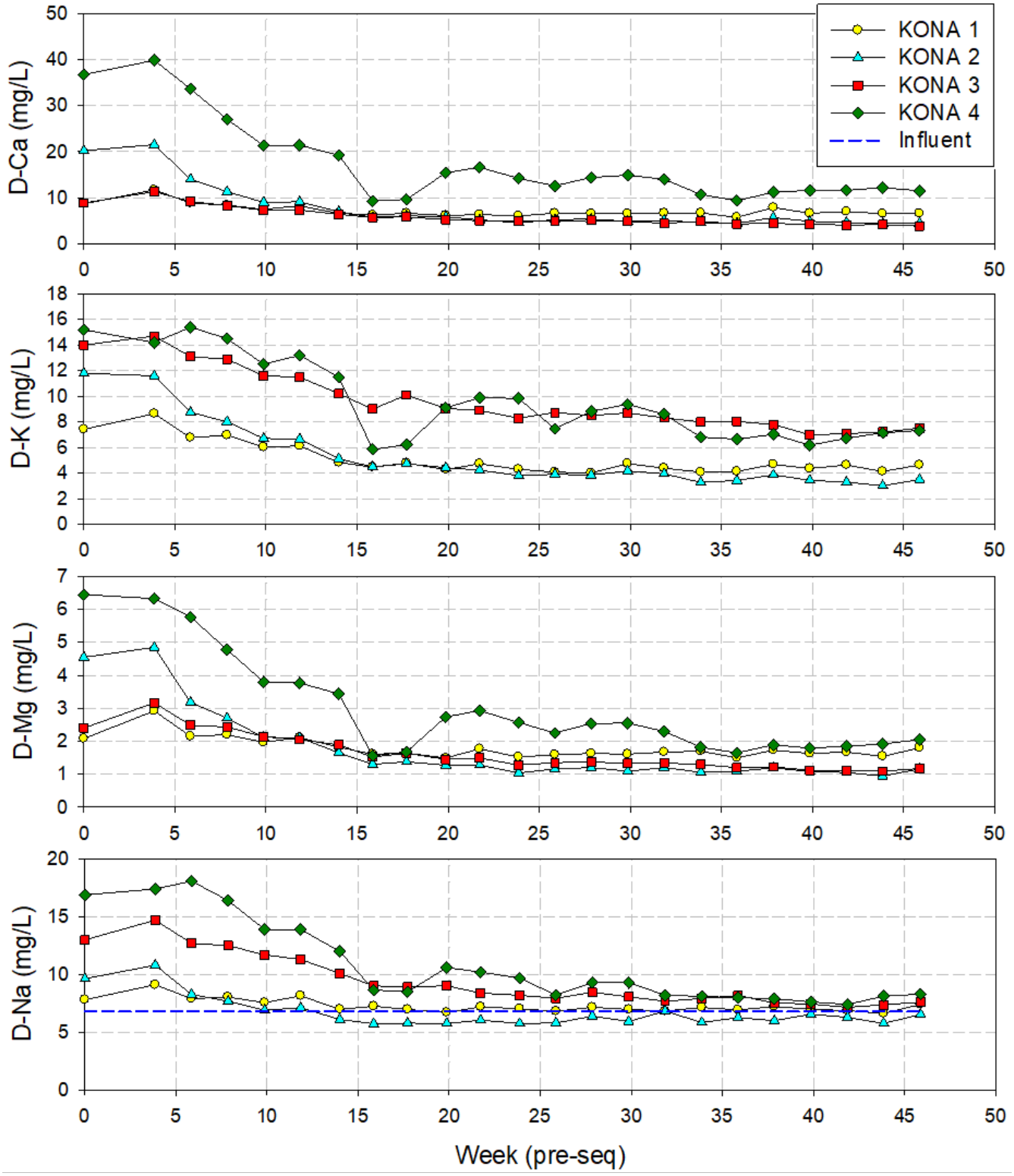


Figure 3-9: **Time series profiles of D-Ca, D-K, D-Mg, and D-Na in granite column effluent in Phase 1.**

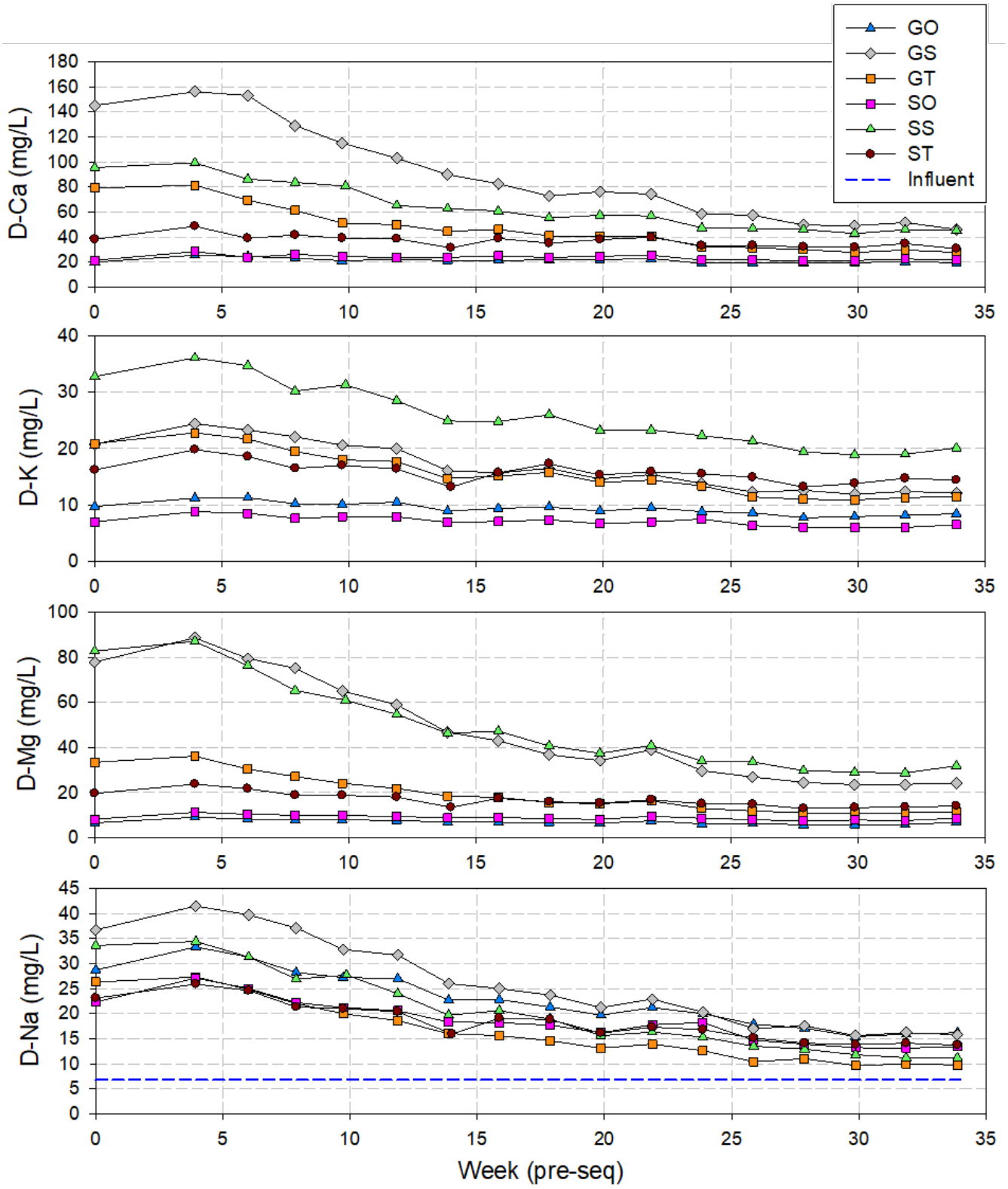


Figure 3-10: **Time series profiles of D-Ca, D-K, D-Mg, and D-Na in gneiss and schist column effluent in Phase 1.**

3.4.1.2 Redox Indicators

Reducing conditions in column substrate are driven by the oxidation (decomposition) of organic compounds. As there is minimal organic carbon expected in rock samples sourced from drill core, the primary source of DOC to the column is from influent which has been spiked with Na-lactate to achieve a concentration of 10 mg/L of DOC. For the entirety of Phase 1, DOC in leachates is consistently below the influent level in all columns, reaching levels near to or below 1 mg/L (Figure 3-11 and Figure 3-12). This indicates that decomposition of DOC by microbial activity is occurring within the columns.

The first terminal electron acceptor to be utilized in the absence of O_2 is NO_3. Since NO_3 is below method detection limit (MDL) in column influent and is consistently near or below MDL values (< 0.005 to 0.025 mg/L) in effluents, it is not an effective redox indicator in this experiment. The dominant nitrogen species in column effluent is NH_4, which is a reduced species that typically dominates nitrogen speciation under anaerobic conditions. The persistence of NH_4 in column leachate (0.005 to 1.89 mg/L) indicates that conditions are sufficiently reducing (i.e., oxygen is absent) to favor NO_3 reduction and NH_4 stability (Figure 3-11 and Figure 3-12).

There is evidence for reductive dissolution of Mn-oxides in granite, gneiss and schist materials (Figure 3-11 and Figure 3-12). This is shown by the increase in Mn concentrations between column influent (< 0.00005 mg/L) and compared to leachates (maximum values of 4.42 to 0.26 mg/L). Mn concentrations gradually decline over time, likely illustrating the progressive depletion of labile Mn-oxide phases.

Distinct trends in Fe concentrations are observed in Kona columns versus the gneiss and schist columns (Figure 3-11 and Figure 3-12). Kona leachates show evidence of reductive dissolution of Fe oxides, specifically Kona 2 where a maximum Fe concentration of 3.5 mg/L was reached. While GS and GO effluents have occasional detectable Fe concentrations (maximum of 0.0076 mg/L), values are consistently below MDL in GT and all schist columns, indicating that reductive dissolution of Fe is not occurring to any significant extent. This may be due to the availability of more energetically favorable terminal electron acceptors (i.e., Mn) or Fe-oxides being present in crystalline forms that are not easily accessible for microbial respiration.

Dissolved sulphide only appears in Kona 2 effluent (Figure 3-13) and is above MDL (< 1.5 µg/L) between Weeks 7 to 20 (pre-seq.). A maximum D-sulphide value of 64 µg/L is reached in Week 16, suggesting that sulphate reduction is occurring in Kona 2. Similarly, the appearance of a black precipitate on Kona 1 indicates formation of secondary sulphide minerals, suggesting that sulphate reduction is also occurring in this column. D-sulphide values were generally below MDL in Kona 1, suggesting that D-sulphide produced from sulphate reduction was insoluble in Kona 1 pore water.

Appendix C
Saturated Column Report

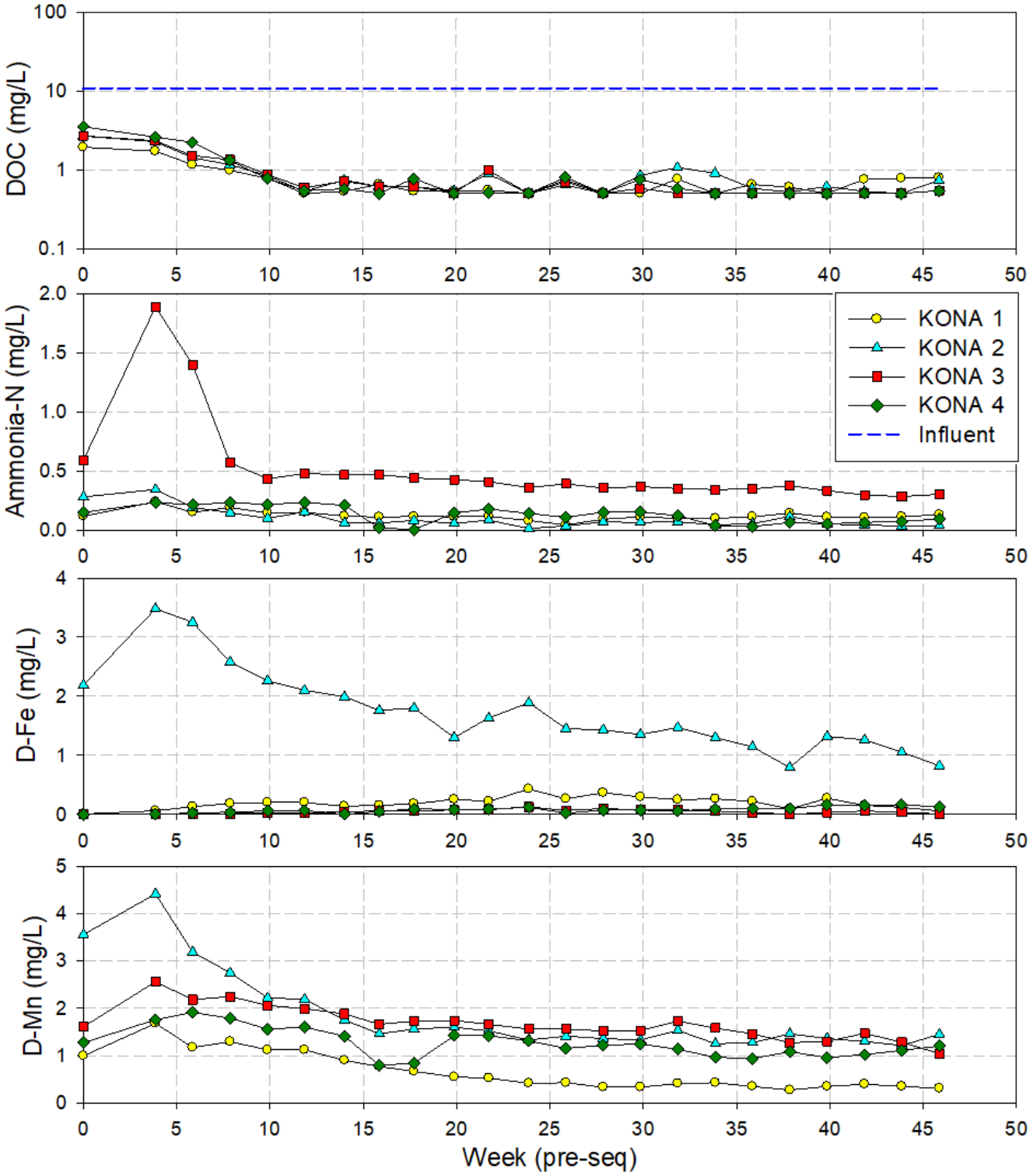


Figure 3-11: Time series profiles of DOC, Ammonia-N, D-Fe, and D-Mn in granite column effluent in Phase 1.

Appendix C

Saturated Column Report

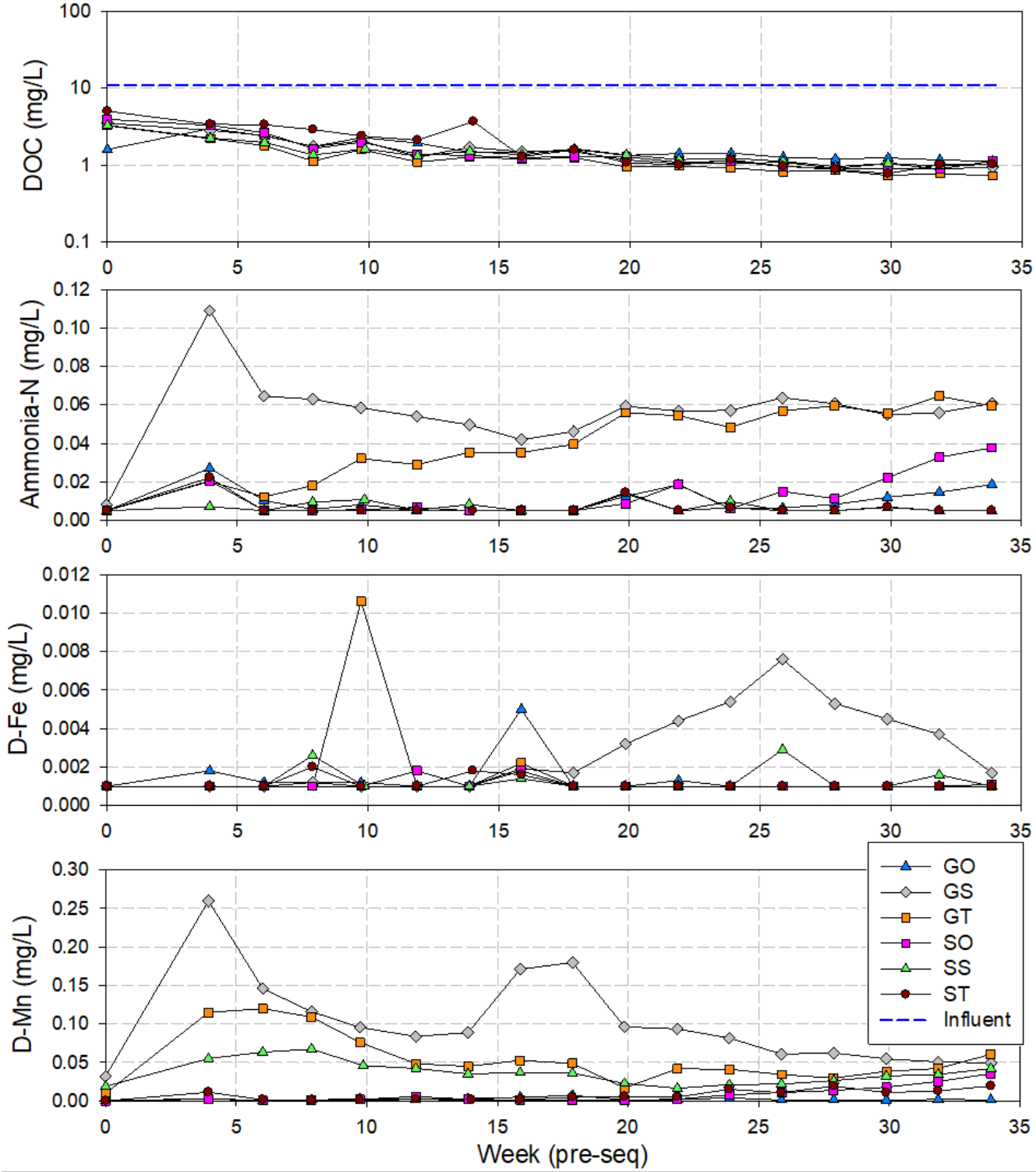


Figure 3-12: Time series profiles of DOC, Ammonia-N, D-Fe, and D-Mn in gneiss and schist column effluent in Phase 1.

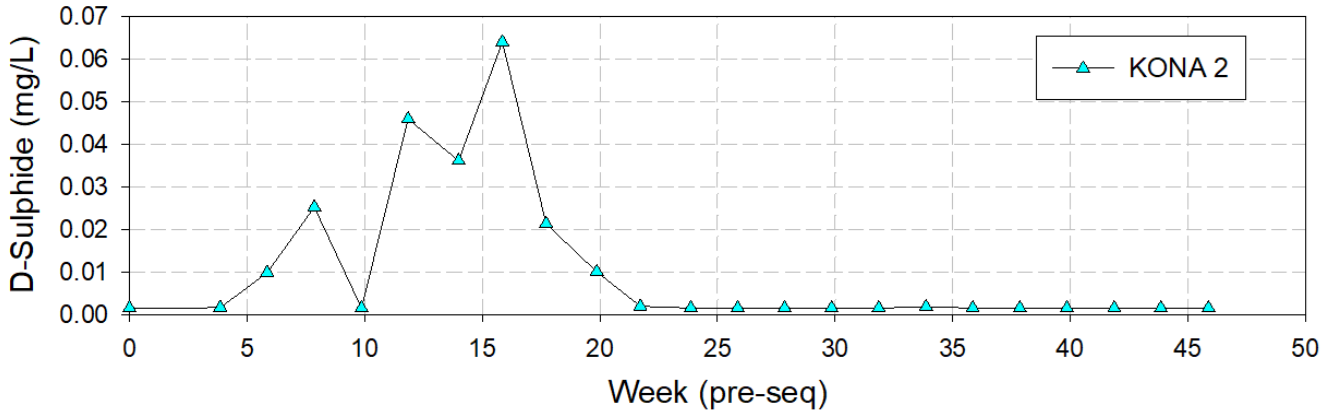


Figure 3-13: Time series profiles of D-Sulphide in the granite KONA 2 column effluent in Phase 1.

3.4.1.3 Trace Elements

Metal cations such as Cd, Co, Cu, Ni, and Zn and metal oxyanions such as Sb, Mo and U either remained relatively stable or showed gradual declines in effluent concentrations (Figure 3-14 through Figure 3-19). Such trends are consistent with the rinsing of water-soluble oxides and mineral surface bound metals through the initial phase of the experiment. Dissolved antimony concentrations in the Kona 2 column were anomalous as concentrations increased from Week 0 to 18 and thereafter gradually declined. Columns GT and GS produced the highest D-U concentrations in Phase 1, reaching maximum values of 0.35 mg/L and 0.29 mg/L, respectively. Maximum D-U concentrations in schist and granite column effluents were significantly lower at 0.089 mg/L and 0.071 mg/L, respectively (Figure 3-14 and Figure 3-15). Uranium concentrations declined over time, similar to other trace metals. Arsenic is unique in that it showed increasing trends in Phase 1, most notably in Kona columns 1 and 2, suggesting conditions in the saturated columns enhanced As release (Figure 3-20 and Figure 3-21).

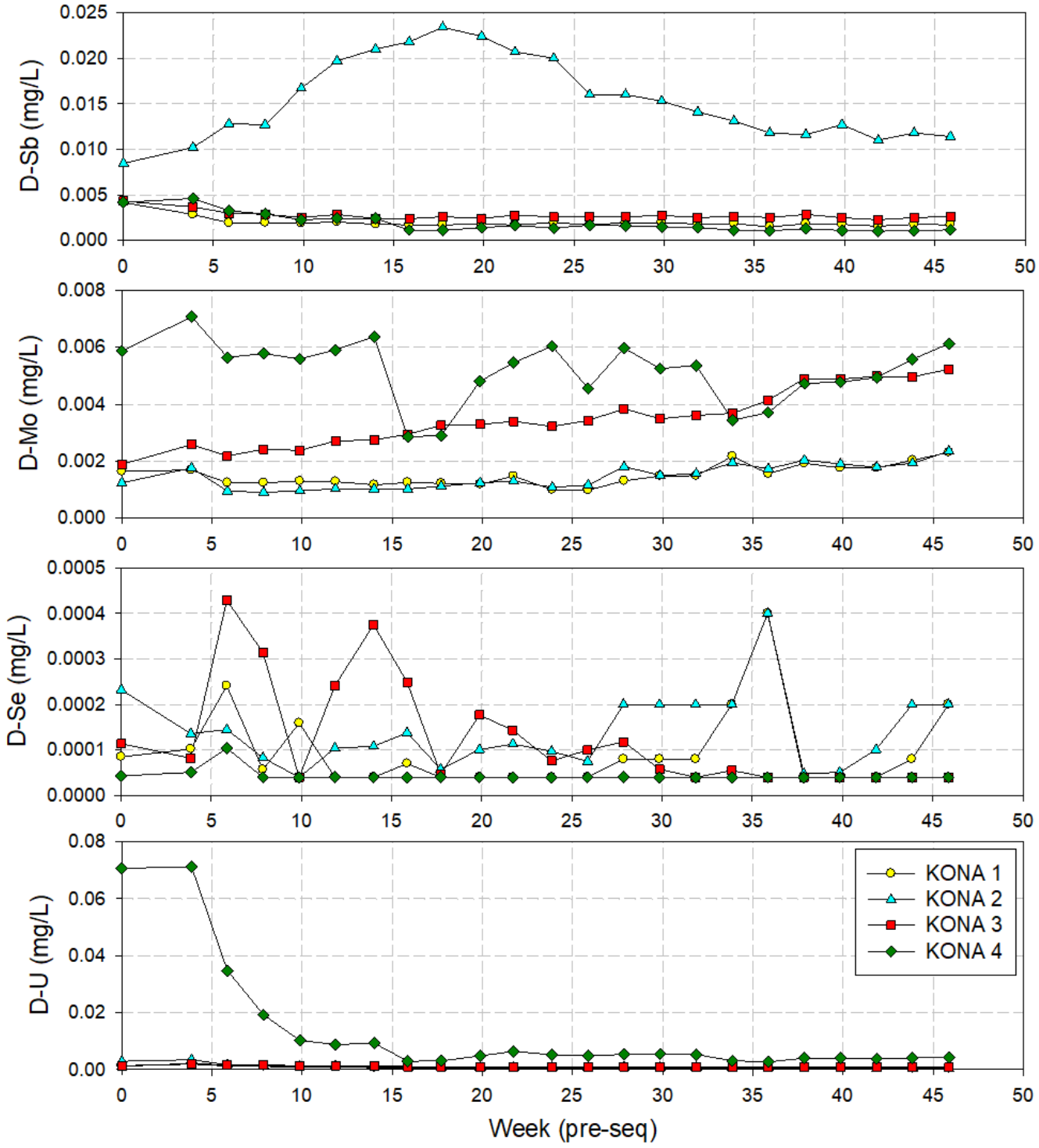


Figure 3-14: Time series profiles of D-Sb, D-Mo, D-Se, and D-U in granite column effluent in Phase 1.

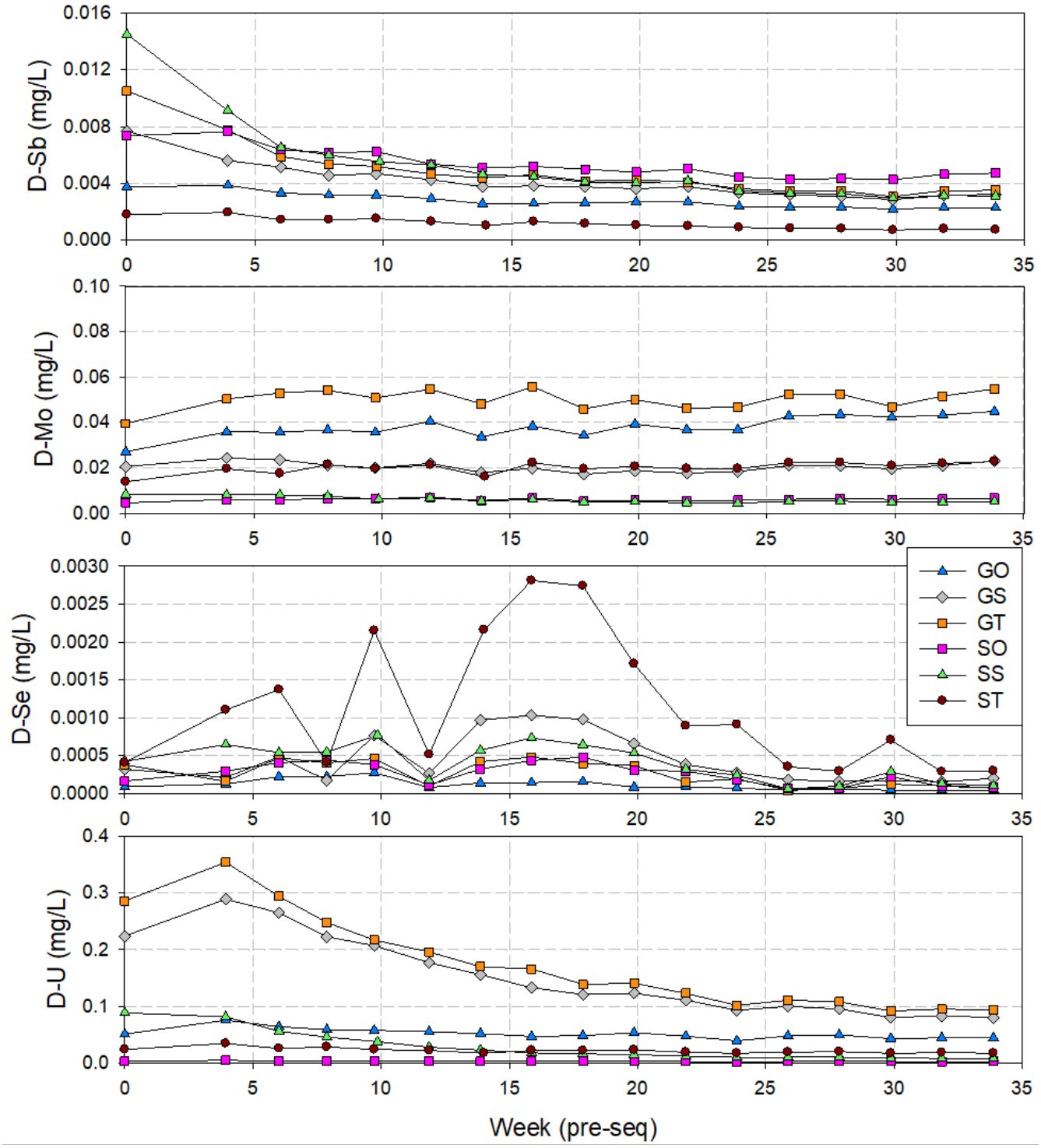


Figure 3-15: Time series profiles of D-Sb, D-Mo, D-Se, and D-U in gneiss and schist column effluent in Phase 1.

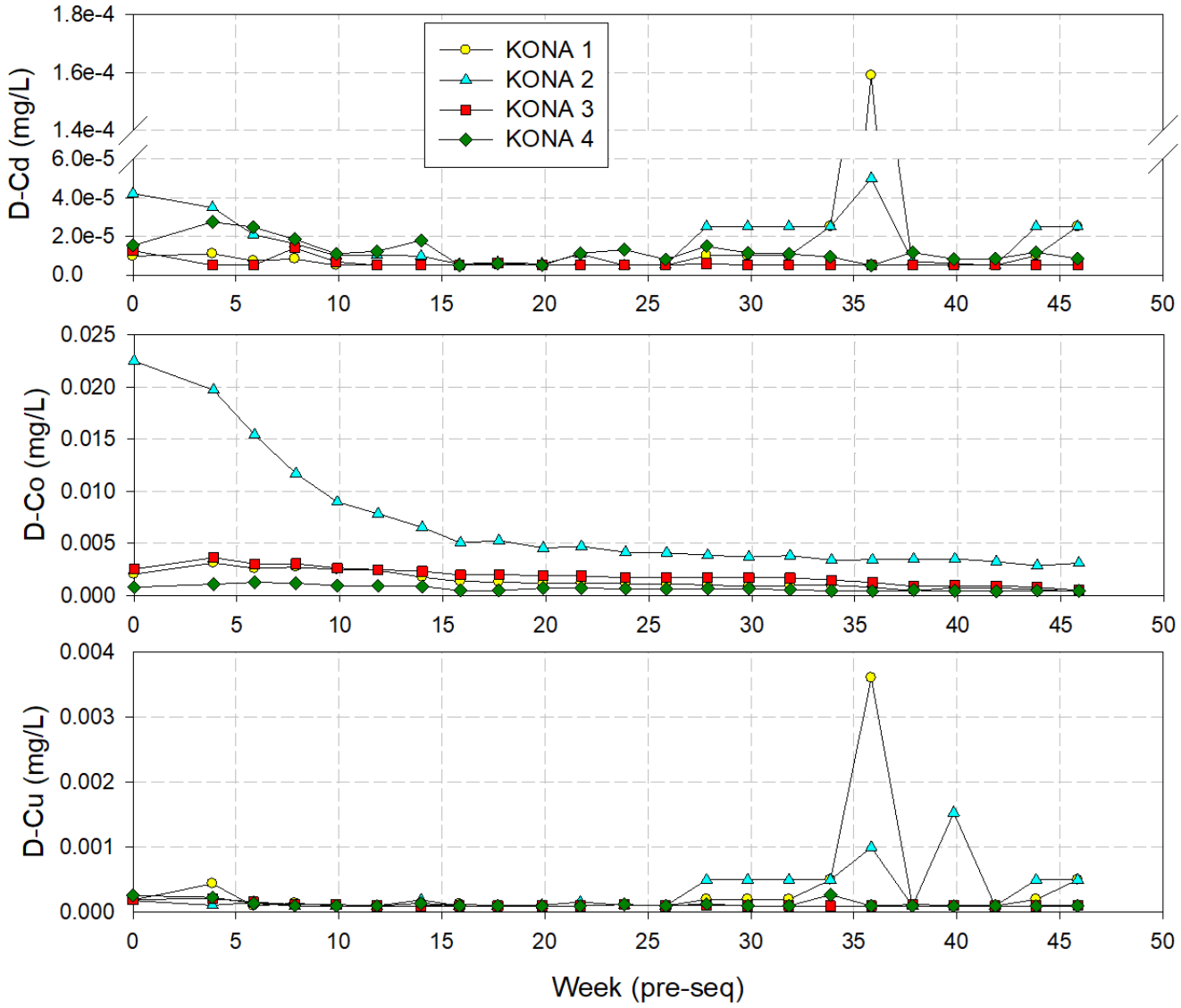


Figure 3-16: Time series profiles of D-Cd, D-Co and D-Cu in granite column effluent in Phase 1.

Appendix C
Saturated Column Report

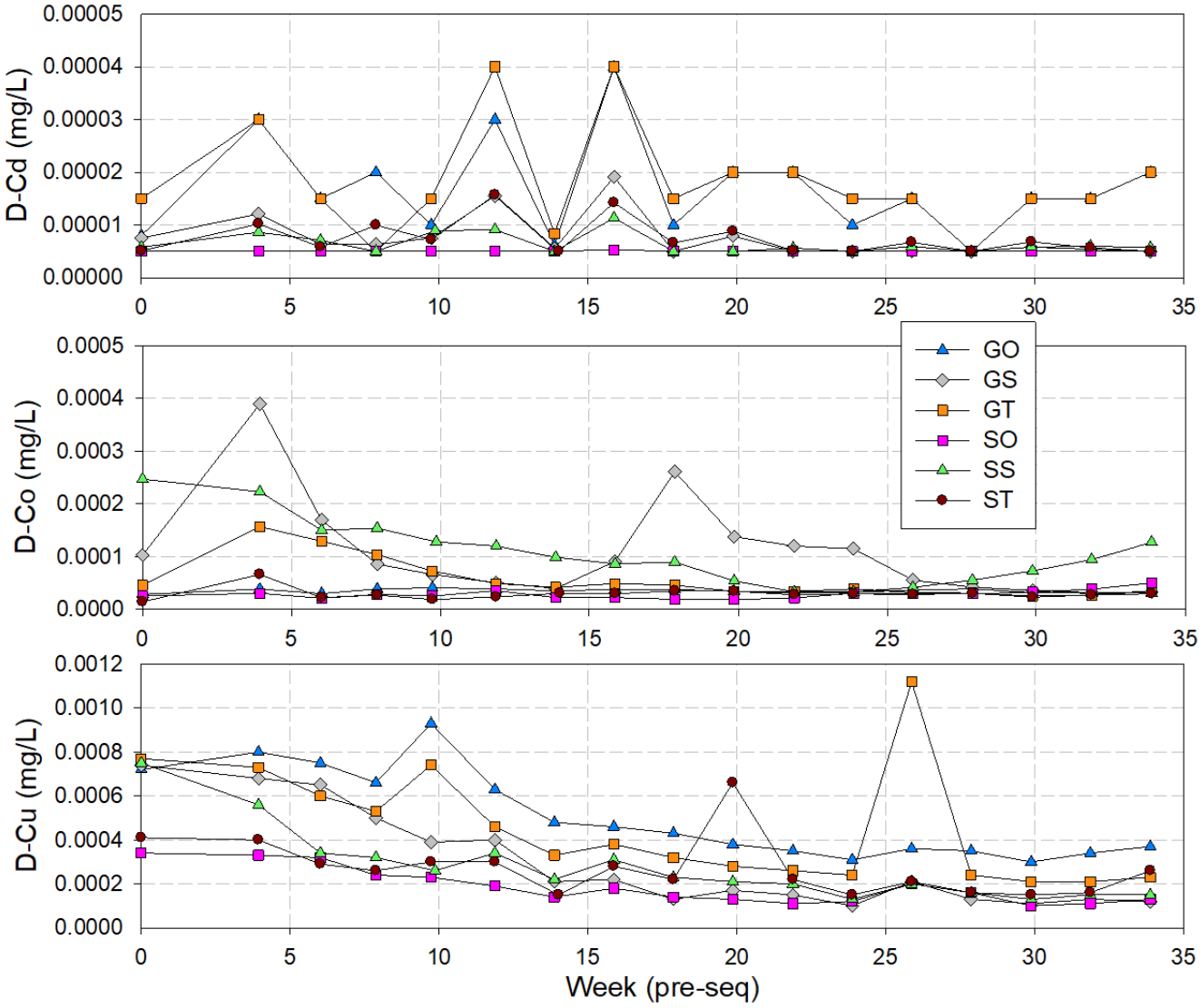


Figure 3-17: Time series profiles of D-Cd, D-Co and D-Cu in gneiss and schist column effluent in Phase 1.

Appendix C
Saturated Column Report

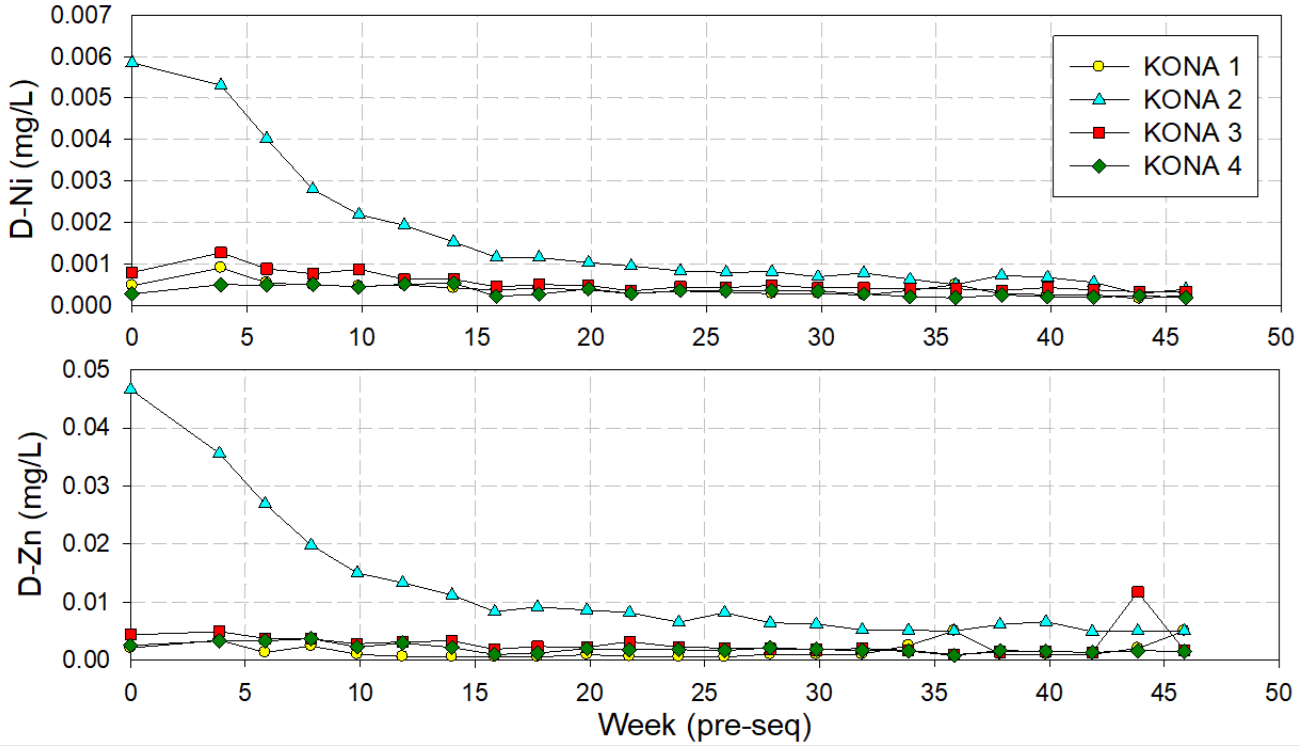


Figure 3-18: Time series profiles of D-Ni and D-Zn in granite column effluent in Phase 1.

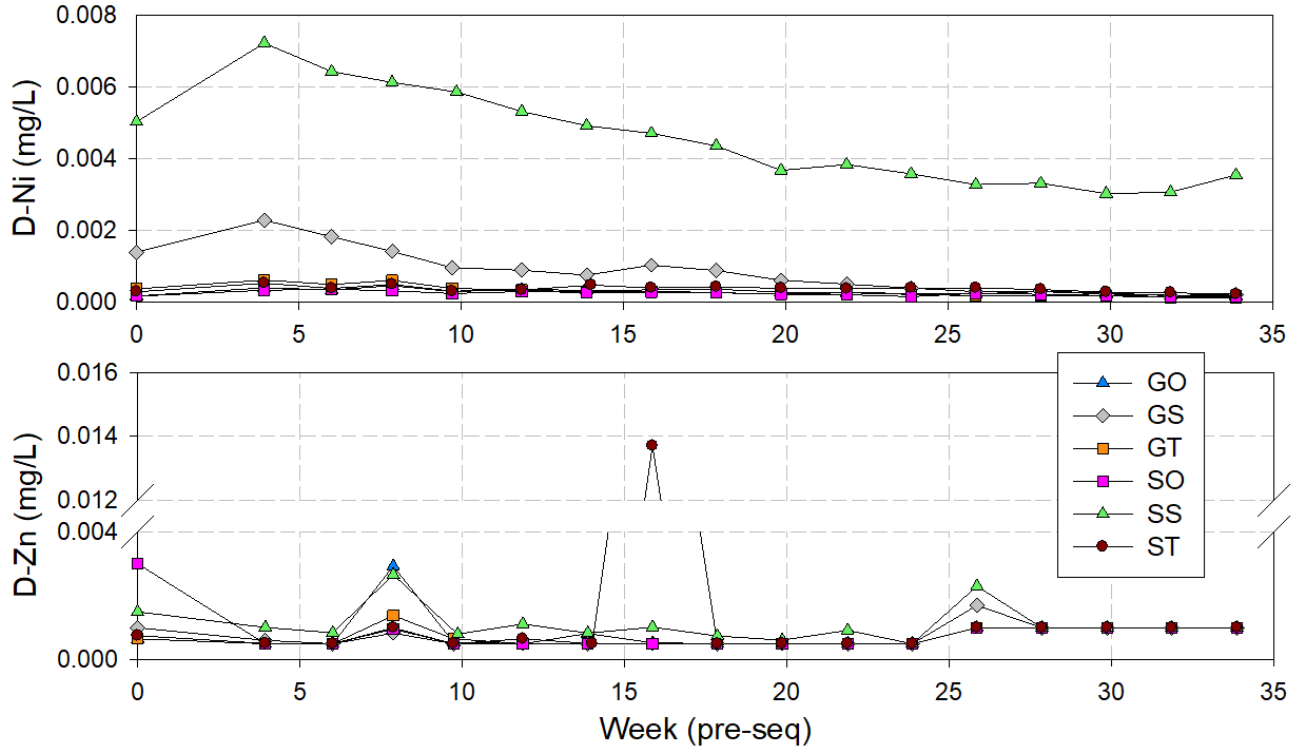


Figure 3-19: Time series profiles of D-Ni and D-Zn in gneiss and schist column effluent in Phase

3.4.1.4 Arsenic Behaviour

A variety of potential mechanism of As release may be occurring within the column materials, which include: reductive dissolution of Fe-oxide minerals; reduction of As(V) to As(III); pH related sorption/desorption on mineral surfaces; and ion exchange of surface complexed As. Arsenic results in granite columns (Kona 1-4) are considerably higher than in gneiss and schist leachates (G&S). In Kona 1, 2 and 3, As is steadily released throughout Phase 1 operation, reaching maximum concentrations of 12.5mg/L, 20.1 mg/L and 3.07 mg/L in Week 46 (pre-seq.), respectively (Figure 3-20). In contrast, As results in Kona 4 remain consistent at a much lower average of 0.348 mg/L. In G&S leachates, As release follows a similar increasing trend throughout Phase 1; values range from 0.0058 to 0.21 mg/L and are highest in GT leachates by up to 10x (Figure 3-21).

In Phase 1, As release can be attributed to several factors. Arsenic is often associated with Fe-oxide minerals as a co-precipitate or sorbed to Fe-oxide surfaces (Bowell, 1994), destabilization of Fe-oxide minerals by anaerobic reduction reactions can lead to the release of As along with any other species associated with Fe-oxides minerals. This mechanism of As release would be expected to result in a correlation between D-Fe and D-As in column effluent. While, reducible As associated with oxides and Fe-oxides does make up a large fraction of As in granite ore WR

and gneiss and schist transition and oxide samples, an Fe-As correlation is not evident in any of the leachates.

A process known to happen concurrently with Fe-oxide reduction is As (V) reduction to As (III). Arsenic can be mobilized by selective reduction of As(V) to more soluble As(III). This reaction occurs at similar redox potential as Fe(III) reduction to Fe(II). Reduction of As(V) can occur in the absence of Fe(III) reduction when Fe-oxide minerals are present as relatively crystalline phase (e.g., goethite and hematite) (Kocar and Fendorf, 2009). QEMSCAN results affirm that across rock types the majority of Fe-oxides is present as goethite. This process can explain how As release is decoupled from Fe release across column leachates.

Arsenic can be mobilized by cation exchange when present as a surface complexed species. The presence of PO_4 can result in the displacement of As(V) and As(III) from Fe-oxide sorption sites, with the magnitude dependent on pH and PO_4 concentrations (Jain and Loeppert, 2000). This process of competitive ion exchange can promote the release of As from mine waste and As-contaminated sediments (Fendorf et al., 2008; Peryea, 1991; Rubinos et al., 2011). In Phase 1, TD-P concentrations range from <0.002 to 0.687 mg/L and demonstrate an increasing trend in Kona, GT and GO leachates. There is no contribution of TD-P in column influent, which suggests that soluble P arises from rinsing of phosphate minerals present in the lithologies. Correlation between TD-P and As (R^2 = 0.54 to 0.82) in the aforementioned leachate samples provides support for the competitive displacement of As(V) and As(III) along with PO_4. Increasing PO_4 concentrations are likely driven by decline in Ca concentrations. Ca is a component ion of apatite [$Ca_5(PO_4)_3(Cl,F,OH)$], hence, declines in Ca concentration can lead to increased apatite dissolution.

Appendix C

Saturated Column Report

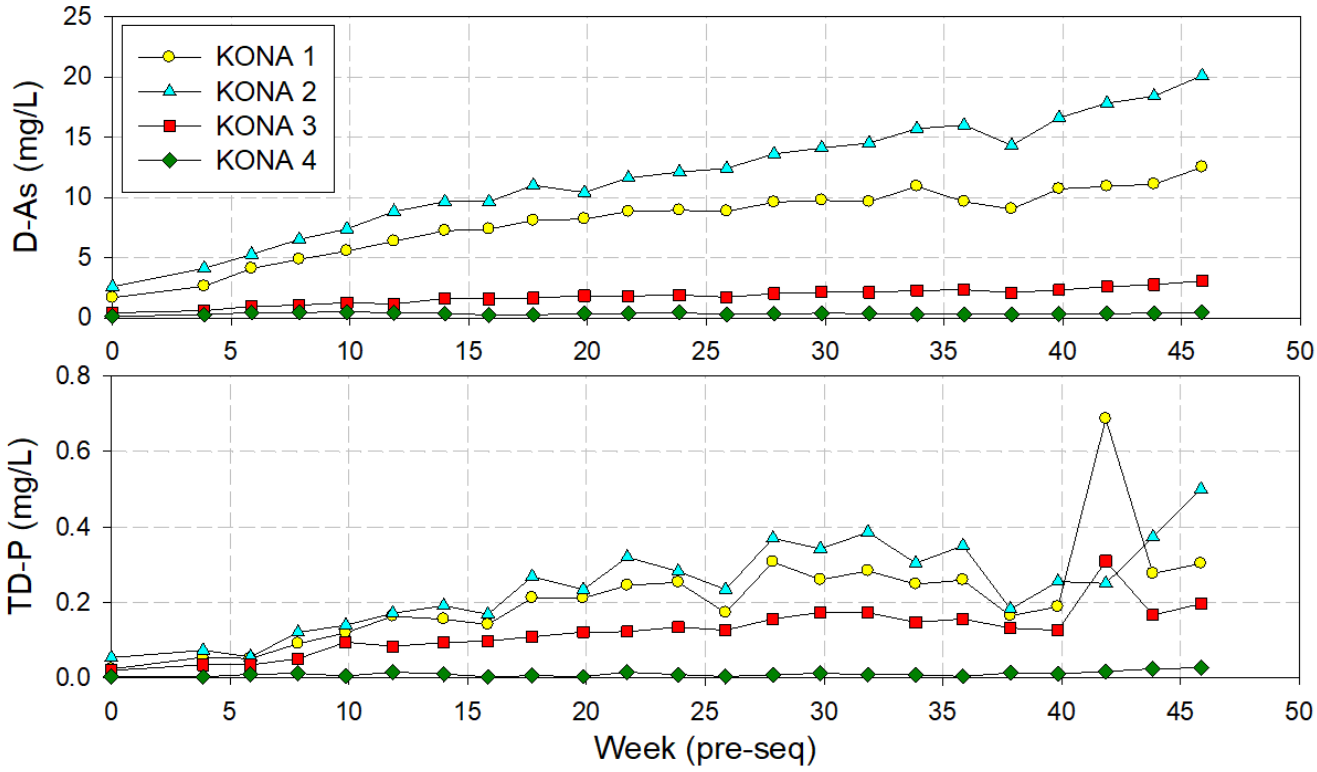


Figure 3-20: Time series profile of D-As and TD-P in granite column effluent in Phase 1.

Appendix C
Saturated Column Report

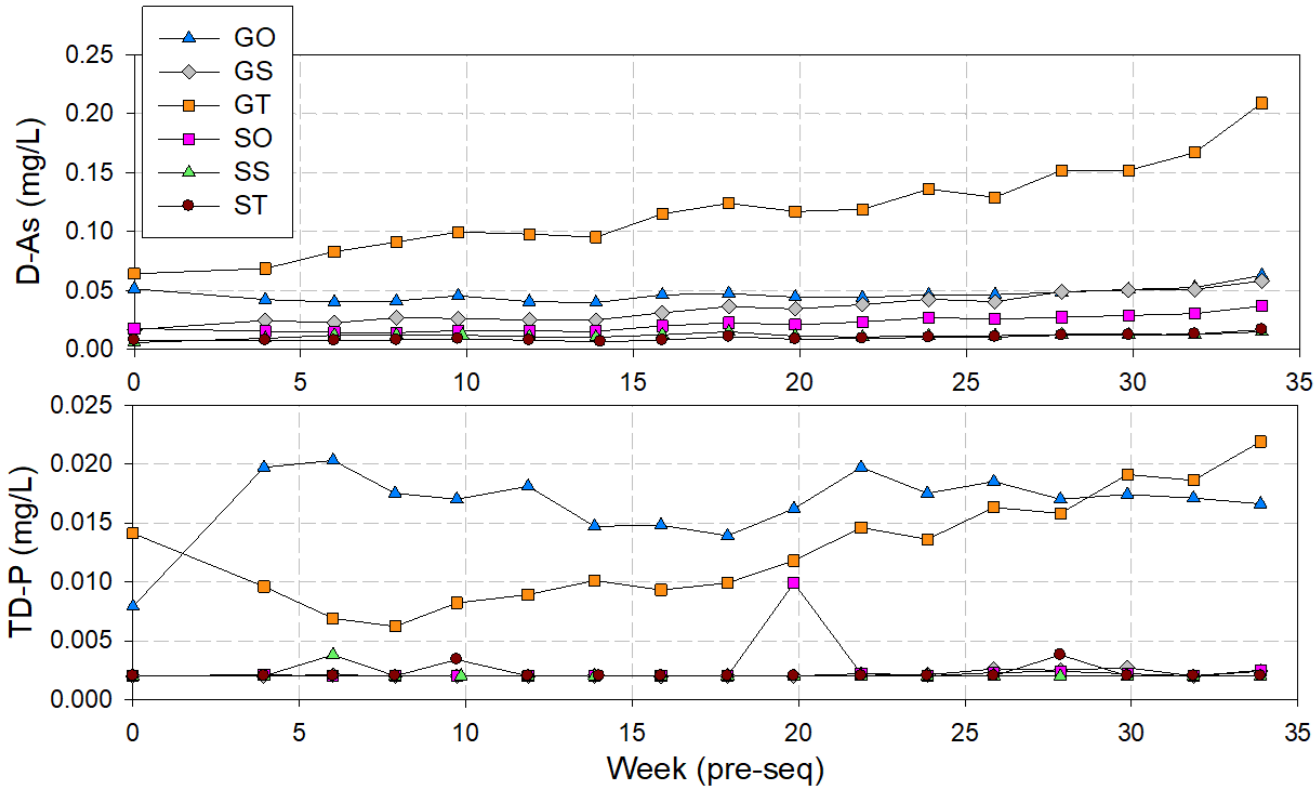


Figure 3-21: Time series profile of D-As and TD-P in gneiss and schist column effluent in Phase 1.

3.4.1.5 Comparison Unsaturated versus Saturated Conditions

The concentrations produced during unsaturated and saturated kinetic testing are compared in Table 3-6, Table 3-7 and Table 3-8. These tables show the final sample from the unsaturated tests, which most closely reflects the chemical conditions of the rock sample prior to submergence in saturated columns. Overall, the results show that saturated columns produce significantly lower concentrations of most major ions and trace metals. The most notable exception to this is As, which is leached in higher concentrations under saturated column conditions.

Appendix C
Saturated Column Report

Table 3-6: Comparison of Unsaturated Kinetic Tests with Phase 1 Granite Saturated Column Effluent Results

		Col 13, Col 14 and Col 8**	Col Kona 1		Col 13, Col 14, and Col 7**	Col Kona 2		Col 13	Col Kona 3		Col 14	Col Kona 4	
		Final Sample*	P10	P90	Final Sample*	P10	P90	Final Sample*	P10	P90	Final Sample*	P10	P90
pH	**s.u.**		6.79	7.06		6.28	6.55	7.23	6.84	7.09	8.08	7.22	7.39
Conductivity	**uS/cm**	125	85.8	121	79.1	75.5	190	80.2	88.2	176	200	115	326
Alkalinity	**mg CaCO3/L**	21.1	47.4	59.8	25.6	40.0	48.8	8.79	50.4	74.0	75.6	68.2	133
Sulphate	**mg/L**	22.0	0.794	6.76	6.91	2.29	44.8	9	1.15	17.8	13	1.80	17.0
D-Al	**mg/L**	0.0638	0.00246	0.00494	0.0452	0.00165	0.0133	0.002	0.00134	0.00256	0.003	0.00233	0.00427
D-Sb	**mg/L**	0.0058	0.0017	0.0020	0.0091	0.011	0.022	0.0059	0.0024	0.0030	0.0059	0.0011	0.0032
D-As	**mg/L**	2.06	4.25	10.9	0.242	5.52	17.6	0.109	0.972	2.53	0.0523	0.259	0.451
D-Ba	**mg/L**	0.00450	0.000711	0.00176	0.00456	0.00397	0.0148	0.00087	0.00221	0.00551	0.0165	0.0121	0.0385
D-Cd	**mg/L**	4.65E-05	0.000005	2.22E-05	1.41E-05	5.36E-06	0.0000329	*< 0.000003*	0.000005	6.68E-06	0.000015	0.00000522	0.0000184
D-Ca	**mg/L**	11.6	6.19	8.61	7.67	4.5	13.5	2.41	4.18	8.75	25.2	9.85	32.3
D-Co	**mg/L**	0.0203	0.000609	0.00258	0.000314	0.00327	0.0147	0.000838	0.000880	0.00296	0.000358	0.000442	0.00105
D-Cu	**mg/L**	0.00699	0.0001	0.000488	0.000623	0.0001	0.0005	0.00033	0.0001	0.000152	0.00042	0.0001	0.000212
D-Fe	**mg/L**	0.041	0.065	0.29	0.012	1.1	2.5	*< 0.007*	0.0031	0.077	*< 0.007*	0.0055	0.15
D-Pb	**mg/L**	0.000075	7.4E-06	2.7E-05	0.00011	5.2E-06	0.000050	0.00009	0.0000051	0.000020	0.00009	0.0000070	0.000042
D-Mg	**mg/L**	2.52	1.52	2.14	1.57	1.05	3.08	0.634	1.13	2.42	4.75	1.70	5.57
D-Mn	**mg/L**	1.29	0.329	1.16	0.256	1.28	3.10	0.441	1.28	2.16	0.593	0.938	1.73
D-Hg	**mg/L**	0.01	0.000005	6.0E-06	0.01	0.000005	0.000014	*< 0.01*	0.000005	0.000005	*< 0.01*	0.000005	0.000005
D-Mo	**mg/L**	0.00134	0.00117	0.00201	0.00160	0.000972	0.00194	0.00208	0.00239	0.00495	0.0032	0.00349	0.00611
D-Ni	**mg/L**	0.00555	0.000251	0.000498	0.000149	0.000511	0.00378	0.0003	0.000347	0.000853	*< 0.0001*	0.000197	0.000506
D-P	**mg/L**	0.011	0.061	0.30	0.013	0.082	0.37	0.015	0.037	0.17	0.006	0.0026	0.016
D-K	**mg/L**	4.42	4.09	6.93	3.82	3.33	8.60	5.09	7.27	13.1	8.77	6.31	14.4
D-Se	**mg/L**	0.00011	0.00004	0.0002	0.00004	0.000052	0.0002	0.00004	0.00004	0.00030	*< 0.00004*	0.00004	0.000042
D-Na	**mg/L**	2.40	6.81	8.01	2.70	5.75	8.14	6.72	7.45	12.7	2.6	7.91	16.8
D-Sr	**mg/L**	0.0408	0.0300	0.0423	0.0240	0.0177	0.0529	0.0115	0.0203	0.0417	0.0636	0.0282	0.0883
D-Tl	**mg/L**	0.00011	9.6E-05	0.00021	3.8E-05	0.00013	0.00051	0.000029	0.000080	0.00015	0.000056	0.000091	0.00019
D-U	**mg/L**	0.00636	0.000471	0.00123	0.00573	0.000507	0.00168	0.000422	0.000805	0.00156	0.0226	0.00306	0.0317
D-Zn	**mg/L**	0.044	0.0005	0.0032	0.0028	0.005	0.025	0.003	0.0014	0.0042	*< 0.002*	0.0012	0.0032

***Final concentration produced by unsaturated test prior to collection of residues for unsaturated columns.**

****Weighted average shown when multiple unsaturated tests used to generate sample.**

Appendix C
Saturated Column Report

Table 3-7: Comparison of Unsaturated Kinetic Tests with Phase 1 Gneiss Saturated Column Effluent Results

		FB-GO	Col GO		FB-GT	Col GT		FB-GS	Col GS	
		Final Sample*	P10	P90	Final Sample*	P10	P90	Final Sample*	P10	P90
pH	**s.u.**	8.35	8.02	8.19	7.84	7.96	8.09	7.97	7.84	8.00
Conductivity	**uS/cm**		232.1	325.2		310.8	757.4		522	1392
Alkalinity	**mg CaCO3/L**	59.4	126	160	59.1	122.6	158.8	70.4	115.4	164.4
Sulphate	**mg/L**	98.2	13.6	51.6	638	48.2	279	1010	139	689
D-Al	**mg/L**	0.028	0.0076	0.011	0.0029	0.0075	0.010	0.0016	0.0044	0.0057
D-Sb	**mg/L**	0.00292	0.00230	0.00349	0.00576	0.00344	0.00664	0.00699	0.00311	0.00532
D-As	**mg/L**	0.0425	0.0405	0.0518	0.0299	0.0773	0.158	0.00905	0.0238	0.0506
D-Ba	**mg/L**	0.0382	0.0807	0.103	0.0266	0.0327	0.0775	0.0181	0.0213	0.0299
D-Cd	**mg/L**	*< 0.00003*	7.28E-06	0.00003	*< 0.00002*	7.04E-06	0.000034	*< 0.00002*	0.000005	0.000013
D-Ca	**mg/L**	20	19	24	158	29	73	216	49	148
D-Co	**mg/L**	0.00014	3.0E-05	0.000039	0.00012	2.9E-05	0.00011	*< 0.0001*	0.000035	0.00021
D-Cu	**mg/L**	0.0025	0.00033	0.00077	0.0016	0.00022	0.00075	0.00078	0.00012	0.00066
D-Fe	**mg/L**	0.027	0.001	0.0015	*< 0.01*	0.001	0.0015	*< 0.01*	0.001	0.0053
D-Pb	**mg/L**	*< 0.00005*	0.000005	0.00001	*< 0.00005*	0.000005	0.00001	*< 0.00005*	0.000005	0.00001
D-Mg	**mg/L**	6.8	5.8	8.0	75	11	32	123	24	79
D-Mn	**mg/L**	0.0012	0.00080	0.0045	0.0041	0.025	0.11	0.0016	0.050	0.17
D-Hg	**mg/L**	0.000005	0.000005	0.000005	*< 0.000005*	0.000005	0.000006	*< 0.000005*	0.000005	0.000005
D-Mo	**mg/L**	0.0689	0.0340	0.0433	0.0439	0.0462	0.0546	0.0345	0.0178	0.0231
D-Ni	**mg/L**	*< 0.0005*	0.00019	0.00038	0.00066	0.00016	0.00054	0.0016	0.00024	0.0016
D-P	**mg/L**	*< 0.05*	0.014	0.020	*< 0.05*	0.0077	0.019	*< 0.05*	0.002	0.0025
D-K	**mg/L**	6.73	8.07	10.8	18.4	11.2	21.2	19.6	12.2	22.6
D-Se	**mg/L**	0.000066	0.00004	0.00022	0.00023	0.000068	0.00046	0.00052	0.00016	0.00097
D-Na	**mg/L**	33.8	16.1	29.7	30.5	9.87	25.4	26.6	16.0	38.1
D-Sr	**mg/L**	0.109	0.111	0.149	0.784	0.170	0.384	1.4	0.349	0.964
D-Tl	**mg/L**	0.000016	7.8E-05	0.00010	0.00015	0.00040	0.00050	0.000051	0.000072	0.00014
D-U	**mg/L**	0.0498	0.0439	0.0611	0.585	0.0946	0.289	0.424	0.0822	0.240
D-Zn	**mg/L**	0.0011	0.0005	0.001	0.060	0.0005	0.001	0.015	0.0005	0.001

***Final concentration produced by unsaturated test prior to collection of residues for unsaturated columns.**

Table 3-8: Comparison of Unsaturated Kinetic Tests with Phase 1 Schist Saturated Column Effluent Results

		FB-SO	Col SO		FB-ST	Col ST		FB-SS	Col SS	
		Final Sample*	P10	P90	Final Sample*	P10	P90	Final Sample*	P10	P90
pH	**s.u.**	8.28	8.02	8.17	7.94	7.99	8.13	7.89	7.86	7.99
Conductivity	**uS/cm**		245.6	316.2		357.8	509.2		523.2	1156
Alkalinity	**mg CaCO3/L**	59.8	113	145	53.6	110	151	93.7	187	250
Sulphate	**mg/L**	87.4	25.1	56.5	478	67.3	159	658	74.8	477
D-Al	**mg/L**	0.0063	0.0039	0.0057	0.0031	0.0075	0.012	0.0018	0.0029	0.0051
D-Sb	**mg/L**	0.0047	0.0043	0.0068	0.0012	0.00077	0.0016	0.013	0.0031	0.0076
D-As	**mg/L**	0.0124	0.0150	0.0294	0.00268	0.00765	0.0125	0.00398	0.01	0.0136
D-Ba	**mg/L**	0.0482	0.0575	0.0888	0.0407	0.0463	0.0737	0.0245	0.0306	0.0735

D-Cd	**mg/L**	*< 0.000005*	0.000005	0.000005	0.000013	0.000005	0.000012	0.0000067	0.000005	0.0000090
D-Ca	**mg/L**	23.2	21.4	25.7	107	31.6	40.5	129	45.6	89.9
D-Co	**mg/L**	*< 0.0001*	2.03E-05	3.68E-05	*< 0.0001*	2.09E-05	0.0000347	0.0003	0.0000385	0.000182
D-Cu	**mg/L**	0.00071	0.00011	0.00032	0.00077	0.00015	0.00040	0.0007	0.00014	0.00043
D-Fe	**mg/L**	0.011	0.001	0.0014	*< 0.01*	0.001	0.0017	*< 0.01*	0.001	0.002
D-Pb	**mg/L**	*< 0.00005*	0.000005	1.3E-05	0.000054	0.000005	0.000013	*< 0.00005*	0.000005	0.000017
D-Mg	**mg/L**	9.69	7.71	10.1	56.9	13.4	20.4	114	29.4	78.9
D-Mn	**mg/L**	0.0036	0.00069	0.021	0.0023	0.00079	0.017	0.014	0.020	0.058
D-Hg	**mg/L**	*< 0.000005*	0.000005	5.3E-06	*< 0.000005*	0.000005	0.000005	*< 0.000005*	0.000005	0.000005
D-Mo	**mg/L**	0.007	0.0054	0.0066	0.024	0.017	0.022	0.0088	0.0047	0.0080
D-Ni	**mg/L**	*< 0.0005*	0.00017	0.00033	0.00066	0.00028	0.00049	0.0077	0.0032	0.0063
D-P	**mg/L**	*< 0.05*	0.002	0.0024	*< 0.05*	0.002	0.0026	*< 0.05*	0.002	0.002
D-K	**mg/L**	4.78	6.03	8.166	18.3	13.56	17.82	29.5	19.24	33.56
D-Se	**mg/L**	0.000101	7.22E-05	0.000434	0.000556	0.000293	0.00239	0.000279	9.54E-05	0.000678
D-Na	**mg/L**	21.8	13.3	23.4	26.6	14.0	23.7	25.3	11.6	32.2
D-Sr	**mg/L**	0.15	0.15	0.19	8.9	3.3	4.3	9.8	3.5	6.7
D-Tl	**mg/L**	0.000058	0.00022	0.00026	*< 0.00001*	1.8E-05	0.000023	0.000046	0.000043	0.000089
D-U	**mg/L**	0.00295	0.00287	0.00384	0.0402	0.0176	0.0269	0.141	0.00876	0.0664
D-Zn	**mg/L**	0.0045	0.0005	0.001	0.059	0.0005	0.001	0.029	0.00069	0.0018

***Final concentration produced by unsaturated test prior to collection of residues for unsaturated columns**

3.4.2 **Phase 2 & 3**

Phase 2 (column sequencing) was initiated and operated from Week 0 to 26 (post-seq.) to evaluate leachate chemistry produced from various combinations of lithologies. Phase 3 ($CaSO_4$ amendment) was initiated and operated from Week 28 to 46 (post-seq.) to assess changes in leachate chemistry following exposure to infiltration water. In the section to follow, discussions of effluent results from granite, gneiss, and schist columns are limited to Weeks 0 to 46 (post-seq.). To facilitate discussion of results, Kona columns 1 through 4 and GT are referred to as primary columns while their corresponding column pairs (GS, ST, SS, SO, and GO, respectively) are referenced as secondary columns.

3.4.2.1 pH and Major Ions

Initiation of Phase 2 had no significant effect on pH, conductivity, and alkalinity compared to Phase 1. Conductivity increases significantly in all columns Phase 3, consistent with higher total dissolved solids associated with $CaSO_4$ addition. Divergent results were observed for pH in Phase 3. Granite column pH declined by 0.8 to 1.3 pH units, while pH schist and gneiss columns remained stable.

Major ions concentrations remained relatively unaffected by Phase 2 column sequencing. Initiation of Phase 3 triggered an increase in release of K, Mg, and Na, although negligible in the

GO column (Figure 3-25 through Figure 3-27). Mobilization of K, Mg, and Na may be associated with cation exchange reactions driven by increased Ca supply.

Appendix C

Saturated Column Report

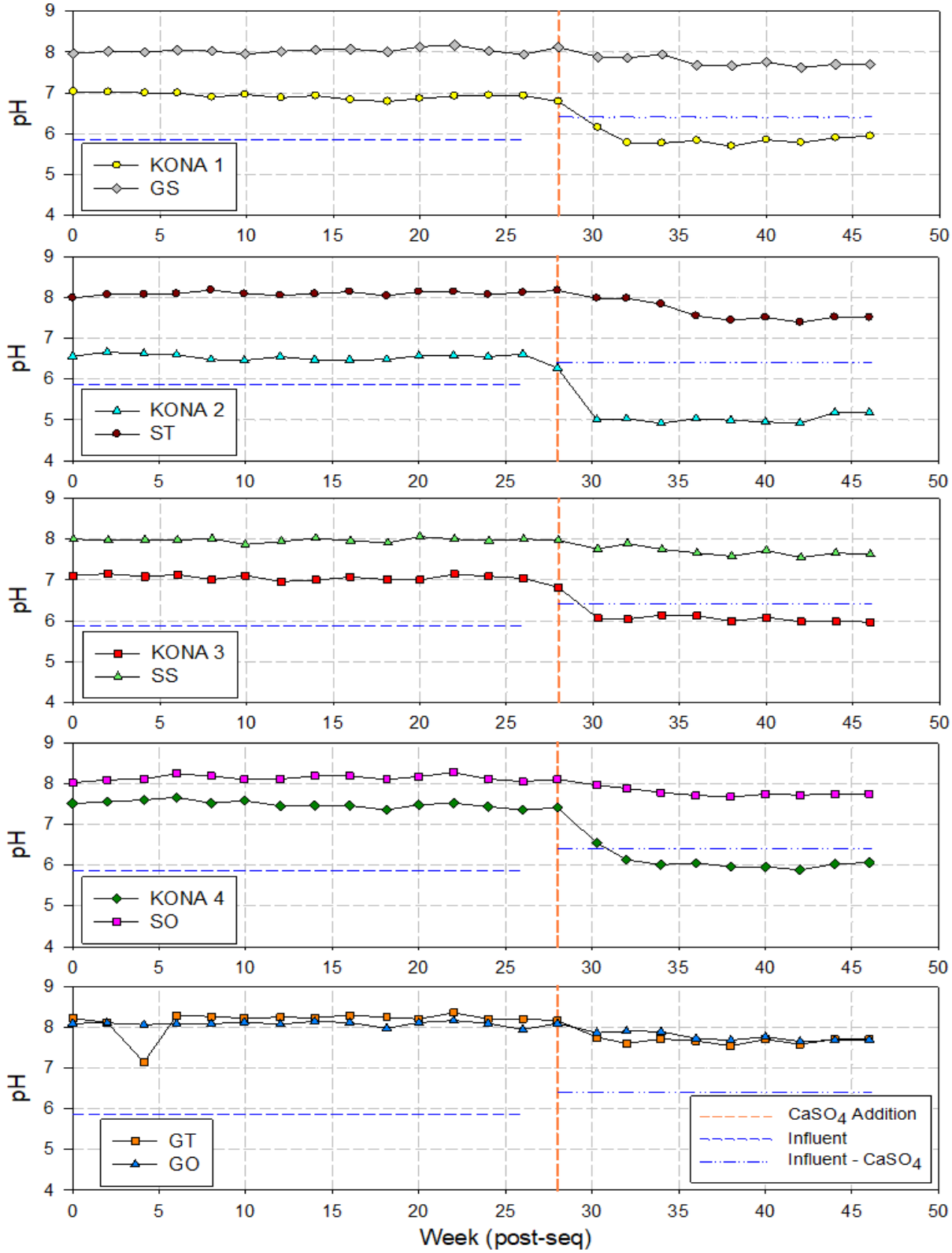


Figure 3-22: Times series profiles of pH in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

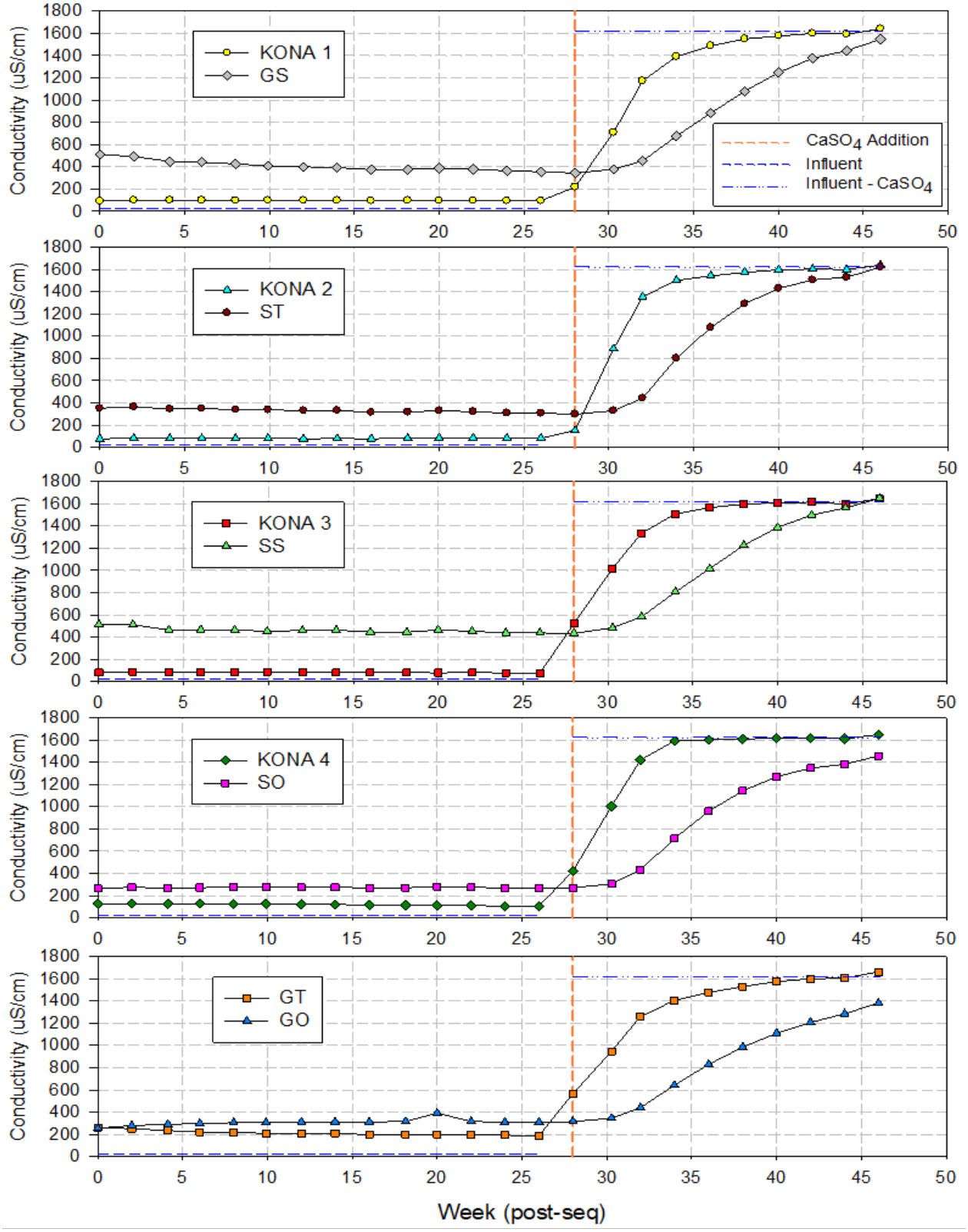


Figure 3-23: Times series profiles of conductivity in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

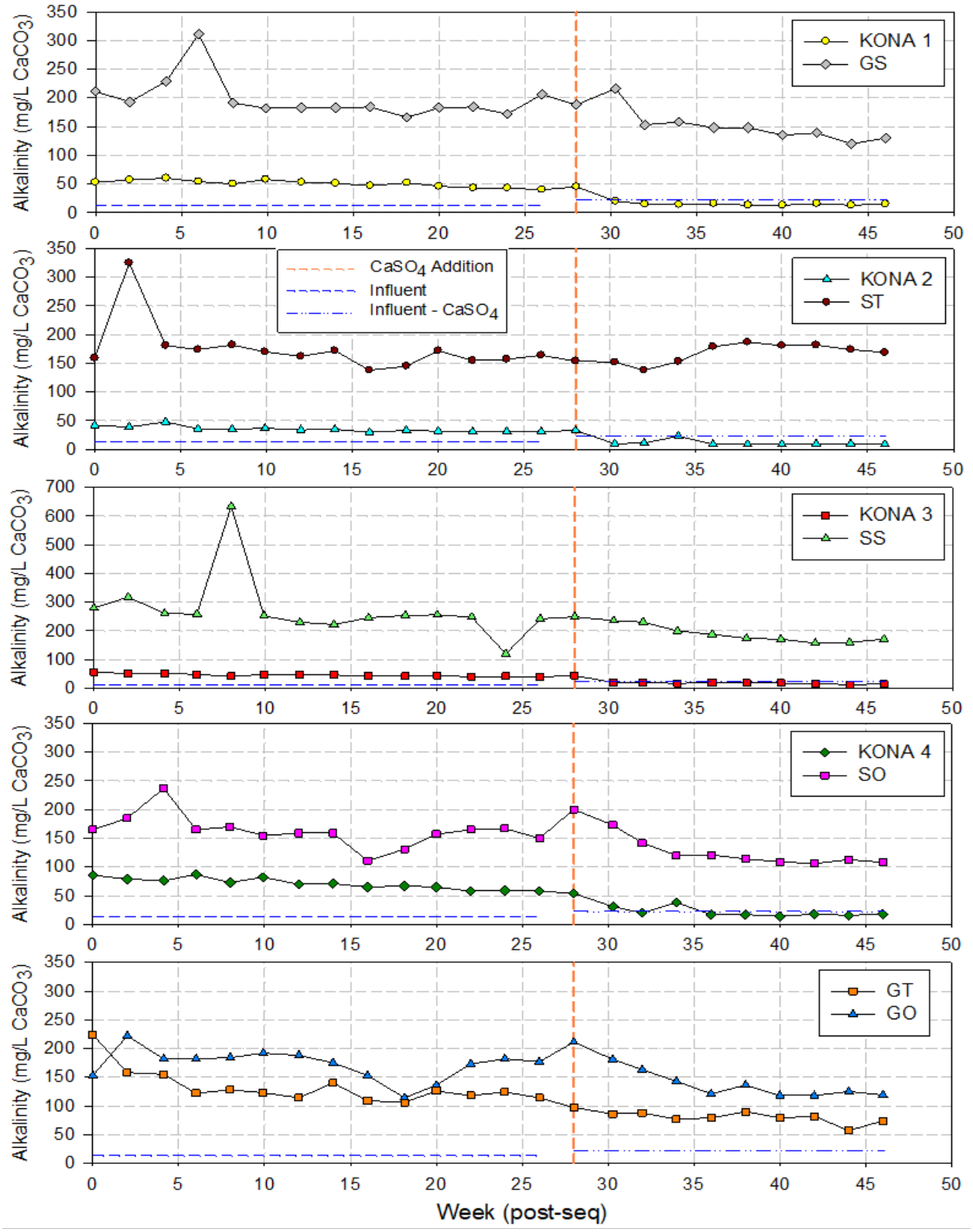


Figure 3-24: Times series profiles of alkalinity in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

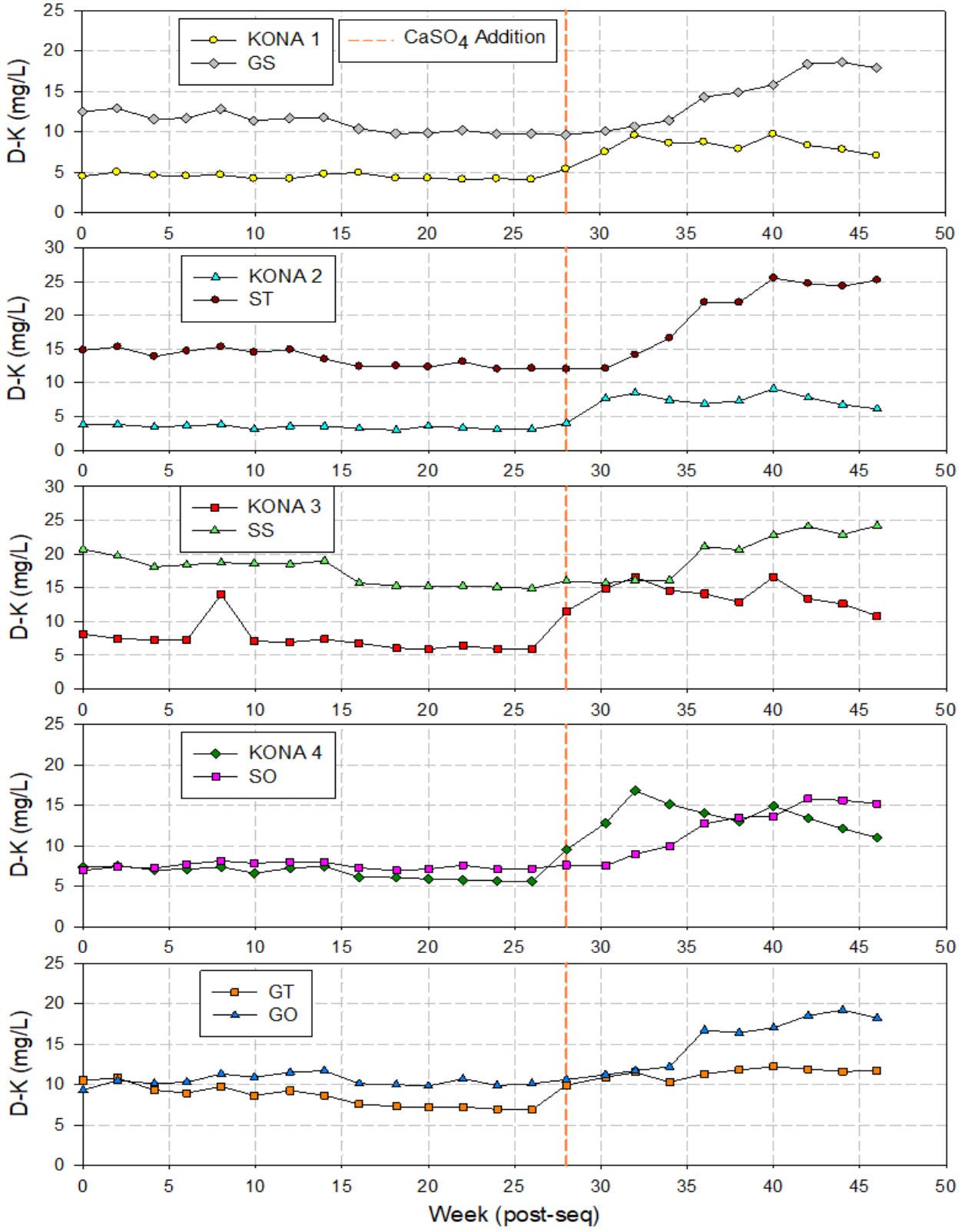


Figure 3-25: Times series profiles of D-K in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

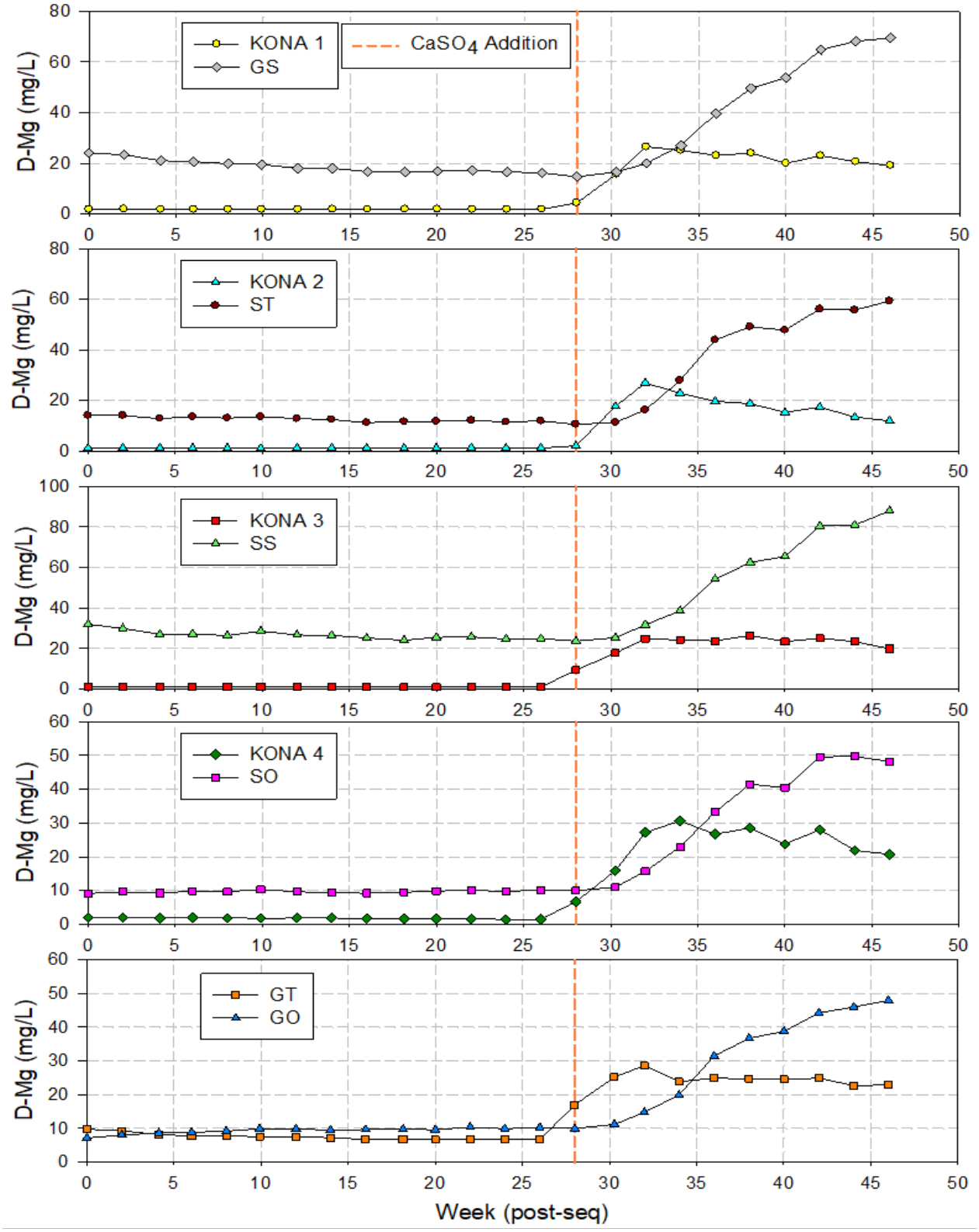


Figure 3-26: Times series profiles of D-Mg in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

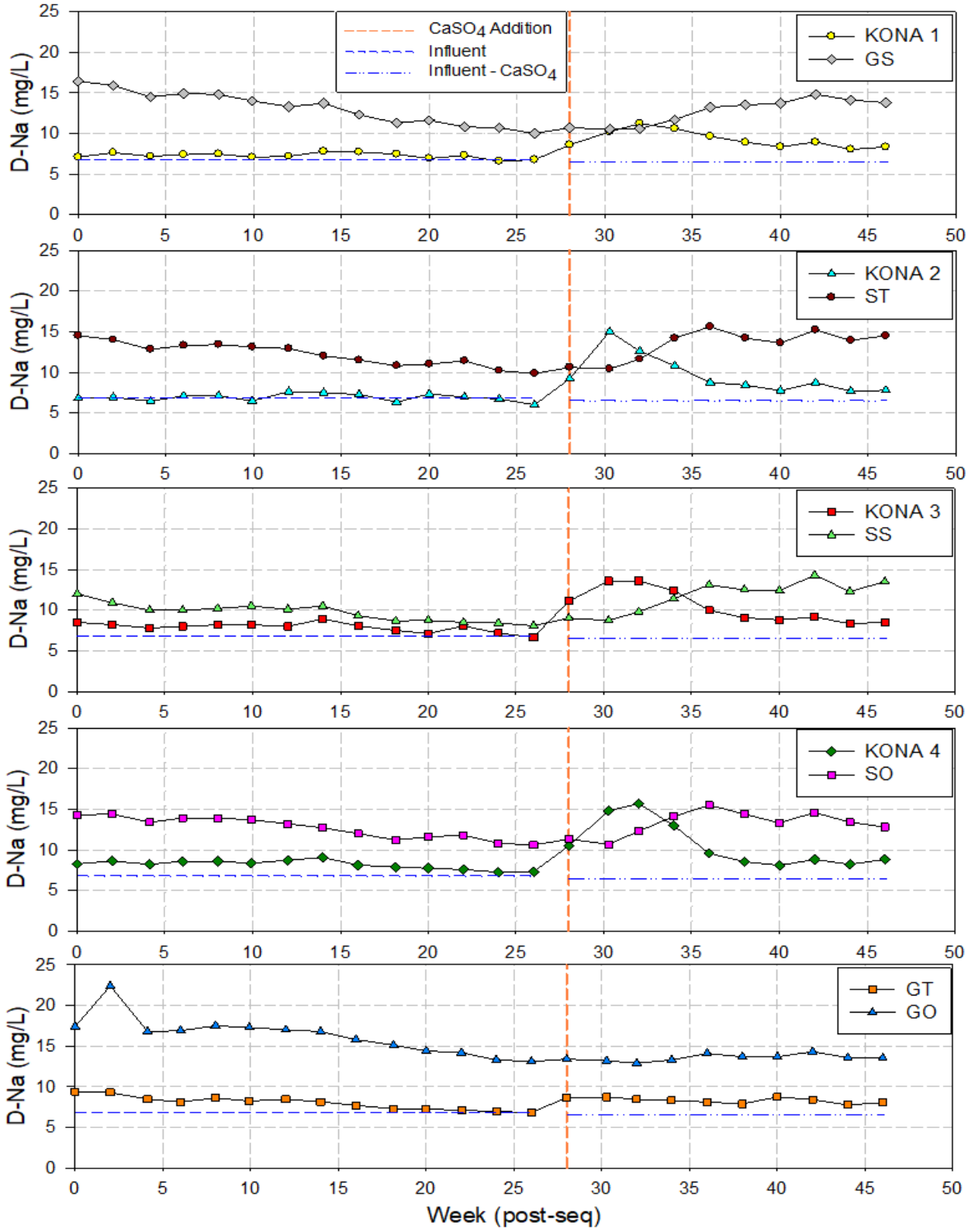


Figure 3-27: Times series profiles of D-Na in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

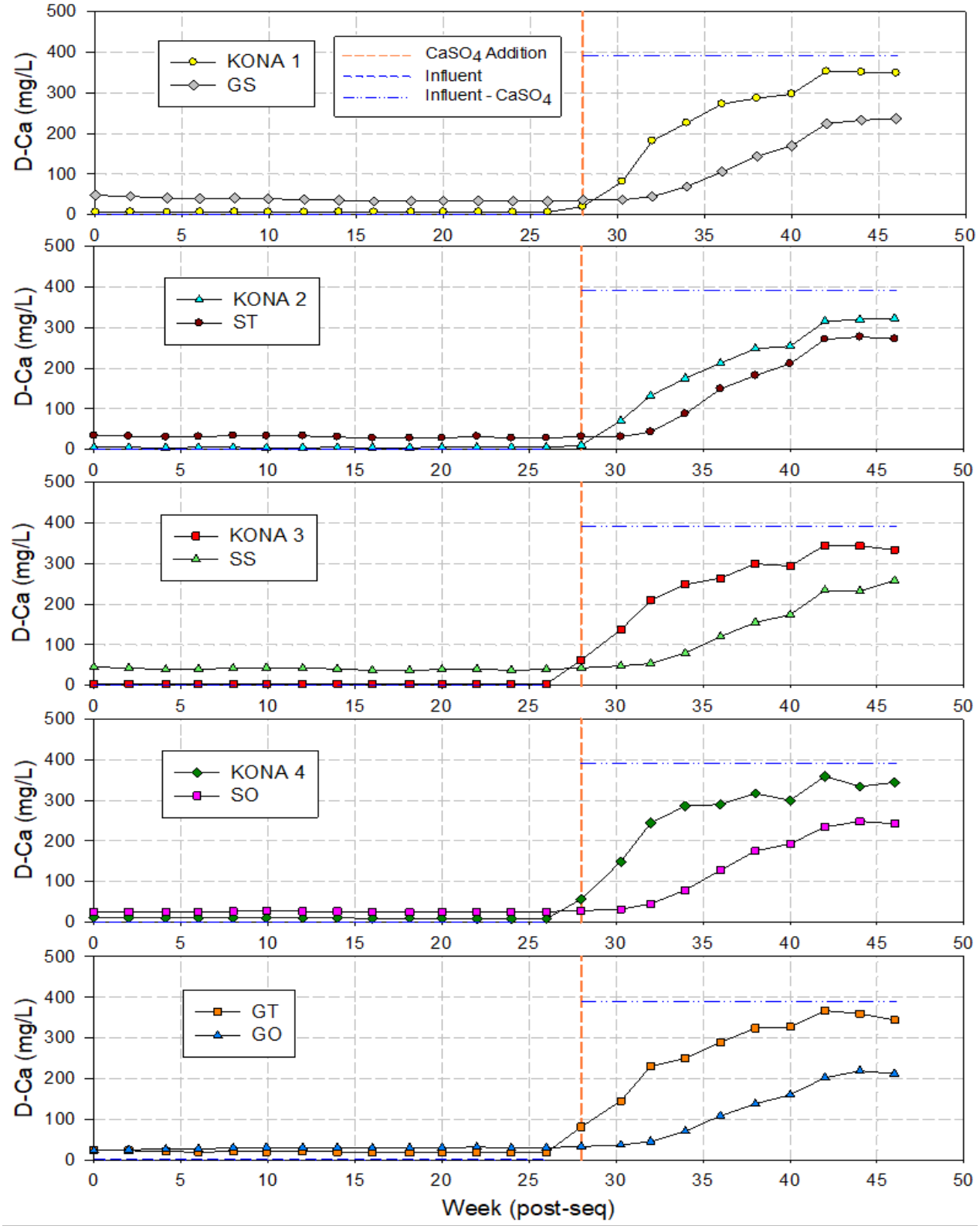


Figure 3-28: Times series profiles of D-Ca in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

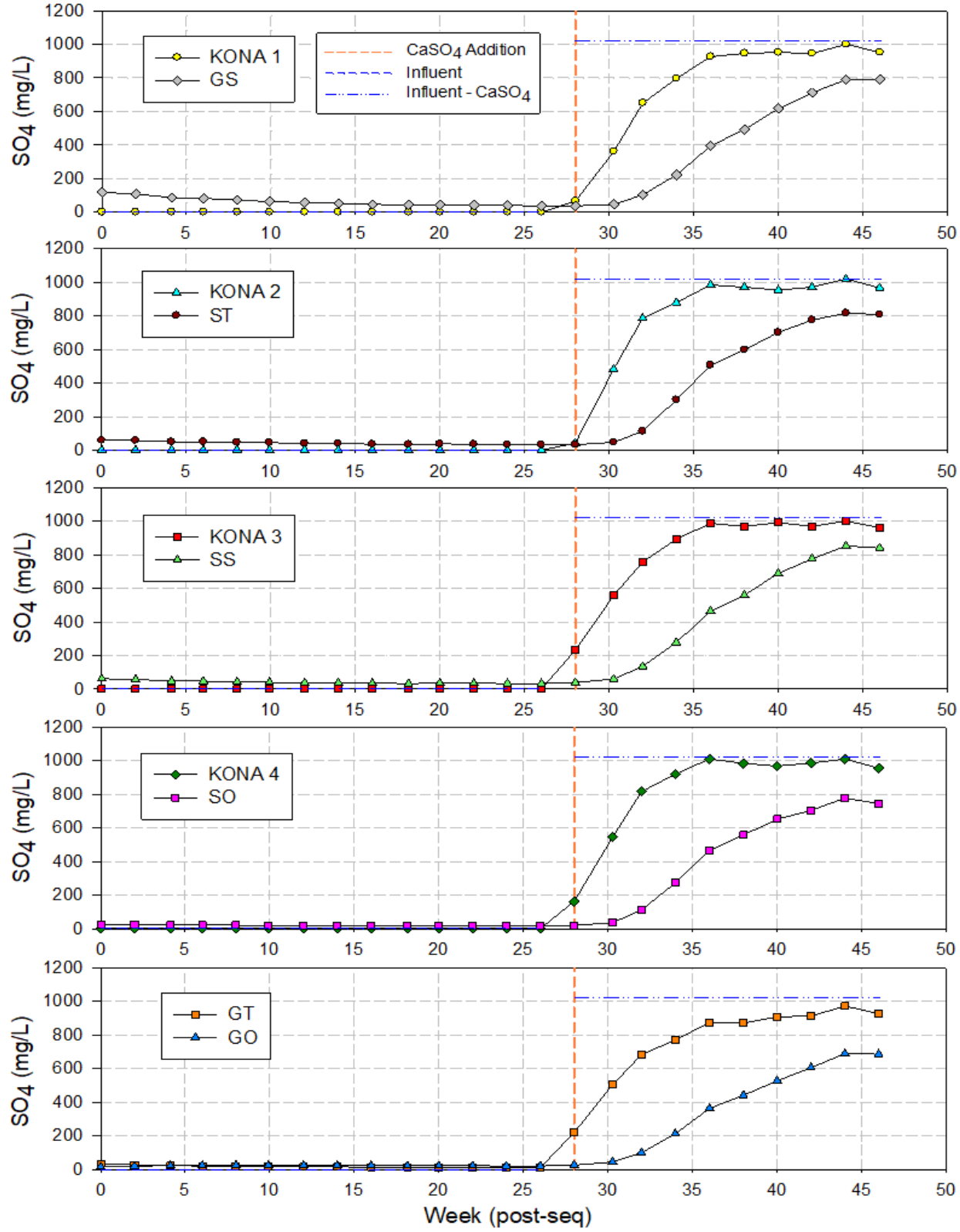


Figure 3-29: Times series profiles of SO_4 in column effluent of sequenced pairs in Phase 2 and 3.

3.4.2.2 Redox Indicators

The primary columns consumed DOC provided in influent to concentrations near or below 1 mg/L. (Figure 3-30). The DOC concentration in secondary column effluent is similar to primary column effluent, indicating the little or no DOC consumption is occurring in secondary columns.

Consistent with Phase 1, NH_3 remains the dominant nitrogen species in column leachates. In most columns, NH_3 concentrations decline in the secondary columns relative to primary column effluent (Figure 3-31). This indicates that some NH_3 may be attenuated in secondary columns. The observed decline is not accompanied by any increase in other nitrogen species (NO_2 or NO_3), indicating that this parameter is likely being attenuated by surface sorption.

Initiation of Phase 3 correlates to an increase in Mn and Fe concentrations in primary columns. This may be related to increased flow rate resulting in higher loading of DOC to primary columns, which could stimulate microbial activity. Release these metals may also be attributed to cation exchange reactions, with Ca^{2+} provided in Phase 3 influent displacing Mn^{2+} and Fe^{2+} from mineral surfaces.

Manganese and Fe attenuation in secondary leachates can be observed in all column pairings (Figure 3-32). In SO and GO leachates, Mn concentrations near the end of Phase 2 approach detection limit values (< 0.00005 mg/L). Similarly, Fe attenuation to near MDL occurs in all secondary leachates. Initiation of Phase 3 results in increased Fe and Mn concentrations in secondary columns; however, the concentrations remain lower than primary column effluent. Speciation in PHREEQC indicates that this attenuation cannot be attributed to secondary mineral solubility constraints. This suggest that Mn and Fe may be attenuated via surface complexation.

Dissolved sulphide concentrations remain below detection limit in Phase 2 and 3 of the column experiments. However, the appearance of a black precipitate on granite and gneiss columns (Figure 3-1, Figure 3-2 and Figure 3-3), indicates that sulphate reducing conditions may have been achieved in these columns.

Appendix C

Saturated Column Report

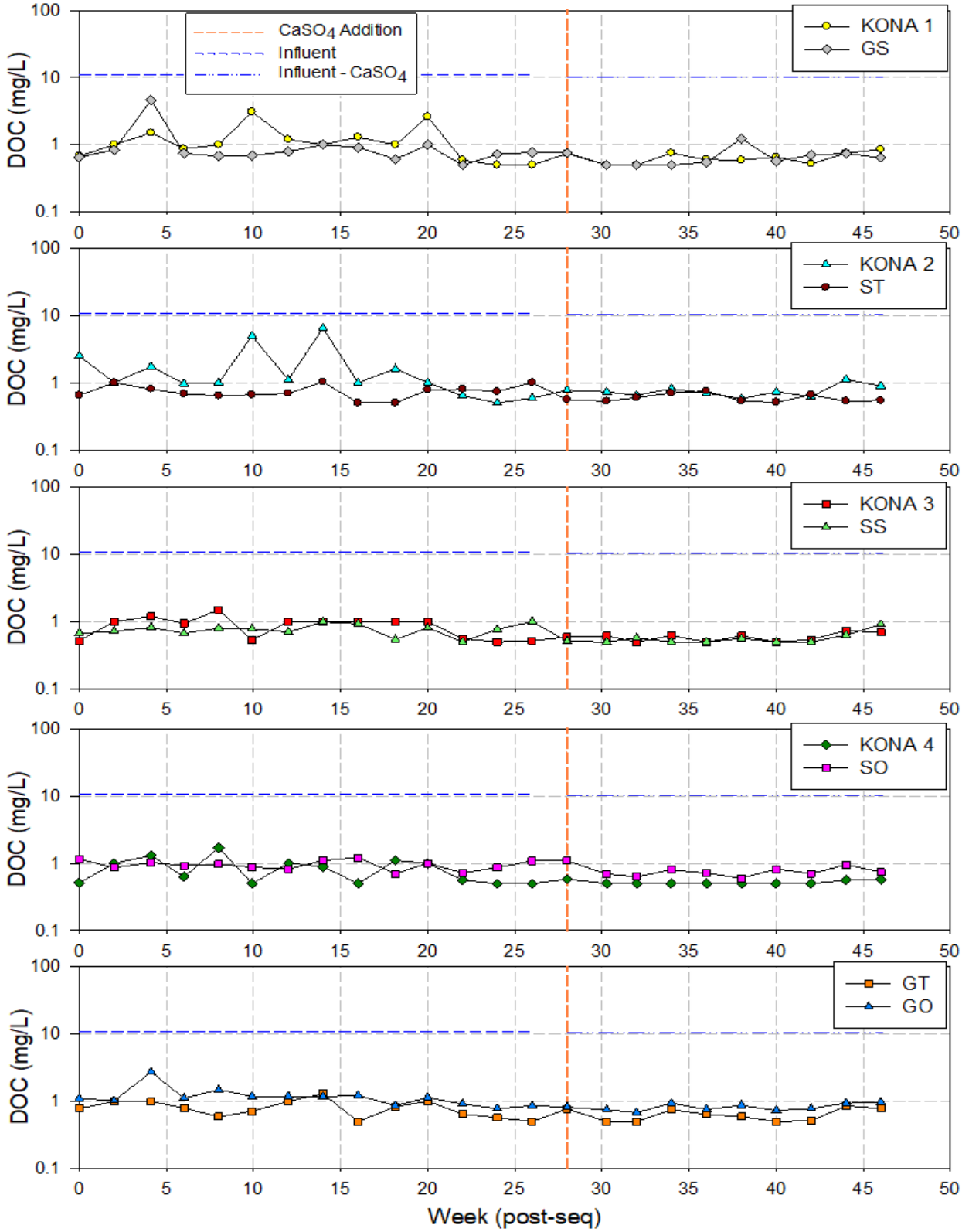


Figure 3-30: Times series profiles of DOC in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

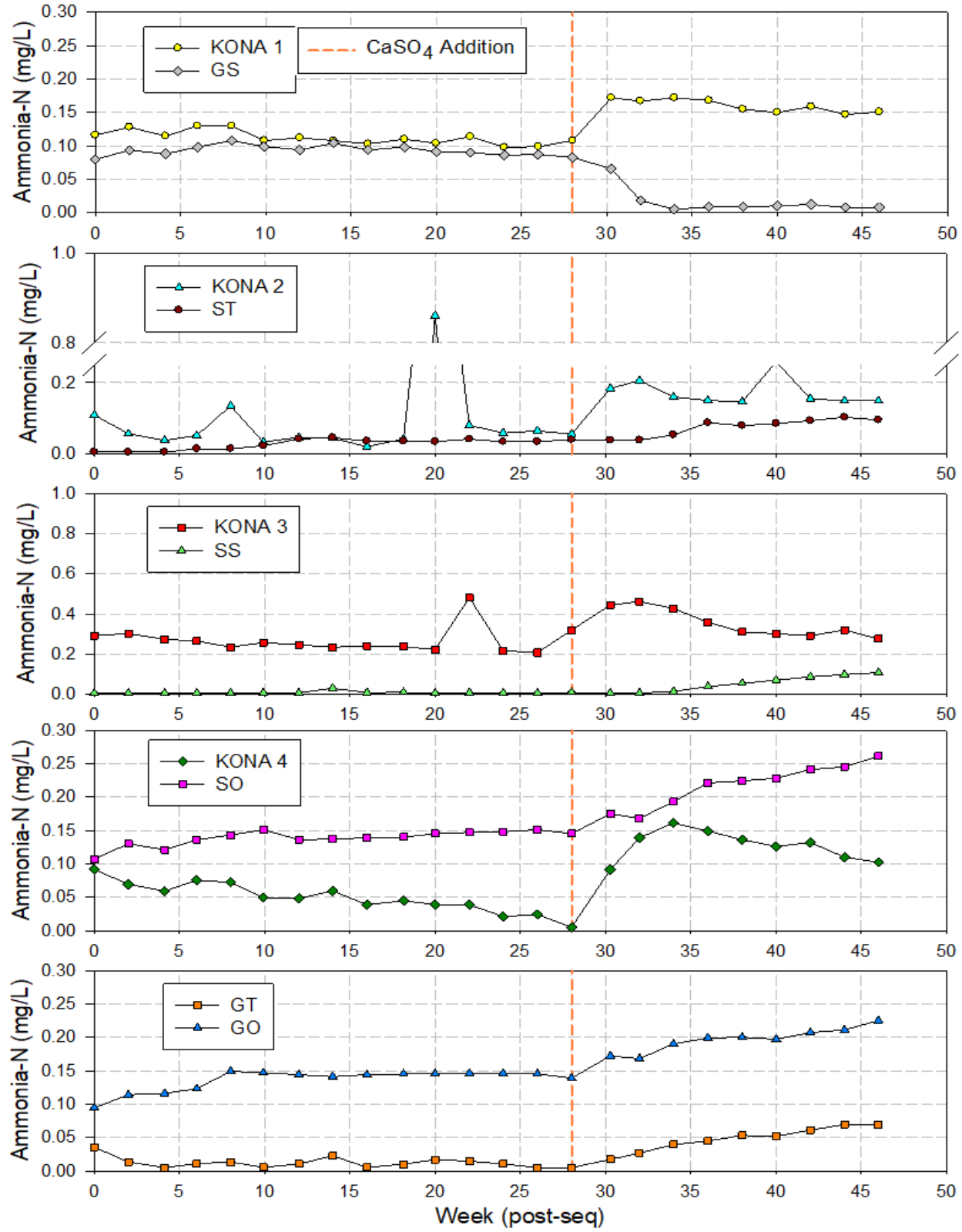


Figure 3-31: Times series profiles of Ammonia-N in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

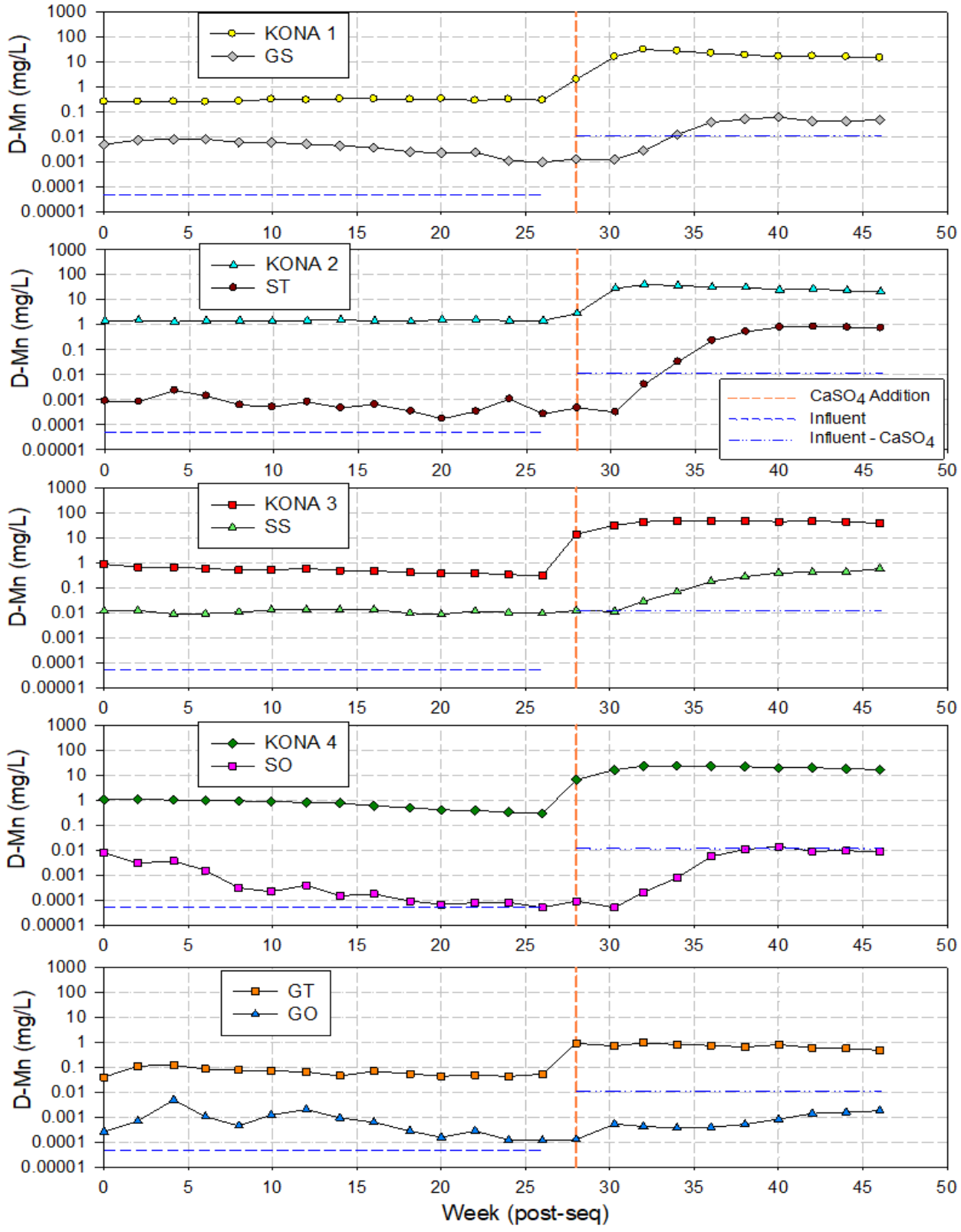


Figure 3-32: Times series profiles of D-Mn in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

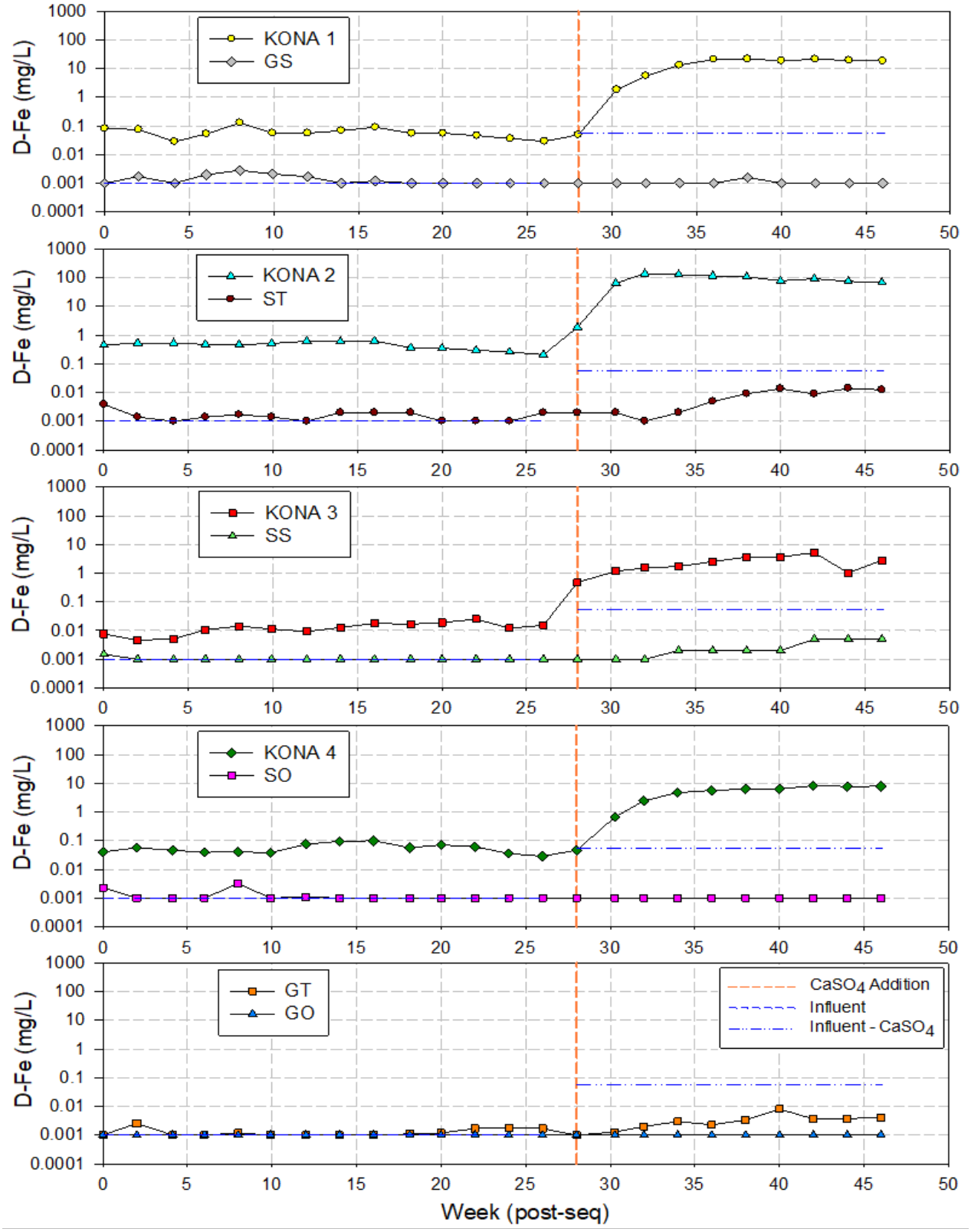


Figure 3-33: Times series profiles of D-Fe in column effluent of sequenced pairs in Phase 2 and 3.

3.4.2.3 Trace Elements

Primary column trace metal trends observed in Phase 2 could generally be characterized as a continuation of what was observed in Phase 1. The secondary columns produced more varied results (Figure 3-34 through Figure 3-41). Arsenic concentrations showed pronounced attenuation in all secondary columns (Figure 3-34). Antimony was attenuated in the ST column and showed evidence of minor attenuation in the SS and GO columns (Figure 3-35). Both U and Mo concentrations in secondary columns were unaffected by sequencing, producing similar concentrations as observed in Phase 1.

Phase 3 prompted a significant change in trace metal concentrations in both secondary and primary columns. Arsenic concentrations declined in all columns in Phase 3, with the exception of Kona 2 and Kona 1. Antimony concentrations decreased in all columns through Phase 3; however, Sb attenuation was no longer observed in the SS and GO columns. All columns showed a decline in Mo concentrations; however, secondary columns showed an increase in remobilisation of U in Phase 3, suggesting that $CaSO_4$ addition to column influent promotes U release.

The release of some metals was enhanced in Phase 3 of the experiment. Specifically, Cd and Zn mobilization occurred in Kona columns, while Co and Ni release was observed in Kona columns and GT. These metals continued to be attenuated in secondary columns throughout Phase 3 of the experiment.

Appendix C

Saturated Column Report

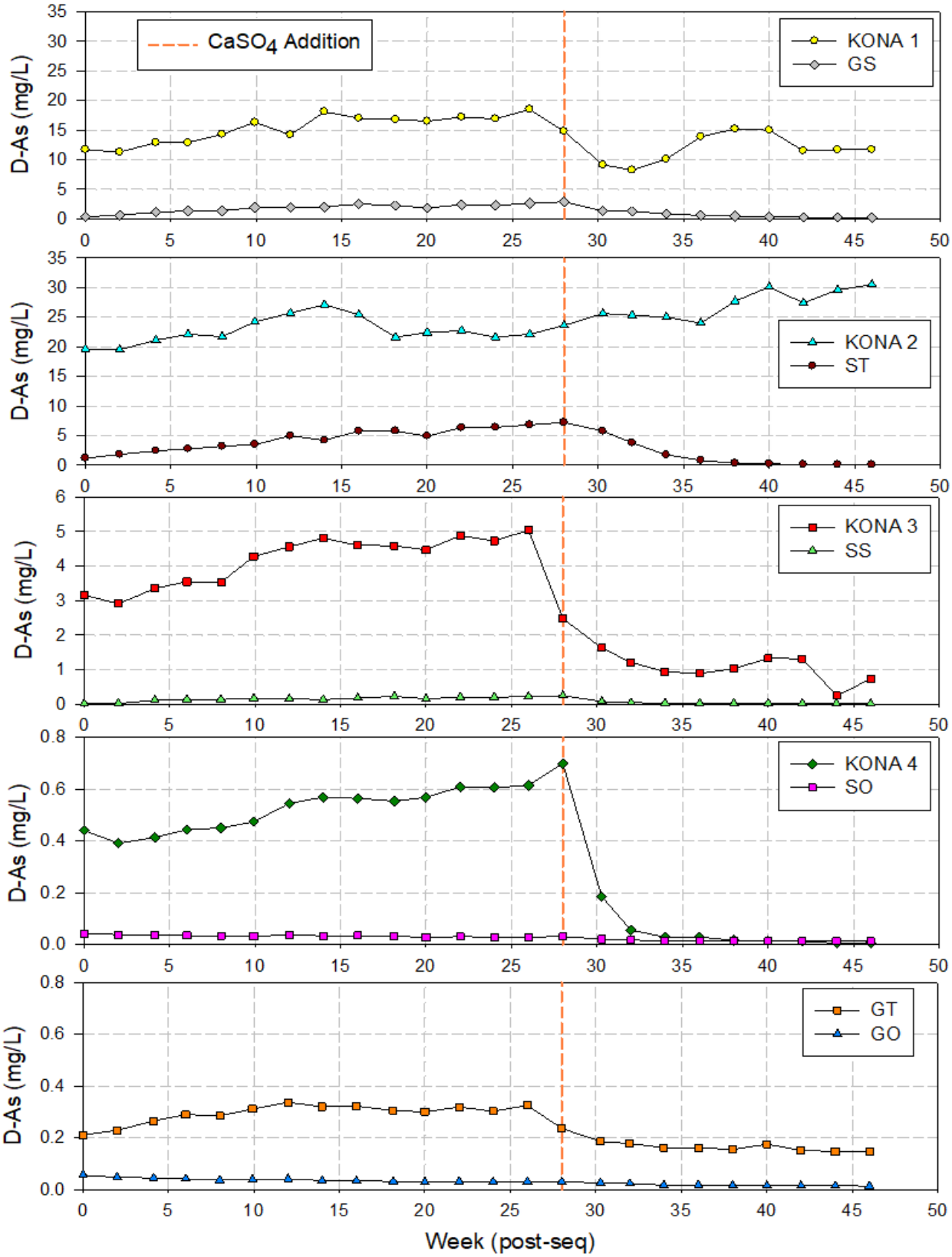


Figure 3-34: Times series profiles of D-As in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

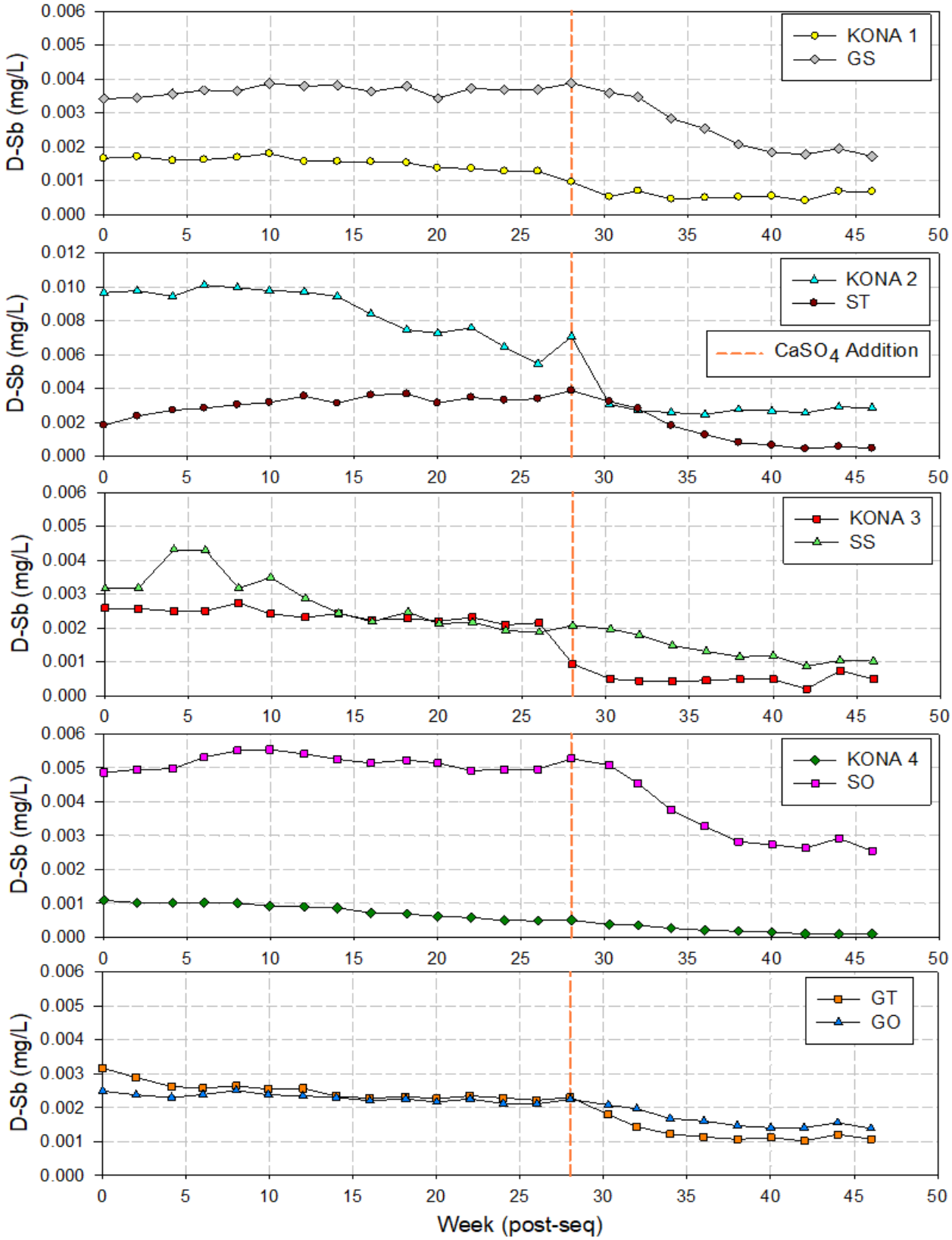


Figure 3-35**: Times series profiles of D-Sb in column effluent of sequenced pairs in Phase 2 and 3.**

Appendix C

Saturated Column Report

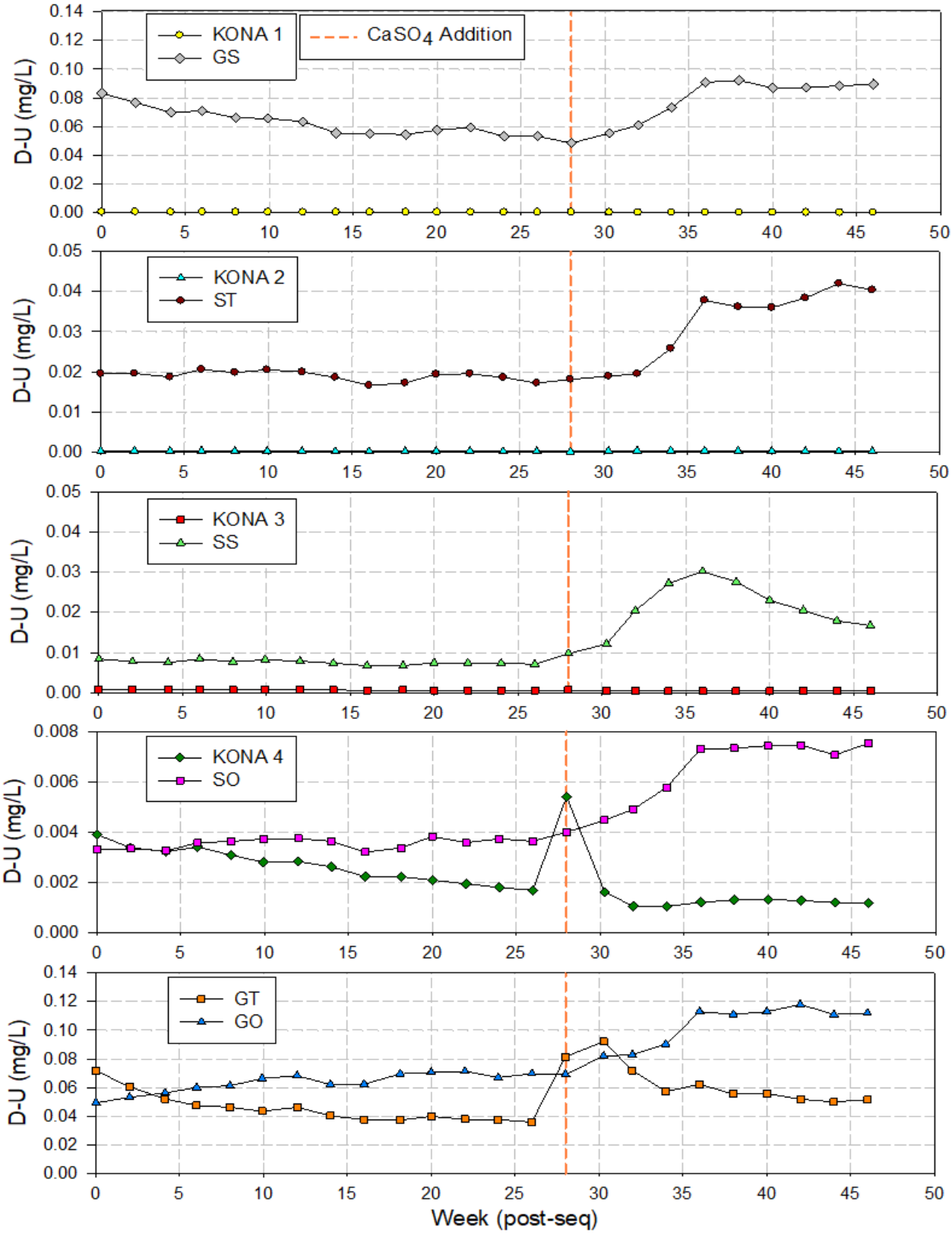


Figure 3-36: Times series profiles of D-U in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

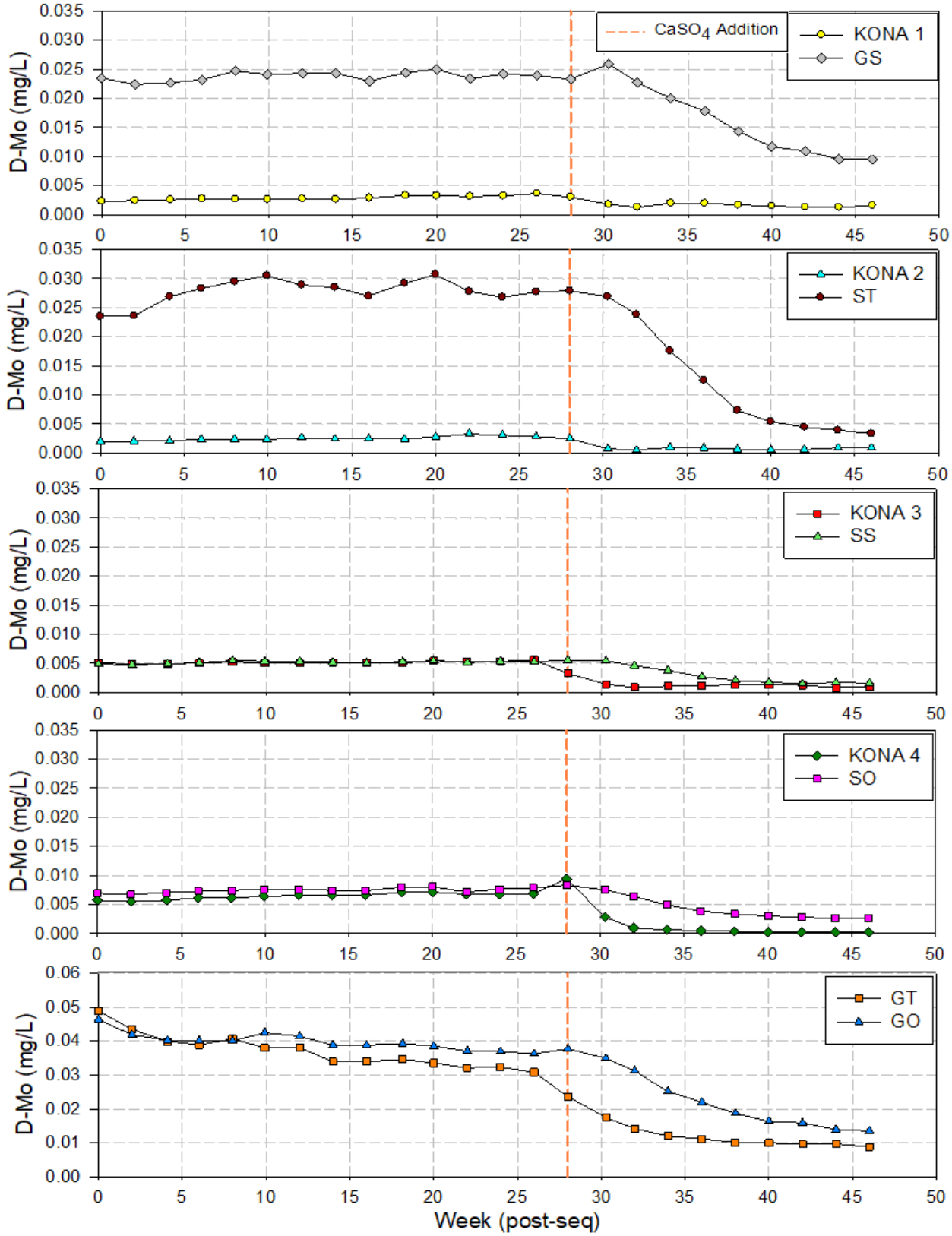


Figure 3-37: Times series profiles of D-Mo in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

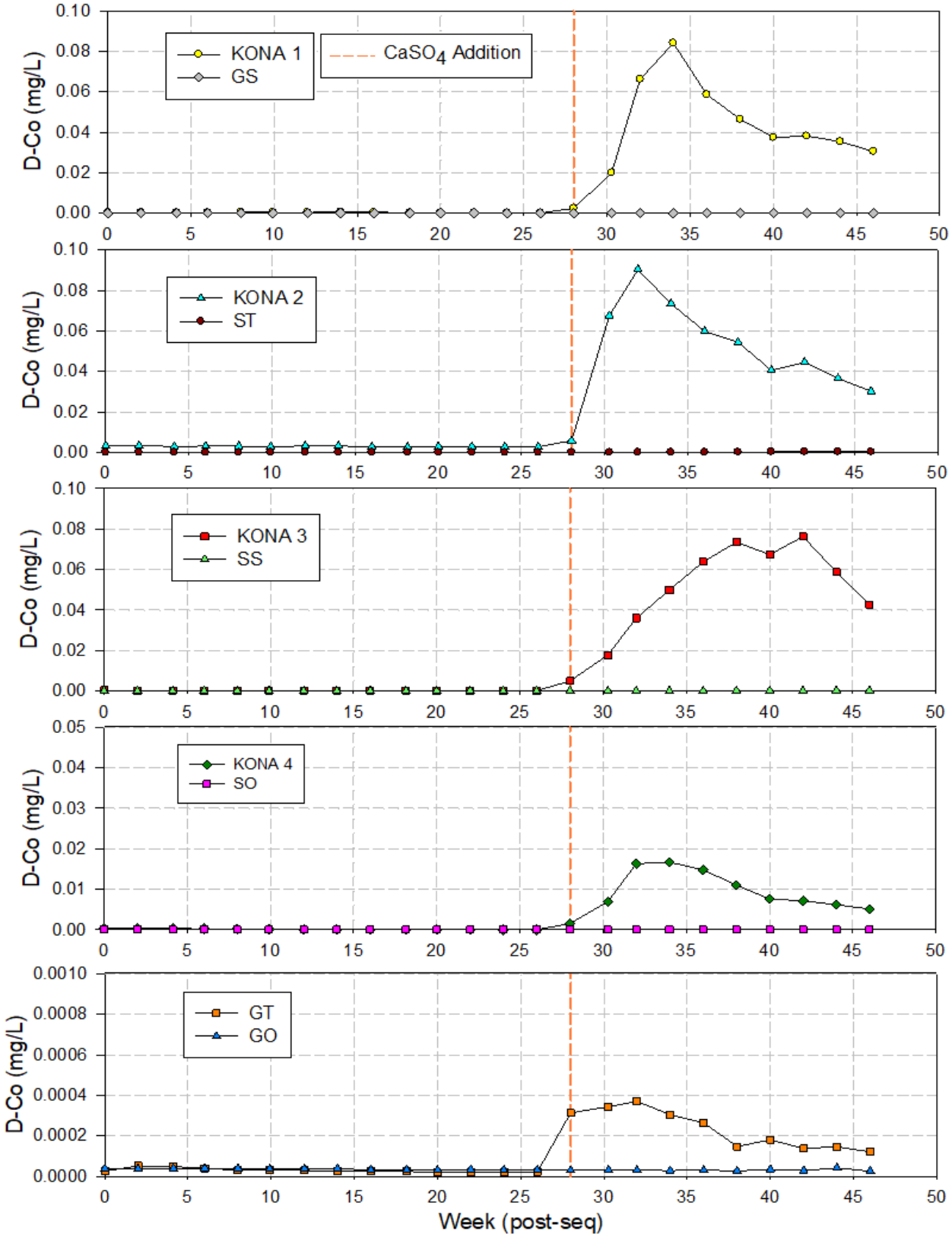


Figure 3-38: Times series profiles of D-Co in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

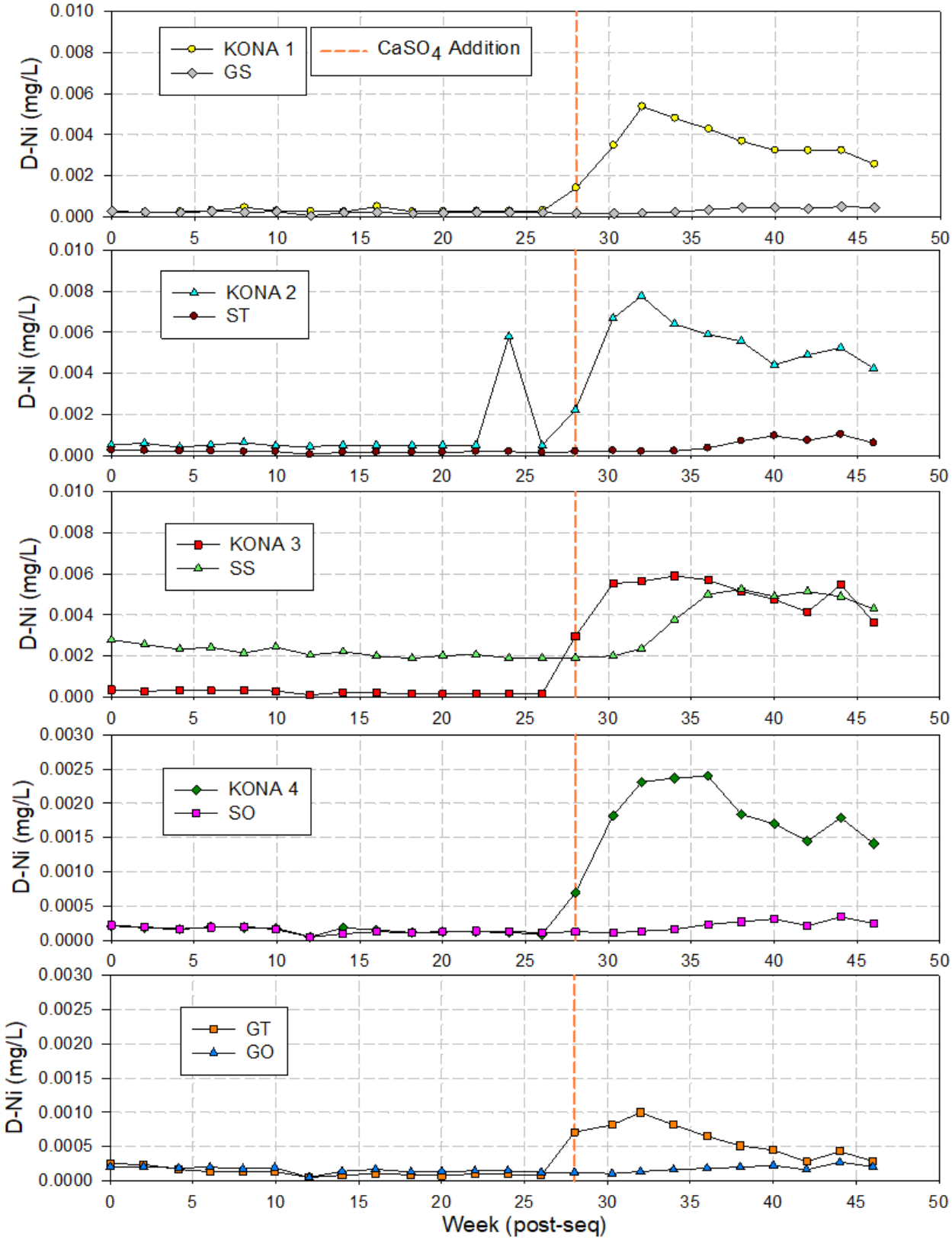


Figure 3-39: Times series profiles of D-Ni in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

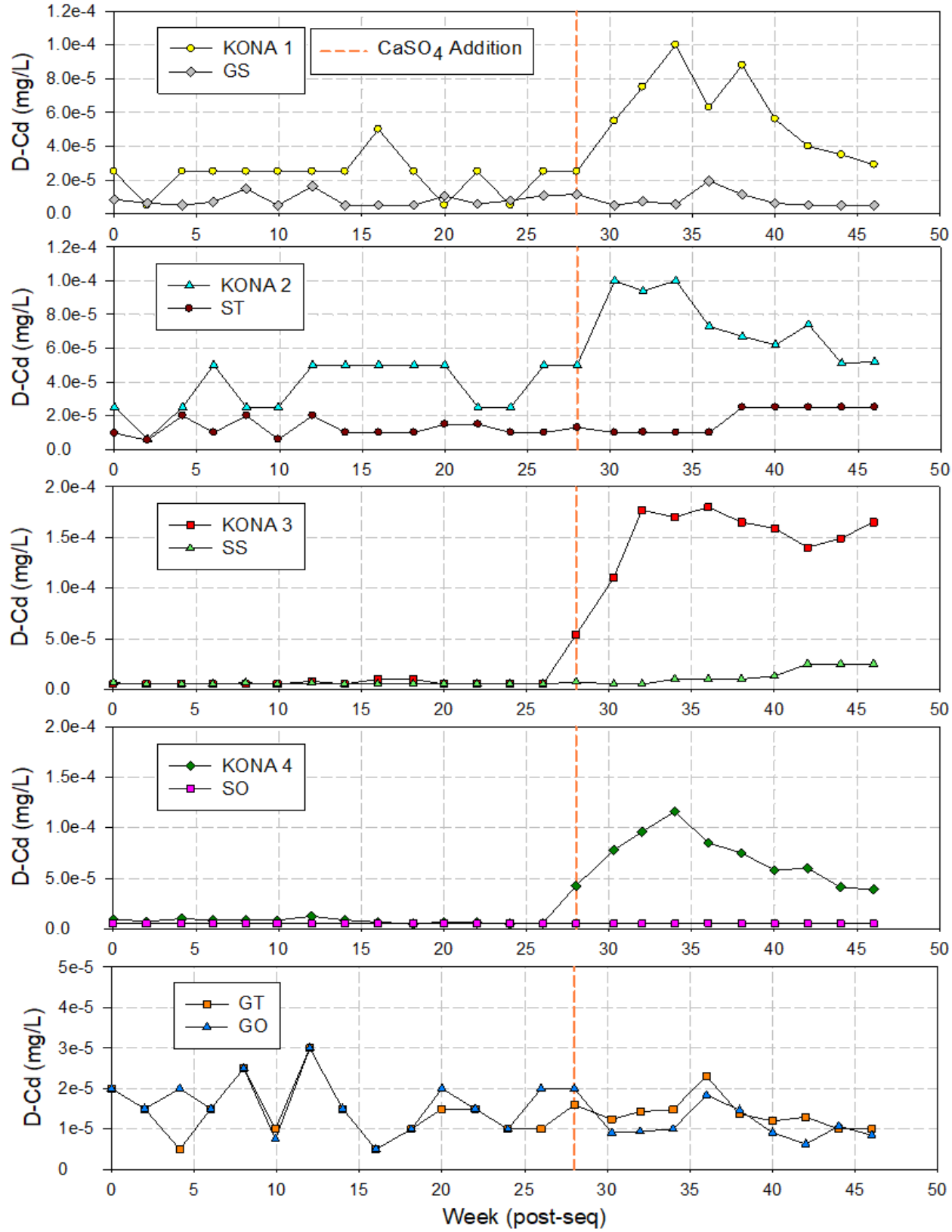


Figure 3-40: Times series profiles of D-Cd in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

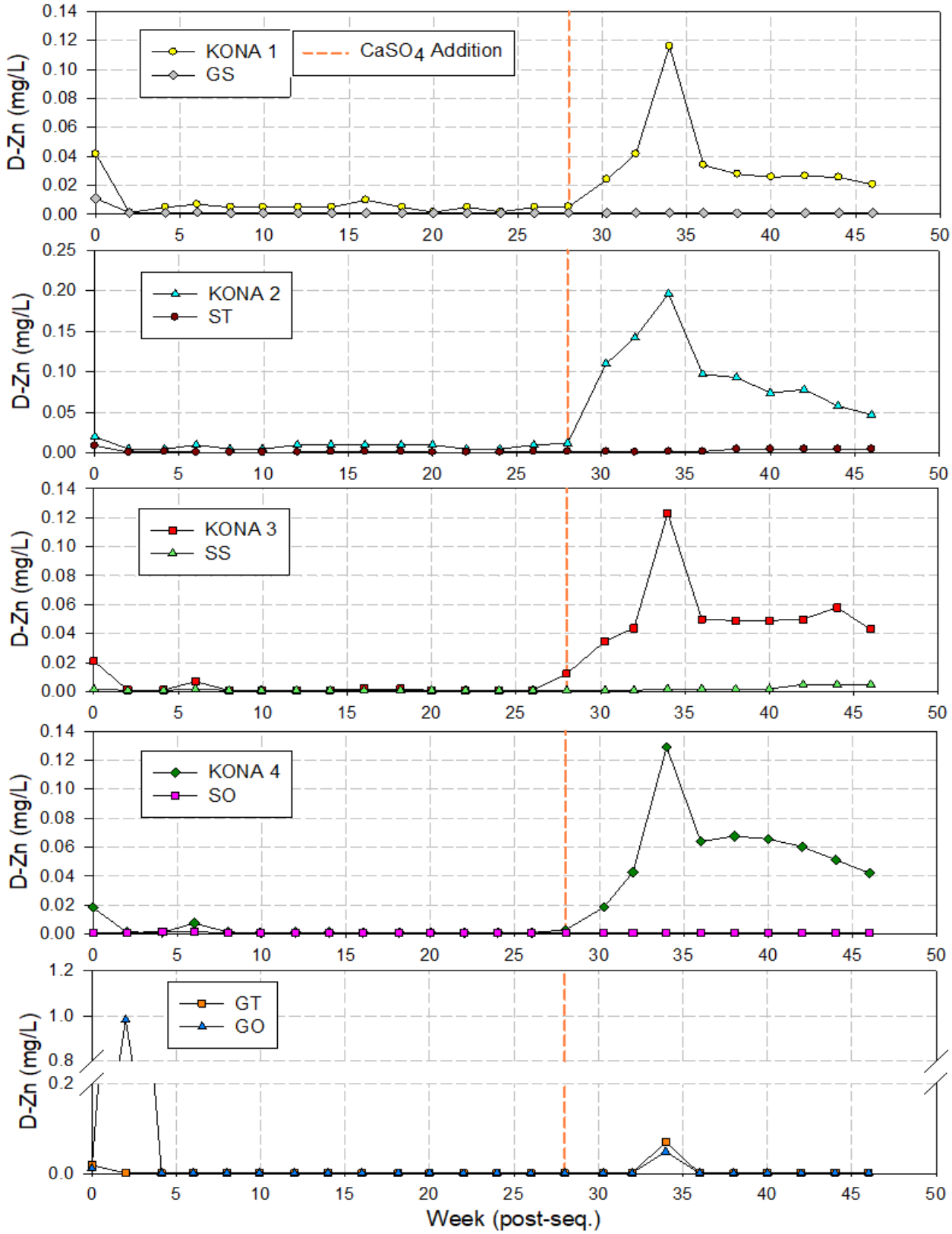


Figure 3-41**: Times series profiles of D-Zn in column effluent of sequenced pairs in Phase 2 and 3.**

3.4.2.4 Arsenic Behaviour

Saturated column results clearly demonstrate non-conservative behaviour of Arsenic. In Phase 2, As is shown to be strongly attenuated in secondary columns (Figure 3-34). Following $CaSO_4$ addition in Phase 3, As concentrations decline substantially in primary and secondary leachates. The attenuation observed in Phase 2 indicate that the solubility controls impacting As concentrations are not significantly impacted when columns are sequenced.

The variety of mechanisms can result in As attenuation and release in saturated columns, as discussed in section 3.4.1.4. The Phase 1 results suggest that As release is being influenced by competition with PO_4 for Fe-oxide sorption sites, as indicated by a strong relationship between PO_4 and As column effluent. Phase 2 and Phase 3 column show a continuation of this relationship, in that a strong correlation between PO_4 on As exists in all secondary columns (Figure 3-42). The decline in As concentrations in Phase 3 can be attributed to a Ca concentrations leading to a decline in PO_4 solubility. That is, Ca is a component ion of apatite [$Ca_5(PO_4)_3(Cl,F,OH)$], hence, declines in Ca concentration can lead to increased apatite dissolution.

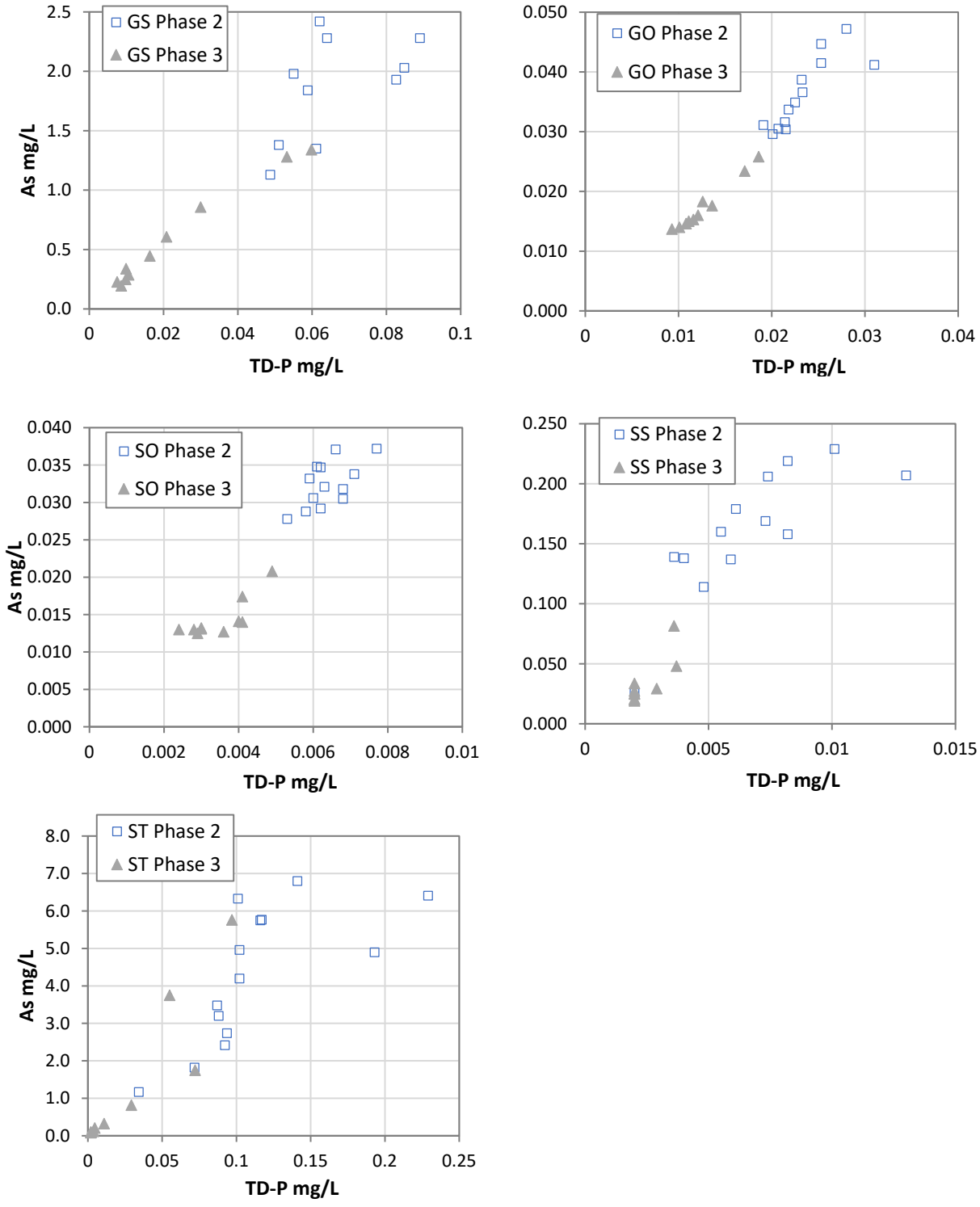


Figure 3-42: Regression of As and TD-P concentrations in secondary columns during Phase 2 and Phase 3 of column experiment.

4 Summary

The saturated column tests were initiated to examine geochemical behaviour and metal mobility in mine waste stored in saturated conditions. The most salient results of the column study with respect to this objective are as follows:

- Most metals concentrations decline during the column experiments, consistent with inhibition of sulphide oxidation, flushing of soluble oxides and rinsing of surface-bound species.
- Uranium concentrations produced by saturated columns are significantly lower than what is observed in unsatruated kinetic tests using the same rock samples.
- Arsenic is unique, in that concentrations increased over the initial phases of the column experiment, and saturated columns produced higher As concentrations then equivalent unsaturated kinetic tests.
- The most significant increase in As concentrations between unsaturated and saturated conditions occurred in granite columns, where saturated columns produced concentrations that were more than 10x those observed in unsaturated kinetic tests.
- Sequencing columns demonstrated that As does not behave conservatively, with significant attenuation occuring in secondary columns receiving effluent from primary columns.
- Addition of $CaSO_4$ in Phase 3 of the experiment corresponds to a significant declines in As concentrations in both primary and secondary columns. This result shows that pore water containing elevated SO_4 and Ca concentrations, which would be typical of waste rock drainage, will inhibit As release and mobility from saturated mine waste.
- A variety of mechanisms can drive As leaching under saturated conditions. Column results indicate that competetive ion exchange with PO_4 as being the most significant process, although other mechanisms (e.g., reduction of As(V) to As(III)) may also be occuring. This mechanism indicates that any process that will modify PO_4 solubility will impact As release.
- The primary source of PO_4 in geologic materials is apatite minerals. Apatite mineral solubility is sensitive to pH and concentratoins of component ions (e.g., Ca). Phase 3 column results show that spiking column influent with Ca reduced apatite solubility, resulting a significant decrease in both PO_4 and As concentratoins in column effluent.

5 Closure

6 References

Bowell, R.J. (1994) Sorption of arsenic by iron oxides and oxyhydroxides in soils. Appl. Geochem. 9, 279-286.

Goldberg, S. (2002). Competitive adsorption of arsenate and arsenite on oxides and clay minerals. Soil Science Society of America Journal, 66(2), 413-421.

Jain, A. and Loeppert, R. H. (2000) Effect of competing anions on the adsorption of arsenate and arsenite by ferrihydrite. Journal of Environmental Quality 29, 1422-1430.

Jurjovec, J., Ptacek, C. J., & Blowes, D. W. (2002). Acid neutralization mechanisms and metal release in mine tailings: a laboratory column experiment. *Geochimica et Cosmochimica Acta*, *66*(9), 1511-1523.

Kocar, B. D., & Fendorf, S. (2009). Thermodynamic constraints on reductive reactions influencing the biogeochemistry of arsenic in soils and sediments. Environmental science & technology, 43(13), 4871-4877.

Lorax (2017). Appendix 12-D Geochemical Characterization Report of Coffee Mine. Prepared for Goldcorp Inc. by Lorax Environmental Services Ltd. May 2017.

Nagpal, S., Chuichulcherm, S., Peeva, L., and Livingston, A. (2000). Microbial sulfate reduction in a liquid–solid fluidized bed reactor. Biotechnology and bioengineering, 70(4): 370-380.

Rubinos, D. A., Iglesias, L., Díaz-Fierros, F., & Barral, M. T. (2011). Interacting effect of pH, phosphate and time on the release of arsenic from polluted river sediments (Anllóns River, Spain). Aquatic geochemistry, 17(3), 281-306.

Parkhurst, D.L. and Appelo, C.A.J. (1999) User's guide to pHREEQC (version 2) - a computer program for speciation, batch reaction, one-dimensional transport, and inverse geochemical calculations. Report # 99-4259, Submitted to US Geological Survey, Denver, CO. 312 pp.

Peryea, F. J. (1991). Phosphate-induced release of arsenic from soils contaminated with lead arsenate. Soil Science Society of America Journal, 55(5), 1301-1306.

Petrunic, B. M., MacQuarrie, K. T. B., & Al, T. A. (2005). Reductive dissolution of Mn oxides in river-recharged aquifers: a laboratory column study. *Journal of Hydrology*, *301*(1-4), 163-181.

Appendix C
Saturated Column Report

Pierce, M. L., & Moore, C. B. (1982). Adsorption of arsenite and arsenate on amorphous iron hydroxide. Water Research, 16(7), 1247-1253.

Sharma, V. K., & Sohn, M. (2009). Aquatic arsenic: toxicity, speciation, transformations, and remediation. Environment international, 35(4), 743-759.

Appendix A: Influent and Effluent Results for Saturated Column Experiment

GOLDCORP

APPENDIX A1: INFLUENT RESULTS FOR SATURATED COLUMN EXPERIMENT

Appendix A1: Influent Results for Saturated Column Experiment

			pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**
KONA_INFLUENT	L1977048-5	8/17/2017 12:25	5.86	24.82	13	10.8	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	*< 0.3*	*< 0.0015*	*< 0.05*	*< 0.5*	*< 0.02*
KONA_INFLUENT	L1992087-5	9/14/2017 14:55				10.4									
KONA_INFLUENT	L2007130-5	10/13/2017 11:25	5.76	22.21	15	9.72									
KONA_INFLUENT	L2020126-5	11/8/2017 12:30				9.46									
KONA_INFLUENT	L2032657-2	12/7/2017 11:30				10.9									
KONA_INFLUENT	L2041649-11	1/4/2018 13:05				10.7									
KONA_INFLUENT	L2052061-11	2/1/2018 12:10				11.4									
KONA_INFLUENT	L2063289-1	3/2/2018				10.5									
KONA_INFLUENT	L2074311-11	3/29/2018 12:15				11.1									
KONA_INFLUENT	L2085708-12	4/26/2018 14:00				10.1									
KONA_INFLUENT	L2100224-12	5/24/2018 14:00				10.3									
KONA_INFLUENT	L2116986-11	6/21/2018 14:00				9.97									
KONA_INFLUENT	L2132784-11	7/19/2018 14:45				10.0									
KONA_INFLUENT	L2148482-11	8/16/2018				9.99									
KONA_INFLUENT	L2164110-11	9/14/2018 10:00				10.2									
KONA_INFLUENT	L2180431-11	10/12/2018 14:10				9.67									
KONA_INFLUENT	L2194529-11	11/8/2018 14:10				10.3									
KONA_INFLUENT	L2207335-11	12/6/2018 13:05				10.7									
KONA_INFLUENT-CaSO4	L2208989-1	12/11/2018 14:50	6.43	1234	23	10.5	*< 0.005*	*< 0.005*	*< 0.025*	0.0051	699	*< 0.0015*	*< 0.25*	*< 2.5*	*< 0.1*
KONA_INFLUENT-CaSO4	L2217203-11	1/5/2019 11:35	6.43	1619	21	10.2	*< 0.005*	*< 0.005*	*< 0.025*	0.0099	1010	*< 0.01*	*< 0.25*	*< 2.5*	*< 0.1*
KONA_INFLUENT-CaSO4	L2227544-11	1/31/2019 10:30	6.3	1629	17	10.1		*< 0.01*	*< 0.05*		962		*< 0.5*	*< 5*	4.72
KONA_INFLUENT-CaSO4	L2233141-11	2/14/2019 14:20	6.38	1625	24	10.4	*< 0.005*	*< 0.01*	*< 0.05*	0.0119	1030	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*
KONA_INFLUENT-CaSO4	L2238565-11	2/28/2019 15:15	6.59	1628	22	10.1		*< 0.005*	*< 0.025*		988		*< 0.25*	*< 2.5*	*< 0.1*
KONA_INFLUENT-CaSO4	L2250817-11	3/28/2019 15:00	6.71	1639	18	10.7		*< 0.005*	*< 0.025*		968		*< 0.25*	*< 2.5*	*< 0.1*
KONA_INFLUENT-CaSO4	L2263301-11	4/25/2019 14:45	6.96	1666	18	10.6		*< 0.005*	*< 0.025*		957		0.28	*< 2.5*	*< 0.1*

Notes:
Results in blue italics are below the indicated detection limit

Appendix A1: Influent Results for Saturated Column Experiment

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**	**D-Cu**
KONA_INFLUENT	L1977048-5	8/17/2017 12:25	*< 0.000005*	0.00056	*< 0.00002*	*< 0.01*	0.000047	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*	*< 0.0001*
KONA_INFLUENT	L1992087-5	9/14/2017 14:55													
KONA_INFLUENT	L2007130-5	10/13/2017 11:25													
KONA_INFLUENT	L2020126-5	11/8/2017 12:30													
KONA_INFLUENT	L2032657-2	12/7/2017 11:30													
KONA_INFLUENT	L2041649-11	1/4/2018 13:05													
KONA_INFLUENT	L2052061-11	2/1/2018 12:10													
KONA_INFLUENT	L2063289-1	3/2/2018													
KONA_INFLUENT	L2074311-11	3/29/2018 12:15													
KONA_INFLUENT	L2085708-12	4/26/2018 14:00													
KONA_INFLUENT	L2100224-12	5/24/2018 14:00													
KONA_INFLUENT	L2116986-11	6/21/2018 14:00													
KONA_INFLUENT	L2132784-11	7/19/2018 14:45													
KONA_INFLUENT	L2148482-11	8/16/2018													
KONA_INFLUENT	L2164110-11	9/14/2018 10:00													
KONA_INFLUENT	L2180431-11	10/12/2018 14:10													
KONA_INFLUENT	L2194529-11	11/8/2018 14:10													
KONA_INFLUENT	L2207335-11	12/6/2018 13:05													
KONA_INFLUENT-CaSO4	L2208989-1	12/11/2018 14:50	*< 0.00001*	0.0728	0.000059	*< 0.02*	0.00225	*< 0.00002*	*< 0.00001*	271	*< 0.00001*	0.000054	*< 0.0002*	*< 0.00002*	0.00070
KONA_INFLUENT-CaSO4	L2217203-11	1/5/2019 11:35	*< 0.00001*	0.114	0.000096	*< 0.02*	0.00694	*< 0.00002*	*< 0.00001*	386	*< 0.00001*	0.000058	*< 0.0002*	*< 0.00002*	0.00144
KONA_INFLUENT-CaSO4	L2227544-11	1/31/2019 10:30	*< 0.00001*	0.380	0.000100	*< 0.02*	0.00637	0.000021	*< 0.00001*	368	*< 0.00001*	0.000177	0.00044	0.000032	0.00501
KONA_INFLUENT-CaSO4	L2233141-11	2/14/2019 14:20	*< 0.00001*	0.181	0.000066	*< 0.02*	0.0115	*< 0.00002*	*< 0.00001*	395	*< 0.00001*	0.000105	0.00028	*< 0.00002*	0.00253
KONA_INFLUENT-CaSO4	L2238565-11	2/28/2019 15:15	*< 0.00001*	0.135	0.000108	*< 0.02*	0.0151	*< 0.00002*	*< 0.00001*	404	*< 0.00001*	0.000080	*< 0.0002*	*< 0.00002*	0.00307
KONA_INFLUENT-CaSO4	L2250817-11	3/28/2019 15:00	*< 0.00001*	0.137	0.000082	*< 0.02*	0.0167	*< 0.00002*	*< 0.00001*	420	*< 0.00001*	0.000069	0.00021	*< 0.00002*	0.00426
KONA_INFLUENT-CaSO4	L2263301-11	4/25/2019 14:45	*< 0.00001*	0.454	0.000144	*< 0.02*	0.0165	*< 0.00002*	*< 0.00001*	417	*< 0.00001*	0.000227	0.00049	0.000034	0.0200

Notes:
Results in blue italics are below the indicated detection limit

Appendix A1: Influent Results for Saturated Column Experiment

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**
KONA_INFLUENT	L1977048-5	8/17/2017 12:25	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	*< 0.005*	*< 0.00005*	*< 0.00005*	6.79	*< 0.00005*	*< 0.05*	0.0000071	*< 0.0002*	*< 0.00002*	*< 0.5*
KONA_INFLUENT	L1992087-5	9/14/2017 14:55														
KONA_INFLUENT	L2007130-5	10/13/2017 11:25														
KONA_INFLUENT	L2020126-5	11/8/2017 12:30														
KONA_INFLUENT	L2032657-2	12/7/2017 11:30														
KONA_INFLUENT	L2041649-11	1/4/2018 13:05														
KONA_INFLUENT	L2052061-11	2/1/2018 12:10														
KONA_INFLUENT	L2063289-1	3/2/2018														
KONA_INFLUENT	L2074311-11	3/29/2018 12:15														
KONA_INFLUENT	L2085708-12	4/26/2018 14:00														
KONA_INFLUENT	L2100224-12	5/24/2018 14:00														
KONA_INFLUENT	L2116986-11	6/21/2018 14:00														
KONA_INFLUENT	L2132784-11	7/19/2018 14:45														
KONA_INFLUENT	L2148482-11	8/16/2018														
KONA_INFLUENT	L2164110-11	9/14/2018 10:00														
KONA_INFLUENT	L2180431-11	10/12/2018 14:10														
KONA_INFLUENT	L2194529-11	11/8/2018 14:10														
KONA_INFLUENT	L2207335-11	12/6/2018 13:05														
KONA_INFLUENT-CaSO4	L2208989-1	12/11/2018 14:50	0.0253		*< 0.1*	*< 0.001*	0.328	0.00330	*< 0.0001*	6.36	0.00012	*< 0.1*	0.000070	*< 0.0004*	*< 0.00004*	265
KONA_INFLUENT-CaSO4	L2217203-11	1/5/2019 11:35	0.0397		*< 0.1*	0.0013	0.485	0.00746	*< 0.0001*	5.96	*< 0.0001*	*< 0.1*	0.000104	*< 0.0004*	*< 0.00004*	343
KONA_INFLUENT-CaSO4	L2227544-11	1/31/2019 10:30	0.145		*< 0.1*	0.0012	0.919	0.0125	*< 0.0001*	6.24	0.00040	*< 0.1*	0.000293	0.00044	*< 0.00004*	327
KONA_INFLUENT-CaSO4	L2233141-11	2/14/2019 14:20	0.0708		*< 0.1*	0.0014	0.712	0.0154	*< 0.0001*	7.03	0.00020	*< 0.1*	0.000133	*< 0.0004*	*< 0.00004*	357
KONA_INFLUENT-CaSO4	L2238565-11	2/28/2019 15:15	0.0598		*< 0.1*	0.0012	0.681	0.0197	*< 0.0001*	6.14	0.00016	*< 0.1*	0.000123	*< 0.0004*	*< 0.00004*	340
KONA_INFLUENT-CaSO4	L2250817-11	3/28/2019 15:00	0.0507		*< 0.1*	0.0012	0.750	0.0248	*< 0.0001*	7.09	*< 0.0001*	*< 0.1*	0.000119	*< 0.0004*	*< 0.00004*	385
KONA_INFLUENT-CaSO4	L2263301-11	4/25/2019 14:45	0.180		*< 0.1*	0.0015	1.49	0.0661	*< 0.0001*	7.14	0.00049	*< 0.1*	0.000489	0.00043	*< 0.00004*	362

Notes:
Results in blue italics are below the indicated detection limit

Appendix A1: Influent Results for Saturated Column Experiment

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
KONA_INFLUENT	L1977048-5	8/17/2017 12:25	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_INFLUENT	L1992087-5	9/14/2017 14:55													
KONA_INFLUENT	L2007130-5	10/13/2017 11:25													
KONA_INFLUENT	L2020126-5	11/8/2017 12:30													
KONA_INFLUENT	L2032657-2	12/7/2017 11:30													
KONA_INFLUENT	L2041649-11	1/4/2018 13:05													
KONA_INFLUENT	L2052061-11	2/1/2018 12:10													
KONA_INFLUENT	L2063289-1	3/2/2018													
KONA_INFLUENT	L2074311-11	3/29/2018 12:15													
KONA_INFLUENT	L2085708-12	4/26/2018 14:00													
KONA_INFLUENT	L2100224-12	5/24/2018 14:00													
KONA_INFLUENT	L2116986-11	6/21/2018 14:00													
KONA_INFLUENT	L2132784-11	7/19/2018 14:45													
KONA_INFLUENT	L2148482-11	8/16/2018													
KONA_INFLUENT	L2164110-11	9/14/2018 10:00													
KONA_INFLUENT	L2180431-11	10/12/2018 14:10													
KONA_INFLUENT	L2194529-11	11/8/2018 14:10													
KONA_INFLUENT	L2207335-11	12/6/2018 13:05													
KONA_INFLUENT-CaSO4	L2208989-1	12/11/2018 14:50	*< 0.00008*	0.17	*< 0.00002*	0.737	*< 0.0004*	*< 0.0002*	0.00125	*< 0.000004*	0.0000150	0.00018	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_INFLUENT-CaSO4	L2217203-11	1/5/2019 11:35	*< 0.00008*	0.27	*< 0.00002*	1.63	*< 0.0004*	*< 0.0002*	*< 0.0006*	*< 0.000004*	0.0000281	0.00023	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_INFLUENT-CaSO4	L2227544-11	1/31/2019 10:30	0.000109	0.84	*< 0.00002*	1.35	*< 0.0004*	*< 0.0002*	*< 0.0057*	*< 0.000004*	0.0000601	0.00049	*< 0.0002*	0.0446	0.00019
KONA_INFLUENT-CaSO4	L2233141-11	2/14/2019 14:20	*< 0.00008*	0.42	*< 0.00002*	2.29	*< 0.0004*	*< 0.0002*	0.00231	*< 0.000004*	0.0000378	0.00037	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_INFLUENT-CaSO4	L2238565-11	2/28/2019 15:15	0.000082	0.31	*< 0.00002*	2.80	*< 0.0004*	*< 0.0002*	*< 0.0012*	0.0000070	0.0000384	0.00028	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_INFLUENT-CaSO4	L2250817-11	3/28/2019 15:00	*< 0.00008*	0.34	*< 0.00002*	2.80	*< 0.0004*	*< 0.0002*	*< 0.0018*	*< 0.000004*	0.0000292	0.00029	*< 0.0002*	0.0020	*< 0.00012*
KONA_INFLUENT-CaSO4	L2263301-11	4/25/2019 14:45	*< 0.00008*	0.63	*< 0.00002*	2.75	*< 0.0004*	*< 0.0002*	0.00278	0.0000049	0.0000935	0.00061	*< 0.0002*	0.0026	0.00014

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX A2: GRANITE COLUMN (KONA 1-4) EFFLUENT RESULTS

Appendix A2: Granite Column (Kona 1-4) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**
KONA_1	L1955323-1	7/7/2017 13:00	0	0		561	7.08	124.9	46	1.93	0.117	0.0011	< 0.005	0.0228	11.8	< 0.0015	< 0.05	4.25	0.215	< 0.000005	0.00468	1.67	0.077	0.00142	< 0.00001	< 0.000005	8.66	0.0000097	0.00205	< 0.0001
KONA_1	L1969885-1	8/3/2017 13:50	4	4		466	7.03	151.3	57	1.72	0.240	< 0.001	< 0.005	0.0542	11.8	< 0.0015	< 0.05	3.91	0.218	< 0.000005	0.00242	2.62	0.089	0.00241	0.000017	< 0.000005	11.7	0.0000110	0.00313	< 0.0001
KONA_1	L1977048-1	8/17/2017 12:25	6	6		684	6.93	121	58	1.16	0.150	< 0.001	< 0.005	0.0506	6.88	< 0.0015	< 0.05	2.35	0.182	< 0.000005	0.00329	4.10	0.058	0.00190	< 0.00001	< 0.000005	8.85	0.0000073	0.00260	< 0.0001
KONA_1	L1984769-1	8/31/2017 14:00	8	8		627	6.97	119.8	70	0.98	0.192	< 0.001	0.0086	0.090	6.26	< 0.0015	< 0.05	2.16	0.196	< 0.000005	0.00560	4.86	0.055	0.00180	< 0.00001	0.0000062	8.40	0.0000083	0.00272	< 0.0001
KONA_1	L1992087-1	9/14/2017 14:55	10	10		728	7.07	107.9	60	0.78	0.145	< 0.001	< 0.005	0.119	4.32	< 0.0015	< 0.05	1.52	0.205	< 0.000005	0.00358	5.54	0.044	0.00159	< 0.00001	< 0.000005	7.47	< 0.000005	0.00249	< 0.0001
KONA_1	L1999487-1	9/28/2017 11:25	12	12		518	6.92	107.8	59	< 0.5	0.150	< 0.001	< 0.005	0.163	3.59	< 0.0015	< 0.05	1.38	0.189	< 0.000005	0.00435	6.36	0.041	0.00153	< 0.00001	< 0.000005	8.24	< 0.000005	0.00240	< 0.0001
KONA_1	L2007130-1	10/13/2017 11:25	14	14		755	6.84	93.7	64	0.53	0.118	< 0.001	< 0.005	0.155	2.65	< 0.0015	< 0.05	1.06	0.203	< 0.000005	0.00268	7.23	0.033	0.00115	< 0.00001	< 0.000005	6.61	< 0.000005	0.00176	< 0.0001
KONA_1	L2014335-1	10/26/2017 11:50	16	16		239	6.89	91.1	53	0.65	0.111	< 0.001	< 0.005	0.141	2.12	< 0.0015	< 0.05	0.84	0.210	< 0.000005	0.00366	7.36	0.027	0.00102	< 0.00001	< 0.000005	6.25	< 0.000005	0.00133	< 0.0001
KONA_1	L2020126-1	11/8/2017 12:30	18	18		550	7.1	90	47	0.53	0.115	< 0.001	< 0.005	0.212	2.25	< 0.0015	< 0.05	0.70	0.229	< 0.000005	< 0.003	8.08	0.028	0.00134	< 0.00001	< 0.000005	6.63	< 0.000005	0.00130	< 0.0001
KONA_1	L2026623-1	11/23/2017 14:15	20	20		615	6.94	85.3	49	0.53	0.113	< 0.001	< 0.005	0.211	1.59	< 0.0015	< 0.05	0.56	0.215	< 0.000005	0.00273	8.20	0.025	0.00117	< 0.00001	< 0.000005	6.17	< 0.000005	0.00114	< 0.0001
KONA_1	L2031965-1	12/6/2017 14:05	22	22		532	6.86	89.1	50	0.55	0.116	< 0.001	< 0.005	0.245	1.42	< 0.0015	< 0.05	0.68	0.210	< 0.000005	0.00266	8.82	0.023	0.00130	< 0.00001	< 0.000005	6.36	< 0.000005	0.00121	< 0.0001
KONA_1	L2038563-1	12/21/2017 13:50	24	24		741	6.87	82.3	47	< 0.5	0.0808	< 0.001	< 0.005	0.253	1.06	< 0.0015	< 0.05	< 0.5	0.208	< 0.000005	0.00355	8.92	0.022	0.00120	< 0.00001	< 0.000005	6.06	< 0.000005	0.00112	< 0.0001
KONA_1	L2041649-1	1/4/2018 13:05	26	26		467	6.92	87.4	50	0.74	0.0446	< 0.001	< 0.005	0.172	1.10	< 0.0015	< 0.05	< 0.5	0.207	< 0.000005	0.00260	8.83	0.020	0.00103	0.000012	< 0.000005	6.64	< 0.000005	0.00112	< 0.0001
KONA_1	L2046871-1	1/18/2018 11:25	28	28		559	6.84	85.9	53	0.51	0.0915	< 0.001	< 0.005	0.307	1.00	< 0.0015	< 0.05	< 0.5	0.216	< 0.00001	0.0038	9.59	0.022	0.000899	< 0.00002	< 0.00001	6.54	< 0.00001	0.000996	< 0.0002
KONA_1	L2052061-1	2/1/2018 12:10	30	30		575	6.82	88.1	54	< 0.5	0.112	< 0.001	< 0.005	0.26	1.10	< 0.0015	< 0.05	< 0.5	0.231	< 0.00001	0.0026	9.74	< 0.02	0.000835	< 0.00002	< 0.00001	6.57	< 0.00001	0.000857	< 0.0002
KONA_1	L2057381-1	2/15/2018 11:35	32	32		529	6.95	88.9	53	0.76	0.0994	< 0.001	< 0.005	0.283	0.92	< 0.0015	< 0.05	< 0.5	0.225	< 0.00001	0.0017	9.64	< 0.02	0.000955	< 0.00002	< 0.00001	6.69	< 0.00001	0.000953	< 0.0002
KONA_1	L2062788-1	3/1/2018 13:25	34	34		572	6.78	85.8	55	< 0.5	0.100	< 0.001	< 0.005	0.248	0.89	< 0.0015	< 0.05	< 0.5	0.226	< 0.000025	0.0040	10.9	< 0.05	0.00075	< 0.00005	< 0.000025	6.70	< 0.000025	0.000990	< 0.0005
KONA_1	L2068449-1	3/15/2018 11:40	36	36		568	6.83	87.8	57	0.65	0.113	< 0.001	< 0.005	0.259	0.87	< 0.0015	< 0.05	< 0.5	0.237	< 0.00005	< 0.005	9.64	< 0.1	0.00089	< 0.0001	< 0.00005	5.75	0.000159	0.000795	< 0.001
KONA_1	L2074311-1	3/29/2018 11:20	38	38		380	6.84	96.1	58	0.60	0.143	< 0.001	< 0.005	0.164	1.00	< 0.0015	< 0.05	< 0.5	0.249	< 0.000005	0.00387	9.03	0.022	0.000701	< 0.00001	0.0000117	7.87	< 0.000005	0.000452	< 0.0001
KONA_1	L2079620-1	4/12/2018 11:00	40	40		573	6.82	89.8	54	< 0.5	0.110	< 0.001	< 0.005	0.188	0.76	< 0.0015	< 0.05	< 0.5	0.255	< 0.000005	0.00308	10.7	0.016	0.000844	< 0.00001	< 0.000005	6.62	< 0.000005	0.000765	< 0.0001
KONA_1	L2085708-1	4/26/2018 13:00	42	42		556	6.76	89.9	51	0.75	0.105	< 0.001	< 0.005	0.687	0.79	< 0.0015	< 0.05	< 0.5	0.253	< 0.000005	0.00202	10.9	0.017	0.000788	< 0.00001	< 0.000005	7.00	< 0.000005	0.000733	< 0.0001
KONA_1	L2092801-1	5/10/2018 11:15	44	44		601	6.83	90.8	52	0.78	0.114	< 0.001	< 0.005	0.276	0.79	< 0.0015	< 0.05	< 0.5	0.250	< 0.00001	0.0033	11.1	< 0.02	0.000565	< 0.00002	< 0.00001	6.54	< 0.00001	0.000578	< 0.0002
KONA_1	L2100224-1	5/24/2018 14:00	46	46		496	6.75	94.5	53	0.79	0.131	< 0.001	< 0.005	0.303	0.81	< 0.0015	< 0.05	< 0.5	0.277	< 0.000025	0.0053	12.5	< 0.05	0.00050	< 0.00005	< 0.000025	6.61	< 0.000025	0.000404	< 0.0005
KONA_1	L2108434-1	6/7/2018 13:30	48		0	502	7.03	91	53	0.68	0.116	< 0.001	< 0.005	0.349	0.77	< 0.0015	< 0.05	< 0.5	0.271	< 0.000025	0.0071	11.7	< 0.05	0.00051	< 0.00005	< 0.000025	6.43	< 0.000025	0.000373	< 0.0005
KONA_1	L2116986-1	6/21/2018 14:00	50		2	497	7.02	100.7	57	< 1	0.128	< 0.001	< 0.005	0.359	0.80	< 0.0015	< 0.05	< 0.5	0.291	< 0.000005	0.00579	11.3	0.019	0.000556	< 0.00001	< 0.000005	7.33	< 0.000005	0.000349	< 0.0001
KONA_1	L2125321-1	7/6/2018 11:30	52		4	494	7	100.6	60	1.5	0.115	< 0.001	< 0.005	0.380	0.73	< 0.0015	< 0.05	< 0.5	0.289	< 0.000025	0.0034	12.9	< 0.05	0.00052	< 0.00005	< 0.000025	6.54	< 0.000025	0.000278	< 0.0005
KONA_1	L2132784-1	7/19/2018 14:45	54		6	515	7	99	54	0.87	0.130	< 0.001	< 0.005	0.368	0.71	< 0.0015	< 0.05	< 0.5	0.294	< 0.000025	0.0089	12.9	< 0.05	0.00059	< 0.00005	< 0.000025	6.92	< 0.000025	0.000319	< 0.0005
	L2140795-1	8/2/2018 13:30	56		8	512	6.89	96.7	50	< 1	0.130	< 0.001	< 0.005	0.363	0.70	< 0.0015	< 0.05	< 0.5	0.286	< 0.000025	0.0079	14.3	< 0.05	0.00076	< 0.00005	< 0.000025	6.99	< 0.000025	0.000396	< 0.0005
KONA_1	L2148482-1	8/16/2018	58		10	522	6.96	98.2	58	3.08	0.108	< 0.001	< 0.005	0.491	0.54	< 0.0015	< 0.05	< 0.5	0.298	< 0.000025	0.0056	16.3	< 0.05	0.00050	< 0.00005	< 0.000025	6.42	< 0.000025	0.000413	< 0.0005
KONA_1	L2156461-1	8/30/2018 14:20	60		12	504	6.88	97.8	53	1.2	0.112	< 0.001	< 0.005	0.308	0.51	< 0.0015	< 0.05	< 0.5	0.291	< 0.000025	0.00638	14.2	< 0.05	0.00063	< 0.00005	< 0.000025	6.70	< 0.000025	0.000384	< 0.0005
KONA_1	L2164110-1	9/13/2018 11:45	62		14	509	6.93	97.2	51	< 1	0.108	< 0.001	< 0.005	0.503	0.56	< 0.0015	< 0.05	< 0.5	0.285	< 0.000025	0.0052	18.1	< 0.05	0.00052	< 0.00005	< 0.000025	6.93	< 0.000025	0.000574	< 0.0005
KONA_1	L2172409-1	9/27/2018 14:00	64		16	551	6.83	94.9	47	1.3	0.103	< 0.001	< 0.005	0.587	0.49	< 0.0015	< 0.05	< 0.5	0.295	< 0.00005	< 0.005	17.0	< 0.1	0.00052	< 0.0001	< 0.00005	6.78	< 0.00005	0.000493	< 0.001
KONA_1	L2180431-1	10/12/2018 14:10	66		18	547	6.79	97.5	52	< 1	0.110	< 0.001	< 0.005	0.550	0.41	< 0.0015	< 0.05	< 0.5	0.275	< 0.000025	0.0072	16.8	< 0.05	0.00046	< 0.00005	< 0.000025	7.19	< 0.000025	0.000278	< 0.0005
KONA_1	L2187510-1	10/25/2018 14:00	68		20	490	6.86	97	46	2.6	0.104	< 0.001	< 0.005	0.47	0.35	< 0.0015	< 0.05	< 0.5	0.287	< 0.000005	0.00925	16.5	0.013	0.000403	< 0.00001	< 0.000005	6.71	< 0.000005	0.000229	< 0.0001
KONA_1	L2194529-1	11/8/2018 13:40	70		22	540	6.92	96.8	43	0.59	0.114	< 0.001	< 0.005	0.553	0.38	< 0.0015	< 0.05	< 0.5	0.296	< 0.000025	0.0133	17.2	< 0.05	0.00041	< 0.00005	< 0.000025	6.96	< 0.000025	0.000139	< 0.0005
KONA_1	L2200705-1	11/22/2018 10:30	72		24	534	6.94	93.3	43	< 0.5	0.0980	< 0.001	0.0095	0.794	0.33	< 0.0015	< 0.05	< 0.5	0.302	< 0.000005	0.00609	16.9	0.011	0.000271	< 0.00001	< 0.000005	6.62	< 0.000005	0.000137	< 0.0001
KONA_1	L2207335-1	12/6/2018 14:45	74		26	527	6.93	93.4	40	< 0.5	0.0990	< 0.001	< 0.005	0.667	< 0.3	< 0.0015	< 0.05	< 0.5	0.306	< 0.000025	0.0136	18.5	< 0.05	0.00034	< 0.00005	< 0.000025	6.86	< 0.000025	0.000094	< 0.0005
KONA_1	L2213525-1	12/20/2018 14:25	76		28	843	6.79	218	45	0.74	0.108	< 0.001	< 0.005	0.352	66.3	< 0.0015	< 0.05	< 0.5	0.249	< 0.000025	0.0091	14.8	< 0.05	0.00076	< 0.00005	< 0.000025	20.0	< 0.000025	0.00240	< 0.0005
KONA_1	L2217203-1	1/5/2019 11:35	78		30	793	6.15	709	20	< 0.5	0.172	< 0.005	< 0.025	0.144	362	< 0.01	< 0.25	< 2.5	0.16	< 0.000025	< 0.0025	9.13	< 0.05	0.00566	< 0.00005	< 0.000025	81.8	0.000055	0.0200	< 0.0005
KONA_1	L2222132-1	1/17/2019 11:45	80		32	781	5.78	1173	15	< 0.5	0.167	< 0.005	< 0.025	0.106	650	< 0.01	< 0.25	< 2.5	0.12	< 0.000005	0.00090	8.28	< 0.01	0.0200	0.000020	< 0.000005	182	0.0000751	0.0661	< 0.0001
KONA_1	L2227544-1	1/31/2019 10:30	82		34	763	5.77	1391	14	0.75	0.172	< 0.005	< 0.025	0.317	797	< 0.0015	< 0.25	< 2.5	0.14	< 0.0001	< 0.01	10.1	< 0.2	0.0221	< 0.0002	< 0.0001	226	< 0.0001	0.0840	< 0.002
KONA_1	L2233141-1	2/14/2019 14:20	84		36	745	5.83	1488	16	0.60	0.168	< 0.01	< 0.05	0.286	926	< 0.0015	< 0.5	< 5	< 0.2	< 0.00005	< 0.005	13.9	< 0.1	0.0146	< 0.0001	< 0.00005	273	0.000063	0.0586	< 0.001
KONA_1	L2238565-1	2/28/2019 15:15	86		38	735	5.69	1550	13	0.59	0.155	< 0.005	< 0.025	0.436	946	< 0.0015	< 0.25	< 2.5	0.12	< 0.000025	0.0034	15.2	< 0.05	0.0102	< 0.00005	0.000066	287	0.000088	0.0464	< 0.0005
KONA_1	L2244540-1	3/14/2019 14:30	88		40	719	5.85	1576	13	0.66	0.150	< 0.005	< 0.025	< 0.2	952	< 0.0015	< 0.25	< 2.5	0.11	< 0.000025	0.0032	15.0	< 0.05	0.00848	< 0.00005	< 0.000025	297	0.000056	0.0374	< 0.0005
KONA_1	L2250817-1	3/28/2019 15:00	90		42	734	5.78	1599	16	0.52	0.159	< 0.005	< 0.025	0.244	945	< 0.01	< 0.25	< 2.5	0.12	< 0.000025	0.0036	11.5	< 0.05	0.00740	< 0.00005	< 0.000025	353	0.000040	0.0381	< 0.0005
KONA_1	L2257457-1	4/11/2019 15:00	92		44	725	5.9	1593	13	0.75	0.147	0.019	< 0.05	0.375	1000	< 0.01	< 0.5	< 5	< 0.2	< 0.000025	< 0.0025	11.7	< 0.05	0.00677	< 0.00005	< 0.000025	351	0.000035	0.0354	< 0.0005
KONA_1	L2263301-1	4/25/2019 14:45	94		46	738	5.94	1641	15	0.85	0.151	< 0.005	< 0.025	0.270	952	< 0.0015	< 0.25	< 2.5	0.12	< 0.000025	0.0029	11.7	< 0.05	0.00656	< 0.00005	< 0.000025	349	0.000029	0.0305	< 0.0005
KONA_2	L1955323-2	7/7/2017 13:00	0	0		526	6.35	265.3	37	2.67	0.281	< 0.001	< 0.005	0.053	74.9	< 0.0015	< 0.05	6.78	0.184	< 0.000005	0.0388	2.58	0.098	0.0204	0.000227	< 0.000005	20.2	0.0000422	0.0225	< 0.0001
KONA_2	L1969885-2	8/3/2017 13:50	4	4		464	6.44	269.4	49	2.27	0.343	< 0.001	< 0.005	0.0726	70.1	0.0016	< 0.05	4.90	0.186	< 0.000005	0.0224	4.11	0.103	0.0214	0.000139	< 0.000005	21.5	0.0000349	0.0197	< 0.0001
KONA_2	L1977048-2	8/17/2017 12:25	6	6		684	6.17	196	43	1.42	0.192	< 0.001	< 0.005	0.0547	46.8	0.0098	< 0.05	2.47	0.117	< 0.000005	0.0143	5.27	0.063	0.0153	0.000092	< 0.000005	14.0	0.0000209	0.0154	< 0.0001
KONA_2	L1984769-2	8/31/2017 14:00	8	8		632	6.89	164.5	48	1.16	0.147	< 0.001	< 0.005	0.12	36.8	0.0252	< 0.05	1.75	0.120	< 0.000005	0.00913	6.51	0.055	0.0130	0.000064	0.0000060	11.3	0.0000162	0.0117	< 0.0001
KONA_2	L1992087-2	9/14/2017 14:55	10	10		702	6.42	134.6	44	0.84	0.0995	0.0021	< 0.005	0.139	25.7	< 0.0015	< 0.05	0.83	0.118	< 0.000005	0.00425	7.38	0.045	0.00978	0.000053	< 0.000005	8.99	0.0000100	0.00898	< 0.0001
KONA_2	L1999487-2	9/28/2017 11:25	12	12		499	6.27	128.4	49	0.53	0.154	< 0.001	< 0.005	0.171	20.9	0.0459	< 0.05	0.74	0.116	< 0.000005	0.00416	8.82	0.040	0.00984	0.000034	< 0.000005	9.14	0.0000103	0.00784	< 0.0001
KONA_2	L2007130-2	10/13/2017 11:25	14	14		754	6.22	105.3	44	0.74	0.0597	< 0.001	< 0.005	0.191	14.6	0.0361	< 0.05	< 0.5	0.117	< 0.000005	0.00269	9.64	0.033	0.00760	0.000037	< 0.000005	6.99	0.0000098	0.00653	< 0.0001
KONA_2	L2014335-2	10/26/2017 11:50	16	16		219	6.36	91.7	44	0.61	0.0606	< 0.001	< 0.005	0.168	9.83	0.0640	< 0.05	< 0.5	0.117	< 0.000005	0.00262	9.63	0.026	0.00507	0.000034	< 0.000005	5.74	0.0000056	0.00505	< 0.0001
KONA_2	L2020126-2	11/8/2017 12:30	18	18		525	6.67	89.5	42	0.61	0.0826	< 0.001	< 0.005	0.268	8.07	0.0213	< 0.05	< 0.5	0.131	< 0.000005	< 0.003	11.0	0.028	0.00625	0.000029	< 0.000005	6.09	0.0000066	0.00527	< 0.0001
KONA_2	L2026623-2	11/23/2017 14:15	20	20		598	6.38	86.2	43	0.54	0.0568	< 0.001	< 0.005	0.234	6.19	0.0100	< 0.05	< 0.5	0.131	< 0.000005	0.00210	10.4	0.022	0.00562	0.000026	< 0.000005	5.85	0.0000057	0.00455	< 0.0001
KONA_2	L2031965-2	12/6/2017 14:05	22	22		525	6.55	58	51	0.88	0.0839	< 0.001	< 0.005	0.32	4.89	0.0019	< 0.05	< 0.5	0.128	< 0.000005	0.00261	11.6	0.018	0.00530	0.000027	< 0.000005	5.20	0.0000107	0.00472	< 0.0001
KONA_2	L2038563-2	12/21/2017 13:50	24	24		716	6.4	75.5	39	< 0.5	0.0138	< 0.001	< 0.005	0.282	3.74	< 0.0015	< 0.05	< 0.5	0.129	< 0.000005	0.00121	12.1	0.017	0.00448	0.000023	< 0.000005	4.60	< 0.000005	0.00415	< 0.0001
KONA_2	L2041649-2	1/4/2018 13:05	26	26		512	6.43	80.4	40	0.64	0.0356	< 0.001	< 0.005	0.234	3.58	< 0.0015	< 0.05	< 0.5	0.134	< 0.000005	0.00154	12.4	0.016	0.00503	0.000022	< 0.000005	5.25	0.0000053	0.00410	< 0.0001
KONA_2	L2046871-2	1/18/2018 11:25	28	28		547	6.44	80.4	42	< 0.5	0.0688	< 0.001	< 0.005	0.37	3.47	< 0.0015	< 0.05	< 0.5	0.145	< 0.000025	< 0.0025	13.6	< 0.05	0.00429	< 0.00005	< 0.000025	5.39	< 0.000025	0.00387	< 0.0005
KONA_2	L2052061-2	2/1/2018 12:10	30	30		560	6.41	79.8	41	0.84	0.0653	< 0.001	< 0.005	0.342	3.29	< 0.0015	< 0.05	< 0.5	0.150	< 0.000025	0.0027	14.1	< 0.05	0.00403	< 0.00005	< 0.000025	4.89	< 0.000025	0.00369	< 0.0005
KONA_2	L2057381-2	2/15/2018 11:35	32	32		523	6.4	80.6	43	1.07	0.0715	< 0.001	< 0.005	0.386	3.07	< 0.0015	< 0.05	< 0.5	0.145	< 0.000025	< 0.0025	14.5	< 0.05	0.00474	< 0.00005	< 0.000025	5.10	< 0.000025	0.00382	< 0.0005
KONA_2	L2062788-2	3/1/2018 13:25	34	34		565	6.39	74.8	44	0.90	0.0433	< 0.001	< 0.005	0.304	2.62	0.0018	< 0.05	< 0.5	0.147	< 0.000025	< 0.0025	15.7	< 0.05	0.00424	< 0.00005	< 0.000025	4.58	< 0.000025	0.00340	< 0.0005

Appendix A2: Granite Column (Kona 1-4) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**
KONA_2	L2068449-2	3/15/2018 11:40	36	36		564	6.44	76.2	46	0.58	0.0555	*< 0.001*	*< 0.005*	0.35	2.56	*< 0.0015*	*< 0.05*	*< 0.5*	0.156	*< 0.00005*	*< 0.005*	16.0	*< 0.1*	0.00395	*< 0.0001*	*< 0.00005*	4.44	*< 0.00005*	0.00343	*< 0.001*
KONA_2	L2074311-2	3/29/2018 11:20	38	38		377	6.54	85	47	0.52	0.115	*< 0.001*	*< 0.005*	0.182	2.86	*< 0.0015*	*< 0.05*	*< 0.5*	0.172	*< 0.000005*	0.00362	14.3	0.014	0.00462	0.000022	*< 0.000005*	5.69	0.0000071	0.00350	*< 0.0001*
KONA_2	L2079620-2	4/12/2018 11:00	40	40		554	6.31	78.3	44	0.61	0.0516	*< 0.001*	*< 0.005*	0.255	2.36	*< 0.0015*	*< 0.05*	*< 0.5*	0.169	*< 0.000005*	0.00233	16.6	0.011	0.00431	0.000013	0.0000076	4.89	0.0000059	0.00352	*< 0.0001*
KONA_2	L2085708-2	4/26/2018 13:40	42	42		540	6.38	75.7	43	0.53	0.0434	*< 0.001*	*< 0.005*	0.25	2.27	*< 0.0015*	*< 0.05*	*< 0.5*	0.162	*< 0.000005*	0.00112	17.8	0.010	0.00363	0.000016	*< 0.000005*	4.61	*< 0.000005*	0.00324	*< 0.0001*
KONA_2	L2092801-2	5/10/2018 11:15	44	44		568	6.4	75.8	40	0.50	0.0345	*< 0.001*	*< 0.005*	0.373	2.19	*< 0.0015*	*< 0.05*	*< 0.5*	0.167	*< 0.000025*	0.0028	18.4	*< 0.05*	0.00345	*< 0.00005*	*< 0.000025*	4.36	*< 0.000025*	0.00286	*< 0.0005*
KONA_2	L2100224-2	5/24/2018 14:00	46	46		480	6.41	80.2	41	0.73	0.0371	*< 0.001*	*< 0.005*	0.500	2.25	*< 0.0015*	*< 0.05*	*< 0.5*	0.185	*< 0.000025*	0.0029	20.1	*< 0.05*	0.00417	*< 0.00005*	*< 0.000025*	4.48	*< 0.000025*	0.00311	*< 0.0005*
KONA_2	L2108434-2	6/7/2018 13:30	48		0	490	6.56	76.6	42	*< 2.5*	0.109	*< 0.001*	*< 0.005*	0.442	2.24	*< 0.0015*	*< 0.05*	*< 0.5*	0.192	*< 0.000025*	0.0051	19.6	*< 0.05*	0.00356	*< 0.00005*	*< 0.000025*	4.79	*< 0.000025*	0.00319	*< 0.0005*
KONA_2	L2116986-2	6/21/2018 14:00	50		2	492	6.66	82.2	39	*< 1*	0.0567	*< 0.001*	*< 0.005*	0.478	2.16	*< 0.0015*	*< 0.05*	*< 0.5*	0.200	*< 0.000005*	0.00206	19.5	0.011	0.00341	*< 0.00001*	0.0000237	4.95	0.0000061	0.00327	*< 0.0001*
KONA_2	L2125321-2	7/6/2018 11:30	52		4	499	6.62	80.8	48	1.74	0.0378	*< 0.001*	*< 0.005*	0.481	2.16	0.0024	*< 0.05*	*< 0.5*	0.198	*< 0.000025*	*< 0.0025*	21.1	*< 0.05*	0.00309	*< 0.00005*	*< 0.000025*	4.39	*< 0.000025*	0.00297	*< 0.0005*
KONA_2	L2132784-2	7/19/2018 14:45	54		6	499	6.59	79.5	36	0.97	0.0519	*< 0.001*	*< 0.005*	0.430	2.11	*< 0.0015*	*< 0.05*	*< 0.5*	0.209	*< 0.00005*	*< 0.005*	22.1	*< 0.1*	0.00303	*< 0.0001*	*< 0.00005*	4.78	*< 0.00005*	0.00313	*< 0.001*
KONA_2	L2140795-2	8/2/2018 13:30	56		8	494	6.48	80.7	35	*< 1*	0.135	*< 0.001*	*< 0.005*	0.409	2.23	*< 0.0015*	*< 0.05*	*< 0.5*	0.208	*< 0.000025*	0.0072	21.7	*< 0.05*	0.00361	*< 0.00005*	*< 0.000025*	4.90	*< 0.000025*	0.00305	*< 0.0005*
KONA_2	L2148482-2	8/16/2018	58		10	520	6.46	82.2	37	4.93	0.0334	*< 0.001*	*< 0.005*	0.561	1.90	*< 0.0015*	*< 0.05*	*< 0.5*	0.224	*< 0.000025*	0.0047	24.2	*< 0.05*	0.00283	*< 0.00005*	*< 0.000025*	4.12	*< 0.000025*	0.00278	*< 0.0005*
KONA_2	L2156461-2	8/30/2018 14:20	60		12	497	6.55	77.4	34	1.1	0.0465	*< 0.001*	*< 0.005*	0.418	1.85	*< 0.0015*	*< 0.05*	*< 0.5*	0.207	*< 0.00005*	0.00552	25.7	*< 0.1*	0.00318	*< 0.0001*	*< 0.00005*	4.65	*< 0.00005*	0.00323	*< 0.001*
KONA_2	L2164110-2	9/13/2018 11:45	62		14	496	6.47	78.8	35	6.5	0.0436	*< 0.001*	*< 0.005*	0.648	2.00	*< 0.0015*	*< 0.05*	*< 0.5*	0.215	*< 0.00005*	0.0095	27.1	*< 0.1*	0.00285	*< 0.0001*	*< 0.00005*	4.69	*< 0.00005*	0.00315	*< 0.001*
KONA_2	L2172409-2	9/27/2018 14:00	64		16	519	6.47	78.3	30	*< 1*	0.0206	*< 0.001*	*< 0.005*	0.492	1.84	*< 0.0015*	*< 0.05*	3.89	0.223	*< 0.00005*	*< 0.005*	25.4	*< 0.1*	0.00283	*< 0.0001*	*< 0.00005*	4.58	*< 0.00005*	0.00280	*< 0.001*
KONA_2	L2180431-2	10/12/2018 14:10	66		18	527	6.48	81.1	33	1.6	0.0420	*< 0.001*	*< 0.005*	0.534	1.71	*< 0.0015*	*< 0.05*	*< 0.5*	0.212	*< 0.00005*	0.0070	21.6	*< 0.1*	0.00276	*< 0.0001*	*< 0.00005*	4.56	*< 0.00005*	0.00262	*< 0.001*
KONA_2	L2187510-2	10/25/2018 14:00	68		20	468	6.57	83	32	*< 1*	0.860	*< 0.001*	*< 0.005*	0.51	1.49	*< 0.0015*	*< 0.05*	*< 0.5*	0.225	*< 0.00005*	0.0092	22.4	*< 0.1*	0.00329	*< 0.0001*	*< 0.00005*	5.12	*< 0.00005*	0.00290	*< 0.001*
KONA_2	L2194529-2	11/8/2018 13:40	70		22	506	6.58	84.5	31	0.64	0.080	*< 0.001*	*< 0.005*	0.498	1.54	*< 0.0015*	*< 0.05*	*< 0.5*	0.239	*< 0.000025*	0.0175	22.7	*< 0.05*	0.00314	*< 0.00005*	*< 0.000025*	5.11	*< 0.000025*	0.00282	*< 0.0005*
KONA_2	L2200705-2	11/22/2018 10:30	72		24	504	6.55	81.8	31	*< 0.5*	0.0588	*< 0.001*	*< 0.005*	0.858	1.39	*< 0.0015*	*< 0.05*	*< 0.5*	0.237	*< 0.000025*	0.0142	21.6	*< 0.05*	0.00284	*< 0.00005*	*< 0.000025*	5.05	*< 0.000025*	0.00272	*< 0.0005*
KONA_2	L2207335-2	12/6/2018 14:45	74		26	500	6.61	82.2	31	0.59	0.0645	*< 0.001*	*< 0.005*	0.600	1.29	*< 0.0015*	*< 0.05*	*< 0.5*	0.243	*< 0.00005*	0.0141	22.1	*< 0.1*	0.00291	*< 0.0001*	*< 0.00005*	4.84	*< 0.00005*	0.00267	*< 0.001*
KONA_2	L2213525-2	12/20/2018 14:25	76		28	798	6.27	151	33	0.77	0.0557	*< 0.001*	*< 0.005*	0.332	42.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.194	*< 0.00005*	0.0131	23.6	*< 0.1*	0.00756	*< 0.0001*	*< 0.00005*	9.99	*< 0.00005*	0.00582	*< 0.001*
KONA_2	L2217203-2	1/5/2019 11:35	78		30	835	5	886	10	0.73	0.184	*< 0.005*	*< 0.025*	0.446	482	*< 0.01*	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.000025*	0.0328	25.6	*< 0.05*	0.0528	0.000097	*< 0.000025*	70.4	0.000100	0.0675	*< 0.0005*
KONA_2	L2222132-2	1/17/2019 11:45	80		32	813	5.03	1354	11	0.65	0.206	*< 0.005*	*< 0.025*	0.482	786	*< 0.01*	*< 0.25*	*< 2.5*	0.10	*< 0.000005*	0.0598	25.3	*< 0.01*	0.0744	0.000213	*< 0.000005*	132	0.0000940	0.0903	*< 0.0001*
KONA_2	L2227544-2	1/31/2019 10:30	82		34	810	4.92	1501	23	0.81	0.160	*< 0.005*	*< 0.025*	0.83	879	0.0068	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.0001*	0.051	25.0	*< 0.2*	0.0601	0.00021	*< 0.0001*	175	*< 0.0001*	0.0734	*< 0.002*
KONA_2	L2233141-2	2/14/2019 14:20	84		36	716	5.03	1543	9	0.70	0.150	*< 0.01*	*< 0.05*	0.661	984	0.0064	*< 0.5*	*< 5*	*< 0.2*	*< 0.000005*	0.0426	24.0	*< 0.1*	0.0535	0.00020	*< 0.00005*	212	0.000073	0.0598	*< 0.001*
KONA_2	L2238565-2	2/28/2019 15:15	86		38	705	4.99	1573	9	0.58	0.146	*< 0.005*	*< 0.025*	0.828	971	0.0075	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.00005*	0.0420	27.7	*< 0.1*	0.0504	*< 0.0001*	*< 0.00005*	248	0.000067	0.0544	*< 0.001*
KONA_2	L2244540-2	3/14/2019 14:30	88		40	692	4.95	1596	9	0.73	0.259	*< 0.005*	*< 0.025*	*< 0.9*	954	0.0120	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.00005*	0.0341	30.1	*< 0.1*	0.0377	*< 0.0001*	*< 0.00005*	254	0.000062	0.0405	*< 0.001*
KONA_2	L2250817-2	3/28/2019 15:00	90		42	580	4.92	1603	10	0.62	0.155	*< 0.005*	*< 0.025*	0.676	971	0.019	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.00005*	0.0500	27.4	*< 0.1*	0.0326	*< 0.0001*	*< 0.00005*	315	0.000074	0.0445	*< 0.001*
KONA_2	L2257457-2	4/11/2019 15:00	92		44	702	5.18	1600	10	1.12	0.149	*< 0.01*	*< 0.05*	0.991	1020	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0199	29.6	*< 0.1*	0.0189	*< 0.0001*	*< 0.00005*	320	0.000051	0.0365	*< 0.001*
KONA_2	L2263301-2	4/25/2019 14:45	94		46	721	5.18	1640	9	0.89	0.149	*< 0.005*	*< 0.025*	0.83	966	0.0399	*< 0.25*	*< 2.5*	0.11	*< 0.00005*	0.0373	30.5	*< 0.1*	0.0110	*< 0.0001*	*< 0.00005*	323	0.000052	0.0302	*< 0.001*
KONA_3	L1955323-3	7/7/2017 13:00	0	0		583	5.79	188.6	40	2.68	0.592	*< 0.001*	*< 0.005*	0.0192	33.7	*< 0.0015*	*< 0.05*	9.08	0.275	*< 0.000005*	0.00183	0.419	0.155	0.00506	0.000013	*< 0.000005*	8.87	0.0000126	0.00254	*< 0.0001*
KONA_3	L1969885-3	8/3/2017 13:50	4	4		464	6.91	209.9	59	2.33	1.89	*< 0.001*	*< 0.005*	0.0336	29.9	*< 0.0015*	*< 0.05*	7.83	0.284	*< 0.000005*	0.00158	0.601	0.158	0.00673	0.000015	*< 0.000005*	11.3	*< 0.000005*	0.00363	*< 0.0001*
KONA_3	L1977048-3	8/17/2017 12:25	6	6		672	7.51	177.9	70	1.51	1.40	*< 0.001*	*< 0.005*	0.0336	18.5	*< 0.0015*	*< 0.05*	4.44	0.278	*< 0.000005*	0.00156	0.950	0.107	0.00585	*< 0.00001*	*< 0.000005*	9.19	*< 0.000005*	0.00304	*< 0.0001*
KONA_3	L1984769-3	8/31/2017 14:00	8	8		605	6.88	167.7	79	1.34	0.570	*< 0.001*	*< 0.005*	0.050	14.8	*< 0.0015*	*< 0.05*	3.16	0.285	*< 0.000005*	0.00380	1.06	0.103	0.00562	0.000010	*< 0.000005*	8.27	0.0000140	0.00305	*< 0.0001*
KONA_3	L1992087-3	9/14/2017 14:55	10	10		695	7.01	146.1	76	0.87	0.435	*< 0.001*	*< 0.005*	0.0942	9.68	*< 0.0015*	*< 0.05*	0.87	0.291	*< 0.000005*	0.00105	1.26	0.086	0.00482	0.000011	*< 0.000005*	7.28	0.0000068	0.00262	*< 0.0001*
KONA_3	L1999487-3	9/28/2017 11:25	12	12		503	6.84	140	75	0.59	0.480	*< 0.001*	*< 0.005*	0.083	7.63	*< 0.0015*	*< 0.05*	1.08	0.295	*< 0.000005*	0.00263	1.15	0.077	0.00490	*< 0.00001*	*< 0.000005*	7.34	*< 0.000005*	0.00247	*< 0.0001*
KONA_3	L2007130-3	10/13/2017 11:25	14	14		758	6.84	127.9	69	0.71	0.467	*< 0.001*	*< 0.005*	0.093	5.23	*< 0.0015*	*< 0.05*	0.58	0.333	*< 0.000005*	0.00173	1.60	0.068	0.00482	*< 0.00001*	*< 0.000005*	6.40	*< 0.000005*	0.00232	*< 0.0001*
KONA_3	L2014335-3	10/26/2017 11:50	16	16		223	6.95	117.6	63	0.61	0.470	*< 0.001*	*< 0.005*	0.097	3.63	*< 0.0015*	*< 0.05*	*< 0.5*	0.354	*< 0.000005*	0.00206	1.57	0.054	0.00344	*< 0.00001*	*< 0.000005*	5.72	*< 0.000005*	0.00197	*< 0.0001*
KONA_3	L2020126-3	11/8/2017 12:30	18	18		530	7.09	115	65	0.61	0.441	*< 0.001*	*< 0.005*	0.108	3.49	*< 0.0015*	*< 0.05*	*< 0.5*	0.385	*< 0.000005*	*< 0.002*	1.65	0.048	0.00407	*< 0.00001*	*< 0.000005*	5.84	0.0000062	0.00202	*< 0.0001*
KONA_3	L2026623-3	11/23/2017 14:15	20	20		590	6.93	105.9	59	*< 0.5*	0.427	*< 0.001*	*< 0.005*	0.121	2.30	*< 0.0015*	*< 0.05*	*< 0.5*	0.365	*< 0.000005*	0.00190	1.84	0.043	0.00365	*< 0.00001*	*< 0.000005*	5.24	*< 0.000005*	0.00189	*< 0.0001*
KONA_3	L2031965-3	12/6/2017 14:05	22	22		506	7.13	104.7	61	0.98	0.409	*< 0.001*	*< 0.005*	0.122	1.94	*< 0.0015*	*< 0.05*	*< 0.5*	0.365	*< 0.000005*	0.00226	1.81	0.033	0.00350	*< 0.00001*	*< 0.000005*	5.03	*< 0.000005*	0.00186	*< 0.0001*
KONA_3	L2038563-3	12/21/2017 13:50	24	24		705	6.9	98.4	59	*< 0.5*	0.361	*< 0.001*	*< 0.005*	0.134	1.49	*< 0.0015*	*< 0.05*	*< 0.5*	0.374	*< 0.000005*	0.00164	1.90	0.031	0.00306	*< 0.00001*	*< 0.000005*	4.94	*< 0.000005*	0.00172	*< 0.0001*
KONA_3	L2041649-3	1/4/2018 13:05	26	26		509	6.98	99.3	57	0.70	0.392	*< 0.001*	*< 0.005*	0.126	1.60	*< 0.0015*	*< 0.05*	*< 0.5*	0.374	*< 0.000005*	0.00139	1.72	0.028	0.00283	*< 0.00001*	*< 0.000005*	4.91	*< 0.000005*	0.00170	*< 0.0001*
KONA_3	L2046871-3	1/18/2018 11:25	28	28		567	6.99	96.8	59	*< 0.5*	0.356	*< 0.001*	*< 0.005*	0.156	1.51	*< 0.0015*	*< 0.05*	*< 0.5*	0.391	*< 0.000005*	0.00183	2.02	0.034	0.00302	*< 0.00001*	*< 0.000005*	5.12	0.0000060	0.00170	*< 0.0001*
KONA_3	L2052061-3	2/1/2018 12:10	30	30		575	6.96	99.6	60	0.58	0.367	*< 0.001*	*< 0.005*	0.173	1.52	*< 0.0015*	*< 0.05*	*< 0.5*	0.399	*< 0.000005*	0.00177	2.13	0.024	0.00287	*< 0.00001*	*< 0.000005*	4.87	*< 0.000005*	0.00171	*< 0.0001*
KONA_3	L2057381-3	2/15/2018 11:35	32	32		529	7.08	95.2	56	*< 0.5*	0.352	*< 0.001*	*< 0.005*	0.172	1.35	*< 0.0015*	*< 0.05*	*< 0.5*	0.388	*< 0.000005*	0.00133	2.12	0.022	0.00329	*< 0.00001*	*< 0.000005*	4.49	0.0000054	0.00169	*< 0.0001*
KONA_3	L2062788-3	3/1/2018 13:25	34	34		567	6.97	92.3	62	*< 0.5*	0.343	*< 0.001*	*< 0.005*	0.147	1.30	*< 0.0015*	*< 0.05*	*< 0.5*	0.393	*< 0.000005*	0.00137	2.26	0.021	0.00263	*< 0.00001*	*< 0.000005*	4.85	*< 0.000005*	0.00148	*< 0.0001*
KONA_3	L2068449-3	3/15/2018 11:40	36	36		556	6.97	91.2	60	*< 0.5*	0.349	*< 0.001*	*< 0.005*	0.156	1.23	*< 0.0015*	*< 0.05*	*< 0.5*	0.407	*< 0.000005*	0.00143	2.34	0.020	0.00257	*< 0.00001*	*< 0.000005*	4.35	*< 0.000005*	0.00124	*< 0.0001*
KONA_3	L2074311-3	3/29/2018 11:20	38	38		372	7	91.7	57	*< 0.5*	0.376	*< 0.001*	*< 0.005*	0.131	1.46	*< 0.0015*	*< 0.05*	*< 0.5*	0.402	*< 0.000005*	0.00115	2.10	0.020	0.00217	*< 0.00001*	*< 0.000005*	4.41	*< 0.000005*	0.000868	*< 0.0001*
KONA_3	L2079620-3	4/12/2018 11:00	40	40		567	6.89	91.2	55	*< 0.5*	0.334	*< 0.001*	*< 0.005*	0.126	1.25	*< 0.0015*	*< 0.05*	*< 0.5*	0.422	*< 0.000005*	0.00212	2.31	0.017	0.00243	*< 0.00001*	*< 0.000005*	4.24	*< 0.000005*	0.000944	*< 0.0001*
KONA_3	L2085708-3	4/26/2018 13:40	42	42		566	6.91	87.4	49	*< 0.5*	0.297	*< 0.001*	*< 0.005*	0.309	1.08	*< 0.0015*	*< 0.05*	*< 0.5*	0.405	*< 0.000005*	0.00208	2.58	0.015	0.00237	*< 0.00001*	*< 0.000005*	4.09	0.0000055	0.000930	*< 0.0001*
KONA_3	L2092801-3	5/10/2018 11:15	44	44		572	6.97	85.6	52	*< 0.5*	0.285	*< 0.001*	*< 0.005*	0.166	1.04	*< 0.0015*	*< 0.05*	*< 0.5*	0.412	*< 0.000005*	0.00213	2.75	0.016	0.00207	*< 0.00001*	*< 0.000005*	4.16	0.0000052	0.000786	*< 0.0001*
KONA_3	L2100224-3	5/24/2018 14:00	46	46		486	6.83	86	50	0.54	0.304	*< 0.001*	*< 0.005*	0.196	1.13	*< 0.0015*	*< 0.05*	*< 0.5*	0.431	*< 0.000005*	0.00486	3.07	0.015	0.00188	*< 0.00001*	*< 0.000005*	3.88	*< 0.000005*	0.000509	*< 0.0001*
KONA_3	L2108434-3	6/7/2018 13:30	48		0	496	7.11	81.5	57	0.52	0.291	*< 0.001*	*< 0.005*	0.217	1.05	*< 0.0015*	*< 0.05*	*< 0.5*	0.421	*< 0.000005*	0.00563	3.16	0.016	0.00153	*< 0.00001*	*< 0.000005*	3.98	*< 0.000005*	0.000358	*< 0.0001*
KONA_3	L2116986-3	6/21/2018 14:00	50		2	408	7.15	88.8	51	*< 1*	0.302	*< 0.001*	*< 0.005*	0.193	1.09	*< 0.003*	*< 0.05*	*< 0.5*	0.455	*< 0.000005*	0.00417	2.91	0.015	0.00126	*< 0.00001*	*< 0.000005*	3.82	*< 0.000005*	0.000247	*< 0.0001*
KONA_3	L2125321-3	7/6/2018 11:30	52		4	498	7.08	88.7	53	1.2	0.273	*< 0.001*	*< 0.005*	0.205	1.05	*< 0.0015*	*< 0.05*	*< 0.5*	0.440	*< 0.000005*	0.00688	3.35	0.015	0.00123	*< 0.00001*	*< 0.000005*	3.75	0.0000057	0.000261	*< 0.0001*
KONA_3	L2132784-3	7/19/2018 14:45	54		6	494	7.13	87.2	48	0.94	0.265	*< 0.001*	*< 0.005*	0.231	0.99	*< 0.0015*	*< 0.05*	*< 0.5*	0.453	*< 0.000005*	0.0127	3.55	0.014	0.00116	*< 0.00001*	*< 0.000005*	3.74	*< 0.000005*	0.000219	*< 0.0001*
KONA_3	L2140795-3	8/2/2018 13:30	56		8	483	7.01	86.2	42	1.5	0.235	*< 0.001*	*< 0.005*	0.216	1.14	*< 0.0015*	*< 0.05*	*< 0.5*	0.444	*< 0.000005*	0.00915	3.53	0.015	0.00118	*< 0.00001*	*< 0.000005*	3.91	*< 0.000005*	0.000164	*< 0.0001*
KONA_3	L2148482-3	8/16/2018	58		10	531	7.11	87.6	48	0.53	0.257	*< 0.001*	*< 0.005*	0.269	0.79	*< 0.0015*	*< 0.05*	*< 0.5*	0.474	*< 0.000005*	0.0121	4.28	0.013	0.00109	*< 0.00001*	*< 0.000005*	3.68	*< 0.000005*	0.000225	*< 0.0001*
KONA_3	L2156461-3	8/30/2018 14:20	60		12	533	6.96	83.5	47	*< 1*	0.246	*< 0.001*	*< 0.005*	0.219	0.71	*< 0.0015*	*< 0.05*	*< 0.5*	0.460	*< 0.000005*	0.00662	4.56	0.013	0.00111	*< 0.00001*	*< 0.000005*	3.51	0.0000079	0.000323	*< 0.0001*
KONA_3	L2164110-3	9/13/2018 11:45	62		14	548	7	83.2	46	*< 1*	0.234	*< 0.001*	*< 0.005*	0.282	0.84	*< 0.0015*	*< 0.05*	*< 0.5*	0.455	*< 0.000005*	0.0139	4.81	0.012	0.00116	*< 0.00001*	*< 0.000005*	3.62	*< 0.000005*	0.000256	*< 0.0001*
KONA_3	L2172409-3	9/27/2018 14:00	64		16	565	7.07	82.7	43	*< 1*	0.240	*< 0.001*	*< 0.005*	0.268	0.80	*< 0.0015*	*< 0.05*	*< 0.5*	0.472	*< 0.00001*	0.0108	4.60	*< 0.02*	0.00112	*< 0.00002*	*< 0.00001*	3.44	*< 0.00001*	0.000258	*< 0.0002*
KONA_3	L2180431-3	10/12/2018 14:10	66		18	555	7.01	81.6	42	*< 1*	0.236	*< 0.001*	*< 0.005*	0.277	0.67	*< 0.0015*	*< 0.05*	*< 0.5*	0.431	*< 0.00001*	0.0108	4.59	*< 0.02*	0.00106	*< 0.00002*	*< 0.00001*	3.46	*< 0.00001*	0.000235	*< 0.0002*
KONA_3	L2187510-3	10/25/2018 14:00	68		20	497	7	80	45	*< 1*	0.223	*< 0.001*	*< 0.005*	0.434	0.58	*< 0.0015*	*< 0.05*	*< 0.5*	0.445	*< 0.000005*	0.0226	4.47	0.010	0.00101	*< 0.00001*	*< 0.000005*	3.26	*< 0.000005*	0.000206	*< 0.0001*
KONA_3	L2194529-3	11/8/2018 13:40	70		22	544	7.14	82	40	0.56	0.481	0.0010	0.0217	0.46	0.63	*< 0.0015*	*< 0.05*	*< 0.5*	0.470	*< 0.000005*	0.0308	4.88	0.011	0.00116	*< 0.00001*	*< 0.000005*	3.52	0.0000051	0.000200	*< 0.0001*
KONA_3	L2200705-3	11/22/2018 10:30	72		24	535	7.09	78.6	42	*< 0.5*	0.216	*< 0.001*	*< 0.005*	0.373	0.58	*< 0.0015*	*< 0.05*	*< 0.5*	0.464	*< 0.000005*	0.0144	4.73	*< 0.01*	0.000859	*< 0.00001*	*< 0.000005*	3.20	*< 0.000005*	0.000174	*< 0.0001*
KONA_3	L2207335-3	12/6/2018 14:45	74		26	543	7.04	78.2	40	0.52	0.207	*< 0.001*	*< 0.005*	0.328	0.53	*< 0.0015*	*< 0.05*	*< 0.5*	0.465	*< 0.000005*	0.0219	5.04	*< 0.01*	0.000975	*< 0.00001*	*< 0.000005*	3.26	*< 0.000005*	0.000155	*< 0.0001*
KONA_3	L2213525-3	12/20/2018 14:25	76		28	901	6.82	524	44	0.59	0.320	*< 0.001*	*< 0.005*	0.083	232	*< 0.0015*	*< 0.05*	*< 0.5*	0.267	*< 0.00001*	0.0024	2.48	*< 0.02*	0.0189	*< 0.00002*	*< 0.00001*	62.5	0.000054	0.00493	*< 0.0002*
KONA_3	L2217203-3	1/5/2019 11:35	78		30	859	6.06	1020	20	0.61	0.444	*< 0.005*	*< 0.025*	0.020	557	*< 0.01*	*< 0.25*	*< 2.5*	0.13	*< 0.00005*	*< 0.005*	1.63	*< 0.1*	0.0526	*< 0.0001*	*< 0.00005*	137	0.000110	0.0177	*< 0.001*
KONA_3	L2222132-3	1/17/2019 11:45	80		32	772	6.04	1336	20	*< 0.5*	0.462	*< 0.005*	*< 0.025*	0.0056	756	*< 0.0067*	*< 0.25*	*< 2.5*	0.14	*< 0.000005*	0.00587	1.21	*< 0.01*	0.0808	0.000053	*< 0.000005*	209	0.000177	0.0360	*< 0.0001*
KONA_3	L2227544-3	1/31/2019 10:30	82		34	771	6.14	1509	17	0.62	0.427	*< 0.005*	*< 0.025*	0.0194	893	*< 0.0015*	*< 0.25*	*< 2.5*	0.14	*< 0.0001*	*< 0.01*	0.939	*< 0.2*	0.0884	*< 0.0002*	*< 0.0001*	248	0.00017	0.0499	*< 0.002*

Appendix A2: Granite Column (Kona 1-4) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**
KONA_3	L2233141-3	2/14/2019 14:20	84		36	770	6.12	1566	20	*< 0.5*	0.358	*< 0.01*	*< 0.05*	0.014	987	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*	*< 0.0001*	0.010	0.890	*< 0.2*	0.0897	*< 0.0002*	*< 0.0001*	264	0.00018	0.0638	*< 0.002*
KONA_3	L2238565-3	2/28/2019 15:15	86		38	785	5.99	1596	19	0.61	0.310	*< 0.005*	*< 0.025*	0.0324	969	*< 0.0015*	*< 0.25*	*< 2.5*	0.12	*< 0.00005*	0.0300	1.03	*< 0.1*	0.0974	*< 0.0001*	*< 0.00005*	299	0.000165	0.0735	*< 0.001*
KONA_3	L2244540-3	3/14/2019 14:30	88		40	764	6.08	1610	18	*< 0.5*	0.301	*< 0.005*	*< 0.025*	*< 0.02*	991	*< 0.0015*	*< 0.25*	*< 2.5*	0.10	*< 0.00005*	0.0053	1.33	*< 0.1*	0.106	*< 0.0001*	*< 0.00005*	294	0.000159	0.0674	*< 0.001*
KONA_3	L2250817-3	3/28/2019 15:00	90		42	738	5.98	1614	16	0.54	0.292	*< 0.005*	*< 0.025*	0.0547	969	*< 0.01*	*< 0.25*	*< 2.5*	0.12	*< 0.00005*	0.0090	1.32	*< 0.1*	0.0968	*< 0.0001*	*< 0.00005*	345	0.000140	0.0762	*< 0.001*
KONA_3	L2257457-3	4/11/2019 15:00	92		44	577	5.98	1597	13	0.74	0.320	*< 0.01*	*< 0.05*	0.0059	1000	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0124	0.251	*< 0.1*	0.0943	*< 0.0001*	*< 0.00005*	343	0.000149	0.0588	*< 0.001*
KONA_3	L2263301-3	4/25/2019 14:45	94		46	765	5.97	1646	15	0.69	0.275	*< 0.005*	*< 0.025*	0.0131	962	*< 0.0015*	*< 0.25*	*< 2.5*	0.14	*< 0.00005*	0.0163	0.731	*< 0.1*	0.0769	*< 0.0001*	*< 0.00005*	334	0.000165	0.0427	*< 0.001*
KONA_4	L1955323-4	7/7/2017 13:00	0	0		524	7.53	365	55	3.50	0.150	*< 0.001*	*< 0.005*	0.0026	37.2	*< 0.0015*	*< 0.05*	20.5	0.331	*< 0.000005*	0.00393	0.132	0.177	0.0390	*< 0.00001*	*< 0.000005*	36.7	0.0000152	0.000788	*< 0.0001*
KONA_4	L1969885-4	8/3/2017 13:50	4	4		467	7.39	388	132	2.59	0.234	*< 0.001*	*< 0.005*	0.0021	34.2	*< 0.0015*	*< 0.05*	16.5	0.329	*< 0.000005*	0.00271	0.259	0.182	0.0415	0.000014	*< 0.000005*	39.8	0.0000275	0.00108	*< 0.0001*
KONA_4	L1977048-4	8/17/2017 12:25	6	6		674	7.36	335	154	2.22	0.214	*< 0.001*	*< 0.005*	0.0084	18.7	*< 0.0015*	*< 0.05*	9.16	0.327	*< 0.000005*	0.00315	0.452	0.139	0.0428	*< 0.00001*	*< 0.000005*	33.6	0.0000247	0.00126	*< 0.0001*
KONA_4	L1984769-4	8/31/2017 14:00	8	8		623	7.32	288.1	156	1.31	0.234	*< 0.001*	*< 0.005*	0.0111	10.3	*< 0.0015*	*< 0.05*	4.85	0.354	*< 0.000005*	0.00494	0.445	0.119	0.0363	*< 0.00001*	*< 0.000005*	27.0	0.0000185	0.00118	*< 0.0001*
KONA_4	L1992087-4	9/14/2017 14:55	10	10		723	7.24	240.9	130	0.77	0.216	*< 0.001*	*< 0.005*	0.0041	4.39	*< 0.0015*	*< 0.05*	*< 0.5*	0.391	*< 0.000005*	0.00329	0.489	0.087	0.0286	0.000012	*< 0.000005*	21.3	0.0000110	0.000938	*< 0.0001*
KONA_4	L1999487-4	9/28/2017 11:25	12	12		512	7.32	225.6	133	0.54	0.235	*< 0.001*	*< 0.005*	0.0147	3.30	*< 0.0015*	*< 0.05*	0.94	0.395	*< 0.000005*	0.00405	0.429	0.071	0.0299	*< 0.00001*	*< 0.000005*	21.4	0.0000123	0.000930	*< 0.0001*
KONA_4	L2007130-4	10/13/2017 11:25	14	14		547	7.33	201.2	115	0.57	0.209	*< 0.001*	*< 0.005*	0.0094	3.40	*< 0.0015*	*< 0.05*	0.62	0.416	*< 0.000005*	0.00286	0.369	0.059	0.0271	*< 0.00001*	*< 0.000005*	19.2	0.0000179	0.000878	*< 0.0001*
KONA_4	L2014335-4	10/26/2017 11:50	16	16		228	7.22	114.1	67	*< 0.5*	0.0186	*< 0.001*	*< 0.005*	*< 0.002*	1.65	*< 0.0015*	*< 0.05*	*< 0.5*	0.224	*< 0.000005*	0.00297	0.247	0.023	0.0113	0.000010	*< 0.000005*	9.31	*< 0.000005*	0.000473	*< 0.0001*
KONA_4	L2020126-4	11/8/2017 12:30	18	18		534	7.35	113.2	65	0.77	*< 0.005*	*< 0.001*	*< 0.005*	0.0050	2.15	*< 0.0015*	*< 0.05*	*< 0.5*	0.283	*< 0.000005*	*< 0.003*	0.260	0.023	0.0137	0.000010	*< 0.000005*	9.64	0.0000061	0.000483	*< 0.0001*
KONA_4	L2026623-4	11/23/2017 14:15	20	20		595	7.32	166.5	97	*< 0.5*	0.145	*< 0.001*	*< 0.005*	0.0028	2.14	*< 0.0015*	*< 0.05*	*< 0.5*	0.352	*< 0.000005*	0.00296	0.334	0.031	0.0179	*< 0.00001*	*< 0.000005*	15.4	*< 0.000005*	0.000705	*< 0.0001*
KONA_4	L2031965-4	12/6/2017 14:05	22	22		513	7.35	174.3	93	0.51	0.179	*< 0.001*	*< 0.005*	0.0142	2.39	*< 0.0015*	*< 0.05*	*< 0.5*	0.387	*< 0.000005*	0.00250	0.368	0.027	0.0197	*< 0.00001*	*< 0.000005*	16.6	0.0000113	0.000709	*< 0.0001*
KONA_4	L2038563-4	12/21/2017 13:50	24	24		616	7.78	160.8	97	*< 0.5*	0.140	*< 0.001*	*< 0.005*	0.0081	1.78	*< 0.0015*	*< 0.05*	*< 0.5*	0.415	*< 0.000005*	0.00185	0.429	0.024	0.0201	*< 0.00001*	*< 0.000005*	14.2	0.0000131	0.000647	*< 0.0001*
KONA_4	L2041649-4	1/4/2018 13:05	26	26		442	7.34	141.6	82	0.80	0.109	*< 0.001*	*< 0.005*	0.0028	3.21	*< 0.0015*	*< 0.05*	*< 0.5*	0.352	*< 0.000005*	0.00243	0.268	0.020	0.0157	*< 0.00001*	*< 0.000005*	12.6	0.0000080	0.000625	*< 0.0001*
KONA_4	L2046871-4	1/18/2018 11:25	28	28		531	7.36	155.5	91	*< 0.5*	0.152	*< 0.001*	*< 0.005*	0.0073	2.72	*< 0.0015*	*< 0.05*	*< 0.5*	0.392	*< 0.000005*	0.00312	0.351	0.021	0.0179	*< 0.00001*	*< 0.000005*	14.4	0.0000149	0.000649	*< 0.0001*
KONA_4	L2052061-4	2/1/2018 12:10	30	30		547	7.3	155.6	94	0.75	0.155	*< 0.001*	*< 0.005*	0.0117	2.48	*< 0.0015*	*< 0.05*	*< 0.5*	0.420	*< 0.000005*	0.00248	0.384	0.019	0.0171	0.000011	*< 0.000005*	14.9	0.0000114	0.000640	*< 0.0001*
KONA_4	L2057381-4	2/15/2018 11:35	32	32		511	7.38	147.4	86	0.58	0.122	*< 0.001*	*< 0.005*	0.0076	2.42	*< 0.0015*	*< 0.05*	*< 0.5*	0.406	*< 0.000005*	0.00231	0.366	0.017	0.0164	*< 0.00001*	*< 0.00001*	14.0	0.0000108	0.000549	*< 0.0001*
KONA_4	L2062788-4	3/1/2018 13:25	34	34		559	7.22	116	81	*< 0.5*	0.0390	*< 0.001*	*< 0.005*	0.0076	1.90	*< 0.0015*	*< 0.05*	*< 0.5*	0.339	*< 0.000005*	0.00331	0.314	0.013	0.0118	*< 0.00001*	*< 0.000005*	10.7	0.0000094	0.000452	*< 0.0001*
KONA_4	L2068449-4	3/15/2018 11:40	36	36		548	7.27	114.9	81	*< 0.5*	0.0306	*< 0.001*	*< 0.005*	0.0034	1.95	*< 0.0015*	*< 0.05*	*< 0.5*	0.332	*< 0.000005*	0.00403	0.295	0.011	0.0116	*< 0.00001*	*< 0.000005*	9.39	*< 0.000005*	0.000425	*< 0.0001*
KONA_4	L2074311-4	3/29/2018 11:20	38	38		364	7.37	126.3	76	*< 0.5*	0.0646	*< 0.001*	*< 0.005*	0.0125	2.58	*< 0.0015*	*< 0.05*	*< 0.5*	0.354	*< 0.000005*	0.00201	0.283	0.012	0.0137	0.000014	0.0000095	11.2	0.0000116	0.000509	*< 0.0001*
KONA_4	L2079620-4	4/12/2018 11:00	40	40		576	7.21	125.4	74	*< 0.5*	0.0535	*< 0.001*	*< 0.005*	0.0098	2.02	*< 0.0015*	*< 0.05*	*< 0.5*	0.366	*< 0.000005*	0.00332	0.320	0.013	0.0133	*< 0.00001*	*< 0.000005*	11.6	0.0000083	0.000439	*< 0.0001*
KONA_4	L2085708-4	4/26/2018 13:40	42	42		552	7.23	126.8	73	*< 0.5*	0.0660	*< 0.001*	*< 0.005*	0.0162	1.89	*< 0.0015*	*< 0.05*	*< 0.5*	0.370	*< 0.000005*	0.00364	0.354	0.012	0.0138	*< 0.00001*	*< 0.000005*	11.6	0.0000084	0.000426	*< 0.0001*
KONA_4	L2092801-4	5/10/2018 11:15	44	44		571	7.32	128.3	76	*< 0.5*	0.0735	*< 0.001*	*< 0.005*	0.0235	1.72	*< 0.0015*	*< 0.05*	*< 0.5*	0.389	*< 0.000005*	0.00691	0.391	0.013	0.0138	*< 0.00001*	*< 0.000005*	12.2	0.0000117	0.000464	*< 0.0001*
KONA_4	L2100224-4	5/24/2018 14:00	46	46		476	7.23	131.8	80	0.54	0.0937	*< 0.001*	*< 0.005*	0.0259	2.01	*< 0.0015*	*< 0.05*	*< 0.5*	0.423	*< 0.000005*	0.00432	0.455	0.012	0.0150	*< 0.00001*	*< 0.000005*	11.5	0.0000084	0.000458	*< 0.0001*
KONA_4	L2108434-4	6/7/2018 13:30	48		0	499	7.51	126.8	86	0.51	0.0916	*< 0.001*	*< 0.005*	0.0187	1.78	*< 0.0015*	*< 0.05*	*< 0.5*	0.429	*< 0.000005*	0.00365	0.440	0.014	0.0136	*< 0.00001*	*< 0.000005*	11.5	0.0000095	0.000433	*< 0.0001*
KONA_4	L2116986-4	6/21/2018 14:00	50		2	486	7.55	128.4	79	*< 1*	0.0691	*< 0.001*	*< 0.005*	0.0412	1.78	*< 0.0015*	*< 0.05*	*< 0.5*	0.436	*< 0.000005*	0.00565	0.391	0.011	0.0129	*< 0.00001*	*< 0.000005*	10.8	0.0000074	0.000379	*< 0.0001*
KONA_4	L2125321-4	7/6/2018 11:30	52		4	487	7.6	128	76	1.3	0.0591	*< 0.001*	*< 0.005*	0.0214	1.85	*< 0.0015*	*< 0.05*	*< 0.5*	0.434	*< 0.000005*	0.00492	0.413	0.011	0.0126	*< 0.00001*	*< 0.000005*	10.5	0.0000100	0.000307	*< 0.0001*
KONA_4	L2132784-4	7/19/2018 14:45	54		6	488	7.66	127.7	87	0.63	0.0754	*< 0.001*	*< 0.005*	0.0246	1.75	*< 0.0015*	*< 0.05*	*< 0.5*	0.455	*< 0.000005*	0.00695	0.444	0.011	0.0120	*< 0.00001*	*< 0.000005*	10.7	0.0000088	0.000233	*< 0.0001*
KONA_4	L2140795-4	8/2/2018 13:30	56		8	482	7.52	125.7	73	1.7	0.0721	0.0015	*< 0.005*	0.0187	1.77	*< 0.0015*	*< 0.05*	*< 0.5*	0.449	*< 0.000005*	0.00501	0.450	0.012	0.0122	*< 0.00001*	*< 0.000005*	10.8	0.0000086	0.000169	*< 0.0001*
KONA_4	L2148482-4	8/16/2018	58		10	496	7.58	127.8	82	*< 0.5*	0.0499	*< 0.001*	*< 0.005*	0.0287	1.41	*< 0.0015*	*< 0.05*	*< 0.5*	0.458	*< 0.000005*	0.00487	0.474	0.011	0.0112	*< 0.00001*	*< 0.000005*	9.93	0.0000085	0.000112	*< 0.0001*
KONA_4	L2156461-4	8/30/2018 14:20	60		12	489	7.45	121.6	70	*< 1*	0.0483	*< 0.001*	0.0061	0.0319	1.36	*< 0.0015*	*< 0.05*	*< 0.5*	0.449	*< 0.000005*	0.00541	0.545	0.011	0.0113	*< 0.00001*	*< 0.000005*	9.83	0.0000125	0.0000758	*< 0.0001*
KONA_4	L2164110-4	9/13/2018 11:45	62		14	496	7.46	121.1	71	0.89	0.0594	*< 0.001*	*< 0.005*	0.0299	1.47	*< 0.0015*	*< 0.05*	*< 0.5*	0.454	*< 0.000005*	0.00380	0.569	0.010	0.0106	*< 0.00001*	*< 0.000005*	10.2	0.0000088	0.0000659	*< 0.0001*
KONA_4	L2172409-4	9/27/2018 14:00	64		16	550	7.46	115.8	65	*< 0.5*	0.0389	*< 0.001*	*< 0.005*	0.0392	1.21	*< 0.0015*	*< 0.05*	*< 0.5*	0.474	*< 0.000005*	0.00513	0.564	*< 0.01*	0.00877	*< 0.00001*	*< 0.000005*	9.10	0.0000068	0.0000468	*< 0.0001*
KONA_4	L2180431-4	10/12/2018 14:10	66		18	548	7.35	114.8	67	1.1	0.0447	*< 0.001*	*< 0.005*	0.0415	1.00	*< 0.0015*	*< 0.05*	*< 0.5*	0.438	*< 0.000005*	0.00635	0.554	*< 0.01*	0.00812	*< 0.00001*	*< 0.000005*	9.17	*< 0.000005*	0.0000360	*< 0.0001*
KONA_4	L2187510-4	10/25/2018 14:00	68		20	490	7.48	114	65	*< 1*	0.0389	*< 0.001*	*< 0.005*	0.0316	0.87	*< 0.0015*	*< 0.05*	*< 0.5*	0.462	*< 0.000005*	0.00837	0.568	*< 0.01*	0.00732	*< 0.00001*	*< 0.000005*	8.76	0.0000068	0.0000412	0.00022
KONA_4	L2194529-4	11/8/2018 13:40	70		22	540	7.52	111.5	58	0.56	0.0386	0.0011	*< 0.005*	0.0376	0.92	*< 0.0015*	*< 0.05*	*< 0.5*	0.472	*< 0.000005*	0.00852	0.609	*< 0.01*	0.00733	*< 0.00001*	*< 0.000005*	8.42	0.0000061	0.0000270	*< 0.0001*
KONA_4	L2200705-4	11/22/2018 10:30	72		24	531	7.43	105.5	59	*< 0.5*	0.0212	*< 0.001*	*< 0.005*	0.0538	0.82	*< 0.0015*	*< 0.05*	*< 0.5*	0.462	*< 0.000005*	0.00728	0.606	*< 0.01*	0.00651	*< 0.00001*	*< 0.000005*	7.99	*< 0.000005*	0.0000249	*< 0.0001*
KONA_4	L2207335-4	12/6/2018 14:45	74		26	529	7.35	105.2	58	*< 0.5*	0.0240	*< 0.001*	*< 0.005*	0.0436	0.80	*< 0.0015*	*< 0.05*	*< 0.5*	0.467	*< 0.000005*	0.00618	0.614	*< 0.01*	0.00689	*< 0.00001*	*< 0.000005*	8.28	0.0000056	0.0000258	*< 0.0001*
KONA_4	L2213525-4	12/20/2018 14:25	76		28	865	7.41	423	54	0.58	*< 0.005*	*< 0.001*	*< 0.005*	0.0180	162	*< 0.0015*	*< 0.05*	*< 0.5*	0.371	*< 0.000005*	0.00134	0.699	*< 0.01*	0.0428	*< 0.00001*	*< 0.000005*	56.3	0.0000426	0.00157	*< 0.0001*
KONA_4	L2217203-4	1/5/2019 11:35	78		30	799	6.54	1004	31	*< 0.5*	0.0913	*< 0.005*	*< 0.025*	*< 0.01*	545	*< 0.0067*	*< 0.25*	*< 2.5*	0.20	*< 0.000025*	0.0026	0.185	*< 0.05*	0.154	*< 0.00005*	*< 0.000025*	149	0.000078	0.00692	*< 0.0005*
KONA_4	L2222132-4	1/17/2019 11:45	80		32	791	6.13	1421	20	*< 0.5*	0.139	*< 0.005*	*< 0.025*	*< 0.002*	816	*< 0.0067*	*< 0.25*	*< 2.5*	0.13	*< 0.000005*	0.00106	0.0558	*< 0.01*	0.250	0.000066	*< 0.000005*	244	0.0000959	0.0163	*< 0.0001*
KONA_4	L2227544-4	1/31/2019 10:30	82		34	786	6.01	1591	38	*< 0.5*	0.161	*< 0.01*	*< 0.05*	*< 0.003*	920	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0069	0.0287	*< 0.1*	0.138	0.00012	*< 0.00005*	286	0.000116	0.0167	*< 0.001*
KONA_4	L2233141-4	2/14/2019 14:20	84		36	735	6.05	1601	17	*< 0.5*	0.149	*< 0.01*	*< 0.05*	0.0020	1010	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0068	0.0287	*< 0.1*	0.0891	0.00022	*< 0.00005*	290	0.000085	0.0148	*< 0.001*
KONA_4	L2238565-4	2/28/2019 15:15	86		38	735	5.96	1609	17	*< 0.5*	0.136	*< 0.005*	*< 0.025*	*< 0.002*	984	*< 0.0015*	*< 0.25*	*< 2.5*	0.13	*< 0.000025*	0.0135	0.0162	*< 0.05*	0.0760	0.000186	*< 0.000025*	317	0.000075	0.0110	*< 0.0005*
KONA_4	L2244540-4	3/14/2019 14:30	88		40	720	5.96	1616	14	*< 0.5*	0.126	*< 0.005*	*< 0.025*	*< 0.002*	968	*< 0.0015*	*< 0.25*	*< 2.5*	0.13	*< 0.000025*	0.0083	0.0142	*< 0.05*	0.0726	0.000153	*< 0.000025*	300	0.000058	0.00760	0.00050
KONA_4	L2250817-4	3/28/2019 15:00	90		42	702	5.88	1619	18	*< 0.5*	0.132	*< 0.005*	*< 0.025*	*< 0.002*	986	*< 0.01*	*< 0.25*	*< 2.5*	0.14	*< 0.000025*	0.0102	0.0115	*< 0.05*	0.0589	0.000158	*< 0.000025*	359	0.000060	0.00718	*< 0.0005*
KONA_4	L2257457-4	4/11/2019 15:00	92		44	707	6.03	1611	16	0.56	0.110	*< 0.01*	*< 0.05*	*< 0.002*	1010	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000025*	0.0054	0.00598	*< 0.05*	0.0520	0.000158	*< 0.000025*	334	0.000041	0.00618	*< 0.0005*
KONA_4	L2263301-4	4/25/2019 14:45	94		46	730	6.06	1648	18	0.57	0.102	*< 0.005*	*< 0.025*	*< 0.002*	956	*< 0.0015*	*< 0.25*	*< 2.5*	0.14	*< 0.000025*	0.0048	0.00674	*< 0.05*	0.0495	0.000110	*< 0.000025*	344	0.000039	0.00513	*< 0.0005*

Notes:
Results in blue italics are below the indicated detection limit

Appendix A2: Granite Column (Kona 1-4) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cs**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
KONA_1	L1955323-1	7/7/2017 13:00	0.000429	0.00019	0.0064	0.0000106	7.42	0.00284	2.08	0.994	0.00164	7.81	0.000477	*< 0.05*	0.0000181	0.0130	0.00415	4.23	0.000085	7.05	0.000021	0.0427	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000213	0.00125	0.000150	0.00012	0.00209	*< 0.00006*
KONA_1	L1969885-1	8/3/2017 13:50	0.000517	0.00044	0.0580	*< 0.000005*	8.64	0.00303	2.92	1.68	0.00169	9.11	0.000903	*< 0.05*	0.000157	0.0166	0.00285	3.82	0.000102	9.77	0.000014	0.0541	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000274	0.00197	0.000185	0.00011	0.00339	*< 0.00006*
KONA_1	L1977048-1	8/17/2017 12:25	0.000396	*< 0.0001*	0.130	0.0000061	6.77	0.00251	2.15	1.17	0.00124	7.89	0.000546	*< 0.05*	0.0000087	0.0128	0.00192	2.56	0.000241	7.59	*< 0.00001*	0.0439	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000215	0.00125	0.000125	*< 0.0001*	0.00132	*< 0.00006*
KONA_1	L1984769-1	8/31/2017 14:00	0.000399	0.00014	0.181	*< 0.000005*	6.97	0.00214	2.20	1.29	0.00124	8.04	0.000487	*< 0.05*	0.0000136	0.0127	0.00194	1.73	0.000057	8.22	*< 0.00001*	0.0408	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000209	0.00113	0.000150	*< 0.0001*	0.00241	*< 0.00006*
KONA_1	L1992087-1	9/14/2017 14:55	0.000334	*< 0.0001*	0.201	*< 0.000005*	6.03	0.00195	1.97	1.12	0.00130	7.55	0.000458	*< 0.05*	0.0000084	0.0107	0.00190	1.52	0.000159	6.70	*< 0.00001*	0.0372	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000198	0.000981	0.000148	*< 0.0001*	0.00097	*< 0.00006*
KONA_1	L1999487-1	9/28/2017 11:25	0.000330	*< 0.0001*	0.200	0.0000100	6.13	0.00197	2.11	1.12	0.00128	8.15	0.000490	*< 0.05*	0.0000154	0.0111	0.00202	1.33	*< 0.00004*	7.55	*< 0.00001*	0.0397	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000203	0.000910	0.000146	*< 0.0001*	0.00060	*< 0.00006*
KONA_1	L2007130-1	10/13/2017 11:25	0.000257	*< 0.0001*	0.138	*< 0.000005*	4.83	0.00150	1.82	0.898	0.00117	6.97	0.000417	*< 0.05*	0.0000104	0.00913	0.00177	0.81	*< 0.00004*	6.23	*< 0.00001*	0.0329	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000158	0.000664	0.000125	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2014335-1	10/26/2017 11:50	0.000235	0.00013	0.152	*< 0.000005*	4.48	0.00137	1.61	0.766	0.00125	7.25	0.000373	*< 0.05*	0.0000274	0.00814	0.00171	*< 0.5*	0.000070	5.93	*< 0.00001*	0.0319	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000142	0.000526	0.000180	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2020126-1	11/8/2017 12:30	0.000229	*< 0.0001*	0.178	0.0000050	4.79	*< 0.0025*	1.64	0.664	0.00122	6.96	0.000413	*< 0.05*	*< 0.000005*	0.00850	0.00172	0.66	*< 0.00004*	6.94	*< 0.00001*	0.0341	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000148	0.000563	0.000114	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2026623-1	11/23/2017 14:15	0.000208	*< 0.0001*	0.255	0.0000055	4.28	0.00142	1.49	0.547	0.00119	6.71	0.000371	*< 0.05*	0.0000074	0.00781	0.00177	*< 0.5*	*< 0.00004*	6.42	*< 0.00001*	0.0318	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000131	0.000542	0.000094	*< 0.0001*	0.00092	*< 0.00006*
KONA_1	L2031965-1	12/6/2017 14:05	0.000205	*< 0.0001*	0.218	0.0000058	4.74	0.00175	1.77	0.521	0.00147	7.19	0.000283	*< 0.05*	0.0000100	0.00883	0.00172	*< 1*	*< 0.00004*	6.82	*< 0.00001*	0.0327	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000141	0.000528	0.000159	*< 0.0001*	0.00061	*< 0.00006*
KONA_1	L2038563-1	12/21/2017 13:50	0.000209	0.00012	0.429	*< 0.000005*	4.30	0.00153	1.52	0.413	0.00100	7.03	0.000345	*< 0.05*	0.0000074	0.00771	0.00195	*< 0.5*	*< 0.00004*	6.15	*< 0.00001*	0.0311	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000113	0.000580	0.000089	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2041649-1	1/4/2018 13:05	0.000207	*< 0.0001*	0.261	*< 0.000005*	4.08	0.00116	1.59	0.422	0.000983	6.80	0.000322	*< 0.05*	*< 0.00002*	0.00748	0.00171	*< 0.5*	*< 0.00004*	6.50	*< 0.00002*	0.0309	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000124	0.000486	0.000068	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2046871-1	1/18/2018 11:25	0.000209	*< 0.0002*	0.365	*< 0.000005*	4.01	0.0012	1.63	0.329	0.00131	7.16	0.00028	*< 0.1*	*< 0.00001*	0.00769	0.00194	*< 1*	*< 0.00008*	6.61	*< 0.00002*	0.0306	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000110	0.000513	0.00016	*< 0.0002*	*< 0.001*	*< 0.00012*
KONA_1	L2052061-1	2/1/2018 12:10	0.000234	*< 0.0002*	0.295	*< 0.000005*	4.75	*< 0.001*	1.61	0.331	0.00148	6.96	0.00029	*< 0.1*	*< 0.00001*	0.00789	0.00195	*< 1*	*< 0.00008*	7.17	*< 0.00002*	0.0320	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000117	0.000515	0.00011	*< 0.0002*	*< 0.001*	*< 0.00012*
KONA_1	L2057381-1	2/15/2018 11:35	0.000210	*< 0.0002*	0.248	*< 0.000005*	4.39	0.0018	1.67	0.407	0.00149	6.83	0.00025	*< 0.1*	*< 0.00001*	0.00794	0.00180	*< 1*	*< 0.00008*	7.25	*< 0.00002*	0.0315	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000105	0.000489	0.00012	*< 0.0002*	*< 0.001*	*< 0.00012*
KONA_1	L2062788-1	3/1/2018 13:25	0.000204	*< 0.0005*	0.262	*< 0.000005*	4.08	*< 0.0025*	1.70	0.424	0.00217	7.14	0.00036	*< 0.25*	*< 0.000025*	0.0080	0.00184	*< 2.5*	*< 0.0002*	7.07	*< 0.00005*	0.0303	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000112	0.000625	*< 0.00025*	*< 0.0005*	*< 0.0025*	*< 0.0003*
KONA_1	L2068449-1	3/15/2018 11:40	0.00020	0.0036	0.216	*< 0.000005*	4.13	*< 0.005*	1.50	0.347	0.00156	6.93	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0078	0.00150	*< 5*	*< 0.0004*	7.35	*< 0.0001*	0.0317	*< 0.002*	*< 0.001*	*< 0.003*	0.000067	0.000674	*< 0.0005*	*< 0.001*	*< 0.005*	*< 0.0006*
KONA_1	L2074311-1	3/29/2018 11:20	0.000247	*< 0.0001*	0.0920	*< 0.000005*	4.69	0.00144	1.73	0.268	0.00193	7.21	0.000271	0.051	0.0000084	0.00878	0.00182	*< 0.5*	*< 0.00004*	9.19	*< 0.00001*	0.0342	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000110	0.000529	0.000185	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_1	L2079620-1	4/12/2018 11:00	0.000220	*< 0.0001*	0.270	*< 0.000005*	4.37	0.00091	1.63	0.346	0.00176	6.98	0.000262	*< 0.05*	*< 0.000015*	0.00827	0.00176	*< 0.5*	*< 0.00004*	7.43	0.000012	0.0299	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000107	0.000504	0.000131	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_1	L2085708-1	4/26/2018 13:00	0.000229	*< 0.0001*	0.152	*< 0.000005*	4.64	0.00089	1.67	0.392	0.00176	6.86	0.000256	*< 0.05*	*< 0.000005*	0.00857	0.00157	*< 0.5*	*< 0.00004*	8.00	*< 0.00001*	0.0296	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000954	0.000442	0.000162	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_1	L2092801-1	5/10/2018 11:15	0.000212	*< 0.0002*	0.119	*< 0.000005*	4.13	0.0014	1.54	0.345	0.00203	6.61	0.00016	*< 0.1*	0.000015	0.00797	0.00176	*< 1*	*< 0.00008*	8.79	*< 0.00002*	0.0271	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000888	0.000467	0.00036	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_1	L2100224-1	5/24/2018 14:00	0.000239	*< 0.0005*	0.0567	*< 0.000005*	4.64	*< 0.0025*	1.80	0.306	0.00231	7.40	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0096	0.00172	*< 2.5*	*< 0.0002*	9.63	*< 0.00005*	0.0306	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000099	0.000452	0.00029	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2108434-1	6/7/2018 13:30	0.000216	*< 0.0005*	0.0802		4.52	*< 0.0025*	1.73	0.267	0.00231	7.10	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0084	0.00166	*< 2.5*	*< 0.0002*	10.5	*< 0.00005*	0.0289	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000093	0.000397	*< 0.00025*	*< 0.0005*	0.0417	*< 0.0003*
KONA_1	L2116986-1	6/21/2018 14:00	0.000260	*< 0.0001*	0.0745		5.04	0.00148	1.90	0.266	0.00244	7.63	0.000221	0.060	0.0000097	0.0100	0.00171	*< 0.5*	*< 0.00004*	10.8	*< 0.00001*	0.0317	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000104	0.000408	0.000155	*< 0.0001*	0.0013	*< 0.00006*
KONA_1	L2125321-1	7/6/2018 11:30	0.000225	*< 0.0005*	0.0283		4.63	*< 0.0025*	1.72	0.266	0.00258	7.18	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0088	0.00160	*< 2.5*	*< 0.0002*	11.7	*< 0.00005*	0.0302	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000091	0.000378	0.00032	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2132784-1	7/19/2018 14:45	0.000222	*< 0.0005*	0.0523		4.56	*< 0.0025*	1.80	0.256	0.00273	7.39	0.00031	*< 0.25*	*< 0.000025*	0.0085	0.00162	*< 2.5*	*< 0.0002*	10.6	*< 0.00005*	0.0293	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000086	0.000400	*< 0.00025*	*< 0.0005*	0.0070	*< 0.0003*
	L2140795-1	8/2/2018 13:30	0.000229	0.00093	0.128		4.69	*< 0.0025*	1.80	0.279	0.00270	7.46	0.00046	*< 0.25*	*< 0.000025*	0.0093	0.00169	*< 2.5*	*< 0.0002*	10.6	*< 0.00005*	0.0307	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000094	0.000363	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2148482-1	8/16/2018	0.000216	*< 0.0005*	0.0566		4.23	*< 0.0025*	1.75	0.328	0.00263	7.07	0.00029	*< 0.25*	*< 0.000025*	0.0088	0.00180	*< 2.5*	*< 0.0002*	11.1	*< 0.00005*	0.0269	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000085	0.000321	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2156461-1	8/30/2018 14:20	0.000222	*< 0.0005*	0.0555		4.22	*< 0.0025*	1.75	0.308	0.00274	7.18	0.000260	*< 0.25*	0.0000054	0.0083	0.00157	*< 2.5*	*< 0.0002*	10.2	*< 0.00005*	0.0299	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000090	0.000308	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2164110-1	9/13/2018 11:45	0.000207	*< 0.0005*	0.0682		4.78	*< 0.0025*	1.85	0.343	0.00268	7.79	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0097	0.00157	*< 2.5*	*< 0.0002*	11.2	*< 0.00005*	0.0302	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000082	0.000269	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2172409-1	9/27/2018 14:00	0.00020	*< 0.001*	0.089		4.97	*< 0.005*	1.78	0.340	0.00286	7.71	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0084	0.00156	*< 5*	*< 0.0004*	11.1	*< 0.0001*	0.0286	*< 0.002*	*< 0.001*	*< 0.003*	0.000086	0.000249	*< 0.0005*	*< 0.001*	*< 0.01*	*< 0.0006*
KONA_1	L2180431-1	10/12/2018 14:10	0.000201	*< 0.0005*	0.0551		4.28	*< 0.0025*	1.83	0.328	0.00332	7.44	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0085	0.00153	*< 2.5*	*< 0.0002*	12.3	*< 0.00005*	0.0296	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000081	0.000277	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2187510-1	10/25/2018 14:00	0.000187	0.00011	0.0550		4.29	0.00128	1.89	0.346	0.00326	6.92	0.000255	0.082	0.0000128	0.00794	0.00137	*< 0.5*	*< 0.00004*	11.4	*< 0.00001*	0.0297	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000767	0.000270	0.000085	*< 0.0001*	0.0015	*< 0.00006*
KONA_1	L2194529-1	11/8/2018 13:40	0.000166	*< 0.0005*	0.0455		4.14	*< 0.0025*	1.80	0.299	0.00315	7.28	0.00027	*< 0.25*	*< 0.000025*	0.0080	0.00136	*< 2.5*	*< 0.0002*	12.3	*< 0.00005*	0.0278	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000062	0.000241	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2200705-1	11/22/2018 10:30	0.000181	*< 0.0001*	0.0358		4.24	0.00122	1.74	0.328	0.00324	6.56	0.000291	0.089	0.0000106	0.00816	0.00128	*< 0.5*	*< 0.00004*	12.1	*< 0.00001*	0.0286	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000667	0.000216	0.000117	*< 0.0001*	0.0018	*< 0.00006*
KONA_1	L2207335-1	12/6/2018 14:45	0.000187	*< 0.0005*	0.0291		4.13	*< 0.0025*	1.84	0.306	0.00368	6.77	0.00031	*< 0.25*	*< 0.000025*	0.0082	0.00128	*< 2.5*	*< 0.0002*	12.7	*< 0.00005*	0.0274	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000063	0.000214	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2213525-1	12/20/2018 14:25	0.000241	*< 0.0005*	0.0485		5.40	*< 0.0025*	4.33	2.03	0.00302	8.59	0.00141	*< 0.25*	*< 0.000025*	0.0105	0.00096	19.5	*< 0.0002*	11.4	*< 0.00005*	0.0872	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000099	0.000166	*< 0.00025*	*< 0.0005*	0.0053	*< 0.0003*
KONA_1	L2217203-1	1/5/2019 11:35	0.000361	*< 0.0005*	1.83		7.54	*< 0.0025*	15.7	16.5	0.00178	10.2	0.00348	*< 0.25*	*< 0.000025*	0.0172	0.00053	111	*< 0.0002*	8.74	*< 0.00005*	0.355	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000205	0.000085	*< 0.00025*	*< 0.0005*	0.0241	*< 0.0003*
KONA_1	L2222132-1	1/17/2019 11:45	0.000437	0.00011	5.48		9.58	0.00285	26.5	32.2	0.00128	11.2	0.00537	*< 0.05*	0.0000095	0.0201	0.000704	242	*< 0.00004*	7.20	*< 0.00001*	0.766	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000419	0.0000591	*< 0.00005*	*< 0.0001*	0.0416	*< 0.00006*
KONA_1	L2227544-1	1/31/2019 10:30	0.00043	*< 0.002*	12.9		8.6	*< 0.01*	25.1	28.2	0.0020	10.6	0.0048	*< 1*	*< 0.0001*	0.0200	0.00046	252	*< 0.0008*	6.9	*< 0.0002*	0.868	*< 0.004*	*< 0.002*	*< 0.006*	0.000478	*< 0.00004*	*< 0.001*	*< 0.002*	0.116	*< 0.0012*
KONA_1	L2233141-1	2/14/2019 14:20	0.00038	*< 0.001*	20.7		8.74	*< 0.005*	23.1	22.7	0.00197	9.65	0.00427	*< 0.5*	*< 0.00005*	0.0201	0.00050	308	*< 0.0004*	6.86	*< 0.0001*	0.941	*< 0.002*	*< 0.001*	*< 0.003*	0.000384	0.000044	*< 0.0005*	*< 0.001*	0.034	*< 0.0006*
KONA_1	L2238565-1	2/28/2019 15:15	0.000420	*< 0.0005*	21.4		7.92	0.0025	24.0	19.3	0.00168	8.90	0.00368	*< 0.25*	0.000071	0.0186	0.00052	311	*< 0.0002*	6.21	*< 0.00005*	1.12	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000456	0.000018	*< 0.00025*	*< 0.0005*	0.0278	*< 0.0003*
KONA_1	L2244540-1	3/14/2019 14:30	0.000434	*< 0.0005*	18.4		9.74	*< 0.0025*	20.0	17.1	0.00149	8.36	0.00324	*< 0.25*	*< 0.000025*	0.0186	0.00055	321	*< 0.0002*	6.33	*< 0.00005*	1.22	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000326	0.000019	*< 0.00025*	*< 0.0005*	0.0258	*< 0.0003*
KONA_1	L2250817-1	3/28/2019 15:00	0.000384	*< 0.0005*	21.0		8.35	0.0028	23.0	17.5	0.00133	8.93	0.00322	*< 0.25*	*< 0.000025*	0.0188	0.00041	350	*< 0.0002*	6.78	*< 0.00005*	1.15	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000282	0.000011	*< 0.00025*	*< 0.0005*	0.0265	*< 0.0003*
KONA_1	L2257457-1	4/11/2019 15:00	0.000412	*< 0.0005*	19.1		7.83	0.0028	20.6	16.5	0.00126	8.02	0.00323	*< 0.25*	*< 0.000025*	0.0199	0.00069	350	*< 0.0002*	6.65	*< 0.00005*	1.33	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000279	0.000020	*< 0.00025*	*< 0.0005*	0.0256	*< 0.0003*
KONA_1	L2263301-1	4/25/2019 14:45	0.000417	*< 0.0005*	18.1		7.08	0.0030	19.1	14.9	0.00159	8.32	0.00256	*< 0.25*	*< 0.000025*	0.0179	0.00068	356	*< 0.0002*	6.52	*< 0.00005*	1.44	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000237	0.000023	*< 0.00025*	*< 0.0005*	0.0206	*< 0.0003*
KONA_2	L1955323-2	7/7/2017 13:00	0.000963	0.00018	2.19	0.0000131	11.8	0.00905	4.55	3.56	0.00124	9.63	0.00585	*< 0.05*	0.000125	0.0241	0.00846	24.8	0.000232	13.7	0.000014	0.0799	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000597	0.00292	0.000195	0.00014	0.0466	*< 0.00006*
KONA_2	L1969885-2	8/3/2017 13:50	0.00103	0.00011	3.48	0.0000074	11.6	0.00709	4.85	4.42	0.00176	10.8	0.00531	*< 0.05*	0.0000346	0.0258	0.0102	22.5	0.000136	14.5	*< 0.00001*	0.0828	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000599	0.00348	0.000234	*< 0.0001*	0.0356	*< 0.00006*
KONA_2	L1977048-2	8/17/2017 12:25	0.000763	0.00015	3.25	0.0000107	8.74	0.00504	3.18	3.19	0.000952	8.26	0.00402	*< 0.05*	0.0000094	0.0192	0.0128	14.9	0.000145	11.1	*< 0.00001*	0.0552	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000528	0.00176	0.000232	*< 0.0001*	0.0269	*< 0.00006*
KONA_2	L1984769-2	8/31/2017 14:00	0.000664	*< 0.0001*	2.58	0.0000116	8.02	0.00407	2.70	2.75	0.000904	7.67	0.00280	*< 0.05*	0.0000496	0.0173	0.0127	11.8	0.000083	11.3	*< 0.00001*	0.0439	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000419	0.00138	0.000220	*< 0.0001*	0.0198	*< 0.00006*
KONA_2	L1992087-2	9/14/2017 14:55	0.000587	*< 0.0001*	2.26	0.0000167	6.71	0.00331	2.12	2.22	0.000960	6.89	0.00219	*< 0.05*	0.0000060	0.0141	0.0167	8.09	*< 0.00004*	9.35	*< 0.00001*	0.0348	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000391	0.00116	0.000221	*< 0.0001*	0.0150	*< 0.00006*
KONA_2	L1999487-2	9/28/2017 11:25	0.000566	*< 0.0001*	2.10	0.0000136	6.66	0.00293	2.11	2.19	0.00103	7.11	0.00193	*< 0.05*	0.0000071	0.0146	0.0197	7.07	0.000104	10.7	*< 0.00001*	0.0341	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000365	0.00121	0.000254	*< 0.0001*	0.0133	*< 0.00006*
KONA_2	L2007130-2	10/13/2017 11:25	0.000434	0.00019	1.99	0.0000122	5.13	0.00229	1.65	1.75	0.00102	6.10	0.00153	*< 0.05*	0.0000328	0.0120	0.0210	4.64	0.000108	8.69	*< 0.00001*	0.0271	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000285	0.00101	0.000235	*< 0.0001*	0.0112	*< 0.00006*
KONA_2	L2014335-2	10/26/2017 11:50	0.000370	*< 0.0001*	1.76	0.0000137	4.49	0.00195	1.30	1.46	0.00102	5.73	0.00116	*< 0.05*	0.0000093	0.00948	0.0218	2.99	0.000138	7.91	*< 0.00001*	0.0218	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000252	0.000844	0.000297	*< 0.0001*	0.00833	*< 0.00006*
KONA_2	L2020126-2	11/8/2017 12:30	0.000383	*< 0.0001*	1.80	0.0000110	4.74	*< 0.0025*	1.38	1.56	0.00112	5.78	0.00115	*< 0.05*	*< 0.000005*	0.0103	0.0234	2.55	0.000058	8.35	*< 0.00001*	0.0229	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000235	0.000837	0.000196	*< 0.0001*	0.00914	*< 0.00006*
KONA_2	L2026623-2	11/23/2017 14:15	0.000329	0.00011	1.30	0.0000112	4.43	0.00176	1.27	1.60	0.00124	5.75	0.00103	*< 0.05*	0.0000172	0.0100	0.0224	1.62	0.000101	8.30	*< 0.00001*	0.0227	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000181	0.000777	0.000241	*< 0.0001*	0.00860	*< 0.00006*
KONA_2	L2031965-2	12/6/2017 14:05	0.000328	0.00016	1.63	0.0000121	4.24	0.00177	1.28	1.52	0.00130	6.03	0.000946	*< 0.05*	0.0000272	0.00987	0.0207	*< 2*	0.000113	8.13	0.000014	0.0214	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000242	0.000841	0.000283	*< 0.0001*	0.00818	*< 0.00006*
KONA_2	L2038563-2	12/21/2017 13:50	0.000334	0.00011	1.89	0.0000082	3.81	0.00156	1.04	1.33	0.00108	5.75	0.000831	*< 0.05*	*< 0.000005*	0.00855	0.0200	1.01	0.000097	7.12	*< 0.00001*	0.0190	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000189	0.000755	0.000193	*< 0.0001*	0.00651	*< 0.00006*
KONA_2	L2041649-2	1/4/2018 13:05	0.000317	*< 0.0001*	1.45	*< 0.000005*	3.91	0.00113	1.16	1.41	0.00116	5.79	0.000796	*< 0.05*	*< 0.00001*	0.00865	0.0160	0.81	0.000075	7.87	*< 0.00001*	0.0203	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000168	0.000683	0.000207	*< 0.0001*	0.00818	*< 0.00006*
KONA_2	L2046871-2	1/18/2018 11:25	0.000333	*< 0.0005*	1.43	0.0000050	3.85	*< 0.0025*	1.20	1.36	0.00181	6.37	0.00081	*< 0.25*	*< 0.000025*	0.0086	0.0160	*< 2.5*	*< 0.0002*	8.05	*< 0.00005*	0.0261	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000174	0.000842	0.00033	0.00163	0.0064	*< 0.0003*
KONA_2	L2052061-2	2/1/2018 12:10	0.000323	*< 0.0005*	1.35	0.0000054	4.18	*< 0.0025*	1.09	1.33	0.00150	5.92	0.00069	*< 0.25*	*< 0.000025*	0.0084	0.0153	*< 2.5*	*< 0.0002*	7.51	*< 0.00005*	0.0193	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000164	0.000711	*< 0.00025*	*< 0.0005*	0.0062	*< 0.0003*
KONA_2	L2057381-2	2/15/2018 11:35	0.000286	*< 0.0005*	1.47	0.0000082	3.95	0.0027	1.20	1.53	0.00156	6.81	0.00078	*< 0.25*	*< 0.000025*	0.0083	0.0141	*< 2.5*	*< 0.0002*	8.00	*< 0.00005*	0.0203	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000164	0.000683	*< 0.00025*	*< 0.0005*	0.0052	*< 0.0003*
KONA_2	L2062788-2	3/1/2018 13:25	0.000289	*< 0.0005*	1.30	0.0000078	3.28	*< 0.0025*	1.06	1.25	0.00194

Appendix A2: Granite Column (Kona 1-4) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cs**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
KONA_2	L2068449-2	3/15/2018 11:40	0.00028	*< 0.001*	1.14	0.0000069	3.43	*< 0.005*	1.09	1.27	0.00173	6.25	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0082	0.0118	*< 5*	*< 0.0004*	7.53	*< 0.0001*	0.0187	*< 0.002*	*< 0.001*	*< 0.003*	0.000128	0.000720	*< 0.0005*	*< 0.001*	*< 0.005*	*< 0.0006*
KONA_2	L2074311-2	3/29/2018 11:20	0.000328	*< 0.0001*	0.793	*< 0.000005*	3.87	0.00143	1.19	1.46	0.00204	5.99	0.000725	*< 0.05*	0.0000157	0.00883	0.0116	0.87	0.000048	9.52	*< 0.00001*	0.0230	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000146	0.000558	0.000387	*< 0.0001*	0.0061	*< 0.00006*
KONA_2	L2079620-2	4/12/2018 11:00	0.000304	0.00153	1.32	*< 0.000005*	3.45	0.00092	1.08	1.36	0.00190	6.55	0.000673	*< 0.05*	0.0000842	0.00795	0.0127	0.72	0.000051	7.64	0.000021	0.0185	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000156	0.000608	0.000267	*< 0.0001*	0.0066	*< 0.00006*
KONA_2	L2085708-2	4/26/2018 13:40	0.000284	*< 0.0001*	1.26	*< 0.000005*	3.30	0.00158	1.05	1.30	0.00179	6.27	0.000555	*< 0.05*	*< 0.000005*	0.00772	0.0110	*< 0.5*	0.000101	7.64	*< 0.00001*	0.0174	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000137	0.000489	0.000253	*< 0.0001*	0.0049	*< 0.00006*
KONA_2	L2092801-2	5/10/2018 11:15	0.000266	*< 0.0005*	1.05	0.0000057	3.02	*< 0.0025*	0.944	1.21	0.00193	5.76	0.00028	*< 0.25*	*< 0.000025*	0.0071	0.0118	*< 2.5*	*< 0.0002*	7.77	*< 0.00005*	0.0156	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000120	0.000494	0.00070	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_2	L2100224-2	5/24/2018 14:00	0.000309	*< 0.0005*	0.822	*< 0.000005*	3.51	*< 0.0025*	1.16	1.45	0.00235	6.54	0.00039	*< 0.25*	*< 0.000025*	0.0086	0.0114	*< 2.5*	*< 0.0002*	8.73	*< 0.00005*	0.0184	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000117	0.000394	0.00039	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_2	L2108434-2	6/7/2018 13:30	0.000284	*< 0.0005*	0.455		3.78	*< 0.0025*	1.19	1.46	0.00202	6.80	0.00052	*< 0.25*	*< 0.000025*	0.0090	0.00965	*< 2.5*	*< 0.0002*	9.59	*< 0.00005*	0.0182	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000122	0.000251	*< 0.00025*	*< 0.0005*	0.0201	*< 0.0003*
KONA_2	L2116986-2	6/21/2018 14:00	0.000323	*< 0.0001*	0.530		3.81	0.00129	1.18	1.52	0.00206	6.91	0.000600	*< 0.05*	0.0000059	0.00934	0.00977	0.54	*< 0.00004*	9.09	*< 0.00001*	0.0186	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000140	0.000266	0.000306	*< 0.0001*	0.0050	*< 0.00006*
KONA_2	L2125321-2	7/6/2018 11:30	0.000275	*< 0.0005*	0.531		3.39	*< 0.0025*	1.06	1.35	0.00207	6.46	0.00040	*< 0.25*	*< 0.000025*	0.0078	0.00944	*< 2.5*	*< 0.0002*	8.98	*< 0.00005*	0.0167	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000129	0.000232	0.00047	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_2	L2132784-2	7/19/2018 14:45	0.00028	*< 0.001*	0.477		3.62	*< 0.005*	1.16	1.46	0.00241	7.09	0.00052	*< 0.5*	*< 0.00005*	0.0083	0.0101	*< 5*	*< 0.0004*	9.45	*< 0.0001*	0.0183	*< 0.002*	*< 0.001*	*< 0.003*	0.000117	0.000244	*< 0.0005*	*< 0.001*	0.010	*< 0.0006*
KONA_2	L2140795-2	8/2/2018 13:30	0.000308	*< 0.0005*	0.459		3.78	*< 0.0025*	1.18	1.49	0.00240	7.10	0.00063	*< 0.25*	*< 0.000025*	0.0085	0.00995	*< 2.5*	*< 0.0002*	9.29	*< 0.00005*	0.0183	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000137	0.000210	0.00035	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_2	L2148482-2	8/16/2018	0.000261	*< 0.0005*	0.514		3.08	*< 0.0025*	1.03	1.37	0.00236	6.48	0.00047	*< 0.25*	*< 0.000025*	0.0075	0.00977	*< 2.5*	*< 0.0002*	8.65	*< 0.00005*	0.0150	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000118	0.000202	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_2	L2156461-2	8/30/2018 14:20	0.00030	*< 0.001*	0.614		3.55	*< 0.005*	1.21	1.51	0.00268	7.61	0.000436	*< 0.5*	*< 0.00005*	0.0089	0.00970	*< 5*	*< 0.0004*	9.03	*< 0.0001*	0.0182	*< 0.002*	*< 0.001*	*< 0.003*	0.000118	0.000203	*< 0.0005*	*< 0.001*	*< 0.01*	*< 0.0006*
KONA_2	L2164110-2	9/13/2018 11:45	0.00028	*< 0.001*	0.607		3.55	*< 0.005*	1.16	1.59	0.00246	7.47	*< 0.0005*	*< 0.5*	0.000075	0.0089	0.00943	*< 5*	*< 0.0004*	9.44	*< 0.0001*	0.0176	*< 0.002*	*< 0.001*	*< 0.003*	0.000120	0.000174	0.00052	*< 0.001*	*< 0.01*	*< 0.0006*
KONA_2	L2172409-2	9/27/2018 14:00	0.00024	*< 0.001*	0.630		3.23	*< 0.005*	1.11	1.42	0.00248	7.26	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0076	0.00839	*< 5*	*< 0.0004*	9.33	*< 0.0001*	0.0163	*< 0.002*	*< 0.001*	*< 0.003*	0.000104	0.000142	*< 0.0005*	*< 0.001*	*< 0.01*	*< 0.0006*
KONA_2	L2180431-2	10/12/2018 14:10	0.00025	*< 0.001*	0.362		2.96	*< 0.005*	1.06	1.38	0.00244	6.32	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0073	0.00746	*< 5*	*< 0.0004*	9.45	*< 0.0001*	0.0162	*< 0.002*	*< 0.001*	*< 0.003*	0.000083	0.000163	*< 0.0005*	*< 0.001*	*< 0.01*	*< 0.0006*
KONA_2	L2187510-2	10/25/2018 14:00	0.00029	*< 0.001*	0.352		3.56	*< 0.005*	1.22	1.62	0.00280	7.34	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0081	0.00727	*< 5*	*< 0.0004*	9.90	*< 0.0001*	0.0190	*< 0.002*	*< 0.001*	*< 0.003*	0.000103	0.000208	*< 0.0005*	*< 0.001*	*< 0.01*	*< 0.0006*
KONA_2	L2194529-2	11/8/2018 13:40	0.000242	*< 0.0005*	0.297		3.31	*< 0.0025*	1.24	1.63	0.00330	6.94	0.00051	*< 0.25*	*< 0.000025*	0.0081	0.00758	*< 2.5*	*< 0.0002*	11.4	*< 0.00005*	0.0218	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000098	0.000248	0.00035	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_2	L2200705-2	11/22/2018 10:30	0.000243	*< 0.0005*	0.261		3.09	*< 0.0025*	1.17	1.46	0.00308	6.71	0.00579	*< 0.25*	*< 0.000025*	0.0075	0.00645	*< 2.5*	*< 0.0002*	10.3	*< 0.00005*	0.0182	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000095	0.000188	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_2	L2207335-2	12/6/2018 14:45	0.00022	*< 0.001*	0.209		3.06	*< 0.005*	1.19	1.50	0.00285	6.00	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0078	0.00546	*< 5*	*< 0.0004*	10.6	*< 0.0001*	0.0170	*< 0.002*	*< 0.001*	*< 0.003*	0.000095	0.000186	*< 0.0005*	*< 0.001*	*< 0.01*	*< 0.0006*
KONA_2	L2213525-2	12/20/2018 14:25	0.00033	*< 0.001*	1.89		4.00	*< 0.005*	2.05	2.86	0.00249	9.20	0.00221	*< 0.5*	0.000060	0.0100	0.00706	11.9	*< 0.0004*	9.50	*< 0.0001*	0.0334	*< 0.002*	*< 0.001*	*< 0.003*	0.000131	0.000129	*< 0.0005*	*< 0.001*	0.012	*< 0.0006*
KONA_2	L2217203-2	1/5/2019 11:35	0.000630	*< 0.0005*	64.5		7.64	0.0027	17.6	28.4	0.00074	15.0	0.00668	*< 0.25*	*< 0.000025*	0.0212	0.00308	150	*< 0.0002*	6.66	*< 0.00005*	0.246	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000319	0.000274	*< 0.00025*	*< 0.0005*	0.110	*< 0.0003*
KONA_2	L2222132-2	1/17/2019 11:45	0.000677	*< 0.0001*	139		8.45	0.00295	26.9	40.9	0.000506	12.6	0.00776	*< 0.05*	*< 0.000005*	0.0222	0.00270	290	0.000521	5.87	*< 0.00001*	0.402	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000344	0.000356	*< 0.00005*	*< 0.0001*	0.142	*< 0.00006*
KONA_2	L2227544-2	1/31/2019 10:30	0.00065	*< 0.002*	128		7.4	*< 0.01*	22.8	37.1	*< 0.001*	10.8	0.0064	*< 1*	*< 0.0001*	0.0214	0.00258	292	*< 0.0008*	5.4	*< 0.0002*	0.478	*< 0.004*	*< 0.002*	*< 0.006*	0.000324	0.000318	*< 0.001*	*< 0.002*	0.196	*< 0.0012*
KONA_2	L2233141-2	2/14/2019 14:20	0.00054	*< 0.001*	116		6.88	*< 0.005*	19.6	32.6	0.00086	8.73	0.00589	*< 0.5*	*< 0.00005*	0.0208	0.00247	311	*< 0.0004*	5.50	*< 0.0001*	0.514	*< 0.002*	*< 0.001*	*< 0.003*	0.000279	0.000281	*< 0.0005*	*< 0.001*	0.097	*< 0.0006*
KONA_2	L2238565-2	2/28/2019 15:15	0.00065	*< 0.001*	107		7.28	*< 0.005*	18.7	31.6	0.00067	8.41	0.00557	*< 0.5*	*< 0.00005*	0.0214	0.00276	303	*< 0.0004*	5.43	*< 0.0001*	0.619	*< 0.002*	*< 0.001*	*< 0.003*	0.000318	0.000265	*< 0.0005*	*< 0.001*	0.093	*< 0.0006*
KONA_2	L2244540-2	3/14/2019 14:30	0.00061	*< 0.001*	77.7		9.12	*< 0.005*	15.3	25.3	0.00055	7.75	0.00441	*< 0.5*	*< 0.00005*	0.0204	0.00268	321	*< 0.0004*	5.64	*< 0.0001*	0.653	*< 0.002*	*< 0.001*	*< 0.003*	0.000285	0.000246	*< 0.0005*	*< 0.001*	0.074	*< 0.0006*
KONA_2	L2250817-2	3/28/2019 15:00	0.00066	*< 0.001*	91.8		7.79	*< 0.005*	17.3	27.7	0.00061	8.71	0.00489	*< 0.5*	*< 0.00005*	0.0210	0.00256	353	0.00071	6.75	*< 0.0001*	0.752	*< 0.002*	*< 0.001*	*< 0.003*	0.000260	0.000242	*< 0.0005*	*< 0.001*	0.078	*< 0.0006*
KONA_2	L2257457-2	4/11/2019 15:00	0.00065	*< 0.001*	74.8		6.74	*< 0.005*	13.4	23.2	0.00091	7.66	0.00524	*< 0.5*	*< 0.00005*	0.0194	0.00291	351	*< 0.0004*	6.15	*< 0.0001*	0.806	*< 0.002*	*< 0.001*	*< 0.003*	0.000236	0.000169	*< 0.0005*	*< 0.001*	0.058	*< 0.0006*
KONA_2	L2263301-2	4/25/2019 14:45	0.00063	*< 0.001*	67.6		6.11	*< 0.005*	11.9	20.8	0.00088	7.78	0.00424	*< 0.5*	*< 0.00005*	0.0162	0.00285	357	*< 0.0004*	6.17	*< 0.0001*	0.889	*< 0.002*	*< 0.001*	*< 0.003*	0.000216	0.000179	*< 0.0005*	*< 0.001*	0.047	*< 0.0006*
KONA_3	L1955323-3	7/7/2017 13:00	0.000662	0.00020	0.0017	0.0000059	14.0	0.00605	2.40	1.61	0.00189	13.0	0.000793	*< 0.05*	0.0000335	0.0206	0.00431	10.7	0.000114	14.6	0.000018	0.0420	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000141	0.00135	0.000126	*< 0.0001*	0.00434	*< 0.00006*
KONA_3	L1969885-3	8/3/2017 13:50	0.000701	0.00021	0.0026	*< 0.000005*	14.7	0.00507	3.17	2.56	0.00258	14.7	0.00127	*< 0.05*	0.0000189	0.0235	0.00367	9.92	0.000082	18.4	0.000012	0.0537	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000176	0.00208	0.000133	*< 0.0001*	0.00490	*< 0.00006*
KONA_3	L1977048-3	8/17/2017 12:25	0.000564	0.00016	0.0088	*< 0.000005*	13.1	0.00407	2.49	2.18	0.00218	12.7	0.000882	*< 0.05*	0.0000310	0.0202	0.00299	6.25	0.000429	16.1	*< 0.00001*	0.0434	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000150	0.00165	0.000185	*< 0.0001*	0.00374	*< 0.00006*
KONA_3	L1984769-3	8/31/2017 14:00	0.000550	0.00012	0.0132	*< 0.000005*	12.9	0.00349	2.43	2.25	0.00242	12.5	0.000761	*< 0.05*	0.0000194	0.0195	0.00287	4.47	0.000314	18.3	*< 0.00001*	0.0403	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000150	0.00160	0.000187	*< 0.0001*	0.00361	*< 0.00006*
KONA_3	L1992087-3	9/14/2017 14:55	0.000486	0.00012	0.0232	*< 0.000005*	11.6	0.00327	2.14	2.06	0.00238	11.7	0.000868	*< 0.05*	0.0000193	0.0175	0.00252	2.90	*< 0.00004*	15.9	0.000012	0.0347	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000148	0.00138	0.000250	*< 0.0001*	0.00280	*< 0.00006*
KONA_3	L1999487-3	9/28/2017 11:25	0.000462	0.00010	0.0216	*< 0.000005*	11.5	0.00299	2.05	1.99	0.00271	11.3	0.000630	0.056	0.0000148	0.0173	0.00284	2.53	0.000241	17.7	*< 0.00001*	0.0345	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000143	0.00133	0.000181	*< 0.0001*	0.00314	*< 0.00006*
KONA_3	L2007130-3	10/13/2017 11:25	0.000391	*< 0.0001*	0.0423	*< 0.000005*	10.2	0.00262	1.89	1.88	0.00275	10.1	0.000632	0.070	0.0000143	0.0160	0.00240	1.66	0.000375	18.0	*< 0.00001*	0.0315	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000130	0.00130	0.000191	*< 0.0001*	0.00329	*< 0.00006*
KONA_3	L2014335-3	10/26/2017 11:50	0.000347	*< 0.0001*	0.0565	*< 0.000005*	9.00	0.00249	1.52	1.66	0.00294	9.01	0.000446	0.065	0.0000115	0.0135	0.00237	0.77	0.000249	18.3	*< 0.00001*	0.0273	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000118	0.00106	0.000307	*< 0.0001*	0.00185	*< 0.00006*
KONA_3	L2020126-3	11/8/2017 12:30	0.000339	*< 0.0001*	0.0544	*< 0.000005*	10.1	0.00233	1.64	1.73	0.00326	8.91	0.000501	0.082	*< 0.000005*	0.0144	0.00259	0.95	0.000047	18.5	*< 0.00001*	0.0290	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000106	0.00103	0.000195	*< 0.0001*	0.00232	*< 0.00006*
KONA_3	L2026623-3	11/23/2017 14:15	0.000302	*< 0.0001*	0.0728	*< 0.000005*	9.04	0.00213	1.45	1.74	0.00329	9.02	0.000485	0.083	0.0000121	0.0133	0.00242	*< 0.5*	0.000177	19.5	*< 0.00001*	0.0266	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000107	0.000968	0.000173	0.00010	0.00219	*< 0.00006*
KONA_3	L2031965-3	12/6/2017 14:05	0.000308	*< 0.0001*	0.0775	*< 0.000005*	8.91	0.00213	1.49	1.66	0.00340	8.38	0.000344	0.090	0.0000181	0.0135	0.00278	*< 1*	0.000143	18.2	*< 0.00001*	0.0273	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000112	0.000938	0.000232	*< 0.0001*	0.00319	*< 0.00006*
KONA_3	L2038563-3	12/21/2017 13:50	0.000301	0.00012	0.125	*< 0.000005*	8.30	0.00207	1.28	1.56	0.00322	8.19	0.000446	0.075	0.0000089	0.0119	0.00258	*< 0.5*	0.000076	17.8	*< 0.00001*	0.0245	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000953	0.000907	0.000101	*< 0.0001*	0.00219	*< 0.00006*
KONA_3	L2041649-3	1/4/2018 13:05	0.000297	*< 0.0001*	0.0650	*< 0.000005*	8.73	0.00128	1.35	1.56	0.00343	7.93	0.000429	0.081	*< 0.000015*	0.0120	0.00261	*< 0.5*	0.000100	18.5	*< 0.00001*	0.0249	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000949	0.000914	0.000172	*< 0.0001*	0.00209	*< 0.00006*
KONA_3	L2046871-3	1/18/2018 11:25	0.000302	0.00011	0.0980	*< 0.000005*	8.50	0.00200	1.37	1.52	0.00384	8.46	0.000479	0.086	0.0000058	0.0123	0.00260	*< 0.5*	0.000118	18.0	*< 0.00001*	0.0351	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000933	0.000951	0.000200	0.00035	0.00191	*< 0.00006*
KONA_3	L2052061-3	2/1/2018 12:10	0.000305	*< 0.0001*	0.0725	*< 0.000005*	8.70	0.00129	1.33	1.53	0.00349	8.06	0.000421	0.076	0.0000054	0.0119	0.00275	*< 0.5*	0.000058	17.9	*< 0.00001*	0.0247	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000102	0.000932	0.000205	*< 0.0001*	0.00176	*< 0.00006*
KONA_3	L2057381-3	2/15/2018 11:35	0.000252	*< 0.0001*	0.0764	*< 0.000005*	8.32	0.00147	1.34	1.73	0.00361	7.67	0.000417	0.080	0.0000086	0.0114	0.00251	*< 0.5*	*< 0.00004*	18.1	*< 0.00001*	0.0268	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000928	0.000904	0.000183	0.00012	0.00200	*< 0.00006*
KONA_3	L2062788-3	3/1/2018 13:25	0.000262	*< 0.0001*	0.0544	*< 0.000005*	8.00	0.00132	1.29	1.58	0.00368	7.92	0.000411	0.099	0.0000072	0.0109	0.00262	*< 0.5*	0.000055	17.9	*< 0.00001*	0.0226	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000925	0.000794	0.000198	*< 0.0001*	0.00166	*< 0.00006*
KONA_3	L2068449-3	3/15/2018 11:40	0.000254	*< 0.0001*	0.0302	*< 0.000005*	8.04	0.00162	1.20	1.46	0.00414	8.17	0.000399	0.095	0.0000083	0.0112	0.00253	*< 0.5*	*< 0.00004*	18.2	*< 0.00001*	0.0207	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000982	0.000734	0.000184	*< 0.0001*	0.00092	*< 0.00006*
KONA_3	L2074311-3	3/29/2018 11:20	0.000270	0.00012	*< 0.001*	*< 0.000005*	7.80	0.00137	1.22	1.27	0.00490	7.53	0.000360	0.104	*< 0.000005*	0.0103	0.00286	0.56	*< 0.00004*	18.8	*< 0.00001*	0.0220	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000787	0.000887	0.000316	*< 0.0001*	0.0014	*< 0.00006*
KONA_3	L2079620-3	4/12/2018 11:00	0.000249	0.00011	0.0307	*< 0.000005*	6.99	0.00118	1.12	1.30	0.00488	7.43	0.000429	0.090	*< 0.00002*	0.0104	0.00248	*< 0.5*	*< 0.00004*	16.8	0.000012	0.0202	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000830	0.000949	0.000206	*< 0.0001*	0.0015	*< 0.00006*
KONA_3	L2085708-3	4/26/2018 13:40	0.000243	*< 0.0001*	0.0551	*< 0.000005*	7.09	0.00136	1.10	1.47	0.00498	7.15	0.000374	0.091	*< 0.000005*	0.00973	0.00226	*< 0.5*	*< 0.00004*	16.7	*< 0.00001*	0.0196	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000796	0.000831	0.000169	*< 0.0001*	0.0013	*< 0.00006*
KONA_3	L2092801-3	5/10/2018 11:15	0.000247	*< 0.0001*	0.0345	*< 0.000005*	7.21	0.00150	1.09	1.28	0.00496	7.37	0.000330	0.083	0.0000101	0.00998	0.00250	*< 0.5*	*< 0.00004*	17.0	*< 0.00001*	0.0193	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000832	0.000864	0.000299	*< 0.0001*	0.0117	*< 0.00006*
KONA_3	L2100224-3	5/24/2018 14:00	0.000270	0.00011	0.0052	*< 0.000005*	7.52	0.00132	1.17	1.04	0.00523	7.60	0.000338	0.116	0.0000067	0.0109	0.00262	*< 0.5*	*< 0.00004*	17.8	*< 0.00001*	0.0208	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000691	0.000799	0.000319	*< 0.0001*	0.0017	*< 0.00006*
KONA_3	L2108434-3	6/7/2018 13:30	0.000271	*< 0.0001*	0.0076		8.14	0.00142	1.22	0.857	0.00515	8.49	0.000360	0.123	0.0000069	0.0114	0.00258	*< 0.5*	*< 0.00004*	19.6	*< 0.00001*	0.0203	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000712	0.000765	0.000252	*< 0.0001*	0.0210	*< 0.00006*
KONA_3	L2116986-3	6/21/2018 14:00	0.000256	*< 0.0001*	0.0046		7.44	0.00134	1.10	0.669	0.00485	8.21	0.000296	0.118	0.0000183	0.0108	0.00257	*< 0.5*	*< 0.00004*	18.9	*< 0.00001*	0.0183	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000698	0.000737	0.000287	*< 0.0001*	0.0012	*< 0.00006*
KONA_3	L2125321-3	7/6/2018 11:30	0.000250	*< 0.0001*	0.0052		7.26	0.00138	1.08	0.645	0.00491	7.80	0.000328	0.105	0.0000124	0.0100	0.00249	*< 0.5*	*< 0.00004*	19.4	*< 0.00001*	0.0189	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000614	0.000707	0.000296	*< 0.0001*	0.0012	*< 0.00006*
KONA_3	L2132784-3	7/19/2018 14:45	0.000238	*< 0.0001*	0.0106		7.25	0.00141	1.08	0.584	0.00508	8.00	0.000312	0.098	0.0000168	0.0103	0.00250	*< 0.5*	*< 0.00004*	19.5	0.000023	0.0181	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000624	0.000737	0.000252	*< 0.0001*	0.0070	*< 0.00006*
KONA_3	L2140795-3	8/2/2018 13:30	0.000258	*< 0.0001*	0.0142		14.0	0.00140	1.08	0.504	0.00525	8.19	0.000325	0.107	0.0000094	0.0105	0.00274	*< 0.5*	0.000049	19.6	*< 0.00001*	0.0192	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000652	0.000683	0.000383	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_3	L2148482-3	8/16/2018	0.000228	*< 0.0001*	0.0113		7.06	0.00134	1.08	0.510	0.00509	8.20	0.000302	0.125	0.0000154	0.00990	0.00241	*< 0.5*	*< 0.00004*	17.9	*< 0.00001*	0.0184	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000635	0.000717	0.000300	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_3	L2156461-3	8/30/2018 14:20	0.000202	*< 0.0001*	0.0092		6.93	0.00128	1.04	0.577	0.00501	8.00	*< 0.0001*	0.107	*< 0.000015*	0.00985	0.00231	*< 0.5*	0.000049	18.9	*< 0.00001*	0.0180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000603	0.000663	0.000271	*< 0.0001*	0.0011	*< 0.00006*
KONA_3	L2164110-3	9/13/2018 11:45	0.000227	*< 0.0001*	0.0127		7.36	0.00133	1.08	0.480	0.00517	8.93	0.000240	0.137	0.0000157	0.0107	0.00242	*< 0.5*	*< 0.00004*	19.3	*< 0.00001*	0.0186	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000598	0.000638	0.000329	*< 0.0001*	0.0011	*< 0.00006*
KONA_3	L2172409-3	9/27/2018 14:00	0.000195	*< 0.0002*	0.0179		6.77	0.0012	1.00	0.466	0.00503	8.05	0.00021	0.11	0.000023	0.00873	0.00223	*< 1*	*< 0.00008*	19.4	*< 0.00002*	0.0162	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000531	0.000578	0.00026	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_3	L2180431-3	10/12/2018 14:10	0.000188	*< 0.0002*	0.0168		6.04	0.0011	0.970	0.398	0.00511	7.50	0.00015	*< 0.1*	0.000022	0.00885	0.00228	*< 1*	*< 0.00008*	19.1	*< 0.00002*	0.0163	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000506	0.000614	0.00031	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_3	L2187510-3	10/25/2018 14:00	0.000181	*< 0.0001*	0.0190		5.89	0.00104	0.929	0.365	0.00541	7.12	0.000151	0.118	0.0000347	0.00802	0.00220	*< 0.5*	*< 0.00004*	18.3	*< 0.00001*	0.0163	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000455	0.000584	0.000316	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_3	L2194529-3	11/8/2

Appendix A2: Granite Column (Kona 1-4) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cs**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
KONA_3	L2233141-3	2/14/2019 14:20	0.00046	*< 0.002*	2.52		14.1	*< 0.01*	23.8	48.2	0.0012	9.99	0.0057	*< 1*	0.00039	0.0229	0.00045	311	*< 0.0008*	11.4	*< 0.0002*	1.28	*< 0.004*	*< 0.002*	*< 0.006*	0.000300	0.000418	*< 0.001*	*< 0.002*	0.050	*< 0.0012*
KONA_3	L2238565-3	2/28/2019 15:15	0.00046	*< 0.001*	3.67		12.9	*< 0.005*	26.5	47.5	0.00133	9.05	0.00515	*< 0.5*	*< 0.00005*	0.0234	0.00049	329	*< 0.0004*	11.7	*< 0.0001*	1.50	*< 0.002*	*< 0.001*	*< 0.003*	0.000357	0.000394	*< 0.0005*	*< 0.001*	0.049	*< 0.0006*
KONA_3	L2244540-3	3/14/2019 14:30	0.00044	*< 0.001*	3.71		16.6	*< 0.005*	23.4	43.5	0.00132	8.79	0.00475	*< 0.5*	*< 0.00005*	0.0234	0.00048	334	*< 0.0004*	11.4	*< 0.0001*	1.56	*< 0.002*	*< 0.001*	*< 0.003*	0.000354	0.000384	*< 0.0005*	*< 0.001*	0.049	*< 0.0006*
KONA_3	L2250817-3	3/28/2019 15:00	0.00039	*< 0.001*	5.19		13.4	*< 0.005*	25.1	46.1	0.00126	9.16	0.00414	*< 0.5*	*< 0.00005*	0.0240	*< 0.0002*	355	*< 0.0004*	12.3	*< 0.0001*	1.56	*< 0.002*	*< 0.001*	*< 0.003*	0.000305	0.000360	*< 0.0005*	*< 0.001*	0.050	*< 0.0006*
KONA_3	L2257457-3	4/11/2019 15:00	0.00051	*< 0.001*	1.02		12.6	*< 0.005*	23.4	42.6	0.00084	8.33	0.00547	*< 0.5*	*< 0.00005*	0.0253	0.00074	352	*< 0.0004*	13.5	*< 0.0001*	1.65	*< 0.002*	*< 0.001*	*< 0.003*	0.000352	0.000413	*< 0.0005*	*< 0.001*	0.058	*< 0.0006*
KONA_3	L2263301-3	4/25/2019 14:45	0.00045	*< 0.001*	2.81		10.8	*< 0.005*	19.9	37.7	0.00104	8.52	0.00365	*< 0.5*	*< 0.00005*	0.0226	0.00049	356	*< 0.0004*	12.8	*< 0.0001*	1.79	*< 0.002*	*< 0.001*	*< 0.003*	0.000260	0.000491	*< 0.0005*	*< 0.001*	0.043	*< 0.0006*
KONA_4	L1955323-4	7/7/2017 13:00	0.00155	0.00026	*< 0.001*	*< 0.000005*	15.2	0.00822	6.45	1.27	0.00587	16.9	0.000274	*< 0.05*	0.0000929	0.0368	0.00418	12.1	0.000043	11.3	0.000019	0.0978	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000174	0.0707	0.000826	0.00032	0.00253	*< 0.00006*
KONA_4	L1969885-4	8/3/2017 13:50	0.00174	0.00023	0.0024	*< 0.000005*	14.2	0.00798	6.33	1.76	0.00707	17.4	0.000500	*< 0.05*	0.0000623	0.0374	0.00461	11.4	0.000051	14.2	0.000017	0.107	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000230	0.0712	0.000866	0.00024	0.00330	*< 0.00006*
KONA_4	L1977048-4	8/17/2017 12:25	0.00155	0.00014	0.0195	*< 0.000005*	15.4	0.00698	5.77	1.91	0.00565	18.1	0.000489	*< 0.05*	0.0000461	0.0394	0.00326	6.19	0.000104	14.4	*< 0.00001*	0.0916	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000199	0.0348	0.000859	0.00019	0.00330	*< 0.00006*
KONA_4	L1984769-4	8/31/2017 14:00	0.00143	0.00010	0.0353	*< 0.000005*	14.5	0.00636	4.78	1.79	0.00578	16.4	0.000508	*< 0.05*	0.0000237	0.0366	0.00290	3.03	*< 0.00004*	15.6	*< 0.00001*	0.0753	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000188	0.0192	0.000733	0.00016	0.00368	*< 0.00006*
KONA_4	L1992087-4	9/14/2017 14:55	0.00134	*< 0.0001*	0.0583	*< 0.000005*	12.5	0.00595	3.80	1.56	0.00559	13.9	0.000443	*< 0.05*	0.0000157	0.0316	0.00227	1.27	*< 0.00004*	14.3	*< 0.00001*	0.0613	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000182	0.0103	0.000630	0.00018	0.00222	*< 0.00006*
KONA_4	L1999487-4	9/28/2017 11:25	0.00124	*< 0.0001*	0.0639	*< 0.000005*	13.2	0.00571	3.77	1.60	0.00591	13.9	0.000510	*< 0.05*	0.0000157	0.0336	0.00240	0.90	*< 0.00004*	16.3	*< 0.00001*	0.0589	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000173	0.00878	0.000743	0.00017	0.00293	*< 0.00006*
KONA_4	L2007130-4	10/13/2017 11:25	0.00103	0.00014	*< 0.001*	*< 0.000005*	11.5	0.00509	3.44	1.41	0.00637	12.0	0.000536	*< 0.05*	0.0000177	0.0304	0.00241	1.09	*< 0.00004*	14.8	*< 0.00001*	0.0519	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000166	0.00934	0.000922	0.00018	0.00217	*< 0.00006*
KONA_4	L2014335-4	10/26/2017 11:50	0.000546	*< 0.0001*	0.0453	*< 0.000005*	5.86	0.00246	1.56	0.793	0.00286	8.64	0.000219	*< 0.05*	0.0000169	0.0155	0.00114	*< 0.5*	*< 0.00004*	7.97	*< 0.00001*	0.0255	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000837	0.00295	0.000434	*< 0.0001*	0.00095	*< 0.00006*
KONA_4	L2020126-4	11/8/2017 12:30	0.000530	*< 0.0001*	0.0932	*< 0.000005*	6.22	0.00236	1.68	0.839	0.00290	8.50	0.000268	*< 0.05*	0.0000051	0.0157	0.00111	0.53	*< 0.00004*	8.21	*< 0.00001*	0.0281	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000736	0.00305	0.000418	*< 0.0001*	0.00120	*< 0.00006*
KONA_4	L2026623-4	11/23/2017 14:15	0.000743	*< 0.0001*	0.0812	*< 0.000005*	9.10	0.00382	2.74	1.42	0.00481	10.6	0.000399	*< 0.05*	0.0000115	0.0229	0.00140	*< 0.5*	*< 0.00004*	15.1	*< 0.00001*	0.0434	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000116	0.00484	0.000413	0.00013	0.00197	*< 0.00006*
KONA_4	L2031965-4	12/6/2017 14:05	0.000786	*< 0.0001*	0.0883	*< 0.000005*	9.88	0.00354	2.93	1.42	0.00546	10.2	0.000285	*< 0.05*	0.0000131	0.0251	0.00165	*< 1*	*< 0.00004*	15.2	*< 0.00001*	0.0484	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000138	0.00641	0.000609	0.00015	0.00175	*< 0.00006*
KONA_4	L2038563-4	12/21/2017 13:50	0.000752	0.00012	0.121	*< 0.000005*	9.83	0.00290	2.57	1.31	0.00604	9.68	0.000358	*< 0.05*	0.0000231	0.0236	0.00135	0.56	*< 0.00004*	15.7	*< 0.00001*	0.0421	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000112	0.00524	0.000510	*< 0.0001*	0.00179	*< 0.00006*
KONA_4	L2041649-4	1/4/2018 13:05	0.000682	*< 0.0001*	0.0178	*< 0.000005*	7.46	0.00276	2.25	1.15	0.00455	8.22	0.000353	*< 0.05*	*< 0.000015*	0.0184	0.00168	0.69	*< 0.00004*	13.2	*< 0.00001*	0.0379	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000110	0.00477	0.000574	0.00011	0.00165	*< 0.00006*
KONA_4	L2046871-4	1/18/2018 11:25	0.000808	0.00013	0.0721	*< 0.000005*	8.83	0.00329	2.54	1.22	0.00597	9.30	0.000355	*< 0.05*	0.0000137	0.0226	0.00159	0.68	*< 0.00004*	15.0	*< 0.00001*	0.0413	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000124	0.00542	0.000668	0.00016	0.00211	*< 0.00006*
KONA_4	L2052061-4	2/1/2018 12:10	0.000832	*< 0.0001*	0.0725	*< 0.000005*	9.38	0.00294	2.55	1.24	0.00525	9.30	0.000343	*< 0.05*	0.0000051	0.0223	0.00149	*< 0.5*	*< 0.00004*	15.4	*< 0.00001*	0.0424	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000124	0.00548	0.000681	0.00013	0.00180	*< 0.00006*
KONA_4	L2057381-4	2/15/2018 11:35	0.000751	*< 0.0001*	0.0588	*< 0.000005*	8.59	0.00308	2.30	1.13	0.00536	8.20	0.000275	*< 0.05*	0.0000070	0.0189	0.00143	0.77	*< 0.00004*	14.5	*< 0.00001*	0.0379	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000122	0.00529	0.000539	0.00015	0.00166	*< 0.00006*
KONA_4	L2062788-4	3/1/2018 13:25	0.000563	0.00027	0.0878	*< 0.000005*	6.82	0.00228	1.82	0.962	0.00344	8.09	0.000212	*< 0.05*	0.0000072	0.0170	0.00111	*< 0.5*	*< 0.00004*	11.7	*< 0.00001*	0.0292	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000899	0.00311	0.000271	0.00010	0.00153	*< 0.00006*
KONA_4	L2068449-4	3/15/2018 11:40	0.000501	*< 0.0001*	0.0957	*< 0.000005*	6.66	0.00244	1.65	0.934	0.00371	7.98	0.000179	*< 0.05*	0.0000082	0.0166	0.00107	*< 0.5*	*< 0.00004*	11.5	*< 0.00001*	0.0276	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000938	0.00270	0.000370	*< 0.0001*	0.00080	*< 0.00006*
KONA_4	L2074311-4	3/29/2018 11:20	0.000588	*< 0.0001*	0.0964	*< 0.000005*	7.03	0.00248	1.89	1.08	0.00473	7.89	0.000254	*< 0.05*	0.0000088	0.0165	0.00129	0.89	*< 0.00004*	12.2	*< 0.00001*	0.0315	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000996	0.00405	0.000569	0.00012	0.0016	*< 0.00006*
KONA_4	L2079620-4	4/12/2018 11:00	0.000604	*< 0.0001*	0.161	*< 0.000005*	6.18	0.00264	1.79	0.954	0.00478	7.62	0.000207	*< 0.05*	*< 0.000015*	0.0161	0.00109	0.71	*< 0.00004*	11.7	0.000010	0.0287	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000103	0.00405	0.000441	0.00013	0.0015	*< 0.00006*
KONA_4	L2085708-4	4/26/2018 13:40	0.000598	*< 0.0001*	0.151	*< 0.000005*	6.73	0.00271	1.85	1.02	0.00494	7.40	0.000195	*< 0.05*	0.0000081	0.0165	0.00101	*< 0.5*	*< 0.00004*	13.2	*< 0.00001*	0.0306	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000101	0.00385	0.000507	0.00014	0.0013	*< 0.00006*
KONA_4	L2092801-4	5/10/2018 11:15	0.000636	*< 0.0001*	0.161	*< 0.000005*	7.16	0.00305	1.92	1.11	0.00558	8.12	0.000238	*< 0.05*	0.0000086	0.0178	0.00105	*< 0.5*	*< 0.00004*	14.0	*< 0.00001*	0.0325	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000120	0.00414	0.000724	0.00018	0.0016	*< 0.00006*
KONA_4	L2100224-4	5/24/2018 14:00	0.000690	*< 0.0001*	0.124	*< 0.000005*	7.33	0.00263	2.05	1.20	0.00613	8.29	0.000179	*< 0.05*	0.0000102	0.0188	0.00116	*< 0.5*	*< 0.00004*	14.5	0.000011	0.0348	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000119	0.00419	0.000595	0.00016	0.0015	*< 0.00006*
KONA_4	L2108434-4	6/7/2018 13:30	0.000648	*< 0.0001*	0.0403		7.31	0.00296	2.01	1.06	0.00574	8.27	0.000210	*< 0.05*	0.0000092	0.0180	0.00109	*< 0.5*	*< 0.00004*	16.4	*< 0.00001*	0.0316	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000124	0.00388	0.000545	0.00017	0.0183	*< 0.00006*
KONA_4	L2116986-4	6/21/2018 14:00	0.000638	*< 0.0001*	0.0572		7.50	0.00265	1.98	1.09	0.00548	8.61	0.000183	*< 0.05*	0.0000141	0.0189	0.00102	*< 0.5*	*< 0.00004*	15.2	*< 0.00001*	0.0305	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000120	0.00337	0.000521	0.00015	0.0014	*< 0.00006*
KONA_4	L2125321-4	7/6/2018 11:30	0.000615	*< 0.0001*	0.0461		7.02	0.00265	1.84	1.01	0.00574	8.23	0.000159	*< 0.05*	0.0000093	0.0176	0.00101	*< 0.5*	*< 0.00004*	15.4	*< 0.00001*	0.0297	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000113	0.00321	0.000519	0.00014	0.0011	*< 0.00006*
KONA_4	L2132784-4	7/19/2018 14:45	0.000615	*< 0.0001*	0.0394		7.09	0.00288	1.95	0.979	0.00612	8.59	0.000198	*< 0.05*	0.0000128	0.0178	0.00102	*< 0.5*	*< 0.00004*	16.2	*< 0.00001*	0.0294	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000112	0.00339	0.000549	0.00015	0.0076	*< 0.00006*
KONA_4	L2140795-4	8/2/2018 13:30	0.000641	*< 0.0001*	0.0406		7.38	0.00281	1.86	0.938	0.00614	8.60	0.000187	*< 0.05*	0.0000584	0.0177	0.00101	0.54	*< 0.00004*	15.7	*< 0.00001*	0.0308	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000119	0.00307	0.000618	0.00015	0.0014	*< 0.00006*
KONA_4	L2148482-4	8/16/2018	0.000577	*< 0.0001*	0.0382		6.59	0.00265	1.78	0.879	0.00641	8.36	0.000181	*< 0.05*	0.0000077	0.0169	0.000928	*< 0.5*	*< 0.00004*	15.0	*< 0.00001*	0.0289	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000115	0.00279	0.000471	0.00012	0.0010	*< 0.00006*
KONA_4	L2156461-4	8/30/2018 14:20	0.000599	*< 0.0001*	0.0753		7.22	0.00275	1.82	0.812	0.00657	8.73	*< 0.00005*	*< 0.05*	*< 0.000015*	0.0178	0.000902	*< 0.5*	*< 0.00004*	15.9	*< 0.00001*	0.0295	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000115	0.00282	0.000491	0.00013	0.0013	*< 0.00006*
KONA_4	L2164110-4	9/13/2018 11:45	0.000585	*< 0.0001*	0.0946		7.46	0.00272	1.83	0.766	0.00661	9.05	0.000184	*< 0.05*	0.0000103	0.0185	0.000869	*< 0.5*	*< 0.00004*	16.5	0.000024	0.0298	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000107	0.00260	0.000603	0.00012	0.0013	*< 0.00006*
KONA_4	L2172409-4	9/27/2018 14:00	0.000497	*< 0.0001*	0.0994		6.11	0.00247	1.69	0.584	0.00661	8.12	0.000152	*< 0.05*	0.0000115	0.0151	0.000722	*< 0.5*	*< 0.00004*	16.3	*< 0.00001*	0.0258	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000886	0.00222	0.000465	0.00011	0.0011	*< 0.00006*
KONA_4	L2180431-4	10/12/2018 14:10	0.000477	*< 0.0001*	0.0567		6.06	0.00248	1.59	0.509	0.00707	7.87	0.000115	*< 0.05*	0.0000094	0.0144	0.000694	0.50	*< 0.00004*	16.3	*< 0.00001*	0.0266	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000891	0.00221	0.000533	0.00010	0.0010	*< 0.00006*
KONA_4	L2187510-4	10/25/2018 14:00	0.000468	0.00011	0.0714		5.87	0.00236	1.60	0.405	0.00715	7.74	0.000124	*< 0.05*	0.0000144	0.0139	0.000617	*< 0.5*	*< 0.00004*	16.2	*< 0.00001*	0.0261	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000854	0.00207	0.000547	0.00015	*< 0.001*	*< 0.00006*
KONA_4	L2194529-4	11/8/2018 13:40	0.000412	*< 0.0001*	0.0619		5.77	0.00227	1.57	0.384	0.00678	7.57	0.000127	*< 0.05*	0.0000120	0.0141	0.000588	*< 0.5*	*< 0.00004*	16.1	*< 0.00001*	0.0239	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000767	0.00193	0.000528	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_4	L2200705-4	11/22/2018 10:30	0.000422	*< 0.0001*	0.0355		5.64	0.00216	1.44	0.328	0.00677	7.25	0.000113	*< 0.05*	0.0000132	0.0135	0.000497	0.51	*< 0.00004*	16.2	*< 0.00001*	0.0226	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000729	0.00178	0.000525	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_4	L2207335-4	12/6/2018 14:45	0.000380	*< 0.0001*	0.0287		5.58	0.00224	1.46	0.292	0.00688	7.29	0.000087	*< 0.05*	0.0000107	0.0131	0.000490	*< 0.5*	*< 0.00004*	15.9	*< 0.00001*	0.0232	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000706	0.00167	0.000543	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_4	L2213525-4	12/20/2018 14:25	0.000686	*< 0.0001*	0.0466		9.50	0.00354	6.66	6.54	0.00940	10.5	0.000695	*< 0.05*	*< 0.000005*	0.0237	0.000511	53.7	*< 0.00004*	14.0	*< 0.00001*	0.167	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000149	0.00540	0.000113	*< 0.0001*	0.0030	*< 0.00006*
KONA_4	L2217203-4	1/5/2019 11:35	0.000978	*< 0.0005*	0.660		12.8	0.0063	15.9	16.4	0.00284	14.8	0.00182	*< 0.25*	*< 0.000025*	0.0348	0.00038	166	*< 0.0002*	13.5	*< 0.00005*	0.472	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000266	0.00160	*< 0.00025*	*< 0.0005*	0.0187	*< 0.0003*
KONA_4	L2222132-4	1/17/2019 11:45	0.00117	*< 0.0001*	2.43		16.8	0.00792	27.2	23.2	0.000975	15.7	0.00231	*< 0.05*	*< 0.000005*	0.0427	0.000355	304	*< 0.00004*	13.7	*< 0.00001*	0.755	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000359	0.00103	*< 0.00005*	*< 0.0001*	0.0427	*< 0.00006*
KONA_4	L2227544-4	1/31/2019 10:30	0.00111	*< 0.001*	4.69		15.1	0.0081	30.6	23.8	0.00067	13.0	0.00237	*< 0.5*	*< 0.00005*	0.0403	0.00027	319	*< 0.0004*	13.8	*< 0.0001*	0.788	*< 0.002*	*< 0.001*	*< 0.003*	0.000329	0.00103	*< 0.0005*	*< 0.001*	0.129	*< 0.0006*
KONA_4	L2233141-4	2/14/2019 14:20	0.00101	*< 0.001*	5.62		14.0	0.0085	26.7	23.3	*< 0.0005*	9.56	0.00240	*< 0.5*	*< 0.00005*	0.0364	0.00021	331	*< 0.0004*	13.0	*< 0.0001*	0.883	*< 0.002*	*< 0.001*	*< 0.003*	0.000306	0.00119	*< 0.0005*	*< 0.001*	0.064	*< 0.0006*
KONA_4	L2238565-4	2/28/2019 15:15	0.00104	*< 0.0005*	6.29		13.0	0.0077	28.5	21.9	0.00037	8.55	0.00184	*< 0.25*	*< 0.000025*	0.0370	0.00018	327	*< 0.0002*	12.6	*< 0.00005*	1.01	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000272	0.00128	*< 0.00025*	*< 0.0005*	0.0675	*< 0.0003*
KONA_4	L2244540-4	3/14/2019 14:30	0.000999	*< 0.0005*	6.37		14.9	0.0080	23.8	19.8	*< 0.00025*	8.09	0.00170	*< 0.25*	*< 0.000025*	0.0365	0.00015	327	*< 0.0002*	12.7	*< 0.00005*	1.08	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000268	0.00130	*< 0.00025*	*< 0.0005*	0.0656	*< 0.0003*
KONA_4	L2250817-4	3/28/2019 15:00	0.000897	*< 0.0005*	8.16		13.4	0.0087	28.0	19.9	*< 0.00025*	8.81	0.00145	*< 0.25*	*< 0.000025*	0.0362	*< 0.0001*	360	*< 0.0002*	14.1	*< 0.00005*	1.12	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000229	0.00126	*< 0.00025*	*< 0.0005*	0.0603	*< 0.0003*
KONA_4	L2257457-4	4/11/2019 15:00	0.000856	*< 0.0005*	7.76		12.1	0.0078	21.9	18.0	*< 0.00025*	8.21	0.00179	*< 0.25*	*< 0.000025*	0.0347	0.00010	337	*< 0.0002*	12.9	*< 0.00005*	1.16	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000229	0.00118	*< 0.00025*	*< 0.0005*	0.0512	*< 0.0003*
KONA_4	L2263301-4	4/25/2019 14:45	0.000879	*< 0.0005*	7.86		11.0	0.0079	20.7	16.9	*< 0.00025*	8.82	0.00141	*< 0.25*	*< 0.000025*	0.0352	*< 0.0001*	348	*< 0.0002*	13.5	*< 0.00005*	1.33	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000210	0.00115	*< 0.00025*	*< 0.0005*	0.0421	*< 0.0003*

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX A3: GNEISS COLUMN (GO, GS, GT) EFFLUENT RESULTS

Appendix A3: Gneiss Column (GO, GS, GT) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
GO	L2000226-1	9/29/2017 10:50	0	0		326	8.16	310	113	1.58	< 0.005	< 0.001	< 0.005	0.0079	53.8	< 0.0015	< 0.05	1.66	0.363	< 0.000005	0.0133	0.0514	0.039	0.0756	< 0.00001	< 0.000005	19.9	< 0.000008	0.0000286	0.00078	0.000013
GO	L2014692-1	10/27/2017	4	4		262	8.12	371	156	2.97	0.0271	< 0.001	< 0.005	0.0197	61.0	0.0020	< 0.05	1.60	0.351	< 0.000005	0.0108	0.0424	0.047	0.105	< 0.00001	< 0.000005	25.4	< 0.00003	0.0000384	0.00016	0.000018
GO	L2021295-1	11/10/2017 13:30	6	6		256	8.29	339	127	2.38	0.0103	< 0.001	< 0.005	0.0203	50.1	< 0.0015	< 0.05	1.34	0.372	< 0.000005	0.0093	0.0403	0.043	0.0943	< 0.00001	< 0.000005	24.4	< 0.000015	0.0000300	< 0.0001	0.000015
GO	L2026623-5	11/23/2017 14:40	8	8		315	8.09	316	146	1.73	0.0057	< 0.001	< 0.005	0.0175	43.7	< 0.0015	< 0.05	1.10	0.385	< 0.000005	0.0108	0.0411	0.042	0.0893	< 0.00001	< 0.000005	23.1	< 0.00002	0.0000387	0.00013	0.000016
GO	L2031965-5	12/6/2017 14:05	10	10		255	8.02	311	184	2.26	0.0081	< 0.001	< 0.005	0.0170	39.0	< 0.0015	< 0.05	0.95	0.392	< 0.000005	0.0103	0.0455	0.034	0.0951	< 0.00001	< 0.000005	21.1	< 0.00001	0.0000409	0.00018	0.000016
GO	L2038563-5	12/21/2017 13:10	12	12		259	8.09	296.1	162	1.92	< 0.005	< 0.001	< 0.005	0.0181	35.5	< 0.0015	< 0.05	0.80	0.375	< 0.000005	0.0082	0.0406	0.037	0.102	< 0.00001	< 0.000005	22.1	< 0.00003	0.0000390	0.00024	0.000016
GO	L2041649-5	1/4/2018 13:05	14	14		257	8.08	277.5	149	1.46	0.0050	< 0.001	< 0.005	0.0147	30.8	< 0.0015	< 0.05	0.72	0.373	< 0.000005	0.0087	0.0397	0.034	0.0892	< 0.00001	< 0.000005	21.2	0.0000062	0.0000350	0.00023	0.000012
GO	L2046871-5	1/18/2018 12:10	16	16		266	8.23	268.8	159	1.45	< 0.005	< 0.001	< 0.005	0.0148	27.5	< 0.0015	< 0.05	0.65	0.382	< 0.000005	0.0115	0.0464	0.033	0.0878	< 0.00001	< 0.000005	21.3	< 0.00004	0.0000379	0.00040	0.000013
GO	L2052061-5	2/1/2018 12:35	18	18		287	8.05	262.1	156	1.58	< 0.005	< 0.001	< 0.005	0.0139	24.8	< 0.0015	< 0.05	0.55	0.384	< 0.000005	0.00890	0.0474	0.031	0.0797	< 0.00001	< 0.000005	21.7	< 0.00001	0.0000375	0.00021	0.000014
GO	L2057381-5	2/15/2018 11:35	20	20		262	8.03	261.2	138	1.33	0.0125	< 0.001	< 0.005	0.0162	22.3	< 0.0015	< 0.05	< 0.5	0.383	< 0.000005	0.0075	0.0444	0.029	0.0861	< 0.00001	< 0.000005	21.9	< 0.00002	0.0000343	0.00014	0.000016
GO	L2062788-5	3/1/2018 14:20	22	22		238	8.06	260	144	1.40	0.0185	< 0.001	< 0.005	0.0197	21.0	< 0.0015	< 0.05	< 0.5	0.387	< 0.000005	0.0086	0.0440	0.033	0.0883	< 0.00001	< 0.000005	22.9	< 0.00002	0.0000314	0.00024	0.000017
GO	L2068449-5	3/15/2018 12:25	24	24		294	8.07	240.5	140	1.42	0.0059	< 0.001	< 0.005	0.0175	17.7	< 0.0015	< 0.05	< 0.5	0.383	< 0.000005	0.0081	0.0464	0.027	0.0814	< 0.00001	< 0.000005	18.9	< 0.00001	0.0000330	0.00014	0.000012
GO	L2074311-5	3/29/2018 12:15	26	26		272	8.06	238.2	152	1.25	0.0065	< 0.001	< 0.005	0.0185	16.0	< 0.0015	< 0.05	< 0.5	0.379	< 0.000005	0.0084	0.0465	0.027	0.0844	< 0.00001	0.0000050	19.5	< 0.000015	0.0000361	0.00026	0.000013
GO	L2079620-5	4/12/2018 11:30	28	28		245	8.08	237.7	150	1.20	0.0082	< 0.001	< 0.005	0.0170	14.4	< 0.0015	< 0.05	< 0.5	0.399	< 0.000005	0.0082	0.0485	0.027	0.0935	< 0.00001	< 0.000005	19.2	< 0.000005	0.0000390	0.00021	0.000012
GO	L2085708-5	4/26/2018 14:00	30	30		251	8.02	232.5	132	1.23	0.0120	< 0.001	< 0.005	0.0174	14.0	< 0.0015	< 0.05	< 0.5	0.396	< 0.000005	0.0077	0.0509	0.027	0.0900	< 0.00001	< 0.000005	19.5	< 0.000015	0.0000318	0.00025	0.000012
GO	L2092801-5	5/10/2018 11:15	32	32		254	8.1	231.6	125	1.16	0.0146	< 0.001	< 0.005	0.0171	13.1	< 0.0015	< 0.05	< 0.5	0.377	< 0.000005	0.0074	0.0525	0.029	0.0880	< 0.00001	< 0.000005	20.3	< 0.000015	0.0000307	0.00028	0.000014
GO	L2100224-5	5/24/2018 14:00	34	34		267	8	230.6	136	1.11	0.0186	< 0.001	< 0.005	0.0166	12.2	< 0.0015	< 0.05	< 0.5	0.392	< 0.000005	0.0084	0.0629	0.026	0.107	< 0.00001	< 0.000005	19.5	< 0.00002	0.0000314	0.00032	0.000015
GO	L2108434-5	6/7/2018 14:00	36		0	187	8.09	255.3	153	1.10	0.0944	< 0.001	< 0.005	0.0275	14.9	< 0.0015	< 0.05	< 0.5	0.425	< 0.000005	0.0061	0.0559	0.034	0.115	< 0.00001	< 0.000005	22.8	< 0.00002	0.0000382	0.00036	0.000019
GO	L2116986-5	6/21/2018 14:00	38		2	202	8.1	279.6	222	1.02	0.114	< 0.001	< 0.005	0.0280	19.9	< 0.0015	< 0.05	< 0.5	0.430	0.0000942	0.0058	0.0472	0.033	0.131	< 0.00001	< 0.000005	24.9	< 0.000015	0.0000385	0.00039	0.000018
GO	L2125321-5	7/6/2018 11:50	40		4	205	8.06	290.9	182	2.73	0.116	< 0.001	< 0.005	0.0253	22.2	< 0.0015	< 0.05	< 0.5	0.412	< 0.000005	0.0048	0.0447	0.032	0.146	< 0.00001	< 0.000005	26.0	< 0.00002	0.0000391	0.00042	0.000020
GO	L2132784-5	7/19/2018 15:15	42		6	206	8.08	297	182	1.11	0.123	< 0.001	< 0.005	0.0253	23.5	< 0.0015	< 0.05	< 0.5	0.423	< 0.000005	0.0049	0.0415	0.033	0.142	< 0.00001	< 0.000005	26.8	< 0.000015	0.0000407	0.00043	0.000021
GO	L2140795-5	8/2/2018 13:45	44		8	195	8.08	305	184	1.49	0.149	< 0.001	< 0.005	0.0233	24.1	< 0.0015	< 0.05	0.58	0.417	< 0.000005	0.0053	0.0366	0.035	0.160	< 0.00001	< 0.000005	29.3	< 0.000025	0.0000394	0.00041	0.000022
GO	L2148482-5	8/16/2018	46		10	211	8.12	306	192	1.18	0.147	< 0.001	< 0.005	0.0232	24.0	< 0.0015	< 0.05	0.65	0.443	< 0.000005	0.0048	0.0387	0.034	0.174	< 0.00001	< 0.000005	30.5	< 7.5E-06	0.0000362	0.00042	0.000022
GO	L2156461-5	8/30/2018 14:20	48		12	198	8.07	312	188	1.19	0.144	< 0.001	< 0.005	0.0310	23.5	< 0.0015	< 0.05	0.75	0.410	< 0.000005	0.0043	0.0412	0.037	0.172	< 0.00001	< 0.000005	29.9	< 0.00003	0.0000372	0.00042	0.000025
GO	L2164110-5	9/13/2018 11:45	50		14	196	8.14	314	175	1.17	0.141	< 0.001	< 0.005	0.0225	23.8	< 0.0015	< 0.05	0.86	0.404	< 0.000005	0.0045	0.0349	0.034	0.171	< 0.00001	< 0.000005	29.8	< 0.000015	0.0000392	0.00048	0.000021
GO	L2172409-5	9/27/2018 14:00	52		16	233	8.11	312	153	1.22	0.144	< 0.001	< 0.005	0.0218	23.5	< 0.0015	< 0.05	1.46	0.416	< 0.000005	0.0037	0.0337	0.035	0.169	< 0.00001	< 0.000005	28.1	< 0.000005	0.0000304	0.00042	0.000018
GO	L2180431-5	10/12/2018 14:10	54		18	231	7.97	316	114	0.86	0.145	< 0.001	< 0.005	0.0214	21.7	< 0.0015	< 0.05	1.13	0.372	< 0.000005	0.00389	0.0316	0.035	0.167	< 0.00001	< 0.000005	29.2	< 0.00001	0.0000310	0.00044	0.000019
	L2187510-5	10/25/2018 14:00	56		20	160	8.11	391	136	1.14	0.145	< 0.001	< 0.005	0.0201	21.5	< 0.0015	< 0.05	1.38	0.391	< 0.000005	0.00336	0.0296	0.034	0.153	< 0.00001	< 0.000005	29.3	< 0.00002	0.0000305	0.00050	0.000019
GO	L2194529-5	11/8/2018 14:10	58		22	213	8.16	316	173	0.91	0.146	< 0.001	< 0.005	0.0191	21.4	< 0.0015	< 0.05	1.46	0.411	< 0.000005	0.0037	0.0311	0.034	0.165	< 0.00001	< 0.000005	31.6	< 0.000015	0.0000332	0.00050	0.000019
GO	L2200705-5	11/22/2018 11:55	60		24	207	8.09	310	182	0.78	0.146	< 0.001	< 0.005	0.0215	20.7	< 0.0015	< 0.05	1.47	0.391	< 0.000005	0.0031	0.0304	0.031	0.159	< 0.00001	< 0.000005	28.9	< 0.00001	0.0000311	0.00044	0.000018
GO	L2207335-5	12/6/2018 13:05	62		26	213	7.94	309	177	0.86	0.145	< 0.001	< 0.005	0.0207	20.0	< 0.0015	< 0.05	1.53	0.396	< 0.000005	0.0037	0.0305	0.031	0.168	< 0.00001	< 0.000005	29.6	< 0.00002	0.0000316	0.00051	0.000017
GO	L2213525-5	12/20/2018 14:45	64		28	409	8.09	315	211	0.82	0.139	< 0.001	< 0.005	0.0196	25.6	< 0.0015	< 0.05	1.60	0.408	< 0.000005	0.0041	0.0302	0.034	0.173	< 0.00001	< 0.000005	32.7	< 0.00002	0.0000301	0.00051	0.000020
GO	L2217203-5	1/5/2019 11:35	66		30	315	7.86	346	181	0.75	0.172	< 0.001	< 0.005	0.0186	43.7	< 0.0067	< 0.05	1.50	0.393	< 0.000005	0.0034	0.0258	0.029	0.197	< 0.00001	< 0.000005	36.7	0.0000091	0.0000324	0.00051	0.000023
GO	L2222132-5	1/17/2019 11:45	68		32	349	7.9	441	163	0.68	0.168	< 0.001	< 0.005	0.0171	100	< 0.0067	< 0.05	1.26	0.384	< 0.000005	0.0029	0.0234	0.029	0.249	< 0.00001	< 0.000005	44.8	0.0000094	0.0000306	0.00048	0.000021
GO	L2227544-5	1/31/2019 10:30	70		34	364	7.89	642	143	0.94	0.190	< 0.001	< 0.005	0.0136	212	< 0.0015	< 0.05	1.05	0.304	< 0.000005	0.002	0.0176	0.026	0.166	< 0.00001	< 0.000005	70.4	< 0.00001	0.0000289	0.00044	0.000030
GO	L2233141-5	2/14/2019 14:20	72		36	367	7.72	830	121	0.76	0.199	< 0.005	< 0.025	0.0126	363	< 0.0015	< 0.25	< 2.5	0.29	< 0.000005	0.00230	0.0183	0.026	0.117	< 0.00001	< 0.000005	108	0.0000184	0.0000312	0.00042	0.000027
GO	L2238565-5	2/28/2019 15:15	74		38	363	7.68	984	136	0.87	0.200	< 0.005	< 0.025	0.0121	441	< 0.0015	< 0.25	< 2.5	0.26	< 0.000005	0.0019	0.0160	0.024	0.101	< 0.00001	< 0.000005	138	0.0000147	0.0000273	0.00037	0.000031
GO	L2244540-5	3/14/2019 14:30	76		40	363	7.76	1110	118	0.73	0.197	< 0.005	< 0.025	0.0111	527	< 0.0015	< 0.25	< 2.5	0.23	0.0000061	0.0021	0.0150	0.025	0.0819	< 0.00001	< 0.000005	160	0.0000091	0.0000343	0.00039	0.000034
GO	L2250817-5	3/28/2019 15:00	78		42	351	7.65	1206	118	0.78	0.207	< 0.005	< 0.025	0.0116	605	< 0.01	< 0.25	< 2.5	0.23	< 0.000005	0.0022	0.0153	0.026	0.0774	< 0.00001	< 0.000005	202	0.0000063	0.0000291	0.00038	0.000031
GO	L2257457-5	4/11/2019 15:00	80		44	360	7.68	1285	125	0.94	0.211	< 0.005	< 0.025	0.0108	689	< 0.01	< 0.25	< 2.5	0.22	< 0.000005	0.0018	0.0146	0.025	0.0700	< 0.00001	< 0.000005	219	0.0000107	0.0000419	0.00041	0.000034
GO	L2263301-5	4/25/2019 14:45	82		46	350	7.69	1380	119	0.97	0.225	< 0.005	< 0.025	0.0101	686	< 0.0015	< 0.25	< 2.5	0.21	< 0.000005	0.002	0.0140	0.022	0.0615	< 0.00001	< 0.000005	212	0.0000085	0.0000258	0.00036	0.000040
GS	L2000226-2	9/29/2017 10:50	0	0		421	7.85	1384	98	3.48	0.0081	< 0.005	0.064	< 0	697	< 0.0015	< 0.25	3.1	1.28	< 0.000005	0.0127	0.0168	0.024	0.0206	< 0.00001	< 0.000005	145	< 7.5E-06	0.000103	< 0.0001	0.00139
GS	L2014692-2	10/27/2017	4	4		264	7.8	1541	121	2.81	0.109	< 0.005	< 0.025	< 0	774	< 0.0015	< 0.25	3.4	0.18	0.0000061	0.0058	0.0246	0.025	0.0226	< 0.00001	< 0.000005	156	0.0000121	0.000389	< 0.0001	0.00159
GS	L2021295-2	11/10/2017 13:30	6	6		260	7.91	1403	107	2.40	0.0645	< 0.005	< 0.025	0.0021	683	< 0.0015	< 0.25	2.9	0.16	< 0.000005	0.0051	0.0225	0.027	0.0202	< 0.00001	< 0.000005	153	0.0000063	0.000169	< 0.0001	0.00136
GS	L2026623-6	11/23/2017 14:40	8	8		306	7.88	1232	161	1.73	0.0630	< 0.005	< 0.025	< 0	596	< 0.0015	< 0.25	< 2.5	0.18	< 0.000005	0.0052	0.0269	0.022	0.0234	< 0.00001	< 0.000005	129	0.0000063	0.0000857	< 0.0001	0.00118
GS	L2031965-6	12/6/2017 14:05	10	10		257	7.84	1163	174	2.05	0.0584	< 0.005	< 0.025	< 0	506	< 0.0015	< 0.25	< 2.5	0.16	< 0.000005	0.0045	0.0263	0.021	0.0217	< 0.00001	< 0.000005	115	0.0000075	0.0000661	< 0.0001	0.00113
GS	L2038563-6	12/21/2017 13:10	12	12		271	7.83	1048	161	1.28	0.0540	< 0.005	< 0.025	< 0	459	< 0.0015	< 0.25	< 2.5	0.15	< 0.000005	0.0039	0.0250	0.023	0.0249	< 0.00001	< 0.000005	103	0.0000155	0.0000508	< 0.0001	0.00110
GS	L2041649-6	1/4/2018 13:05	14	14		255	7.86	933	136	1.69	0.0496	< 0.005	< 0.025	0.0020	393	< 0.0015	< 0.25	< 2.5	0.16	< 0.000005	0.0046	0.0250	0.020	0.0220	< 0.00001	< 0.000005	89.8	0.0000055	0.0000399	< 0.0001	0.000933
GS	L2046871-6	1/18/2018 12:10	16	16		265	7.98	826	143	1.48	0.0419	< 0.005	< 0.025	< 0	331	< 0.0015	< 0.25	< 2.5	0.18	< 0.000005	0.0057	0.0311	0.019	0.0231	< 0.00001	< 0.000005	82.6	0.0000191	0.0000911	< 0.0001	0.000940
GS	L2052061-6	2/1/2018 12:35	18	18		289	7.95	759	134	1.48	0.0462	< 0.001	< 0.005	< 0	279	< 0.0015	< 0.05	0.97	0.180	< 0.000005	0.0051	0.0365	0.018	0.0224	< 0.00001	< 0.000005	72.7	< 0.000005	0.000261	< 0.0001	0.000895
GS	L2057381-6	2/15/2018 11:35	20	20		273	7.99	733	154	1.16	0.0593	< 0.001	< 0.005	< 0	253	< 0.0015	< 0.05	0.79	0.177	< 0.000005	0.0042	0.0344	0.018	0.0257	< 0.00001	< 0.000005	76.1	0.0000079	0.000138	< 0.0001	0.000832
GS	L2062788-6	3/1/2018 14:20	22	22		239	7.88	711	165	1.04	0.0568	< 0.001	< 0.005	0.0022	236	< 0.0015	< 0.05	0.73	0.189	< 0.000005	0.0056	0.0381	0.020	0.0251	< 0.00001	< 0.000005	74.2	< 0.000005	0.000120	< 0.0001	0.000817
GS	L2068449-6	3/15/2018 12:25	24	24		295	8.04	637	157	1.04	0.0571	< 0.001	< 0.005	0.0021	202	< 0.0015	< 0.05	0.61	0.193	< 0.000005	0.0049	0.0426	0.018	0.0244	< 0.00001	< 0.000005	58.6	< 0.000005	0.000115	< 0.0001	0.000713
GS	L2074311-6	3/29/2018 12:15	26	26		269	7.94	603	164	1.08	0.0637	< 0.001	< 0.005	0.0026	182	< 0.0015	< 0.05	0.54	0.189	< 0.000005	0.0048	0.0406	0.017	0.0246	< 0.00001	0.0000056	57.4	< 0.000005	0.0000553	< 0.0001	0.000736
GS	L2079620-6	4/12/2018 11:30	28	28		258	7.92	564	151	0.90	0.0606	< 0.001	< 0.005	0.0025	156	< 0.0015	< 0.05	< 0.5	0.305	< 0.000005	0.0051	0.0489	0.016	0.0283	< 0.00001	< 0.000005	49.5	< 0.000005	0.0000420	< 0.0001	0.000716
GS	L2085708-6	4/26/2018 14:00	30	30		261	7.89	532	146	1.04	0.0548	< 0.001	< 0.005	0.0027	144	0.0026	< 0.05	< 0.5	0.201	< 0.000005	0.0046	0.0503	0.017	0.0294	< 0.00001	< 0.000005	49.0	0.0000058	0.0000359	< 0.0001	0.000698
GS	L2092801-6	5/10/2018 11:15	32	32		259	8.01	507	160	0.88	0.0560	< 0.001	< 0.005	< 0	132	< 0.0015	< 0.05	< 0.5	0.198	< 0.000005	0.0054	0.0511	0.018	0.0307	< 0.00001	< 0.000005	51.5	0.0000054	0.0000318	< 0.0001	0.000742
GS	L2100224-6	5/24/2018 14:00	34	34		271	7.87	496	151	0.94	0.0607	< 0.001	< 0.005	0.0024	121	< 0.0015	< 0.05	< 0.5	0.209	< 0.000005	0.0056	0.0582	0.016	0.0381	< 0.00001	< 0.000005	46.1	< 0.000005	0.0000333	< 0.0001	0.000782
GS	L2108434-6	6/7/2018 14:00	36		0	207	7.96	510	211	0.65	0.0798	< 0.001	< 0.005	0.0103	119	< 0.0015	< 0.05	< 0.5	0.240	< 0.000005	0.0047	0.361	0.023	0.0374	< 0.00001	< 0.000005	47.7	0.0000084	0.0000111	< 0.0001	0.000813
GS	L2116986-6	6/21/2018 14:00	38		2	351	8.02	493	193	0.84	0.0936	< 0.001	< 0.005	0.0243	109	< 0.0015	< 0.05	< 0.5	0.258	< 0.000005	0.0046	0.637	0.022	0.0391	< 0.00001	< 0.000005	45.3	0.0000063	0.0000107	< 0.0001	0.000861
GS	L2125321-6	7/6/2018 11:50	40		4	216	8	448	229	4.61	0.0882	< 0.001	< 0.005	0.0487	87.5	< 0.0015	< 0.05	0.62	0.261	< 0.000005	0.0044	1.13	0.022	0.0431	< 0.00001	< 0.000005	40.5	0.0000051	0.0000089	< 0.0001	0.000773
GS	L2132784-6	7/19/2018 15:15	42		6	337	8.05	441	311	0.74	0.0985	< 0.001	< 0.005	0.0611	82.9	< 0.0015	< 0.05	0.62	0.274	< 0.000005	0.0047	1.35	0.023	0.0414	< 0.00001	< 0.000005	39.8	0.0000070	0.0000227	< 0.0001	0.000767
GS	L2140795-6	8/2/2018 13:45	44		8	184	8.02	425	191	0.68	0.108	< 0.001	< 0.005	0.0510	73.2	< 0.0015	< 0.05	0.93	0.282	< 0.000005	0.0051	1.38	0.024	0.0485	< 0.00001	< 0.000005	41.4	0.0000148	0.0000156	< 0.0001	0.000840

Appendix A3: Gneiss Column (GO, GS, GT) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
GS	L2148482-6	8/16/2018	46		10	335	7.95	409	182	0.69	0.0991	< 0.001	< 0.005	0.0826	63.0	< 0.0015	< 0.05	1.37	0.295	< 0.000005	0.00490	1.93	0.023	0.0500	< 0.00001	< 0.000005	39.0	< 0.000005	0.0000124	< 0.0001	0.000772
GS	L2156461-6	8/30/2018 14:20	48		12	314	8.02	399	183	0.79	0.0942	< 0.001	< 0.005	0.055	57.3	< 0.0015	< 0.05	1.63	0.290	< 0.000005	0.0047	1.98	0.024	0.0519	< 0.00001	< 0.000005	37.6	0.0000163	0.0000151	< 0.0001	0.000770
GS	L2164110-6	9/13/2018 11:45	50		14	304	8.05	393	183	1.0	0.104	< 0.001	< 0.005	0.0848	53.4	< 0.0015	< 0.05	1.66	0.290	< 0.000005	0.0042	2.03	0.023	0.0541	< 0.00001	< 0.000005	35.6	< 0.000005	0.0000115	< 0.0001	0.000764
GS	L2172409-6	9/27/2018 14:00	52		16	333	8.07	374	184	0.91	0.0940	< 0.001	< 0.005	0.062	47.6	< 0.0015	< 0.05	1.64	0.307	< 0.000005	0.0041	2.53	0.023	0.0505	< 0.00001	< 0.000005	33.0	< 0.000005	0.0000147	< 0.0001	0.000640
GS	L2180431-6	10/12/2018 14:10	54		18	208	8.01	375	166	0.61	0.0985	< 0.001	< 0.005	0.064	43.8	< 0.0015	< 0.05	1.60	0.279	< 0.000005	0.0038	2.28	0.024	0.0521	< 0.00001	< 0.000005	33.1	< 0.000005	0.0000112	< 0.0001	0.000657
GS	L2187510-6	10/25/2018 14:00	56		20	211	8.13	388	183	0.99	0.0911	< 0.001	< 0.005	0.0588	45.2	< 0.0015	< 0.05	1.70	0.292	< 0.000005	0.0032	1.84	0.023	0.0521	< 0.00001	< 0.000005	34.0	0.0000105	0.0000104	< 0.0001	0.000647
GS	L2194529-6	11/8/2018 14:10	58		22	328	8.17	376	184	< 1	0.0900	< 0.001	< 0.005	0.062	43.3	< 0.0015	< 0.05	1.62	0.300	< 0.000005	0.0037	2.42	0.024	0.0537	< 0.00001	< 0.000005	34.7	0.0000058	0.0000118	< 0.0001	0.000573
GS	L2200705-6	11/22/2018 11:55	60		24	304	8.03	364	172	0.72	0.0864	< 0.001	< 0.005	0.089	40.9	< 0.0015	< 0.05	1.54	0.305	< 0.000005	0.0037	2.28	0.022	0.0514	< 0.00001	< 0.000005	33.7	0.0000078	0.0000109	< 0.0001	0.000640
GS	L2207335-6	12/6/2018 13:05	62		26	292	7.94	355	206	0.77	0.0871	< 0.001	< 0.005	0.069	38.1	< 0.0015	< 0.05	1.47	0.313	< 0.000005	0.0150	2.63	0.022	0.0596	< 0.00001	< 0.000005	33.0	0.0000108	0.0000144	< 0.0001	0.000598
GS	L2213525-6	12/20/2018 14:45	64		28	413	8.12	344	188	0.76	0.0830	< 0.001	0.0073	0.057	37.9	< 0.0015	< 0.05	1.45	0.332	< 0.000005	0.004	2.89	0.022	0.0608	< 0.00001	< 0.000005	36.3	0.0000115	0.0000114	< 0.0001	0.000600
GS	L2217203-6	1/5/2019 11:35	66		30	437	7.88	377	216	< 1	0.0657	< 0.001	0.0743	0.0598	47.1	< 0.0067	< 0.05	1.46	0.327	< 0.000005	0.0034	1.34	0.020	0.0672	< 0.00001	< 0.000005	36.9	< 0.000005	0.0000109	< 0.0001	0.000632
GS	L2222132-6	1/17/2019 11:45	68		32	423	7.86	453	153	< 1	0.0186	< 0.001	0.172	0.0532	104	< 0.0067	< 0.05	1.23	0.322	< 0.000005	0.0037	1.28	0.019	0.0794	< 0.00001	< 0.000005	44.9	0.0000074	0.0000141	< 0.0001	0.000570
GS	L2227544-6	1/31/2019 10:30	70		34	401	7.94	676	158	< 1	< 0.005	< 0.001	0.181	0.0300	223	< 0.0015	< 0.05	0.95	0.256	< 0.000005	0.0022	0.857	0.017	0.0762	< 0.00001	< 0.000005	69.4	0.0000055	0.0000147	< 0.0001	0.000706
GS	L2233141-6	2/14/2019 14:20	72		36	430	7.68	882	148	0.55	0.0087	< 0.005	0.161	0.0208	396	< 0.0015	< 0.25	< 2.5	0.25	< 0.000005	0.0021	0.607	0.018	0.0638	< 0.00001	< 0.000005	106	0.0000195	0.0000185	< 0.0001	0.000749
GS	L2238565-6	2/28/2019 15:15	74		38	457	7.66	1080	148	1.23	0.0089	< 0.005	0.130	0.0163	493	< 0.0015	< 0.25	< 2.5	0.21	< 0.000005	0.002	0.446	0.017	0.0570	< 0.00001	< 0.000005	144	0.0000114	0.0000251	< 0.0001	0.000814
GS	L2244540-6	3/14/2019 14:30	76		40	466	7.76	1248	135	0.57	0.0104	< 0.005	0.136	0.0099	617	< 0.0015	< 0.25	< 2.5	0.19	< 0.000005	0.0016	0.338	0.016	0.0495	< 0.00001	< 0.000005	170	0.0000061	0.0000278	< 0.0001	0.000875
GS	L2250817-6	3/28/2019 15:00	78		42	427	7.62	1375	139	0.70	0.0125	< 0.005	0.139	0.0106	712	< 0.01	< 0.25	< 2.5	0.19	< 0.000005	0.002	0.287	0.017	0.0482	< 0.00001	< 0.000005	224	0.0000051	0.0000269	< 0.0001	0.000930
GS	L2257457-6	4/11/2019 15:00	80		44	406	7.7	1444	120	0.74	0.0078	< 0.01	0.128	0.0098	790	< 0.01	< 0.5	< 5	< 0.2	< 0.000005	0.0017	0.249	0.017	0.0426	< 0.00001	< 0.000005	233	< 0.000005	0.0000360	< 0.0001	0.00101
GS	L2263301-6	4/25/2019 14:45	82		46	408	7.7	1547	130	0.64	0.0082	< 0.005	0.127	0.0075	792	< 0.0015	< 0.25	< 2.5	0.18	< 0.000005	0.0017	0.227	0.017	0.0373	< 0.00001	< 0.000005	237	< 0.000005	0.0000230	< 0.0001	0.00103
GT	L2000226-3	9/29/2017 10:50	0	0		415	8	815	104	3.24	< 0.005	< 0.005	< 0.025	0.0141	325	< 0.0015	< 0.25	< 2.5	1.30	< 0.000005	0.0122	0.0643	0.036	0.0289	< 0.00001	< 0.000005	79.1	< 0.000015	0.0000457	< 0.0001	0.000553
GT	L2014692-3	10/27/2017	4	4		259	7.98	856	135	2.19	0.0202	< 0.005	< 0.025	0.0096	334	< 0.0015	< 0.25	< 2.5	0.47	< 0.000005	0.00860	0.0687	0.039	0.0328	< 0.00001	< 0.000005	81.4	< 0.00003	0.000157	< 0.0001	0.000602
GT	L2021295-3	11/10/2017 13:30	6	6		255	8.04	719	119	1.78	0.0122	< 0.001	< 0.005	0.0069	249	< 0.0015	< 0.05	1.68	0.522	< 0.000005	0.0086	0.0830	0.037	0.0326	< 0.00001	< 0.000005	69.4	< 0.000015	0.000129	< 0.0001	0.000502
GT	L2026623-7	11/23/2017 14:40	8	8		308	7.96	633	152	1.12	0.0180	< 0.001	< 0.005	0.0062	210	< 0.0015	< 0.05	1.37	0.525	< 0.000005	0.00880	0.0911	0.037	0.0352	< 0.00001	< 0.000005	61.2	< 0.000005	0.000104	< 0.0001	0.000488
GT	L2031965-7	12/6/2017 14:05	10	10		232	7.93	579	214	1.58	0.0321	< 0.001	< 0.005	0.0082	175	< 0.0015	< 0.05	1.08	0.542	< 0.000005	0.0098	0.0997	0.030	0.0387	< 0.00001	< 0.000005	51.1	< 0.000015	0.0000727	< 0.0001	0.000425
GT	L2038563-7	12/21/2017 13:10	12	12		256	7.99	536	169	1.09	0.0289	< 0.001	< 0.005	0.0089	158	< 0.0015	< 0.05	0.91	0.533	< 0.000005	0.0072	0.0979	0.032	0.0424	< 0.00001	< 0.000005	49.8	< 0.00004	0.0000489	< 0.0001	0.000416
GT	L2041649-7	1/4/2018 13:05	14	14		257	7.97	485	127	1.26	0.0353	< 0.001	< 0.005	0.0101	135	< 0.0015	< 0.05	0.77	0.543	< 0.000005	0.0078	0.0953	0.028	0.0416	< 0.00001	< 0.000005	44.5	0.0000084	0.0000416	< 0.0001	0.000394
GT	L2046871-7	1/18/2018 12:10	16	16		265	8.1	448	134	1.19	0.0353	< 0.001	< 0.005	0.0093	116	< 0.0015	< 0.05	0.65	0.559	< 0.000005	0.0100	0.115	0.031	0.0454	< 0.00001	< 0.000005	46.1	< 0.00004	0.0000490	< 0.0001	0.000434
GT	L2052061-7	2/1/2018 12:35	18	18		283	8.09	415	137	1.24	0.0395	< 0.001	< 0.005	0.0099	100	< 0.0015	< 0.05	0.54	0.572	< 0.000005	0.0085	0.124	0.026	0.0484	< 0.00001	< 0.000005	40.9	< 0.000015	0.0000460	< 0.0001	0.000377
GT	L2057381-7	2/15/2018 11:35	20	20		255	7.99	403	125	0.94	0.0559	< 0.001	< 0.005	0.0118	89.5	< 0.0015	< 0.05	< 0.5	0.570	< 0.000005	0.0076	0.117	0.026	0.0547	< 0.00001	< 0.000005	40.4	< 0.00002	0.0000343	< 0.0001	0.000368
GT	L2062788-7	3/1/2018 14:20	22	22		239	7.96	385	143	0.97	0.0544	< 0.001	< 0.005	0.0146	79.8	< 0.0015	< 0.05	< 0.5	0.561	< 0.000005	0.0084	0.119	0.027	0.0645	< 0.00001	< 0.000005	40.4	< 0.00002	0.0000343	< 0.0001	0.000334
GT	L2068449-7	3/15/2018 12:25	24	24		298	8.07	355	140	0.91	0.0483	< 0.001	< 0.005	0.0136	68.3	< 0.0015	< 0.05	< 0.5	0.576	< 0.000005	0.0110	0.136	0.025	0.0610	< 0.00001	< 0.000005	32.3	< 0.000015	0.0000387	< 0.0001	0.000302
GT	L2074311-7	3/29/2018 12:15	26	26		272	8.04	341	141	0.82	0.0569	< 0.001	< 0.005	0.0163	60.1	< 0.0015	< 0.05	< 0.5	0.563	< 0.000005	0.00740	0.129	0.023	0.0675	< 0.00001	0.0000057	31.5	< 0.000015	0.0000319	< 0.0001	0.000303
GT	L2079620-7	4/12/2018 11:30	28	28		255	8.03	326	127	0.85	0.0595	< 0.001	< 0.005	0.0158	52.1	< 0.0015	< 0.05	< 0.5	0.594	< 0.000005	0.0088	0.152	0.023	0.0731	< 0.00001	< 0.000005	29.9	< 0.000005	0.0000308	< 0.0001	0.000300
GT	L2085708-7	4/26/2018 14:00	30	30		260	8.02	314	138	0.73	0.0558	< 0.001	< 0.005	0.0191	49.8	< 0.0015	< 0.05	< 0.5	0.587	< 0.000005	0.008	0.152	0.022	0.0748	< 0.00001	< 0.000005	27.6	< 0.000015	0.0000255	< 0.0001	0.000288
GT	L2092801-7	5/10/2018 11:15	32	32		257	8.09	306	128	0.77	0.0644	< 0.001	< 0.005	0.0186	45.8	< 0.0015	< 0.05	< 0.5	0.568	< 0.000005	0.0086	0.167	0.024	0.0816	< 0.00001	< 0.000005	29.6	< 0.000015	0.0000262	< 0.0001	0.000288
GT	L2100224-7	5/24/2018 14:00	34	34		270	8.01	296	133	0.72	0.0595	< 0.001	< 0.005	0.0219	40.5	< 0.0015	< 0.05	< 0.5	0.583	< 0.000005	0.0101	0.209	0.022	0.105	< 0.00001	< 0.000005	27.7	< 0.00002	0.0000346	< 0.0001	0.000316
GT	L2108434-7	6/7/2018 13:30	36		0	340	8.22	262.4	224	0.78	0.0357	< 0.001	< 0.005	0.0150	32.4	< 0.0015	< 0.05	< 0.5	0.570	< 0.000005	0.0109	0.211	0.023	0.0911	< 0.00001	< 0.000005	24.3	< 0.00002	0.0000257	< 0.0001	0.000293
GT	L2116986-7	6/21/2018 14:00	38		2	330	8.11	250.4	158	< 1	0.0133	< 0.001	< 0.005	0.0145	27.7	< 0.006	< 0.05	< 0.5	0.566	< 0.000005	0.0107	0.229	0.020	0.112	< 0.00001	< 0.000005	22.8	< 0.000015	0.0000518	0.00027	0.000283
GT	L2125321-7	7/6/2018 11:50	40		4	106	7.14	234.6	155	< 1	< 0.005	< 0.001	< 0.005	0.0194	23.0	< 0.0015	< 0.05	< 0.5	0.516	< 0.000005	0.0111	0.265	0.018	0.118	< 0.00001	< 0.000005	20.7	< 0.000005	0.0000491	< 0.0001	0.000257
GT	L2132784-7	7/19/2018 15:15	42		6	361	8.28	220.8	122	0.79	0.0108	< 0.001	< 0.005	0.0234	20.2	< 0.0015	< 0.05	< 0.5	0.509	< 0.000005	0.0107	0.290	0.017	0.118	< 0.00001	< 0.000005	19.0	< 0.000015	0.0000393	< 0.0001	0.000231
GT	L2140795-7	8/2/2018 13:45	44		8	358	8.26	219.6	128	0.59	0.0134	< 0.001	< 0.005	0.0184	19.2	< 0.0015	< 0.05	< 0.5	0.514	< 0.000005	0.0109	0.285	0.018	0.132	< 0.00001	< 0.000005	20.8	< 0.000025	0.0000310	< 0.0001	0.000267
GT	L2148482-7	8/16/2018	46		10	367	8.22	208.5	123	0.71	0.0054	< 0.001	< 0.005	0.0221	16.6	< 0.0015	< 0.05	< 0.5	0.481	< 0.000005	0.0119	0.311	0.016	0.147	< 0.00001	< 0.000005	19.7	< 0.00001	0.0000310	< 0.0001	0.000242
GT	L2156461-7	8/30/2018 14:20	48		12	349	8.24	209.7	114	< 1	0.0104	< 0.001	< 0.005	0.0221	15.5	< 0.0015	< 0.05	< 0.5	0.464	< 0.000005	0.0108	0.337	0.017	0.162	< 0.00001	< 0.000005	19.9	< 0.00003	0.0000302	< 0.0001	0.000244
GT	L2164110-7	9/13/2018 11:45	50		14	329	8.23	208.3	140	1.3	0.0225	< 0.001	< 0.005	0.0233	15.0	< 0.0015	< 0.05	< 0.5	0.453	< 0.000005	0.0115	0.320	0.016	0.146	< 0.00001	< 0.000005	19.7	< 0.000015	0.0000250	< 0.0001	0.000229
GT	L2172409-7	9/27/2018 14:00	52		16	370	8.29	198.3	109	< 1	0.0053	< 0.001	< 0.005	0.0243	13.5	< 0.0015	< 0.05	< 0.5	0.441	< 0.000005	0.0104	0.322	0.015	0.146	< 0.00001	< 0.000005	17.5	< 0.000005	0.0000291	< 0.0001	0.000199
GT	L2180431-7	10/12/2018 14:10	54		18	365	8.24	197.8	106	0.83	0.0102	< 0.001	< 0.005	0.0361	12.0	< 0.0015	< 0.05	< 0.5	0.388	< 0.000005	0.0095	0.305	0.014	0.157	< 0.00001	< 0.000005	17.7	< 0.00001	0.0000249	< 0.0001	0.000197
GT	L2187510-7	10/25/2018 14:00	56		20	316	8.2	200	126	< 1	0.0169	< 0.001	< 0.005	0.0197	11.5	< 0.0015	< 0.05	< 0.5	0.404	< 0.000005	0.0091	0.300	0.014	0.149	< 0.00001	< 0.000005	17.3	< 0.000015	0.0000186	< 0.0001	0.000193
GT	L2194529-7	11/8/2018 13:40	58		22	349	8.35	195.6	118	0.65	0.0146	< 0.001	< 0.005	0.0246	11.3	< 0.0015	< 0.05	< 0.5	0.422	< 0.000005	0.009	0.319	0.014	0.170	< 0.00001	< 0.000005	18.7	< 0.000015	0.0000205	< 0.0001	0.000173
GT	L2200705-7	11/22/2018 10:30	60		24	360	8.2	192.3	124	0.57	0.0103	< 0.001	< 0.005	0.0322	10.9	< 0.0015	< 0.05	< 0.5	0.389	< 0.000005	0.0095	0.302	0.013	0.152	< 0.00001	< 0.000005	17.7	< 0.00001	0.0000213	< 0.0001	0.000196
GT	L2207335-7	12/6/2018 14:45	62		26	362	8.2	187.9	114	< 1	< 0.005	< 0.001	< 0.005	0.0285	10.1	< 0.0015	< 0.05	< 0.5	0.374	< 0.000005	0.0091	0.325	0.013	0.170	< 0.00001	< 0.000005	17.6	< 0.00001	0.0000215	< 0.0001	0.000169
GT	L2213525-7	12/20/2018 14:45	64		28	532	8.16	567	97	0.77	< 0.005	< 0.001	< 0.005	0.0109	220	< 0.0015	< 0.05	< 0.5	0.295	< 0.000005	0.0121	0.236	0.011	0.288	0.000011	< 0.000005	81.0	0.0000160	0.000314	< 0.0001	0.000260
GT	L2217203-7	1/5/2019 11:35	66		30	513	7.75	947	86	< 1	0.0171	< 0.005	< 0.025	0.0054	504	< 0.01	< 0.25	< 2.5	0.24	< 0.000005	0.0048	0.186	0.010	0.0717	< 0.00001	< 0.000005	145	0.0000124	0.000344	< 0.0001	0.000293
GT	L2222132-7	1/17/2019 11:45	68		32	564	7.6	1260	88	< 1	0.0269	< 0.005	< 0.025	0.0034	683	< 0.01	< 0.25	< 2.5	0.19	< 0.000005	0.0046	0.178	0.010	0.0431	< 0.00001	< 0.000005	230	0.0000143	0.000371	< 0.0001	0.000309
GT	L2227544-7	1/31/2019 10:30	70		34	578	7.71	1405	77	0.75	0.0394	< 0.005	< 0.025	0.0041	771	< 0.0015	< 0.25	< 2.5	0.18	< 0.000005	0.0029	0.162	< 0.01	0.0270	< 0.00001	< 0.000005	250	0.0000148	0.000305	< 0.0001	0.000350
GT	L2233141-7	2/14/2019 14:20	72		36	565	7.66	1477	79	0.64	0.0447	< 0.01	< 0.05	0.0055	873	< 0.0015	< 0.5	< 5	< 0.2	< 0.000005	0.0025	0.162	< 0.01	0.0250	< 0.00001	< 0.000005	289	0.0000231	0.000265	< 0.0001	0.000332
GT	L2238565-7	2/28/2019 15:15	74		38	566	7.54	1529	90	0.59	0.0532	< 0.005	< 0.025	0.0065	871	< 0.0015	< 0.25	< 2.5	0.15	< 0.000005	0.0031	0.155	< 0.01	0.0232	< 0.00001	< 0.000005	324	0.0000137	0.000148	< 0.0001	0.000358
GT	L2244540-7	3/14/2019 14:30	76		40	579	7.7	1574	79	0.50	0.0516	< 0.005	< 0.025	0.0021	909	< 0.0015	< 0.25	< 2.5	0.13	< 0.00001	0.0040	0.175	< 0.02	0.0241	< 0.00002	< 0.00001	327	0.000012	0.000181	< 0.0002	0.000360
GT	L2250817-7	3/28/2019 15:00	78		42	571	7.58	1599	82	0.51	0.0611	< 0.005	< 0.025	0.0077	913	< 0.01	< 0.25	< 2.5	0.14	< 0.00001	0.0038	0.152	< 0.02	0.0233	< 0.00002	< 0.00001	367	0.000013	0.000138	< 0.0002	0.000361
GT	L2257457-7	4/11/2019 15:00	80		44	568	7.7	1605	57	0.86	0.0695	< 0.01	< 0.05	0.0053	972	< 0.01	< 0.5	< 5	< 0.2	< 0.00001	0.0032	0.147	< 0.02	0.0215	< 0.00002	< 0.00001	360	0.000010	0.000147	< 0.0002	0.000411
GT	L2263301-7	4/25/2019 14:45	82		46	549	7.7	1661	74	0.78	0.0692	< 0.005	< 0.025	0.0060	928	< 0.0015	< 0.25	< 2.5	0.12	< 0.00001	0.0035	0.148	< 0.02	0.0200	< 0.00002	< 0.00001	344	< 0.00001	0.000121	< 0.0002	0.000407

Notes:
Results in blue italics are below the indicated detection limit

Appendix A3: Gneiss Column (GO, GS, GT) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
GO	L2000226-1	9/29/2017 10:50	0.00072	*< 0.001*	0.0000086	9.73	0.00221	6.59	0.000142	0.0270	28.7	0.000179	*< 0.05*	*< 0.000005*	0.00137	0.00374	17.5	0.000085	6.85	0.000026	0.119	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000357	0.0513	0.000465	0.0285	*< 0.00065*	*< 0.00006*
GO	L2014692-1	10/27/2017	0.00080	0.0018	*< 0.000005*	11.2	0.00313	9.00	0.00307	0.0358	33.3	0.000409	*< 0.05*	0.0000061	0.00176	0.00386	21.9	0.000121	8.63	0.000016	0.158	*< 0.0002*	*< 0.0001*	0.00043	0.0000813	0.0757	0.000447	0.0278	*< 0.0005*	*< 0.00006*
GO	L2021295-1	11/10/2017 13:30	0.00075	0.0012	*< 0.000005*	11.3	0.00325	8.18	0.000449	0.0356	31.3	0.000349	*< 0.05*	*< 0.000005*	0.00161	0.00332	16.1	0.000217	7.34	0.000012	0.153	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000726	0.0642	0.000425	0.0260	*< 0.0005*	*< 0.00006*
GO	L2026623-5	11/23/2017 14:40	0.00066	0.0012	*< 0.000005*	10.2	0.00275	7.94	0.00125	0.0367	28.2	0.000465	*< 0.05*	0.0000073	0.00160	0.00318	13.5	0.000220	7.53	0.000010	0.146	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000817	0.0590	0.000401	0.0272	0.00293	0.000108
GO	L2031965-5	12/6/2017 14:05	0.00093	0.0012	*< 0.000005*	10.1	0.00263	7.89	0.00270	0.0356	27.2	0.000304	*< 0.05*	0.0000212	0.00165	0.00317	13.2	0.000271	7.52	*< 0.00001*	0.141	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000962	0.0578	0.000476	0.0274	0.00055	*< 0.00006*
GO	L2038563-5	12/21/2017 13:10	0.00063	0.0010	*< 0.000005*	10.5	0.00207	7.55	0.00215	0.0404	27.0	0.000363	*< 0.05*	0.0000081	0.00161	0.00292	12.5	0.000076	7.35	*< 0.00001*	0.137	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000920	0.0555	0.000465	0.0271	*< 0.0005*	*< 0.00006*
GO	L2041649-5	1/4/2018 13:05	0.00048	*< 0.001*	*< 0.000005*	8.89	0.00209	6.93	0.00299	0.0336	22.7	0.000339	*< 0.05*	*< 0.00001*	0.00139	0.00256	9.35	0.000137	6.85	*< 0.00001*	0.125	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000925	0.0521	0.000392	0.0237	0.00082	*< 0.00006*
GO	L2046871-5	1/18/2018 12:10	0.00046	0.0050	*< 0.000005*	9.41	0.00227	6.79	0.00495	0.0383	22.8	0.000351	*< 0.05*	*< 0.000005*	0.00157	0.00259	8.64	0.000140	7.05	*< 0.00001*	0.125	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000923	0.0473	0.000441	0.0263	0.00053	*< 0.00006*
GO	L2052061-5	2/1/2018 12:35	0.00043	*< 0.001*	*< 0.000005*	9.62	0.00194	6.66	0.00703	0.0343	21.3	0.000367	*< 0.05*	*< 0.000005*	0.00151	0.00262	7.94	0.000154	6.87	*< 0.00001*	0.126	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000103	0.0485	0.000458	0.0253	*< 0.0005*	*< 0.00006*
GO	L2057381-5	2/15/2018 11:35	0.00038	*< 0.001*	*< 0.000005*	8.92	0.00217	6.43	0.00161	0.0392	19.7	0.000289	*< 0.05*	*< 0.000005*	0.00124	0.00268	7.71	0.000080	6.73	*< 0.00001*	0.128	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000965	0.0537	0.000398	0.0267	*< 0.0005*	*< 0.00006*
GO	L2062788-5	3/1/2018 14:20	0.00035	0.0013	*< 0.000005*	9.50	0.00207	7.43	0.00156	0.0368	21.2	0.000270	*< 0.05*	0.0000050	0.00144	0.00269	7.12	0.000082	7.37	*< 0.00001*	0.135	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000938	0.0476	0.000375	0.0222	*< 0.0005*	*< 0.00006*
GO	L2068449-5	3/15/2018 12:25	0.00031	*< 0.001*	*< 0.000005*	8.81	0.00220	6.07	0.00412	0.0368	20.0	0.000252	*< 0.05*	*< 0.000005*	0.00145	0.00236	5.81	0.000067	6.77	*< 0.00001*	0.110	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000942	0.0396	0.000385	0.0267	*< 0.0005*	*< 0.00006*
GO	L2074311-5	3/29/2018 12:15	0.00036	*< 0.001*	*< 0.000005*	8.60	0.00204	6.21	0.00129	0.0428	17.9	0.000241	*< 0.05*	*< 0.000005*	0.00136	0.00231	5.21	*< 0.00004*	6.36	*< 0.00001*	0.118	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000976	0.0479	0.000428	0.0280	*< 0.001*	*< 0.00006*
GO	L2079620-5	4/12/2018 11:30	0.00035	*< 0.001*	*< 0.000005*	7.72	0.00167	5.68	0.00167	0.0435	17.1	0.000302	*< 0.05*	*< 0.00001*	0.00148	0.00233	4.79	0.000053	6.40	*< 0.00001*	0.112	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000106	0.0496	0.000358	0.0273	*< 0.001*	*< 0.00006*
GO	L2085708-5	4/26/2018 14:00	0.00030	*< 0.001*	*< 0.000005*	7.92	0.00213	5.69	0.00104	0.0423	15.4	0.000237	*< 0.05*	*< 0.000005*	0.00134	0.00217	4.35	*< 0.00004*	6.58	*< 0.00001*	0.110	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000101	0.0433	0.000365	0.0260	*< 0.001*	*< 0.00006*
GO	L2092801-5	5/10/2018 11:15	0.00034	*< 0.001*	*< 0.000005*	8.17	0.00223	5.84	0.00188	0.0432	15.9	0.000192	*< 0.05*	*< 0.000005*	0.00143	0.00230	3.48	*< 0.00004*	6.57	*< 0.00001*	0.115	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000108	0.0446	0.000490	0.0259	*< 0.001*	*< 0.00006*
GO	L2100224-5	5/24/2018 14:00	0.00037	*< 0.001*	*< 0.000005*	8.42	0.00199	6.75	0.00159	0.0449	16.2	0.000179	*< 0.05*	*< 0.000005*	0.00159	0.00229	3.62	*< 0.00004*	6.65	*< 0.00001*	0.124	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000103	0.0443	0.000407	0.0254	*< 0.001*	*< 0.00006*
GO	L2108434-5	6/7/2018 14:00	0.00034	*< 0.001*		9.32	0.00241	7.19	0.000266	0.0463	17.4	0.000207	*< 0.05*	*< 0.000005*	0.00171	0.00249	4.77	*< 0.00004*	8.19	*< 0.00001*	0.134	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000110	0.0493	0.000454	0.0227	0.0113	*< 0.00006*
GO	L2116986-5	6/21/2018 14:00	0.00036	*< 0.001*		10.5	0.00239	8.04	0.000719	0.0418	22.4	0.000207	*< 0.05*	0.0000124	0.00197	0.00238	9.51	*< 0.00004*	7.66	*< 0.00001*	0.151	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000129	0.0533	0.000405	0.0199	0.982	*< 0.00006*
GO	L2125321-5	7/6/2018 11:50	0.00029	*< 0.001*		10.1	0.00251	8.66	0.00499	0.0402	16.8	0.000190	*< 0.05*	0.0000054	0.00187	0.00230	7.10	0.000053	7.82	*< 0.00001*	0.161	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000133	0.0563	0.000410	0.0167	*< 0.001*	*< 0.00006*
GO	L2132784-5	7/19/2018 15:15	0.00038	*< 0.001*		10.3	0.00266	8.89	0.00106	0.0401	16.9	0.000199	*< 0.05*	*< 0.000005*	0.00192	0.00239	7.75	0.000050	8.39	*< 0.00001*	0.161	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000136	0.0601	0.000408	0.0161	0.0017	*< 0.00006*
GO	L2140795-5	8/2/2018 13:45	0.00038	*< 0.001*		11.3	0.00281	9.21	0.000459	0.0401	17.5	0.000176	*< 0.05*	*< 0.000005*	0.00202	0.00251	7.60	0.000079	8.17	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000136	0.0613	0.000439	0.0149	*< 0.001*	*< 0.00006*
GO	L2148482-5	8/16/2018	0.00035	*< 0.001*		10.9	0.00279	9.92	0.00125	0.0424	17.3	0.000192	*< 0.05*	*< 0.000005*	0.00214	0.00238	7.56	*< 0.00004*	8.30	*< 0.00001*	0.188	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000155	0.0664	0.000427	0.0164	*< 0.001*	*< 0.00006*
GO	L2156461-5	8/30/2018 14:20	0.00041	*< 0.001*		11.5	0.00273	9.85	0.00207	0.0414	17.0	*< 0.00005*	*< 0.05*	*< 0.000005*	0.00211	0.00235	7.58	*< 0.00004*	8.32	*< 0.00001*	0.186	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000160	0.0683	0.000397	0.0143	*< 0.001*	*< 0.00006*
GO	L2164110-5	9/13/2018 11:45	0.00039	*< 0.001*		11.7	0.00274	9.55	0.000945	0.0388	16.8	0.000140	*< 0.05*	*< 0.000005*	0.00213	0.00230	7.43	*< 0.00004*	8.18	*< 0.00001*	0.185	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000143	0.0621	0.000441	0.0127	*< 0.001*	*< 0.00006*
GO	L2172409-5	9/27/2018 14:00	0.00042	*< 0.001*		10.1	0.00257	9.69	0.000639	0.0388	15.8	0.000168	*< 0.05*	*< 0.000005*	0.00188	0.00221	8.02	0.000069	8.63	*< 0.00001*	0.173	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000131	0.0624	0.000374	0.0119	*< 0.001*	*< 0.00006*
GO	L2180431-5	10/12/2018 14:10	0.00034	*< 0.001*		10.0	0.00260	9.77	0.000282	0.0392	15.1	0.000131	*< 0.05*	*< 0.000005*	0.00181	0.00226	8.17	0.000051	8.47	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000119	0.0696	0.000421	0.0117	*< 0.001*	*< 0.00006*
	L2187510-5	10/25/2018 14:00	0.00035	*< 0.001*		9.81	0.00249	9.63	0.000159	0.0385	14.4	0.000141	*< 0.05*	*< 0.000005*	0.00192	0.00217	7.87	0.000054	8.42	*< 0.00001*	0.179	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000105	0.0707	0.000405	0.0117	*< 0.001*	*< 0.00006*
GO	L2194529-5	11/8/2018 14:10	0.00030	*< 0.001*		10.7	0.00249	10.4	0.000290	0.0370	14.2	0.000144	*< 0.05*	*< 0.000005*	0.00196	0.00226	7.76	0.000053	8.69	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000106	0.0714	0.000386	0.0107	*< 0.001*	*< 0.00006*
GO	L2200705-5	11/22/2018 11:55	0.00031	*< 0.001*		9.88	0.00240	9.95	0.000124	0.0369	13.3	0.000146	*< 0.05*	*< 0.000005*	0.00192	0.00212	7.63	0.000060	8.40	*< 0.00001*	0.181	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000971	0.0670	0.000407	0.0104	*< 0.001*	*< 0.00006*
GO	L2207335-5	12/6/2018 13:05	0.00036	*< 0.001*		10.1	0.00242	10.3	0.000120	0.0362	13.1	0.000126	*< 0.05*	*< 0.000005*	0.00185	0.00211	7.69	0.000113	8.41	*< 0.00001*	0.177	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000909	0.0698	0.000409	0.0103	*< 0.001*	*< 0.00006*
GO	L2213525-5	12/20/2018 14:45	0.00028	*< 0.001*		10.6	0.00260	10.0	0.000131	0.0377	13.4	0.000127	*< 0.05*	*< 0.000005*	0.00207	0.00225	8.85	0.000048	8.89	*< 0.00001*	0.191	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000963	0.0692	0.000387	0.00981	*< 0.001*	*< 0.00006*
GO	L2217203-5	1/5/2019 11:35	0.00026	*< 0.001*		11.2	0.00262	11.2	0.000544	0.0349	13.2	0.000107	*< 0.05*	*< 0.000005*	0.00217	0.00208	13.7	0.000083	8.12	*< 0.00001*	0.216	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000982	0.0820	0.000333	0.0105	*< 0.001*	*< 0.00006*
GO	L2222132-5	1/17/2019 11:45	0.00035	*< 0.001*		11.7	0.00271	14.8	0.000433	0.0312	12.9	0.000136	*< 0.05*	*< 0.000005*	0.00231	0.00197	34.9	0.000052	8.04	*< 0.00001*	0.276	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000102	0.0829	0.000302	0.00859	*< 0.001*	*< 0.00006*
GO	L2227544-5	1/31/2019 10:30	0.00034	*< 0.001*		12.2	0.00299	19.9	0.000376	0.0251	13.3	0.000165	*< 0.05*	*< 0.000005*	0.00249	0.00168	70.7	0.000062	7.62	*< 0.00001*	0.400	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000111	0.0904	0.000229	0.00629	0.0488	*< 0.00006*
GO	L2233141-5	2/14/2019 14:20	0.00032	*< 0.001*		16.7	0.00376	31.5	0.000401	0.0219	14.1	0.000184	*< 0.05*	*< 0.000005*	0.00301	0.00161	127	0.000044	8.63	*< 0.00001*	0.517	*< 0.0002*	*< 0.0001*	0.00034	0.000126	0.113	0.000219	0.00554	*< 0.001*	*< 0.00006*
GO	L2238565-5	2/28/2019 15:15	0.00037	*< 0.001*		16.4	0.00359	36.7	0.000532	0.0187	13.7	0.000199	*< 0.05*	*< 0.000005*	0.00318	0.00147	152	0.000045	8.15	*< 0.00001*	0.637	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000140	0.111	0.000193	0.00458	*< 0.001*	*< 0.00006*
GO	L2244540-5	3/14/2019 14:30	0.00041	*< 0.001*		17.0	0.00399	38.8	0.000846	0.0163	13.7	0.000225	*< 0.05*	*< 0.000005*	0.00350	0.00141	218	0.000047	8.34	*< 0.00001*	0.671	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000153	0.113	0.000232	0.00410	*< 0.001*	*< 0.00006*
GO	L2250817-5	3/28/2019 15:00	0.00041	*< 0.001*		18.5	0.00458	44.2	0.00143	0.0159	14.3	0.000163	*< 0.05*	*< 0.000005*	0.00395	0.00141	239	0.000064	8.92	*< 0.00001*	0.778	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000162	0.118	0.000206	0.00378	*< 0.001*	*< 0.00006*
GO	L2257457-5	4/11/2019 15:00	0.00039	*< 0.001*		19.2	0.00482	46.0	0.00159	0.0139	13.6	0.000274	*< 0.05*	0.0000085	0.00438	0.00156	237	0.000082	8.88	*< 0.00001*	0.873	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000173	0.111	0.000155	0.00341	*< 0.001*	*< 0.00006*
GO	L2263301-5	4/25/2019 14:45	0.00038	*< 0.001*		18.2	0.00434	47.9	0.00183	0.0135	13.5	0.000208	*< 0.05*	*< 0.000005*	0.00427	0.00139	251	0.000049	8.42	*< 0.00001*	0.857	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000165	0.112	0.000193	0.00319	*< 0.001*	*< 0.00006*
GS	L2000226-2	9/29/2017 10:50	0.00074	*< 0.001*	0.0000079	20.8	0.00670	77.9	0.0322	0.0205	36.7	0.00140	*< 0.05*	0.0000105	0.0236	0.00768	239	0.000316	3.58	0.000030	0.934	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000119	0.224	0.000571	0.00067	*< 0.001*	*< 0.00006*
GS	L2014692-2	10/27/2017	0.00068	*< 0.001*	*< 0.000005*	24.4	0.00801	88.6	0.260	0.0242	41.5	0.00229	*< 0.05*	*< 0.000005*	0.0273	0.00561	280	0.000209	4.50	0.000016	1.01	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000172	0.289	0.000538	0.00068	0.00060	*< 0.00006*
GS	L2021295-2	11/10/2017 13:30	0.00065	*< 0.001*	*< 0.000005*	23.3	0.00868	79.5	0.146	0.0235	39.7	0.00183	*< 0.05*	*< 0.000005*	0.0248	0.00513	229	0.000481	4.07	0.000014	1.04	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000143	0.265	0.000443	0.00052	*< 0.0005*	*< 0.00006*
GS	L2026623-6	11/23/2017 14:40	0.00050	0.0012	*< 0.000005*	22.1	0.00613	75.2	0.116	0.0211	37.1	0.00142	*< 0.05*	0.0000086	0.0250	0.00455	198	0.000170	4.32	0.00245	0.818	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000128	0.223	0.000449	0.00038	0.00083	*< 0.00006*
GS	L2031965-6	12/6/2017 14:05	0.00039	*< 0.001*	*< 0.000005*	20.6	0.00606	65.0	0.0954	0.0199	32.8	0.000966	*< 0.05*	0.0000089	0.0233	0.00468	177	0.000765	4.10	0.000012	0.846	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000138	0.207	0.000466	0.00035	*< 0.0005*	*< 0.00006*
GS	L2038563-6	12/21/2017 13:10	0.00040	*< 0.001*	*< 0.000005*	20.0	0.00505	59.0	0.0837	0.0219	31.7	0.000897	*< 0.05*	0.0000097	0.0222	0.00425	166	0.000263	4.17	0.000011	0.718	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000109	0.177	0.000423	0.00043	*< 0.0005*	*< 0.00006*
GS	L2041649-6	1/4/2018 13:05	0.00021	*< 0.001*	*< 0.000005*	16.1	0.00475	46.7	0.0889	0.0179	26.0	0.000760	*< 0.05*	*< 0.000005*	0.0180	0.00375	132	0.000966	3.97	*< 0.00002*	0.622	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000973	0.156	0.000368	0.00046	*< 0.0005*	*< 0.00006*
GS	L2046871-6	1/18/2018 12:10	0.00022	0.0019	*< 0.000005*	15.7	0.00509	43.0	0.171	0.0197	25.0	0.00104	*< 0.05*	0.0000290	0.0184	0.00381	116	0.00103	4.01	0.000011	0.551	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000994	0.133	0.000391	0.00043	*< 0.0005*	*< 0.00006*
GS	L2052061-6	2/1/2018 12:35	0.00013	0.0017	*< 0.000005*	16.5	0.00407	36.8	0.180	0.0171	23.7	0.000887	*< 0.05*	*< 0.000005*	0.0168	0.00374	99.1	0.000973	3.93	*< 0.00001*	0.511	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000808	0.121	0.000391	0.00061	*< 0.0005*	*< 0.00006*
GS	L2057381-6	2/15/2018 11:35	0.00017	0.0032	*< 0.000005*	14.6	0.00467	34.2	0.0962	0.0187	21.2	0.000620	*< 0.05*	*< 0.000005*	0.0147	0.00362	90.4	0.000657	3.85	*< 0.00001*	0.489	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000739	0.123	0.000318	0.00047	*< 0.0005*	*< 0.00006*
GS	L2062788-6	3/1/2018 14:20	0.00015	0.0044	*< 0.000005*	15.4	0.00461	39.0	0.0935	0.0176	22.9	0.000509	*< 0.05*	*< 0.000005*	0.0167	0.00375	89.7	0.000380	4.11	*< 0.00001*	0.507	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000806	0.111	0.000388	0.00050	*< 0.0005*	*< 0.00006*
GS	L2068449-6	3/15/2018 12:25	*< 0.0001*	0.0054	*< 0.000005*	13.8	0.00444	29.7	0.0817	0.0183	20.3	0.000400	*< 0.05*	*< 0.000005*	0.0157	0.00333	78.8	0.000274	4.01	*< 0.00001*	0.401	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000723	0.0933	0.000321	0.00052	*< 0.0005*	*< 0.00006*
GS	L2074311-6	3/29/2018 12:15	0.00021	0.0076	*< 0.000005*	12.3	0.00413	26.9	0.0609	0.0209	17.0	0.000301	*< 0.05*	*< 0.000005*	0.0128	0.00320	57.2	0.000178	3.58	*< 0.00001*	0.407	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000718	0.100	0.000390	0.00044	0.0017	*< 0.00006*
GS	L2079620-6	4/12/2018 11:30	0.00013	0.0053	*< 0.000005*	12.6	0.00333	24.5	0.0622	0.0208	17.6	0.000319	*< 0.05*	*< 0.000015*	0.0142	0.00306	53.1	0.000156	3.79	0.000011	0.347	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000758	0.0956	0.000397	0.00050	*< 0.001*	*< 0.00006*
GS	L2085708-6	4/26/2018 14:00	0.00011	0.0045	*< 0.000005*	11.9	0.00328	23.5	0.0546	0.0194	15.6	0.000256	*< 0.05*	*< 0.000005*	0.0132	0.00285	47.9	0.000165	3.86	*< 0.00001*	0.318	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000662	0.0806	0.000394	0.00045	*< 0.001*	*< 0.00006*
GS	L2092801-6	5/10/2018 11:15	0.00013	0.0037	*< 0.000005*	12.4	0.00430	23.6	0.0507	0.0210	16.2	0.000198	*< 0.05*	*< 0.000005*	0.0139	0.00314	38.6	0.000153	3.88	*< 0.00001*	0.350	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000741	0.0832	0.000508	0.00052	*< 0.001*	*< 0.00006*
GS	L2100224-6	5/24/2018 14:00	0.00012	0.0017	*< 0.000005*	12.1	0.00360	24.2	0.0493	0.0229	15.8	0.000213	*< 0.05*	*< 0.000005*	0.0140	0.00323	37.6	0.000194	3.88	*< 0.00001*	0.355	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000729	0.0805	0.000517	0.00049	*< 0.001*	0.000074
GS	L2108434-6	6/7/2018 14:00	0.00024	*< 0.001*		12.5	0.00422	24.0	0.00512	0.0235	16.4	0.000265	*< 0.05*	*< 0.000005*	0.0142	0.00342	42.9	0.000113	5.17	0.000015	0.333	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000782	0.0833	0.000573	0.00047	0.0110	*< 0.00006*
GS	L2116986-6	6/21/2018 14:00	0.00025	0.0017		12.9	0.00395	23.4	0.00765	0.0224	15.9	0.000234	*< 0.05*	*< 0.000005*	0.0152	0.00345	35.2	0.000149	5.20	*< 0.00001*	0.330	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000769	0.0767	0.000679	0.00053	0.0012	*< 0.00006*
GS	L2125321-6	7/6/2018 11:50	0.00013	*< 0.001*		11.6	0.00373	21.0	0.00816	0.0227	14.5	0.000201	*< 0.05*	*< 0.000005*	0.0138	0.00356	28.6	0.000153	5.40	*< 0.00001*	0.303	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000695	0.0699	0.000923	0.00056	*< 0.001*	*< 0.00006*
GS	L2132784-6	7/19/2018 15:15	0.00023	0.0020		11.7	0.00377	20.6	0.00840	0.0232	14.9	0.000278	*< 0.05*	*< 0.000005*	0.0137	0.00367	27.0	0.000279	5.71	0.000024	0.285	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000676	0.0709	0.000971	0.00055	0.0016	*< 0.00006*
GS	L2140795-6	8/2/2018 13:45	0.00024	0.0028		12.8	0.00402	19.8	0.00622	0.0247	14.8	0.000234	*< 0.05*	*< 0.000005*	0.0140	0.00365	24.8	0.000188	5.59	*< 0.00001*	0.308	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000756	0.0660	0.00119	0.00063	*< 0.001*	*< 0.00006*

Appendix A3: Gneiss Column (GO, GS, GT) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
GS	L2148482-6	8/16/2018	0.00021	0.0021		11.4	0.00374	19.5	0.00621	0.0241	14.0	0.000260	*< 0.05*	*< 0.000005*	0.0140	0.00387	21.5	0.000124	5.95	*< 0.00001*	0.298	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000693	0.0656	0.00127	0.00066	*< 0.001*	*< 0.00006*
GS	L2156461-6	8/30/2018 14:20	0.00026	0.0017		11.7	0.00374	18.0	0.00523	0.0243	13.3	*< 0.00005*	*< 0.05*	*< 0.000005*	0.0135	0.00380	18.5	0.000103	5.76	*< 0.00001*	0.286	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000675	0.0635	0.00139	0.00071	*< 0.001*	*< 0.00006*
GS	L2164110-6	9/13/2018 11:45	0.00020	*< 0.001*		11.8	0.00370	18.0	0.00455	0.0243	13.7	0.000207	*< 0.05*	*< 0.000005*	0.0141	0.00381	17.4	0.000076	5.94	*< 0.00001*	0.286	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000625	0.0554	0.00153	0.00071	*< 0.001*	*< 0.00006*
GS	L2172409-6	9/27/2018 14:00	0.00022	0.0012		10.4	0.00337	16.7	0.00382	0.0230	12.3	0.000217	*< 0.05*	*< 0.000005*	0.0117	0.00363	17.2	0.000138	6.20	*< 0.00001*	0.250	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000538	0.0550	0.00146	0.00076	*< 0.001*	*< 0.00006*
GS	L2180431-6	10/12/2018 14:10	0.00020	*< 0.001*		9.81	0.00338	16.5	0.00259	0.0244	11.3	0.000168	*< 0.05*	*< 0.000005*	0.0115	0.00379	15.8	0.000096	5.96	*< 0.00001*	0.245	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000502	0.0545	0.00159	0.00075	*< 0.001*	*< 0.00006*
GS	L2187510-6	10/25/2018 14:00	0.00020	*< 0.001*		9.85	0.00337	16.8	0.00237	0.0250	11.6	0.000194	*< 0.05*	*< 0.000005*	0.0117	0.00343	16.3	0.000116	5.61	0.000020	0.251	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000480	0.0575	0.00160	0.00075	*< 0.001*	*< 0.00006*
GS	L2194529-6	11/8/2018 14:10	0.00014	*< 0.001*		10.2	0.00328	17.2	0.00249	0.0234	10.8	0.000230	*< 0.05*	*< 0.000005*	0.0115	0.00372	15.8	0.000102	6.16	*< 0.00001*	0.250	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000440	0.0595	0.00162	0.00077	*< 0.001*	*< 0.00006*
GS	L2200705-6	11/22/2018 11:55	0.00019	*< 0.001*		9.75	0.00324	16.6	0.00115	0.0242	10.7	0.000213	*< 0.05*	*< 0.000005*	0.0114	0.00368	15.2	0.000092	5.96	*< 0.00001*	0.243	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000416	0.0532	0.00183	0.00075	*< 0.001*	*< 0.00006*
GS	L2207335-6	12/6/2018 13:05	0.00036	*< 0.001*		9.78	0.00314	16.2	0.00100	0.0239	10.0	0.000202	*< 0.05*	0.0000051	0.0110	0.00369	14.3	0.000126	5.99	*< 0.00001*	0.238	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000382	0.0532	0.00197	0.00081	*< 0.001*	*< 0.00006*
GS	L2213525-6	12/20/2018 14:45	0.00014	*< 0.001*		9.65	0.00320	14.7	0.00132	0.0233	10.7	0.000179	*< 0.05*	*< 0.000005*	0.0109	0.00388	12.9	0.000094	6.51	*< 0.00001*	0.231	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000388	0.0485	0.00192	0.00085	*< 0.001*	*< 0.00006*
GS	L2217203-6	1/5/2019 11:35	0.00017	*< 0.001*		10.1	0.00336	16.5	0.00128	0.0259	10.5	0.000168	*< 0.05*	*< 0.000005*	0.0124	0.00360	14.6	0.000046	5.54	*< 0.00001*	0.266	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000348	0.0553	0.00206	0.00078	*< 0.001*	*< 0.00006*
GS	L2222132-6	1/17/2019 11:45	0.00022	*< 0.001*		10.7	0.00341	20.0	0.00289	0.0227	10.6	0.000196	*< 0.05*	*< 0.000005*	0.0118	0.00347	37.1	0.000116	5.61	0.000013	0.314	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000392	0.0610	0.00210	0.00073	*< 0.001*	*< 0.00006*
GS	L2227544-6	1/31/2019 10:30	0.00024	*< 0.001*		11.4	0.00374	27.0	0.0126	0.0200	11.7	0.000251	*< 0.05*	*< 0.000005*	0.0135	0.00283	74.1	0.000097	5.16	*< 0.00001*	0.469	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000398	0.0733	0.00159	0.00041	*< 0.001*	*< 0.00006*
GS	L2233141-6	2/14/2019 14:20	0.00020	*< 0.001*		14.3	0.00472	39.7	0.0393	0.0178	13.2	0.000344	*< 0.05*	*< 0.000005*	0.0150	0.00254	126	0.000088	5.51	*< 0.00001*	0.640	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000462	0.0909	0.00142	0.00020	*< 0.001*	*< 0.00006*
GS	L2238565-6	2/28/2019 15:15	0.00025	0.0016		14.9	0.00471	49.6	0.0521	0.0143	13.5	0.000459	*< 0.05*	*< 0.000005*	0.0165	0.00207	170	0.000059	5.56	*< 0.00001*	0.841	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000515	0.0922	0.00119	0.00011	*< 0.001*	*< 0.00006*
GS	L2244540-6	3/14/2019 14:30	0.00027	*< 0.001*		15.8	0.00564	53.8	0.0629	0.0117	13.7	0.000465	*< 0.05*	*< 0.000005*	0.0183	0.00184	238	0.000066	5.57	*< 0.00001*	0.933	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000551	0.0870	0.00111	*< 0.0001*	*< 0.001*	*< 0.00006*
GS	L2250817-6	3/28/2019 15:00	0.00030	*< 0.001*		18.4	0.00595	64.8	0.0440	0.0109	14.8	0.000403	*< 0.05*	*< 0.000005*	0.0209	0.00178	274	0.000083	5.88	*< 0.00001*	1.08	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000595	0.0873	0.00109	*< 0.0001*	*< 0.001*	*< 0.00006*
GS	L2257457-6	4/11/2019 15:00	0.00033	*< 0.001*		18.6	0.00633	68.2	0.0436	0.00956	14.1	0.000498	*< 0.05*	0.0000986	0.0223	0.00195	275	0.000124	5.73	*< 0.00001*	1.18	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000604	0.0884	0.00102	*< 0.0001*	*< 0.001*	*< 0.00006*
GS	L2263301-6	4/25/2019 14:45	0.00021	*< 0.001*		17.9	0.00611	69.5	0.0497	0.00950	13.8	0.000455	*< 0.05*	*< 0.000005*	0.0207	0.00172	296	0.000109	5.53	*< 0.00001*	1.20	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000513	0.0895	0.000951	*< 0.0001*	*< 0.001*	*< 0.00006*
GT	L2000226-3	9/29/2017 10:50	0.00077	*< 0.001*	0.0000094	20.9	0.00371	33.4	0.0100	0.0394	26.3	0.000377	*< 0.05*	0.0000081	0.0119	0.0105	107	0.000375	6.44	0.000017	0.388	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000422	0.286	0.000192	0.00108	*< 0.00065*	*< 0.00006*
GT	L2014692-3	10/27/2017	0.00073	*< 0.001*	*< 0.000005*	22.8	0.00411	36.1	0.115	0.0503	27.3	0.000624	*< 0.05*	0.0000056	0.0132	0.00776	114	0.000158	7.57	0.000012	0.409	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000542	0.354	0.000208	0.00126	*< 0.0005*	*< 0.00006*
GT	L2021295-3	11/10/2017 13:30	0.00060	*< 0.001*	0.0000055	21.7	0.00420	30.4	0.120	0.0529	24.8	0.000499	*< 0.05*	*< 0.000005*	0.0120	0.00589	83.5	0.000467	6.75	*< 0.00001*	0.381	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000474	0.294	0.000182	0.00120	*< 0.0005*	*< 0.00006*
GT	L2026623-7	11/23/2017 14:40	0.00053	*< 0.001*	*< 0.000005*	19.5	0.00394	27.1	0.109	0.0541	22.0	0.000613	*< 0.05*	*< 0.000005*	0.0113	0.00536	69.6	0.000401	6.96	0.000033	0.333	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000491	0.248	0.000209	0.00127	0.00138	*< 0.00006*
GT	L2031965-7	12/6/2017 14:05	0.00074	0.0106	0.0000056	18.0	0.00314	24.1	0.0761	0.0507	20.0	0.000388	*< 0.05*	0.0000169	0.0112	0.00519	61.0	0.000457	6.77	*< 0.00001*	0.296	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000505	0.217	0.000247	0.00109	0.00065	*< 0.00006*
GT	L2038563-7	12/21/2017 13:10	0.00046	*< 0.001*	*< 0.000005*	17.7	0.00255	21.8	0.0483	0.0546	18.6	0.000347	*< 0.05*	0.0000052	0.0106	0.00465	54.2	0.000094	6.70	*< 0.00001*	0.262	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000452	0.196	0.000224	0.00095	*< 0.0005*	*< 0.00006*
GT	L2041649-7	1/4/2018 13:05	0.00033	*< 0.001*	*< 0.000005*	14.7	0.00253	18.5	0.0449	0.0482	16.0	0.000287	*< 0.05*	*< 0.000005*	0.00879	0.00438	43.1	0.000415	6.30	*< 0.00001*	0.251	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000430	0.170	0.000203	0.00092	*< 0.0005*	*< 0.00006*
GT	L2046871-7	1/18/2018 12:10	0.00038	0.0022	*< 0.000005*	15.1	0.00328	17.8	0.0526	0.0558	15.6	0.000312	*< 0.05*	*< 0.000005*	0.00962	0.00460	39.1	0.000478	6.50	*< 0.00001*	0.249	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000457	0.166	0.000266	0.00106	*< 0.0005*	*< 0.00006*
GT	L2052061-7	2/1/2018 12:35	0.00032	*< 0.001*	*< 0.000005*	15.8	0.00208	15.6	0.0487	0.0460	14.6	0.000276	*< 0.05*	*< 0.000005*	0.00876	0.00416	33.9	0.000395	6.45	*< 0.00001*	0.224	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000439	0.139	0.000292	0.00101	*< 0.0005*	*< 0.00006*
GT	L2057381-7	2/15/2018 11:35	0.00028	*< 0.001*	*< 0.000005*	14.0	0.00275	15.0	0.0170	0.0500	13.1	0.000228	*< 0.05*	*< 0.000005*	0.00767	0.00425	30.2	0.000365	6.18	*< 0.00001*	0.214	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000407	0.141	0.000258	0.00087	*< 0.0005*	*< 0.00006*
GT	L2062788-7	3/1/2018 14:20	0.00026	*< 0.001*	*< 0.000005*	14.4	0.00261	16.3	0.0417	0.0463	13.9	0.000272	*< 0.05*	*< 0.000005*	0.00789	0.00409	29.6	0.000147	6.65	*< 0.00001*	0.217	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000421	0.123	0.000264	0.00085	*< 0.0005*	*< 0.00006*
GT	L2068449-7	3/15/2018 12:25	0.00024	*< 0.001*	*< 0.000005*	13.4	0.00275	13.0	0.0411	0.0467	12.6	0.000222	*< 0.05*	*< 0.000005*	0.00810	0.00362	25.5	0.000189	6.54	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000423	0.102	0.000263	0.00100	*< 0.0005*	*< 0.00006*
GT	L2074311-7	3/29/2018 12:15	0.00112	*< 0.001*	*< 0.000005*	11.4	0.00245	11.8	0.0343	0.0523	10.4	0.000189	*< 0.05*	0.0000058	0.00640	0.00343	18.3	*< 0.00004*	5.81	*< 0.00001*	0.189	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000407	0.111	0.000304	0.00102	*< 0.001*	*< 0.00006*
GT	L2079620-7	4/12/2018 11:30	0.00024	*< 0.001*	*< 0.000005*	11.0	0.00199	11.0	0.0297	0.0525	11.0	0.000183	*< 0.05*	*< 0.00002*	0.00693	0.00345	18.1	0.000069	6.10	*< 0.00001*	0.168	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000402	0.108	0.000302	0.00098	*< 0.001*	*< 0.00006*
GT	L2085708-7	4/26/2018 14:00	0.00021	*< 0.001*	*< 0.000005*	10.9	0.00282	10.9	0.0384	0.0469	9.63	0.000181	*< 0.05*	*< 0.000005*	0.00667	0.00306	16.6	0.000115	6.27	*< 0.00001*	0.158	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000380	0.0920	0.000291	0.00099	*< 0.001*	*< 0.00006*
GT	L2092801-7	5/10/2018 11:15	0.00021	*< 0.001*	*< 0.000005*	11.3	0.00268	11.0	0.0420	0.0516	9.95	0.000139	*< 0.05*	*< 0.000005*	0.00675	0.00349	13.5	0.000106	6.33	*< 0.00001*	0.172	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000402	0.0953	0.000444	0.00108	*< 0.001*	*< 0.00006*
GT	L2100224-7	5/24/2018 14:00	0.00023	*< 0.001*	*< 0.000005*	11.5	0.00246	11.4	0.0606	0.0547	9.75	0.000115	*< 0.05*	*< 0.000005*	0.00696	0.00350	12.5	0.000067	6.34	*< 0.00001*	0.185	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000404	0.0936	0.000391	0.00112	*< 0.001*	*< 0.00006*
GT	L2108434-7	6/7/2018 13:30	0.00023	*< 0.001*		10.5	0.00244	9.78	0.0410	0.0488	9.39	0.000249	*< 0.05*	0.0000060	0.00661	0.00317	11.2	0.000054	6.91	0.000016	0.151	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000369	0.0718	0.000422	0.00116	0.0191	*< 0.00006*
GT	L2116986-7	6/21/2018 14:00	0.00021	0.0026		10.8	0.00232	9.31	0.115	0.0434	9.29	0.000241	*< 0.05*	*< 0.000005*	0.00665	0.00289	8.31	*< 0.00004*	6.32	*< 0.00001*	0.151	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000386	0.0606	0.000383	0.00141	*< 0.001*	*< 0.00006*
GT	L2125321-7	7/6/2018 11:50	0.00010	*< 0.001*		9.30	0.00220	8.20	0.123	0.0399	8.46	0.000168	*< 0.05*	0.0000068	0.00575	0.00262	7.84	*< 0.00004*	6.29	*< 0.00001*	0.144	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000330	0.0522	0.000387	0.00139	*< 0.001*	0.000108
GT	L2132784-7	7/19/2018 15:15	0.00018	*< 0.001*		8.95	0.00222	7.75	0.0864	0.0389	8.15	0.000135	*< 0.05*	*< 0.000005*	0.00549	0.00258	6.64	0.000051	6.27	*< 0.00001*	0.130	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000309	0.0475	0.000347	0.00139	0.0029	*< 0.00006*
GT	L2140795-7	8/2/2018 13:45	0.00019	0.0012		9.76	0.00230	7.83	0.0778	0.0406	8.60	0.000136	*< 0.05*	*< 0.000005*	0.00581	0.00264	6.47	0.000105	6.10	*< 0.00001*	0.147	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000352	0.0463	0.000436	0.00153	*< 0.001*	*< 0.00006*
GT	L2148482-7	8/16/2018	0.00014	*< 0.001*		8.65	0.00218	7.57	0.0728	0.0380	8.25	0.000137	*< 0.05*	*< 0.000005*	0.00576	0.00255	5.45	0.000047	6.14	*< 0.00001*	0.141	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000315	0.0435	0.000435	0.00146	*< 0.001*	*< 0.00006*
GT	L2156461-7	8/30/2018 14:20	0.00019	*< 0.001*		9.23	0.00217	7.60	0.0661	0.0380	8.46	*< 0.00005*	*< 0.05*	*< 0.000005*	0.00572	0.00257	5.11	0.000053	5.98	*< 0.00001*	0.146	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000311	0.0463	0.000402	0.00143	*< 0.001*	*< 0.00006*
GT	L2164110-7	9/13/2018 11:45	0.00014	*< 0.001*		8.66	0.00208	7.27	0.0458	0.0339	8.15	0.000082	*< 0.05*	*< 0.000005*	0.00546	0.00234	4.99	*< 0.00004*	5.94	*< 0.00001*	0.140	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000282	0.0403	0.000452	0.00130	*< 0.001*	*< 0.00006*
GT	L2172409-7	9/27/2018 14:00	0.00018	0.0010		7.58	0.00194	6.78	0.0694	0.0339	7.71	0.000107	*< 0.05*	0.0000059	0.00470	0.00228	4.55	0.000046	5.98	*< 0.00001*	0.126	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000243	0.0377	0.000407	0.00138	*< 0.001*	*< 0.00006*
GT	L2180431-7	10/12/2018 14:10	0.00015	0.0011		7.28	0.00193	6.79	0.0563	0.0346	7.30	0.000089	*< 0.05*	0.0000165	0.00466	0.00233	4.33	0.000052	5.93	*< 0.00001*	0.132	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000238	0.0373	0.000431	0.00131	*< 0.001*	*< 0.00006*
GT	L2187510-7	10/25/2018 14:00	0.00016	0.0012		7.19	0.00182	6.65	0.0446	0.0335	7.26	0.000076	*< 0.05*	0.0000069	0.00456	0.00227	4.13	0.000073	5.76	*< 0.00001*	0.126	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000232	0.0399	0.000478	0.00127	*< 0.001*	*< 0.00006*
GT	L2194529-7	11/8/2018 13:40	*< 0.0001*	0.0017		7.21	0.00179	6.67	0.0504	0.0321	7.10	0.000104	*< 0.05*	*< 0.000005*	0.00465	0.00235	4.00	0.000076	5.99	*< 0.00001*	0.127	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000212	0.0379	0.000474	0.00128	*< 0.001*	*< 0.00006*
GT	L2200705-7	11/22/2018 10:30	0.00012	0.0018		6.95	0.00178	6.68	0.0439	0.0323	6.97	0.000095	*< 0.05*	0.0000051	0.00430	0.00229	4.44	0.000102	6.00	*< 0.00001*	0.128	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000200	0.0376	0.000502	0.00126	*< 0.001*	*< 0.00006*
GT	L2207335-7	12/6/2018 14:45	0.00013	0.0017		6.86	0.00175	6.73	0.0538	0.0308	6.82	0.000080	*< 0.05*	0.0000072	0.00414	0.00222	3.73	0.000095	5.61	*< 0.00001*	0.125	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000188	0.0360	0.000478	0.00129	*< 0.001*	*< 0.00006*
GT	L2213525-7	12/20/2018 14:45	0.00020	*< 0.001*		9.93	0.00261	17.0	0.922	0.0236	8.68	0.000711	*< 0.05*	0.0000183	0.00688	0.00231	74.7	0.000069	5.58	*< 0.00001*	0.428	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000399	0.0816	0.000314	0.00278	*< 0.001*	*< 0.00006*
GT	L2217203-7	1/5/2019 11:35	0.00029	0.0013		10.9	0.00319	25.2	0.716	0.0175	8.72	0.000817	*< 0.05*	0.0000069	0.00840	0.00180	156	0.000056	5.49	*< 0.00001*	0.593	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000426	0.0921	0.000280	0.00070	*< 0.001*	*< 0.00006*
GT	L2222132-7	1/17/2019 11:45	0.00029	0.0020		11.5	0.00363	28.6	0.970	0.0142	8.46	0.000999	*< 0.05*	0.0000075	0.00916	0.00144	250	0.000104	5.22	*< 0.00001*	0.854	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000445	0.0721	0.000210	0.00037	*< 0.001*	*< 0.00006*
GT	L2227544-7	1/31/2019 10:30	0.00024	0.0030		10.3	0.00326	23.9	0.819	0.0120	8.33	0.000817	*< 0.05*	0.0000055	0.00958	0.00122	276	0.000131	4.83	*< 0.00001*	0.992	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000415	0.0573	0.000169	0.00021	0.0697	*< 0.00006*
GT	L2233141-7	2/14/2019 14:20	0.00016	0.0023		11.3	0.00375	24.9	0.761	0.0112	8.12	0.000652	*< 0.05*	*< 0.000005*	0.0103	0.00114	303	0.000122	5.12	*< 0.00001*	1.16	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000429	0.0623	0.000179	0.00017	*< 0.001*	*< 0.00006*
GT	L2238565-7	2/28/2019 15:15	0.00021	0.0034		11.8	0.00356	24.7	0.657	0.0101	7.89	0.000514	*< 0.05*	*< 0.000005*	0.0117	0.00107	270	0.000094	5.07	*< 0.00001*	1.35	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000397	0.0555	0.000177	0.00012	*< 0.001*	*< 0.00006*
GT	L2244540-7	3/14/2019 14:30	*< 0.0002*	0.0081		12.2	0.0036	24.5	0.814	0.00996	8.76	0.00045	*< 0.1*	*< 0.00001*	0.0126	0.00112	334	*< 0.00008*	5.09	*< 0.00002*	1.37	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000439	0.0560	0.00017	*< 0.0002*	*< 0.002*	*< 0.00012*
GT	L2250817-7	3/28/2019 15:00	0.00021	0.0037		11.9	0.0040	24.9	0.618	0.00956	8.41	0.00028	*< 0.1*	*< 0.00001*	0.0128	0.00102	354	0.000119	5.42	*< 0.00002*	1.49	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000408	0.0519	0.00020	*< 0.0002*	*< 0.002*	*< 0.00012*
GT	L2257457-7	4/11/2019 15:00	*< 0.0002*	0.0038		11.6	0.0041	22.7	0.572	0.00971	7.76	0.00043	*< 0.1*	*< 0.00001*	0.0134	0.00121	339	*< 0.00008*	5.30	*< 0.00002*	1.63	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000419	0.0501	0.00013	*< 0.0002*	*< 0.002*	*< 0.00012*
GT	L2263301-7	4/25/2019 14:45	*< 0.0002*	0.0041		11.7	0.0039	22.9	0.490	0.00884	8.06	0.00029	*< 0.1*	*< 0.00001*	0.0136	0.00108	343	*< 0.00008*	5.33	*< 0.00002*	1.64	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000376	0.0516	0.00020	*< 0.0002*	*< 0.002*	*< 0.00012*

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX A4: SCHIST COLUMN (SO, SS, ST) EFFLUENT RESULTS

Appendix A4: Schist Column (SO, SS, ST) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
SO	L2000226-4	9/29/2017 10:50	0	0		433	8.21	299	104	3.90	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	55.9	*< 0.0015*	*< 0.05*	2.34	1.62	*< 0.000005*	0.00919	0.0179	0.023	0.0466	*< 0.00001*	*< 0.000005*	21.4	*< 0.000005*	0.0000255	0.00097	0.000085
SO	L2014692-4	10/27/2017	4	4		258	8.15	361	127	3.26	0.0205	*< 0.001*	*< 0.005*	0.0021	68.3	*< 0.0015*	*< 0.05*	2.39	0.529	*< 0.000005*	0.00466	0.0153	0.028	0.0645	*< 0.00001*	*< 0.000005*	28.3	*< 0.000005*	0.0000305	0.00047	0.000123
SO	L2021295-4	11/10/2017 13:30	6	6		258	8.2	324	111	2.61	0.0051	*< 0.001*	*< 0.005*	*< 0.002*	57.3	*< 0.0015*	*< 0.05*	1.94	0.500	*< 0.000005*	0.00525	0.0146	0.024	0.0571	*< 0.00001*	*< 0.000005*	23.8	*< 0.000005*	0.0000211	*< 0.0001*	0.000099
SO	L2026623-8	11/23/2017 14:40	8	8		295	8.12	311	150	1.63	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	51.9	*< 0.0015*	*< 0.05*	1.62	0.508	*< 0.000005*	0.00523	0.0143	0.025	0.0577	*< 0.00001*	*< 0.000005*	26.1	*< 0.000005*	0.0000284	0.00028	0.000093
SO	L2031965-8	12/6/2017 14:05	10	10		262	8.06	308	164	1.97	0.0056	*< 0.001*	*< 0.005*	*< 0.002*	47.5	*< 0.0015*	*< 0.05*	1.39	0.546	*< 0.000005*	0.00534	0.0159	0.020	0.0630	*< 0.00001*	*< 0.000005*	24.5	*< 0.000005*	0.0000253	0.00036	0.000091
SO	L2038563-8	12/21/2017 13:10	12	12		268	8.09	297.4	141	1.38	0.0067	*< 0.001*	*< 0.005*	*< 0.002*	44.4	*< 0.0015*	*< 0.05*	1.48	0.510	*< 0.000005*	0.00520	0.0155	0.022	0.0720	*< 0.00001*	*< 0.000005*	23.4	*< 0.000005*	0.0000357	0.00042	0.000094
SO	L2041649-8	1/4/2018 13:05	14	14		254	8.05	286.4	125	1.32	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	41.8	*< 0.0015*	*< 0.05*	1.07	0.508	*< 0.000005*	0.00506	0.0153	0.019	0.0663	*< 0.00001*	*< 0.000005*	23.8	*< 0.000005*	0.0000221	0.00035	0.000087
SO	L2046871-8	1/18/2018 12:10	16	16		269	8.11	274.5	136	1.24	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	38.5	*< 0.0015*	*< 0.05*	0.92	0.505	*< 0.000005*	0.00556	0.0200	0.021	0.0678	*< 0.00001*	*< 0.000005*	24.8	0.0000053	0.0000221	0.00040	0.000097
SO	L2052061-8	2/1/2018 12:35	18	18		290	8.06	265.1	129	1.29	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	35.5	0.0032	*< 0.05*	0.78	0.500	*< 0.000005*	0.00504	0.0226	0.018	0.0685	*< 0.00001*	*< 0.000005*	23.7	*< 0.000005*	0.0000192	0.00039	0.000089
SO	L2057381-8	2/15/2018 11:35	20	20		274	8.06	268.1	125	1.27	0.0086	*< 0.001*	*< 0.005*	0.0099	33.8	*< 0.0015*	*< 0.05*	0.64	0.493	*< 0.000005*	0.00421	0.0210	0.018	0.0768	*< 0.00001*	*< 0.000005*	24.6	*< 0.000005*	0.0000186	0.00028	0.000088
SO	L2062788-8	3/1/2018 14:20	22	22		236	8.02	270.1	133	1.08	0.0186	*< 0.001*	*< 0.005*	0.0022	33.5	*< 0.0015*	*< 0.05*	0.61	0.506	*< 0.000005*	0.00434	0.0234	0.020	0.0809	*< 0.00001*	*< 0.000005*	25.4	*< 0.000005*	0.0000217	0.00043	0.000091
SO	L2068449-8	3/15/2018 12:25	24	24		299	8.06	248.8	135	1.12	0.0061	*< 0.001*	*< 0.005*	*< 0.002*	28.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.489	*< 0.000005*	0.00582	0.0271	0.017	0.0819	*< 0.00001*	*< 0.000005*	21.6	*< 0.000005*	0.0000306	0.00034	0.000077
SO	L2074311-8	3/29/2018 12:15	26	26		275	8.05	249.2	140	0.95	0.0150	*< 0.001*	*< 0.005*	0.0023	27.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.494	*< 0.000005*	0.00479	0.0257	0.016	0.0834	*< 0.00001*	0.0000058	21.6	*< 0.000005*	0.0000311	0.00039	0.000081
SO	L2079620-8	4/12/2018 11:30	28	28		260	8.06	248.1	126	0.91	0.0113	*< 0.001*	*< 0.005*	0.0024	25.4	*< 0.0015*	*< 0.05*	*< 0.5*	0.519	*< 0.000005*	0.00402	0.0274	0.017	0.0887	*< 0.00001*	0.0000177	21.3	*< 0.000005*	0.0000294	0.00031	0.000087
SO	L2085708-8	4/26/2018 14:00	30	30		259	8.01	244.5	118	0.88	0.0221	*< 0.001*	*< 0.005*	0.0022	25.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.517	*< 0.000005*	0.00375	0.0288	0.017	0.0876	*< 0.00001*	*< 0.000005*	21.3	*< 0.000005*	0.0000328	0.00038	0.000089
SO	L2092801-8	5/10/2018 11:15	32	32		261	8.11	244.6	127	0.89	0.0327	*< 0.001*	*< 0.005*	*< 0.002*	24.6	*< 0.0015*	*< 0.05*	*< 0.5*	0.503	*< 0.000005*	*< 0.004*	0.0304	0.019	0.0890	*< 0.00001*	*< 0.000005*	22.4	*< 0.000005*	0.0000385	0.00036	0.000094
SO	L2100224-8	5/24/2018 14:00	34	34		273	8.02	246.2	114	1.12	0.0377	*< 0.001*	*< 0.005*	0.0025	22.6	*< 0.0015*	*< 0.05*	*< 0.5*	0.513	*< 0.000005*	0.00386	0.0369	0.017	0.111	*< 0.00001*	0.0000213	22.1	*< 0.000005*	0.0000500	0.00040	0.000107
SO	L2108434-8	6/7/2018 14:00	36		0	205	8.02	264.2	165	1.15	0.107	*< 0.001*	*< 0.005*	0.0038	24.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.555	*< 0.000005*	0.00377	0.0431	0.022	0.121	*< 0.00001*	*< 0.000005*	24.6	*< 0.000005*	0.0000247	0.00045	0.000118
SO	L2116986-8	6/21/2018 14:00	38		2	355	8.09	275	185	0.86	0.130	*< 0.001*	*< 0.005*	0.0051	24.6	*< 0.0015*	*< 0.05*	*< 0.5*	0.584	*< 0.000005*	0.00309	0.0383	0.022	0.124	*< 0.00001*	*< 0.000005*	25.2	*< 0.000005*	0.0000190	0.00051	0.000130
SO	L2125321-8	7/6/2018 11:50	40		4	206	8.11	268.3	237	1.02	0.121	*< 0.001*	*< 0.005*	0.0066	21.4	*< 0.0015*	*< 0.05*	*< 0.5*	0.577	*< 0.000005*	0.00283	0.0371	0.021	0.134	*< 0.00001*	*< 0.000005*	24.5	0.0000056	0.0000205	0.00056	0.000127
SO	L2132784-8	7/19/2018 15:15	42		6	331	8.24	272.6	165	0.92	0.136	*< 0.001*	*< 0.005*	0.0061	21.7	*< 0.0015*	*< 0.05*	*< 0.5*	0.588	*< 0.000005*	0.00311	0.0348	0.022	0.131	*< 0.00001*	*< 0.000005*	25.3	*< 0.000005*	0.0000172	0.00054	0.000139
SO	L2140795-8	8/2/2018 13:45	44		8	175	8.18	275.6	170	0.97	0.143	*< 0.001*	*< 0.005*	0.0059	20.9	*< 0.0015*	*< 0.05*	*< 0.5*	0.588	*< 0.000005*	*< 0.004*	0.0332	0.024	0.138	*< 0.00001*	*< 0.000005*	26.6	*< 0.000005*	0.0000229	0.00057	0.000141
SO	L2148482-8	8/16/2018	46		10	283	8.1	277.1	155	0.87	0.151	*< 0.001*	*< 0.005*	0.0063	20.1	*< 0.0015*	*< 0.05*	0.79	0.589	*< 0.000005*	0.00275	0.0321	0.023	0.152	*< 0.00001*	*< 0.000005*	27.6	*< 0.000005*	0.0000199	0.00054	0.000149
SO	L2156461-8	8/30/2018 14:20	48		12	324	8.11	272.8	159	0.82	0.136	*< 0.001*	*< 0.005*	0.0077	18.2	*< 0.0015*	*< 0.05*	1.05	0.582	*< 0.000005*	0.00267	0.0372	0.024	0.150	*< 0.00001*	*< 0.000005*	26.3	*< 0.000005*	0.0000193	0.00057	0.000149
SO	L2164110-8	9/13/2018 11:45	50		14	295	8.18	277.2	159	1.1	0.137	*< 0.001*	*< 0.005*	0.0071	18.6	*< 0.0015*	*< 0.05*	1.22	0.584	*< 0.000005*	0.00282	0.0338	0.023	0.145	*< 0.00001*	*< 0.000005*	26.6	*< 0.000005*	0.0000214	0.00054	0.000142
SO	L2172409-8	9/27/2018 14:00	52		16	319	8.18	267.8	111	1.21	0.139	*< 0.001*	*< 0.005*	0.0062	17.3	*< 0.0015*	*< 0.05*	1.34	0.598	*< 0.000005*	0.00247	0.0347	0.022	0.139	*< 0.00001*	*< 0.000005*	24.5	*< 0.000005*	0.0000208	0.00048	0.000129
SO	L2180431-8	10/12/2018 14:10	54		18	205	8.1	270.5	131	0.70	0.140	*< 0.001*	*< 0.005*	0.0068	16.0	*< 0.0015*	*< 0.05*	1.39	0.549	*< 0.000005*	0.00222	0.0318	0.022	0.147	*< 0.00001*	*< 0.000005*	24.2	*< 0.000005*	0.0000205	0.00049	0.000125
	L2187510-8	10/25/2018 14:00	56		20	197	8.17	282	157	*< 1*	0.145	*< 0.001*	*< 0.005*	0.0053	16.8	*< 0.0015*	*< 0.05*	1.51	0.585	*< 0.000005*	0.00212	0.0278	0.023	0.142	*< 0.00001*	*< 0.000005*	25.3	*< 0.000005*	0.0000194	0.00058	0.000135
SO	L2194529-8	11/8/2018 14:10	58		22	312	8.27	275.3	165	0.72	0.147	*< 0.001*	*< 0.005*	0.0060	16.6	*< 0.0015*	*< 0.05*	1.50	0.592	*< 0.000005*	0.00198	0.0306	0.021	0.155	*< 0.00001*	*< 0.000005*	25.4	*< 0.000005*	0.0000184	0.00055	0.000113
SO	L2200705-8	11/22/2018 11:55	60		24	287	8.11	268.8	167	0.86	0.148	*< 0.001*	*< 0.005*	0.0058	15.9	*< 0.0015*	*< 0.05*	1.43	0.590	*< 0.000005*	0.00169	0.0288	0.022	0.131	*< 0.00001*	*< 0.000005*	25.6	*< 0.000005*	0.0000171	0.00054	0.000128
SO	L2207335-8	12/6/2018 13:05	62		26	274	8.05	268.2	150	1.08	0.151	*< 0.001*	*< 0.005*	0.0062	15.5	*< 0.0015*	*< 0.05*	1.39	0.599	*< 0.000005*	0.00233	0.0292	0.021	0.153	*< 0.00001*	*< 0.000005*	25.8	*< 0.000005*	0.0000171	0.00059	0.000124
SO	L2213525-8	12/20/2018 14:45	64		28	388	8.1	271	200	1.09	0.145	*< 0.001*	*< 0.005*	0.0068	19.6	*< 0.0015*	*< 0.05*	1.42	0.619	*< 0.000005*	0.00215	0.0305	0.022	0.157	*< 0.00001*	*< 0.000005*	28.3	*< 0.000005*	0.0000180	0.00053	0.000144
SO	L2217203-8	1/5/2019 11:35	66		30	350	7.96	305	173	0.69	0.175	*< 0.001*	*< 0.005*	0.0049	36.2	*< 0.0067*	*< 0.05*	1.33	0.605	*< 0.000005*	0.00232	0.0208	0.020	0.157	*< 0.00001*	*< 0.000005*	31.6	*< 0.000005*	0.0000203	0.00059	0.000142
SO	L2222132-8	1/17/2019 11:45	68		32	376	7.88	432	142	0.63	0.168	*< 0.001*	*< 0.005*	0.0041	112	*< 0.01*	*< 0.05*	1.09	0.560	*< 0.000005*	0.00157	0.0174	0.020	0.149	*< 0.00001*	*< 0.000005*	44.8	*< 0.000005*	0.0000254	0.00046	0.000164
SO	L2227544-8	1/31/2019 10:30	70		34	366	7.78	714	120	0.80	0.193	*< 0.005*	*< 0.025*	0.0040	273	*< 0.0015*	*< 0.25*	*< 2.5*	0.44	*< 0.000005*	0.00123	0.0141	0.018	0.0431	*< 0.00001*	*< 0.000005*	78.9	*< 0.000005*	0.0000213	0.00046	0.000204
SO	L2233141-8	2/14/2019 14:20	72		36	397	7.71	959	121	0.71	0.221	*< 0.005*	*< 0.025*	0.0041	465	*< 0.0015*	*< 0.25*	*< 2.5*	0.40	*< 0.000005*	0.00099	0.0140	0.019	0.0339	*< 0.00001*	*< 0.000005*	128	0.0000058	0.0000290	0.00045	0.000199
SO	L2238565-8	2/28/2019 15:15	74		38	427	7.67	1142	114	0.60	0.224	*< 0.005*	*< 0.025*	0.0030	558	*< 0.0015*	*< 0.25*	*< 2.5*	0.36	*< 0.000005*	0.00098	0.0132	0.018	0.0314	*< 0.00001*	*< 0.000005*	175	*< 0.000005*	0.0000272	0.00041	0.000234
SO	L2244540-8	3/14/2019 14:30	76		40	433	7.74	1270	109	0.82	0.228	*< 0.005*	*< 0.025*	0.0036	652	*< 0.0015*	*< 0.25*	*< 2.5*	0.33	*< 0.000005*	0.00106	0.0127	0.017	0.0275	*< 0.00001*	*< 0.000005*	193	*< 0.000005*	0.0000292	0.00045	0.000234
SO	L2250817-8	3/28/2019 15:00	78		42	405	7.72	1346	106	0.70	0.241	*< 0.005*	*< 0.025*	0.0030	704	*< 0.01*	*< 0.25*	*< 2.5*	0.32	*< 0.000005*	0.00133	0.0131	0.019	0.0291	*< 0.00001*	*< 0.000005*	234	*< 0.000005*	0.0000299	0.00048	0.000238
SO	L2257457-8	4/11/2019 15:00	80		44	397	7.74	1382	113	0.95	0.245	*< 0.005*	*< 0.025*	0.0028	778	*< 0.01*	*< 0.25*	*< 2.5*	0.31	*< 0.000005*	0.00105	0.0130	0.019	0.0262	*< 0.00001*	*< 0.000005*	248	*< 0.000005*	0.0000372	0.00051	0.000269
SO	L2263301-8	4/25/2019 14:45	82		46	397	7.75	1456	108	0.74	0.261	*< 0.005*	*< 0.025*	0.0024	744	*< 0.0015*	*< 0.25*	*< 2.5*	0.30	*< 0.000005*	0.00128	0.0130	0.018	0.0252	*< 0.00001*	*< 0.000005*	242	*< 0.000005*	0.0000245	0.00045	0.000267
SS	L2000226-5	9/29/2017 10:50	0	0		416	7.99	1218	138	3.26	*< 0.005*	*< 0.005*	*< 0.025*	*< 0.002*	539	*< 0.0015*	*< 0.25*	3.8	1.24	0.0000067	0.00830	0.00583	0.038	0.0313	*< 0.00001*	*< 0.000005*	95.5	0.0000058	0.000247	*< 0.0001*	0.00352
SS	L2014692-5	10/27/2017	4	4		262	7.9	1296	185	2.23	0.0071	*< 0.005*	*< 0.025*	*< 0.002*	549	*< 0.0015*	*< 0.25*	3.7	0.27	0.0000304	0.00464	0.00940	0.043	0.0284	*< 0.00001*	*< 0.000005*	99.2	0.0000086	0.000223	*< 0.0001*	0.00351
SS	L2021295-5	11/10/2017 13:30	6	6		211	8	1115	188	1.96	*< 0.005*	*< 0.005*	*< 0.025*	0.0038	435	*< 0.0015*	*< 0.25*	2.9	0.26	*< 0.000005*	0.00436	0.0121	0.045	0.0295	*< 0.00001*	*< 0.000005*	86.2	0.0000071	0.000150	*< 0.0001*	0.00303
SS	L2026623-9	11/23/2017 14:40	8	8		322	7.97	1007	248	1.35	0.0095	*< 0.005*	*< 0.025*	*< 0.002*	390	*< 0.0015*	*< 0.25*	*< 2.5*	0.28	*< 0.000005*	0.00399	0.0122	0.044	0.0318	*< 0.00001*	*< 0.000005*	83.6	*< 0.000005*	0.000154	*< 0.0001*	0.00289
SS	L2032657-1	12/7/2017 11:30	10	10		267	7.79	942	227	1.61	0.0108	*< 0.005*	*< 0.025*	*< 0.002*	331	*< 0.0015*	*< 0.25*	*< 2.5*	0.24	0.0000057	0.00378	0.0121	0.048	0.0313	*< 0.00001*	*< 0.000005*	80.7	0.0000089	0.000128	*< 0.0001*	0.00256
SS	L2038563-9	12/21/2017 13:10	12	12		270	7.88	853	246	1.30	0.0053	0.0052	*< 0.025*	*< 0.002*	280	*< 0.0015*	*< 0.25*	*< 2.5*	0.22	0.0000052	0.00327	0.0108	0.037	0.0375	*< 0.00001*	*< 0.000005*	65.2	0.0000091	0.000120	*< 0.0001*	0.00241
SS	L2041649-9	1/4/2018 13:05	14	14		259	7.95	790	233	1.50	0.0082	*< 0.005*	*< 0.025*	*< 0.002*	247	*< 0.0015*	*< 0.25*	*< 2.5*	0.25	*< 0.000005*	0.00262	0.0104	0.035	0.0368	*< 0.00001*	*< 0.000005*	62.6	*< 0.000005*	0.0000988	*< 0.0001*	0.00225
SS	L2046871-9	1/18/2018 12:10	16	16		274	7.97	745	232	1.35	*< 0.005*	*< 0.005*	*< 0.025*	*< 0.002*	209	*< 0.0015*	*< 0.25*	*< 2.5*	0.27	*< 0.000005*	0.00376	0.0124	0.035	0.0371	*< 0.00001*	*< 0.000005*	60.7	0.0000113	0.0000863	*< 0.0001*	0.00225
SS	L2052061-9	2/1/2018 12:35	18	18		291	7.92	691	230	1.62	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	172	*< 0.0015*	*< 0.05*	0.64	0.278	*< 0.000005*	0.00341	0.0149	0.031	0.0413	*< 0.00001*	*< 0.000005*	55.3	*< 0.000005*	0.0000897	*< 0.0001*	0.00216
SS	L2057381-9	2/15/2018 11:35	20	20		275	7.88	669	232	1.35	0.0137	*< 0.001*	*< 0.005*	*< 0.002*	151	*< 0.0015*	*< 0.05*	*< 0.5*	0.269	*< 0.000005*	0.00317	0.0114	0.032	0.0453	*< 0.00001*	*< 0.000005*	57.4	*< 0.000005*	0.0000538	*< 0.0001*	0.00194
SS	L2062788-9	3/1/2018 14:20	22	22		245	7.88	649	242	1.17	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	137	*< 0.0015*	*< 0.05*	*< 0.5*	0.279	*< 0.000005*	0.00280	0.0106	0.034	0.0455	*< 0.00001*	*< 0.000005*	56.9	0.0000056	0.0000336	*< 0.0001*	0.00187
SS	L2068449-9	3/15/2018 12:25	24	24		306	7.88	587	240	1.22	0.0098	*< 0.001*	*< 0.005*	*< 0.002*	112	*< 0.0015*	*< 0.05*	*< 0.5*	0.283	*< 0.000005*	0.00344	0.0116	0.031	0.0512	*< 0.00001*	*< 0.000005*	47.4	*< 0.000005*	0.0000333	*< 0.0001*	0.00160
SS	L2074311-9	3/29/2018 12:15	26	26		288	7.96	568	253	1.11	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	97.2	*< 0.0015*	*< 0.05*	*< 0.5*	0.281	*< 0.000005*	0.00573	0.0116	0.029	0.0581	*< 0.00001*	0.000113	46.8	0.0000059	0.0000418	*< 0.0001*	0.00165
SS	L2079620-9	4/12/2018 11:30	28	28		271	7.93	551	258	0.95	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	83.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.427	*< 0.000005*	0.00367	0.0127	0.032	0.0690	*< 0.00001*	*< 0.000005*	46.0	*< 0.000005*	0.0000556	*< 0.0001*	0.00169
SS	L2085708-9	4/26/2018 14:00	30	30		272	7.9	526	232	1.05	0.0067	*< 0.001*	*< 0.005*	*< 0.002*	77.4	*< 0.0015*	*< 0.05*	*< 0.5*	0.294	*< 0.000005*	0.00296	0.0127	0.029	0.0723	*< 0.00001*	0.0000071	42.8	0.0000058	0.0000729	*< 0.0001*	0.00160
SS	L2092801-9	5/10/2018 11:15	32	32		268	8.02	519	248	0.96	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	70.9	*< 0.0015*	*< 0.05*	*< 0.5*	0.290	*< 0.000005*	*< 0.004*	0.0126	0.031	0.0753	*< 0.00001*	0.0000076	45.8	0.0000060	0.0000944	*< 0.0001*	0.00162
SS	L2100224-9	5/24/2018 14:00	34	34		282	7.83	515	241	1.02	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	63.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.299	*< 0.000005*	0.00364	0.0149	0.028	0.0996	*< 0.00001*	*< 0.000005*	45.2	0.0000057	0.000127	*< 0.0001*	0.00168
SS	L2108434-9	6/7/2018 14:00	36		0	216	8	517	280	0.67	*< 0.005*	*< 0.001*	*< 0.005*	0.0021	61.7	*< 0.0015*	*< 0.05*	*< 0.5*	0.305	*< 0.000005*	0.00362	0.0143	0.035	0.0951	*< 0.00001*	*< 0.000005*	44.9	0.0000063	0.0000255	*< 0.0001*	0.00164
SS	L2116986-9	6/21/2018 14:00	38		2	385	7.97	512	318	0.72	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	58.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.325	*< 0.000005*	0.00302	0.0256	0.033	0.0958	*< 0.00001*	*< 0.000005*	42.9	*< 0.000005*	0.0000252	*< 0.0001*	0.00167
SS	L2125321-9	7/6/2018 11:50	40		4	217	7.98	466	260	0.82	*< 0.005*	*< 0.001*	*< 0.005*	0.0048	47.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.343	*< 0.000005*	0.00295	0.114	0.030	0.107	*< 0.00001*	*< 0.000005*	38.6	*< 0.000005*	0.0000181	*< 0.0001*	0.00152
SS	L2132784-9	7/19/2018 15:15	42		6	340	7.98	468	259	0.67	*< 0.005*	*< 0.001*	*< 0.005*	0.0059	47.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.354	*< 0.000005*	0.00348	0.137	0.030	0.106	*< 0.00001*	*< 0.000005*	40.1	*< 0.000005*	0.0000165	*< 0.0001*	0.00152
SS	L2140795-9	8/2/2018 13:45	44		8	179	8.01	465	634	0.80	*< 0.005*	*< 0.001*	*< 0.005*	0.0036	43.6	*< 0.0015*	*< 0.05*	0.68	0.357	*< 0.000005*	*< 0.004*	0.139	0.031	0.123	*< 0.00001*	*< 0.000005*	42.2	0.0000063	0.0000175	*< 0.0001*	0.00153

Appendix A4: Schist Column (SO, SS, ST) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
SS	L2148482-9	8/16/2018	46		10	340	7.87	454	252	0.78	0.0059	*< 0.001*	*< 0.005*	0.0073	40.7	*< 0.0015*	*< 0.05*	1.04	0.360	*< 0.000005*	0.00339	0.169	0.030	0.139	*< 0.00001*	*< 0.000005*	43.4	*< 0.000005*	0.0000193	*< 0.0001*	0.00160
SS	L2156461-9	8/30/2018 14:20	48		12	317	7.94	461	230	0.70	0.0064	*< 0.001*	*< 0.005*	0.0082	38.0	*< 0.0015*	*< 0.05*	1.24	0.362	0.0000050	0.00263	0.158	0.031	0.143	*< 0.00001*	*< 0.000005*	42.3	0.0000061	0.0000197	*< 0.0001*	0.00146
SS	L2164110-9	9/13/2018 11:45	50		14	307	8.02	464	222	0.99	0.029	*< 0.001*	*< 0.005*	0.0040	37.8	*< 0.0015*	*< 0.05*	1.33	0.355	*< 0.000005*	0.00288	0.138	0.030	0.140	*< 0.00001*	*< 0.000005*	40.7	0.0000051	0.0000158	*< 0.0001*	0.00147
SS	L2172409-9	9/27/2018 14:00	52		16	342	7.96	447	246	0.93	0.0082	*< 0.001*	*< 0.005*	0.0061	35.3	*< 0.0015*	*< 0.05*	1.37	0.371	*< 0.000005*	0.00273	0.179	0.030	0.138	*< 0.00001*	*< 0.000005*	36.7	*< 0.000005*	0.0000214	*< 0.0001*	0.00124
SS	L2180431-9	10/12/2018 14:10	54		18	209	7.91	446	254	0.54	0.0083	*< 0.001*	*< 0.005*	0.0101	32.7	*< 0.0015*	*< 0.05*	1.27	0.341	*< 0.000005*	0.00232	0.229	0.029	0.127	*< 0.00001*	*< 0.000005*	37.0	*< 0.000005*	0.0000171	*< 0.0001*	0.00122
SS	L2187510-9	10/25/2018 14:00	56		20	212	8.06	465	256	0.81	*< 0.005*	*< 0.001*	*< 0.005*	0.0055	35.2	0.0016	*< 0.05*	1.36	0.359	*< 0.000005*	0.00247	0.160	0.029	0.131	*< 0.00001*	*< 0.000005*	39.3	*< 0.000005*	0.0000121	*< 0.0001*	0.00127
SS	L2194529-9	11/8/2018 14:10	58		22	330	8	454	248	*< 0.5*	0.0076	*< 0.001*	*< 0.005*	0.0074	35.0	*< 0.0015*	*< 0.05*	1.31	0.364	*< 0.000005*	0.00249	0.206	0.027	0.139	*< 0.00001*	*< 0.000005*	40.0	0.0000051	0.0000233	*< 0.0001*	0.00112
SS	L2200705-9	11/22/2018 11:55	60		24	306	7.96	438	120	0.77	0.0051	*< 0.001*	*< 0.005*	0.0130	33.1	*< 0.0015*	*< 0.05*	1.23	0.368	*< 0.000005*	0.00213	0.207	0.027	0.128	*< 0.00001*	*< 0.000005*	37.4	*< 0.000005*	0.0000149	*< 0.0001*	0.00120
SS	L2207335-9	12/6/2018 13:05	62		26	296	8	439	242	*< 1*	*< 0.005*	*< 0.001*	*< 0.005*	0.0082	33.3	*< 0.0015*	*< 0.05*	1.21	0.381	*< 0.000005*	0.00264	0.219	0.027	0.139	*< 0.00001*	*< 0.000005*	39.2	*< 0.000005*	0.0000159	*< 0.0001*	0.00112
SS	L2213525-9	12/20/2018 14:45	64		28	417	7.97	435	249	0.51	0.0083	*< 0.001*	0.0066	0.0122	38.7	*< 0.0015*	*< 0.05*	1.22	0.395	0.0000057	0.00246	0.251	0.026	0.147	*< 0.00001*	*< 0.000005*	43.0	0.0000072	0.0000207	*< 0.0001*	0.00126
SS	L2217203-9	1/5/2019 11:35	66		30	449	7.76	484	236	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0036	60.2	*< 0.0067*	*< 0.05*	1.17	0.384	*< 0.000005*	0.00129	0.0815	0.024	0.128	*< 0.00001*	*< 0.000005*	47.7	*< 0.000005*	0.0000170	*< 0.0001*	0.00126
SS	L2222132-9	1/17/2019 11:45	68		32	446	7.89	584	231	0.57	0.0055	*< 0.001*	*< 0.005*	0.0037	135	*< 0.0067*	*< 0.05*	0.90	0.391	*< 0.000005*	0.00212	0.0480	0.023	0.0866	*< 0.00001*	*< 0.000005*	53.6	*< 0.000005*	0.0000150	*< 0.0001*	0.00126
SS	L2227544-9	1/31/2019 10:30	70		34	417	7.75	808	200	*< 0.5*	0.0136	*< 0.005*	*< 0.025*	*< 0.002*	278	*< 0.0015*	*< 0.25*	*< 2.5*	0.33	*< 0.00001*	0.0023	0.0336	0.021	0.0479	*< 0.00002*	*< 0.00001*	79.6	*< 0.00001*	0.000030	*< 0.0002*	0.00155
SS	L2233141-9	2/14/2019 14:20	72		36	451	7.66	1016	188	*< 0.5*	0.0376	*< 0.005*	*< 0.025*	0.0029	464	*< 0.0015*	*< 0.25*	*< 2.5*	0.31	*< 0.00001*	0.0024	0.0293	0.021	0.0394	*< 0.00002*	*< 0.00001*	120	*< 0.00001*	0.000054	*< 0.0002*	0.00156
SS	L2238565-9	2/28/2019 15:15	74		38	477	7.58	1227	174	0.56	0.0539	*< 0.005*	*< 0.025*	*< 0.002*	560	*< 0.0015*	*< 0.25*	*< 2.5*	0.27	*< 0.00001*	0.0024	0.0253	0.020	0.0338	*< 0.00002*	*< 0.00001*	155	*< 0.00001*	0.000097	*< 0.0002*	0.00175
SS	L2244540-9	3/14/2019 14:30	76		40	483	7.72	1388	171	*< 0.5*	0.0697	*< 0.005*	*< 0.025*	*< 0.002*	689	*< 0.0015*	*< 0.25*	*< 2.5*	0.25	*< 0.00001*	0.0023	0.0273	*< 0.02*	0.0345	*< 0.00002*	*< 0.00001*	174	0.000013	0.000127	*< 0.0002*	0.00195
SS	L2250817-9	3/28/2019 15:00	78		42	452	7.55	1499	157	0.50	0.0862	*< 0.005*	*< 0.025*	*< 0.002*	775	*< 0.01*	*< 0.25*	*< 2.5*	0.24	*< 0.000025*	0.0036	0.0208	*< 0.05*	0.0304	*< 0.00005*	*< 0.000025*	234	*< 0.000025*	0.000143	*< 0.0005*	0.00198
SS	L2257457-9	4/11/2019 15:00	80		44	362	7.66	1562	160	0.63	0.0978	*< 0.01*	*< 0.05*	*< 0.002*	852	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000025*	*< 0.003*	0.0190	*< 0.05*	0.0257	*< 0.00005*	*< 0.000025*	232	*< 0.000025*	0.000168	*< 0.0005*	0.00210
SS	L2263301-9	4/25/2019 14:45	82		46	438	7.63	1650	171	0.91	0.107	*< 0.005*	*< 0.025*	*< 0.002*	840	*< 0.0015*	*< 0.25*	*< 2.5*	0.24	*< 0.000025*	0.0032	0.0200	*< 0.05*	0.0254	*< 0.00005*	*< 0.000025*	258	*< 0.000025*	0.000219	*< 0.0005*	0.00230
ST	L2000226-6	9/29/2017 10:50	0	0		441	8.2	500	94	4.98	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	161	*< 0.0015*	*< 0.05*	1.46	2.18	*< 0.000005*	0.0213	0.00778	0.029	0.0424	*< 0.00001*	*< 0.000005*	38.1	0.0000051	0.0000143	0.00092	0.000025
ST	L2014692-6	10/27/2017	4	4		262	8.11	597	115	3.36	0.0222	*< 0.001*	*< 0.005*	*< 0.002*	186	*< 0.0015*	*< 0.05*	1.40	0.393	0.0000221	0.0101	0.00777	0.038	0.0531	*< 0.00001*	*< 0.000005*	48.5	0.0000102	0.0000662	0.00072	0.000029
ST	L2021295-6	11/10/2017 13:30	6	6		261	8.13	523	102	3.32	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	158	*< 0.0015*	*< 0.05*	1.16	0.369	*< 0.000005*	0.0107	0.00746	0.032	0.0471	*< 0.00001*	*< 0.000005*	38.9	0.0000058	0.0000223	0.00022	0.000020
ST	L2026623-10	11/23/2017 14:40	8	8		331	8.07	486	144	2.87	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	140	*< 0.0015*	*< 0.05*	0.96	0.364	*< 0.00001*	0.0120	0.00801	0.034	0.0452	*< 0.00002*	*< 0.00001*	41.6	*< 0.00001*	0.000027	0.00045	0.000026
ST	L2031965-9	12/6/2017 14:05	10	10		262	7.99	477	143	2.37	*< 0.005*	*< 0.001*	*< 0.005*	0.0034	129	*< 0.0015*	*< 0.05*	0.82	0.368	*< 0.000005*	0.0115	0.00908	0.027	0.0522	*< 0.00001*	*< 0.000005*	39.0	0.0000072	0.0000187	0.00046	0.000021
ST	L2038563-10	12/21/2017 13:10	12	12		263	8.02	459	144	2.09	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	125	*< 0.0015*	*< 0.05*	0.72	0.350	0.0000053	0.00957	0.00780	0.028	0.0567	*< 0.00001*	*< 0.000005*	38.5	0.0000157	0.0000235	0.00029	0.000025
ST	L2042065-1	1/5/2018 11:50	14	14		314	8.08	353	118	3.66	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	86.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.307	*< 0.000005*	0.0123	0.00655	0.018	0.0489	*< 0.00001*	*< 0.000005*	31.3	*< 0.000005*	0.0000307	0.00021	0.000015
ST	L2046871-10	1/18/2018 12:10	16	16		269	8.14	436	144	1.28	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	106	*< 0.0015*	*< 0.05*	0.53	0.390	*< 0.000005*	0.0103	0.00793	0.026	0.0632	*< 0.00001*	*< 0.000005*	38.8	0.0000142	0.0000296	0.00060	0.000023
ST	L2052061-10	2/1/2018 12:35	18	18		292	8.06	414	142	1.57	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	96.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.399	*< 0.000005*	0.00975	0.0109	0.024	0.0615	*< 0.00001*	*< 0.000005*	35.1	0.0000066	0.0000351	0.00043	0.000021
ST	L2057381-10	2/15/2018 11:35	20	20		271	8.03	418	153	1.07	0.0144	*< 0.001*	*< 0.005*	*< 0.002*	93.9	*< 0.0015*	*< 0.05*	*< 0.5*	0.388	*< 0.000005*	0.00701	0.00867	0.025	0.0606	*< 0.00001*	*< 0.000005*	37.9	0.0000088	0.0000345	0.00029	0.000020
ST	L2062788-10	3/1/2018 14:20	22	22		243	7.99	413	176	1.00	*< 0.005*	*< 0.001*	*< 0.005*	0.0020	90.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.389	*< 0.000005*	0.0113	0.00929	0.027	0.0616	*< 0.00001*	*< 0.000005*	39.7	0.0000051	0.0000276	0.00040	0.000023
ST	L2068449-10	3/15/2018 12:25	24	24		298	8.13	385	150	1.16	0.0066	*< 0.001*	*< 0.005*	*< 0.002*	80.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.379	*< 0.000005*	0.00853	0.0103	0.024	0.0628	*< 0.00001*	*< 0.000005*	33.1	*< 0.000005*	0.0000296	0.00027	0.000020
ST	L2074311-10	3/29/2018 12:15	26	26		275	8.03	385	143	0.96	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	76.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.376	*< 0.000005*	0.00775	0.0105	0.022	0.0673	*< 0.00001*	*< 0.000005*	33.2	0.0000067	0.0000283	0.00031	0.000021
ST	L2079620-10	4/12/2018 11:30	28	28		260	8.04	371	146	0.87	*< 0.005*	*< 0.001*	*< 0.005*	0.0038	68.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.381	*< 0.000005*	0.00819	0.0120	0.022	0.0718	*< 0.00001*	*< 0.000005*	32.1	*< 0.000005*	0.0000307	0.00027	0.000020
ST	L2085708-10	4/26/2018 14:00	30	30		252	8.02	367	144	0.77	0.0069	*< 0.001*	*< 0.005*	*< 0.002*	69.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.381	*< 0.000005*	0.00750	0.0122	0.022	0.0741	*< 0.00001*	*< 0.000005*	31.8	0.0000068	0.0000229	0.00031	0.000020
ST	L2092801-10	5/10/2018 11:15	32	32		261	8.09	359	142	1.01	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	65.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.365	*< 0.000005*	0.00749	0.0130	0.023	0.0735	*< 0.00001*	0.0000182	34.7	0.0000057	0.0000273	0.00027	0.000021
ST	L2100224-10	5/24/2018 14:00	34	34		272	7.99	356	146	1.02	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	58.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.366	*< 0.000005*	0.00847	0.0168	0.021	0.0865	*< 0.00001*	*< 0.000005*	30.7	*< 0.000005*	0.0000296	0.00030	0.000018
ST	L2108434-10	6/7/2018 14:00	36		0	226	7.99	352	159	0.65	*< 0.005*	*< 0.001*	*< 0.005*	0.0342	59.4	*< 0.0015*	*< 0.05*	*< 0.5*	0.388	*< 0.000005*	0.00836	1.17	0.026	0.0875	*< 0.00001*	*< 0.000005*	33.7	0.0000097	0.0000206	0.00034	0.000024
ST	L2116986-10	6/21/2018 14:00	38		2	390	8.07	364	325	*< 1*	*< 0.005*	*< 0.001*	*< 0.005*	0.0717	58.3	*< 0.0015*	*< 0.05*	*< 0.5*	0.417	*< 0.000005*	0.00730	1.82	0.025	0.0865	*< 0.00001*	*< 0.000005*	32.4	0.0000055	0.0000125	0.00032	0.000021
ST	L2125321-10	7/6/2018 11:50	40		4	224	8.07	345	181	0.80	*< 0.005*	*< 0.001*	*< 0.005*	0.0922	50.6	*< 0.0015*	*< 0.05*	*< 0.5*	0.408	*< 0.000005*	0.00695	2.42	0.024	0.0971	*< 0.00001*	*< 0.000005*	30.1	*< 0.00002*	0.0000145	0.00036	0.000019
ST	L2132784-10	7/19/2018 15:15	42		6	355	8.09	350	174	0.68	0.0145	*< 0.001*	*< 0.005*	0.0936	51.2	*< 0.0015*	*< 0.05*	*< 0.5*	0.423	*< 0.000005*	0.00735	2.74	0.025	0.0925	*< 0.00001*	*< 0.000005*	31.3	*< 0.00001*	0.0000160	0.00039	0.000022
ST	L2140795-10	8/2/2018 13:45	44		8	187	8.18	339	182	0.64	0.0146	*< 0.001*	*< 0.005*	0.088	47.3	*< 0.0015*	*< 0.05*	*< 0.5*	0.428	*< 0.000005*	0.00770	3.20	0.026	0.0979	*< 0.00001*	*< 0.000005*	33.7	*< 0.00002*	0.0000173	0.00031	0.000024
ST	L2148482-10	8/16/2018	46		10	297	8.09	338	170	0.66	0.0227	*< 0.001*	*< 0.005*	0.087	45.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.430	*< 0.000005*	0.00812	3.48	0.025	0.104	*< 0.00001*	*< 0.000005*	33.3	*< 0.000006*	0.0000139	0.00038	0.000021
ST	L2156461-10	8/30/2018 14:20	48		12	337	8.05	330	162	0.69	0.0423	*< 0.001*	*< 0.005*	0.102	40.7	*< 0.0015*	*< 0.05*	*< 0.5*	0.418	0.0000054	0.00751	4.96	0.026	0.103	*< 0.00001*	0.0000139	33.2	*< 0.00002*	0.0000235	0.00029	0.000029
ST	L2164110-10	9/13/2018 11:45	50		14	304	8.09	332	172	1.03	0.0456	*< 0.001*	*< 0.005*	0.102	40.7	*< 0.0015*	*< 0.05*	*< 0.5*	0.428	*< 0.00001*	0.0073	4.20	0.025	0.0934	*< 0.00002*	*< 0.00001*	30.5	*< 0.00001*	0.000013	0.00036	0.000023
ST	L2172409-10	9/27/2018 14:00	52		16	346	8.14	314	138	*< 0.5*	0.0361	*< 0.001*	*< 0.005*	0.116	37.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.433	*< 0.00001*	0.0062	5.75	0.025	0.0903	*< 0.00002*	*< 0.00001*	27.6	*< 0.00001*	0.000017	0.00037	*< 0.00002*
ST	L2180431-10	10/12/2018 14:10	54		18	208	8.04	318	145	*< 0.5*	0.0363	*< 0.001*	*< 0.005*	0.117	35.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.394	*< 0.00001*	0.0059	5.77	0.024	0.0865	*< 0.00002*	*< 0.00001*	28.0	*< 0.00001*	0.000024	0.00043	0.000023
ST	L2187510-10	10/25/2018 14:00	56		20	208	8.14	330	172	0.78	0.0346	*< 0.001*	*< 0.005*	0.193	37.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.419	*< 0.000005*	0.00494	4.90	0.024	0.0896	*< 0.00001*	*< 0.000005*	28.3	*< 0.000015*	0.0000194	0.00046	0.000021
ST	L2194529-10	11/8/2018 14:10	58		22	326	8.14	321	155	0.80	0.0414	*< 0.001*	*< 0.005*	0.101	37.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.418	*< 0.000005*	0.00576	6.33	0.025	0.0953	*< 0.00001*	*< 0.000005*	31.8	*< 0.000015*	0.0000189	0.00044	0.000020
ST	L2200705-10	11/22/2018 11:55	60		24	301	8.07	308	157	0.74	0.0342	*< 0.001*	*< 0.005*	0.229	34.7	*< 0.0015*	*< 0.05*	0.57	0.422	*< 0.000005*	0.00587	6.41	0.023	0.0866	*< 0.00001*	*< 0.000005*	27.7	*< 0.00001*	0.0000182	0.00048	0.000022
ST	L2207335-10	12/6/2018 13:05	62		26	289	8.12	307	164	*< 1*	0.0346	*< 0.001*	*< 0.005*	0.141	33.6	*< 0.0015*	*< 0.05*	0.77	0.429	*< 0.00001*	0.0062	6.80	0.023	0.0907	*< 0.00002*	*< 0.00001*	28.3	*< 0.00001*	0.000021	0.00048	*< 0.00002*
ST	L2213525-10	12/20/2018 14:45	64		28	413	8.17	299	154	0.56	0.0402	*< 0.001*	0.0343	0.107	33.8	*< 0.0015*	*< 0.05*	0.98	0.443	*< 0.00001*	0.0055	7.20	0.023	0.0913	*< 0.00002*	*< 0.00001*	31.6	0.000013	0.000022	0.00047	0.000024
ST	L2217203-10	1/5/2019 11:35	66		30	371	7.98	330	152	0.53	0.0386	*< 0.001*	*< 0.005*	0.097	47.5	*< 0.0067*	*< 0.05*	1.13	0.443	*< 0.00001*	0.0053	5.76	0.021	0.0963	*< 0.00002*	*< 0.00001*	31.0	*< 0.00001*	0.000012	0.00050	0.000021
ST	L2222132-10	1/17/2019 11:45	68		32	398	7.98	443	138	0.60	0.0390	*< 0.001*	*< 0.005*	0.055	114	*< 0.01*	*< 0.05*	1.08	0.417	*< 0.000005*	0.00379	3.75	0.020	0.134	*< 0.00001*	*< 0.000005*	43.2	0.0000103	0.0000199	0.00046	0.000024
ST	L2227544-10	1/31/2019 10:30	70		34	376	7.84	801	153	0.70	0.0534	*< 0.005*	*< 0.025*	0.0722	300	*< 0.0015*	*< 0.25*	*< 2.5*	0.30	*< 0.00001*	0.0031	1.75	*< 0.02*	0.0962	*< 0.00002*	*< 0.00001*	87.5	*< 0.00001*	0.000023	0.00057	0.000038
ST	L2233141-10	2/14/2019 14:20	72		36	422	7.55	1078	179	0.75	0.0875	*< 0.005*	*< 0.025*	0.0293	506	*< 0.0015*	*< 0.25*	*< 2.5*	0.25	0.000021	0.0026	0.819	0.020	0.0675	*< 0.00002*	*< 0.00001*	149	*< 0.00001*	0.000076	0.00036	0.000045
ST	L2238565-10	2/28/2019 15:15	74		38	452	7.44	1291	187	0.53	0.0796	*< 0.005*	*< 0.025*	0.0109	598	*< 0.0015*	*< 0.25*	*< 2.5*	0.20	*< 0.000025*	*< 0.003*	0.323	*< 0.05*	0.0467	*< 0.00005*	*< 0.000025*	182	*< 0.000025*	0.000160	*< 0.0005*	0.000061
ST	L2244540-10	3/14/2019 14:30	76		40	460	7.51	1430	181	0.51	0.0855	*< 0.005*	*< 0.025*	0.0046	701	*< 0.0015*	*< 0.25*	*< 2.5*	0.18	*< 0.000025*	*< 0.003*	0.207	*< 0.05*	0.0461	*< 0.00005*	*< 0.000025*	211	*< 0.000025*	0.000248	0.00056	0.000062
ST	L2250817-10	3/28/2019 15:00	78		42	372	7.39	1506	182	0.66	0.0932	*< 0.005*	*< 0.025*	0.0038	775	*< 0.01*	*< 0.25*	*< 2.5*	0.18	*< 0.000025*	0.0038	0.116	*< 0.05*	0.0384	*< 0.00005*	*< 0.000025*	271	*< 0.000025*	0.000269	*< 0.0005*	0.000052
ST	L2257457-10	4/11/2019 15:00	80		44	434	7.52	1530	174	0.53	0.103	*< 0.01*	*< 0.05*	*< 0.002*	816	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000025*	*< 0.003*	0.103	*< 0.05*	0.0332	*< 0.00005*	*< 0.000025*	277	*< 0.000025*	0.000328	*< 0.0005*	0.000074
ST	L2263301-10	4/25/2019 14:45	82		46	410	7.51	1621	169	0.54	0.0954	*< 0.005*	*< 0.025*	*< 0.002*	808	*< 0.0015*	0.27	*< 2.5*	0.18	*< 0.000025*	0.0034	0.0887	*< 0.05*	0.0312	*< 0.00005*	*< 0.000025*	272	*< 0.000025*	0.000265	*< 0.0005*	0.000089

Notes:
Results in blue italics are below the indicated detection limit

Appendix A4: Schist Column (SO, SS, ST) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
SO	L2000226-4	9/29/2017 10:50	0.00034	*< 0.001*	*< 0.000005*	6.99	0.00306	8.19	0.000104	0.00457	22.3	0.000172	*< 0.05*	0.0000086	0.00240	0.00736	17.9	0.000161	4.15	0.000016	0.146	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000159	0.00313	0.000179	0.00043	*< 0.003*	*< 0.00006*
SO	L2014692-4	10/27/2017	0.00033	*< 0.001*	*< 0.000005*	8.80	0.00478	11.2	0.00238	0.00600	27.1	0.000340	*< 0.05*	*< 0.000005*	0.00321	0.00763	23.8	0.000291	5.39	*< 0.00001*	0.192	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000259	0.00517	0.000180	0.00041	*< 0.0005*	*< 0.00006*
SO	L2021295-4	11/10/2017 13:30	0.00032	*< 0.001*	*< 0.000005*	8.52	0.00444	10.4	0.000765	0.00596	25.0	0.000368	*< 0.05*	*< 0.000005*	0.00298	0.00635	18.4	0.000402	4.67	*< 0.00001*	0.190	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000216	0.00363	0.000176	0.00044	*< 0.0005*	*< 0.00006*
SO	L2026623-8	11/23/2017 14:40	0.00024	*< 0.001*	*< 0.000005*	7.62	0.00435	9.92	0.000898	0.00633	22.2	0.000322	*< 0.05*	0.0000073	0.00284	0.00616	16.2	0.000436	4.59	0.000015	0.182	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000237	0.00369	0.000159	0.00048	0.00096	*< 0.00006*
SO	L2031965-8	12/6/2017 14:05	0.00023	*< 0.001*	0.0000060	7.93	0.00345	9.80	0.00197	0.00623	21.2	0.000249	*< 0.05*	0.0000112	0.00294	0.00623	16.5	0.000377	4.63	*< 0.00001*	0.186	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000267	0.00393	0.000209	0.00046	*< 0.0005*	*< 0.00006*
SO	L2038563-8	12/21/2017 13:10	0.00019	0.0018	*< 0.000005*	7.90	0.00310	9.44	0.00566	0.00701	20.6	0.000300	*< 0.05*	0.0000059	0.00281	0.00535	15.2	0.000109	4.43	*< 0.00001*	0.172	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000245	0.00378	0.000167	0.00043	*< 0.0005*	*< 0.00006*
SO	L2041649-8	1/4/2018 13:05	0.00014	*< 0.001*	*< 0.000005*	6.90	0.00285	8.67	0.00200	0.00554	18.3	0.000278	*< 0.05*	*< 0.000005*	0.00250	0.00508	13.2	0.000318	4.14	*< 0.00001*	0.165	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000240	0.00356	0.000152	0.00038	*< 0.0005*	*< 0.00006*
SO	L2046871-8	1/18/2018 12:10	0.00018	0.0018	*< 0.000005*	7.07	0.00366	8.93	0.00146	0.00665	18.2	0.000287	*< 0.05*	*< 0.000005*	0.00260	0.00519	12.7	0.000432	4.23	*< 0.00001*	0.167	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000259	0.00355	0.000165	0.00043	*< 0.0005*	*< 0.00006*
SO	L2052061-8	2/1/2018 12:35	0.00014	*< 0.001*	*< 0.000005*	7.36	0.00248	8.34	0.000870	0.00535	17.7	0.000271	*< 0.05*	*< 0.000005*	0.00251	0.00499	11.9	0.000477	4.10	*< 0.00001*	0.162	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000249	0.00328	0.000182	0.00036	*< 0.0005*	*< 0.00006*
SO	L2057381-8	2/15/2018 11:35	0.00013	*< 0.001*	*< 0.000005*	6.66	0.00337	8.14	0.000582	0.00567	16.2	0.000225	*< 0.05*	*< 0.000005*	0.00226	0.00478	11.6	0.000302	4.03	*< 0.00001*	0.163	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000258	0.00338	0.000145	0.00036	*< 0.0005*	*< 0.00006*
SO	L2062788-8	3/1/2018 14:20	0.00011	*< 0.001*	*< 0.000005*	6.97	0.00341	9.52	0.00247	0.00549	17.8	0.000214	*< 0.05*	*< 0.000005*	0.00256	0.00502	11.8	0.000294	4.41	*< 0.00001*	0.177	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000258	0.00294	0.000139	0.00030	*< 0.0005*	*< 0.00006*
SO	L2068449-8	3/15/2018 12:25	0.00012	*< 0.001*	*< 0.000005*	7.50	0.00311	8.58	0.00779	0.00567	18.2	0.000162	*< 0.05*	*< 0.000005*	0.00260	0.00445	10.2	0.000179	4.08	*< 0.00001*	0.148	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000259	0.00259	0.000151	0.00035	*< 0.0005*	*< 0.00006*
SO	L2074311-8	3/29/2018 12:15	0.00020	*< 0.001*	*< 0.000005*	6.31	0.00326	7.98	0.0109	0.00610	14.7	0.000252	*< 0.05*	0.0000239	0.00221	0.00426	8.92	0.000058	3.77	*< 0.00001*	0.156	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000246	0.00302	0.000192	0.00033	0.0010	*< 0.00006*
SO	L2079620-8	4/12/2018 11:30	0.00016	*< 0.001*	*< 0.000005*	6.02	0.00267	7.30	0.0136	0.00630	13.9	0.000229	*< 0.05*	*< 0.000015*	0.00234	0.00434	8.33	0.000065	3.87	*< 0.00001*	0.144	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000255	0.00330	0.000146	0.00034	*< 0.001*	*< 0.00006*
SO	L2085708-8	4/26/2018 14:00	0.00010	*< 0.001*	*< 0.000005*	6.03	0.00335	7.79	0.0178	0.00610	13.2	0.000191	*< 0.05*	*< 0.000005*	0.00232	0.00425	8.24	0.000219	4.07	*< 0.00001*	0.147	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000228	0.00289	0.000131	0.00032	*< 0.001*	*< 0.00006*
SO	L2092801-8	5/10/2018 11:15	0.00011	*< 0.001*	0.0000058	6.03	0.00366	7.58	0.0252	0.00629	13.1	0.000160	*< 0.05*	0.0000079	0.00236	0.00463	7.31	0.000090	4.10	*< 0.00001*	0.153	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000237	0.00285	0.000238	0.00033	*< 0.001*	*< 0.00006*
SO	L2100224-8	5/24/2018 14:00	0.00013	0.0011	*< 0.000005*	6.46	0.00332	8.62	0.0355	0.00658	13.4	0.000169	*< 0.05*	*< 0.000005*	0.00268	0.00471	7.40	0.000077	4.11	*< 0.00001*	0.167	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000245	0.00297	0.000165	0.00033	*< 0.001*	*< 0.00006*
SO	L2108434-8	6/7/2018 14:00	0.00014	0.0023		6.95	0.00399	9.10	0.00798	0.00691	14.3	0.000221	*< 0.05*	0.0000135	0.00271	0.00486	8.27	0.000094	5.90	*< 0.00001*	0.172	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000246	0.00329	0.000155	0.00028	*< 0.001*	*< 0.00006*
SO	L2116986-8	6/21/2018 14:00	0.00014	*< 0.001*		7.41	0.00403	9.61	0.00298	0.00672	14.4	0.000194	*< 0.05*	*< 0.000005*	0.00323	0.00495	7.67	0.000112	6.08	*< 0.00001*	0.182	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000275	0.00332	0.000173	0.00027	*< 0.001*	*< 0.00006*
SO	L2125321-8	7/6/2018 11:50	0.00011	*< 0.001*		7.22	0.00397	9.21	0.00371	0.00707	13.4	0.000167	*< 0.05*	0.0000200	0.00303	0.00497	6.98	0.000073	6.82	*< 0.00001*	0.179	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000272	0.00324	0.000241	0.00024	0.0017	*< 0.00006*
SO	L2132784-8	7/19/2018 15:15	0.00017	*< 0.001*		7.74	0.00429	9.84	0.00155	0.00730	13.9	0.000188	*< 0.05*	*< 0.000005*	0.00331	0.00531	6.65	0.000090	6.84	*< 0.00001*	0.181	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000304	0.00356	0.000219	0.00027	0.0016	*< 0.00006*
SO	L2140795-8	8/2/2018 13:45	0.00021	0.0032		8.10	0.00445	9.65	0.000306	0.00743	13.9	0.000202	*< 0.05*	*< 0.000005*	0.00340	0.00551	7.46	0.000126	6.93	*< 0.00001*	0.196	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000306	0.00362	0.000246	0.00028	*< 0.001*	*< 0.00006*
SO	L2148482-8	8/16/2018	0.00014	*< 0.001*		7.85	0.00435	10.3	0.000220	0.00763	13.7	0.000160	*< 0.05*	0.0000216	0.00364	0.00554	6.18	0.000071	7.26	*< 0.00001*	0.211	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000312	0.00371	0.000237	0.00029	*< 0.001*	*< 0.00006*
SO	L2156461-8	8/30/2018 14:20	0.00018	0.0011		8.01	0.00437	9.65	0.000398	0.00764	13.2	*< 0.00005*	*< 0.05*	*< 0.00001*	0.00354	0.00541	6.39	0.000069	7.73	*< 0.00001*	0.195	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000316	0.00373	0.000269	0.00026	0.0011	*< 0.00006*
SO	L2164110-8	9/13/2018 11:45	0.00015	*< 0.001*		7.96	0.00426	9.32	0.000150	0.00744	12.7	0.000095	*< 0.05*	*< 0.000005*	0.00355	0.00525	5.89	*< 0.00004*	7.40	*< 0.00001*	0.194	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000285	0.00362	0.000264	0.00025	*< 0.001*	*< 0.00006*
SO	L2172409-8	9/27/2018 14:00	0.00018	*< 0.001*		7.27	0.00395	9.20	0.000176	0.00740	12.0	0.000126	*< 0.05*	0.0000242	0.00320	0.00514	5.77	0.000073	7.75	*< 0.00001*	0.174	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000267	0.00319	0.000239	0.00025	*< 0.001*	*< 0.00006*
SO	L2180431-8	10/12/2018 14:10	0.00015	*< 0.001*		6.92	0.00400	9.47	0.000091	0.00798	11.2	0.000112	*< 0.05*	0.0000058	0.00303	0.00523	5.97	*< 0.00004*	7.63	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000258	0.00336	0.000281	0.00024	*< 0.001*	*< 0.00006*
	L2187510-8	10/25/2018 14:00	0.00019	*< 0.001*		7.12	0.00397	9.82	0.000067	0.00807	11.6	0.000121	*< 0.05*	0.0000077	0.00320	0.00514	6.28	0.000057	7.29	*< 0.00001*	0.191	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000241	0.00381	0.000268	0.00024	*< 0.001*	*< 0.00006*
SO	L2194529-8	11/8/2018 14:10	0.00011	*< 0.001*		7.58	0.00372	10.1	0.000077	0.00716	11.8	0.000137	*< 0.05*	*< 0.000005*	0.00319	0.00492	5.90	0.000052	7.73	*< 0.00001*	0.173	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000238	0.00357	0.000276	0.00023	*< 0.001*	*< 0.00006*
SO	L2200705-8	11/22/2018 11:55	0.00015	*< 0.001*		7.08	0.00397	9.68	0.000081	0.00765	10.8	0.000129	*< 0.05*	*< 0.000005*	0.00313	0.00495	6.15	0.000110	7.62	*< 0.00001*	0.185	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000221	0.00372	0.000262	0.00023	*< 0.001*	*< 0.00006*
SO	L2207335-8	12/6/2018 13:05	0.00019	*< 0.001*		7.19	0.00391	10.2	*< 0.00005*	0.00789	10.6	0.000111	*< 0.05*	0.0000141	0.00311	0.00496	5.63	0.000155	7.47	*< 0.00001*	0.186	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000212	0.00362	0.000274	0.00025	*< 0.001*	*< 0.00006*
SO	L2213525-8	12/20/2018 14:45	0.00012	*< 0.001*		7.61	0.00410	9.95	0.000092	0.00832	11.3	0.000127	*< 0.05*	*< 0.000005*	0.00340	0.00527	6.39	0.000071	7.84	*< 0.00001*	0.200	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000246	0.00399	0.000223	0.00025	*< 0.001*	*< 0.00006*
SO	L2217203-8	1/5/2019 11:35	0.00017	*< 0.001*		7.51	0.00413	11.0	*< 0.00005*	0.00753	10.7	0.000110	*< 0.05*	*< 0.000005*	0.00362	0.00508	11.6	0.000063	7.05	*< 0.00001*	0.216	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000213	0.00446	0.000211	0.00025	*< 0.001*	*< 0.00006*
SO	L2222132-8	1/17/2019 11:45	0.00018	*< 0.001*		8.97	0.00477	15.7	0.000207	0.00639	12.3	0.000133	*< 0.05*	*< 0.000005*	0.00366	0.00454	38.4	0.000091	7.20	*< 0.00001*	0.294	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000258	0.00490	0.000177	0.00019	*< 0.001*	*< 0.00006*
SO	L2227544-8	1/31/2019 10:30	0.00020	*< 0.001*		9.97	0.00543	22.9	0.000776	0.00492	14.1	0.000159	*< 0.05*	*< 0.000005*	0.00461	0.00375	87.2	0.000067	7.18	*< 0.00001*	0.425	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000291	0.00577	0.000147	0.00013	*< 0.001*	*< 0.00006*
SO	L2233141-8	2/14/2019 14:20	0.00017	*< 0.001*		12.7	0.00709	33.3	0.00558	0.00387	15.5	0.000233	*< 0.05*	*< 0.000005*	0.00583	0.00327	151	0.000045	7.96	*< 0.00001*	0.556	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000374	0.00731	0.000124	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2238565-8	2/28/2019 15:15	0.00123	*< 0.001*		13.5	0.00703	41.5	0.0106	0.00338	14.4	0.000272	*< 0.05*	0.0000271	0.00667	0.00282	196	0.000053	8.29	*< 0.00001*	0.726	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000407	0.00733	0.000112	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2244540-8	3/14/2019 14:30	0.00019	*< 0.001*		13.6	0.00888	40.4	0.0140	0.00303	13.3	0.000311	*< 0.05*	*< 0.000005*	0.00696	0.00273	227	0.000053	8.14	*< 0.00001*	0.765	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000465	0.00743	0.000134	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2250817-8	3/28/2019 15:00	0.00019	*< 0.001*		15.8	0.00883	49.6	0.00898	0.00278	14.6	0.000213	*< 0.05*	*< 0.000005*	0.00811	0.00263	274	0.000061	9.16	*< 0.00001*	0.841	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000483	0.00745	0.000131	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2257457-8	4/11/2019 15:00	0.00019	*< 0.001*		15.6	0.00925	49.7	0.00955	0.00269	13.4	0.000342	*< 0.05*	*< 0.000005*	0.00885	0.00292	262	0.000083	8.89	*< 0.00001*	0.955	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000513	0.00706	0.000119	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2263301-8	4/25/2019 14:45	0.00017	*< 0.001*		15.2	0.00886	48.2	0.00830	0.00261	12.8	0.000245	*< 0.05*	*< 0.000005*	0.00821	0.00255	277	0.000056	8.90	*< 0.00001*	0.934	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000488	0.00753	0.000124	*< 0.0001*	*< 0.001*	*< 0.00006*
SS	L2000226-5	9/29/2017 10:50	0.00075	*< 0.001*	*< 0.000005*	32.8	0.0122	82.8	0.0190	0.00822	33.6	0.00503	*< 0.05*	0.0000193	0.0486	0.0145	185	0.000420	2.22	0.000027	6.67	0.00042	*< 0.0001*	*< 0.0003*	0.000110	0.0886	0.000358	0.00041	*< 0.0015*	*< 0.00006*
SS	L2014692-5	10/27/2017	0.00056	*< 0.001*	*< 0.000005*	36.1	0.0134	87.0	0.0552	0.00804	34.4	0.00722	*< 0.05*	0.0000121	0.0507	0.00913	200	0.000644	2.95	0.000015	6.82	0.00036	*< 0.0001*	*< 0.0003*	0.000102	0.0816	0.000320	0.00038	0.00101	*< 0.00006*
SS	L2021295-5	11/10/2017 13:30	0.00034	*< 0.001*	*< 0.000005*	34.7	0.0139	76.3	0.0634	0.00801	31.3	0.00643	*< 0.05*	0.0000086	0.0466	0.00652	144	0.000536	2.64	0.000013	6.64	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000800	0.0562	0.000255	0.00042	0.00084	*< 0.00006*
SS	L2026623-9	11/23/2017 14:40	0.00032	0.0026	*< 0.000005*	30.2	0.0125	65.3	0.0673	0.00744	26.9	0.00613	*< 0.05*	0.0000093	0.0431	0.00598	125	0.000545	2.80	0.000015	6.27	0.00029	*< 0.0001*	*< 0.0003*	0.0000736	0.0459	0.000222	0.00044	0.00266	*< 0.00006*
SS	L2032657-1	12/7/2017 11:30	0.00026	*< 0.001*	*< 0.000005*	31.3	0.0120	60.9	0.0459	0.00611	27.7	0.00586	*< 0.05*	0.0000080	0.0436	0.00552	127	0.000770	2.89	*< 0.00001*	5.40	0.00043	*< 0.0001*	*< 0.0003*	0.0000727	0.0377	0.000266	0.00038	*< 0.0008*	*< 0.00006*
SS	L2038563-9	12/21/2017 13:10	0.00034	*< 0.001*	*< 0.000005*	28.5	0.00871	54.7	0.0422	0.00669	24.0	0.00532	*< 0.05*	0.0000084	0.0402	0.00529	96.1	0.000170	2.64	*< 0.00001*	5.02	0.00027	*< 0.0001*	*< 0.0003*	0.0000700	0.0281	0.000196	0.00035	0.00112	*< 0.00006*
SS	L2041649-9	1/4/2018 13:05	0.00022	*< 0.001*	*< 0.000005*	24.9	0.00894	46.3	0.0351	0.00526	19.7	0.00492	*< 0.05*	*< 0.00001*	0.0340	0.00464	77.1	0.000566	2.48	*< 0.00001*	4.61	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000634	0.0231	0.000211	0.00031	0.00083	*< 0.00006*
SS	L2046871-9	1/18/2018 12:10	0.00031	0.0014	*< 0.000005*	24.8	0.00928	47.2	0.0368	0.00596	20.6	0.00471	*< 0.05*	0.0000062	0.0374	0.00446	66.2	0.000729	2.51	0.000010	4.50	0.00022	*< 0.0001*	*< 0.0003*	0.0000565	0.0181	0.000216	0.00037	0.00102	*< 0.00006*
SS	L2052061-9	2/1/2018 12:35	0.00023	*< 0.001*	*< 0.000005*	26.0	0.00754	40.7	0.0361	0.00485	18.9	0.00436	*< 0.05*	*< 0.000005*	0.0342	0.00409	61.9	0.000639	2.64	*< 0.00001*	4.36	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000568	0.0165	0.000225	0.00039	0.00074	*< 0.00006*
SS	L2057381-9	2/15/2018 11:35	0.00021	*< 0.001*	*< 0.000005*	23.2	0.00885	37.4	0.0225	0.00506	15.6	0.00368	*< 0.05*	*< 0.000005*	0.0292	0.00402	53.4	0.000531	2.53	*< 0.00001*	4.07	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000531	0.0151	0.000187	0.00034	0.00061	*< 0.00006*
SS	L2062788-9	3/1/2018 14:20	0.00020	*< 0.001*	*< 0.000005*	23.3	0.00902	40.9	0.0165	0.00456	16.3	0.00384	*< 0.05*	0.0000056	0.0304	0.00418	49.4	0.000316	2.66	*< 0.00001*	4.25	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000521	0.0124	0.000195	0.00026	0.00092	*< 0.00006*
SS	L2068449-9	3/15/2018 12:25	0.00013	*< 0.001*	*< 0.000005*	22.3	0.00801	34.0	0.0213	0.00439	15.3	0.00358	*< 0.05*	*< 0.000005*	0.0313	0.00347	43.8	0.000237	2.71	*< 0.00001*	3.53	0.00026	*< 0.0001*	*< 0.0003*	0.0000489	0.0102	0.000154	0.00036	*< 0.0005*	*< 0.00006*
SS	L2074311-9	3/29/2018 12:15	0.00020	0.0029	*< 0.000005*	21.3	0.00832	33.6	0.0219	0.00519	13.5	0.00328	*< 0.05*	0.0000217	0.0274	0.00329	31.8	0.000057	2.48	*< 0.00001*	3.77	0.00021	*< 0.0001*	*< 0.0003*	0.0000436	0.0105	0.000230	0.00038	0.0023	*< 0.00006*
SS	L2079620-9	4/12/2018 11:30	0.00016	*< 0.001*	*< 0.000005*	19.4	0.00815	29.7	0.0264	0.00526	12.9	0.00332	*< 0.05*	*< 0.000015*	0.0281	0.00326	28.6	0.000093	2.55	*< 0.00001*	3.69	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000480	0.0105	0.000199	0.00039	*< 0.001*	*< 0.00006*
SS	L2085708-9	4/26/2018 14:00	0.00013	*< 0.001*	*< 0.000005*	18.9	0.00677	29.0	0.0323	0.00472	11.8	0.00303	*< 0.05*	*< 0.000005*	0.0263	0.00296	26.5	0.000283	2.61	*< 0.00001*	3.30	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000418	0.00895	0.000157	0.00040	*< 0.001*	*< 0.00006*
SS	L2092801-9	5/10/2018 11:15	0.00015	0.0016	*< 0.000005*	19.0	0.00858	28.7	0.0344	0.00474	11.2	0.00307	*< 0.05*	0.0000059	0.0267	0.00314	21.4	0.000128	2.66	*< 0.00001*	3.53	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000452	0.00844	0.000243	0.00041	*< 0.001*	*< 0.00006*
SS	L2100224-9	5/24/2018 14:00	0.00015	*< 0.001*	*< 0.000005*	20.1	0.00788	31.9	0.0420	0.00503	11.2	0.00355	*< 0.05*	0.0000066	0.0287	0.00310	20.0	0.000097	2.67	*< 0.00001*	3.69	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000420	0.00848	0.000209	0.00046	*< 0.001*	*< 0.00006*
SS	L2108434-9	6/7/2018 14:00	0.00023	0.0015		20.7	0.00842	32.0	0.0117	0.00486	12.0	0.00279	*< 0.05*	0.0000067	0.0280	0.00316	21.5	0.000072	3.19	*< 0.00001*	3.51	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000455	0.00839	0.000200	0.00035	0.0018	*< 0.00006*
SS	L2116986-9	6/21/2018 14:00	0.00020	*< 0.001*		19.7	0.00777	29.9	0.0121	0.00474	10.9	0.00256	*< 0.05*	0.0000065	0.0286	0.00318	19.0	0.000084	3.33	*< 0.00001*	3.45	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000436	0.00772	0.000186	0.00040	*< 0.001*	*< 0.00006*
SS	L2125321-9	7/6/2018 11:50	*< 0.0001*	*< 0.001*		18.1	0.00715	27.0	0.00878	0.00491	10.0	0.00232	*< 0.05*	*< 0.000005*	0.0254	0.00431	16.6	0.000086	4.30	*< 0.00001*	3.14	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000396	0.00747	0.000416	0.00043	*< 0.001*	*< 0.00006*
SS	L2132784-9	7/19/2018 15:15	0.00025	*< 0.001*		18.4	0.00749	27.2	0.00903	0.00511	10.0	0.00242	*< 0.05*	0.0000146	0.0261	0.00429	15.5	0.000075	4.38	*< 0.00001*	3.12	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000436	0.00839	0.000377	0.00042	0.0018	*< 0.00006*
SS	L2140795-9	8/2/2018 13:45	0.00021	0.0010		18.7	0.00763	26.4	0.0104	0.00546	10.2	0.00214	*< 0.05*	0.0000082	0.0258	0.00317	15.7	0.000079	4.28	*< 0.00001*	3.35	0.00021	*< 0.0001*	*< 0.0003*	0.0000377	0.00766	0.000291	0.00045	*< 0.001*	*< 0.00006*

Appendix A4: Schist Column (SO, SS, ST) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
SS	L2148482-9	8/16/2018	0.00018	*< 0.001*		18.6	0.00746	28.6	0.0126	0.00537	10.5	0.00243	*< 0.05*	0.0000051	0.0275	0.00349	13.0	0.000042	4.57	*< 0.00001*	3.51	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000422	0.00820	0.000320	0.00052	*< 0.001*	*< 0.00006*
SS	L2156461-9	8/30/2018 14:20	0.00023	*< 0.001*		18.5	0.00731	26.7	0.0132	0.00536	10.1	0.00204	*< 0.05*	*< 0.000005*	0.0261	0.00287	13.1	*< 0.00004*	4.37	*< 0.00001*	3.31	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000341	0.00783	0.000280	0.00051	*< 0.001*	*< 0.00006*
SS	L2164110-9	9/13/2018 11:45	0.00019	*< 0.001*		19.0	0.00725	26.5	0.0128	0.00520	10.5	0.00221	*< 0.05*	0.0000439	0.0272	0.00244	12.4	*< 0.00004*	4.25	*< 0.00001*	3.38	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000322	0.00733	0.000296	0.00044	*< 0.001*	*< 0.00006*
SS	L2172409-9	9/27/2018 14:00	0.00042	*< 0.001*		15.7	0.00672	25.2	0.0132	0.00503	9.31	0.00200	*< 0.05*	*< 0.000005*	0.0226	0.00218	12.5	*< 0.00004*	4.53	*< 0.00001*	3.01	0.00024	*< 0.0001*	*< 0.0003*	0.0000283	0.00671	0.000249	0.00047	*< 0.001*	*< 0.00006*
SS	L2180431-9	10/12/2018 14:10	0.00017	*< 0.001*		15.3	0.00664	24.1	0.00942	0.00526	8.69	0.00189	*< 0.05*	*< 0.000005*	0.0217	0.00247	12.3	*< 0.00004*	4.75	*< 0.00001*	3.02	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000297	0.00674	0.000290	0.00044	*< 0.001*	*< 0.00006*
SS	L2187510-9	10/25/2018 14:00	0.00016	*< 0.001*		15.2	0.00673	25.5	0.00848	0.00544	8.73	0.00202	*< 0.05*	*< 0.000005*	0.0224	0.00212	13.2	0.000061	4.30	*< 0.00001*	3.17	0.00033	*< 0.0001*	*< 0.0003*	0.0000304	0.00742	0.000306	0.00043	*< 0.001*	*< 0.00006*
SS	L2194529-9	11/8/2018 14:10	*< 0.0001*	*< 0.001*		15.3	0.00639	25.7	0.0114	0.00515	8.50	0.00207	*< 0.05*	*< 0.000005*	0.0226	0.00217	13.1	0.000040	4.66	*< 0.00001*	3.09	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000309	0.00737	0.000273	0.00043	*< 0.001*	*< 0.00006*
SS	L2200705-9	11/22/2018 11:55	0.00013	*< 0.001*		15.1	0.00641	24.7	0.0101	0.00535	8.41	0.00190	*< 0.05*	*< 0.000005*	0.0214	0.00192	12.6	0.000044	4.68	*< 0.00001*	3.01	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000291	0.00731	0.000327	0.00043	*< 0.001*	*< 0.00006*
SS	L2207335-9	12/6/2018 13:05	0.00014	*< 0.001*		14.9	0.00642	24.9	0.00924	0.00527	8.08	0.00190	*< 0.05*	*< 0.000005*	0.0206	0.00187	12.4	0.000058	4.53	*< 0.00001*	2.97	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000277	0.00709	0.000321	0.00043	*< 0.001*	*< 0.00006*
SS	L2213525-9	12/20/2018 14:45	*< 0.0001*	*< 0.001*		16.0	0.00642	23.7	0.0120	0.00557	9.01	0.00192	*< 0.05*	*< 0.000005*	0.0225	0.00207	13.2	*< 0.00004*	5.06	*< 0.00001*	3.12	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000303	0.00974	0.000316	0.00044	*< 0.001*	*< 0.00006*
SS	L2217203-9	1/5/2019 11:35	*< 0.0001*	*< 0.001*		15.7	0.00662	25.3	0.0111	0.00543	8.72	0.00200	*< 0.05*	*< 0.000005*	0.0230	0.00197	19.3	0.000054	3.97	*< 0.00001*	3.40	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000348	0.0121	0.000373	0.00031	*< 0.001*	*< 0.00006*
SS	L2222132-9	1/17/2019 11:45	0.00020	*< 0.001*		16.1	0.00655	31.7	0.0285	0.00460	9.80	0.00236	*< 0.05*	*< 0.000005*	0.0230	0.00179	48.7	0.000041	4.01	*< 0.00001*	3.85	0.00028	*< 0.0001*	*< 0.0003*	0.0000368	0.0204	0.000374	0.00023	*< 0.001*	*< 0.00006*
SS	L2227544-9	1/31/2019 10:30	0.00024	*< 0.002*		16.1	0.0068	38.6	0.0673	0.00379	11.4	0.00376	*< 0.1*	*< 0.00001*	0.0254	0.00148	93.2	*< 0.00008*	3.90	*< 0.00002*	5.16	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000381	0.0272	0.00030	*< 0.0002*	*< 0.002*	*< 0.00012*
SS	L2233141-9	2/14/2019 14:20	*< 0.0002*	*< 0.002*		21.1	0.0082	54.2	0.173	0.00270	13.1	0.00500	*< 0.1*	*< 0.00001*	0.0290	0.00131	148	*< 0.00008*	4.21	*< 0.00002*	6.45	0.00061	*< 0.0002*	*< 0.0006*	0.0000486	0.0302	0.00029	*< 0.0002*	*< 0.002*	*< 0.00012*
SS	L2238565-9	2/28/2019 15:15	0.00025	*< 0.002*		20.6	0.0080	62.5	0.276	0.00210	12.5	0.00525	*< 0.1*	*< 0.00001*	0.0305	0.00115	198	*< 0.00008*	4.32	*< 0.00002*	8.02	0.00069	*< 0.0002*	*< 0.0006*	0.0000468	0.0276	0.00026	*< 0.0002*	*< 0.002*	*< 0.00012*
SS	L2244540-9	3/14/2019 14:30	0.00025	*< 0.002*		22.8	0.0094	65.4	0.388	0.00178	12.4	0.00490	*< 0.1*	*< 0.00001*	0.0338	0.00118	232	*< 0.00008*	4.48	*< 0.00002*	8.98	0.00042	*< 0.0002*	*< 0.0006*	0.0000551	0.0230	0.00033	*< 0.0002*	*< 0.002*	*< 0.00012*
SS	L2250817-9	3/28/2019 15:00	*< 0.0005*	*< 0.005*		24.1	0.0099	80.5	0.408	0.00148	14.3	0.00514	*< 0.25*	*< 0.000025*	0.0372	0.00087	268	*< 0.0002*	4.37	*< 0.00005*	9.45	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000043	0.0205	0.00032	*< 0.0005*	*< 0.005*	*< 0.0003*
SS	L2257457-9	4/11/2019 15:00	*< 0.0005*	*< 0.005*		22.9	0.0098	81.0	0.426	0.00172	12.3	0.00489	*< 0.25*	*< 0.000025*	0.0372	0.00104	284	*< 0.0002*	4.47	*< 0.00005*	9.93	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000055	0.0179	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
SS	L2263301-9	4/25/2019 14:45	*< 0.0005*	*< 0.005*		24.2	0.0107	87.9	0.575	0.00161	13.5	0.00429	*< 0.25*	*< 0.000025*	0.0386	0.00102	305	*< 0.0002*	4.76	*< 0.00005*	10.9	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000057	0.0167	0.00038	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2000226-6	9/29/2017 10:50	0.00041	*< 0.001*	*< 0.000005*	16.2	0.00892	19.6	0.000159	0.0138	23.1	0.000298	*< 0.05*	0.0000051	0.00161	0.00179	54.8	0.000405	5.15	0.000032	3.90	0.00025	*< 0.0001*	*< 0.0003*	0.0000136	0.0241	0.00135	0.00040	*< 0.00075*	*< 0.00006*
ST	L2014692-6	10/27/2017	0.00040	*< 0.001*	*< 0.000005*	19.8	0.0121	23.7	0.0114	0.0195	25.9	0.000537	*< 0.05*	0.0000124	0.00203	0.00194	66.6	0.00110	6.57	0.000019	4.95	0.00027	*< 0.0001*	*< 0.0003*	0.0000233	0.0347	0.00122	0.00045	0.00051	*< 0.00006*
ST	L2021295-6	11/10/2017 13:30	0.00029	*< 0.001*	*< 0.000005*	18.6	0.0112	21.7	0.00165	0.0174	24.6	0.000392	*< 0.05*	*< 0.000005*	0.00192	0.00142	51.6	0.00137	5.66	*< 0.00001*	4.29	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000175	0.0259	0.00121	0.00037	*< 0.0005*	*< 0.00006*
ST	L2026623-10	11/23/2017 14:40	0.00026	*< 0.002*	*< 0.000005*	16.5	0.0105	18.8	0.00064	0.0213	21.3	0.00050	*< 0.1*	*< 0.00001*	0.00170	0.00142	46.8	0.000405	5.73	*< 0.00002*	4.26	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000184	0.0285	0.00122	0.00052	*< 0.001*	*< 0.00012*
ST	L2031965-9	12/6/2017 14:05	0.00030	*< 0.001*	*< 0.000005*	17.0	0.00873	18.7	0.000889	0.0196	21.0	0.000317	*< 0.05*	0.0000147	0.00202	0.00150	45.9	0.00215	5.68	0.000011	4.27	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000225	0.0241	0.00132	0.00043	*< 0.0005*	*< 0.00006*
ST	L2038563-10	12/21/2017 13:10	0.00030	*< 0.001*	*< 0.000005*	16.4	0.00796	18.0	0.00208	0.0212	20.4	0.000344	*< 0.05*	0.0000086	0.00190	0.00130	43.9	0.000511	5.59	*< 0.00001*	4.09	0.00024	*< 0.0001*	*< 0.0003*	0.0000207	0.0223	0.00117	0.00038	0.00065	*< 0.00006*
ST	L2042065-1	1/5/2018 11:50	0.00015	0.0018	*< 0.000005*	13.2	0.00729	13.4	0.00125	0.0160	15.9	0.000483	*< 0.05*	*< 0.000005*	0.00149	0.00101	28.1	0.00216	4.29	*< 0.00001*	3.14	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000227	0.0175	0.00103	0.00024	*< 0.0005*	*< 0.00006*
ST	L2046871-10	1/18/2018 12:10	0.00028	0.0016	*< 0.000005*	15.7	0.00911	17.4	0.00164	0.0222	19.1	0.000402	*< 0.05*	*< 0.000005*	0.00206	0.00129	35.3	0.00281	5.72	*< 0.00001*	3.94	0.00023	*< 0.0001*	*< 0.0003*	0.0000222	0.0223	0.00118	0.00042	0.0137	*< 0.00006*
ST	L2052061-10	2/1/2018 12:35	0.00022	*< 0.001*	*< 0.000005*	17.3	0.00820	15.9	0.00489	0.0195	18.8	0.000435	*< 0.05*	*< 0.000005*	0.00198	0.00115	33.8	0.00274	5.70	*< 0.00001*	3.95	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000201	0.0220	0.00110	0.00044	*< 0.0005*	*< 0.00006*
ST	L2057381-10	2/15/2018 11:35	0.00066	*< 0.001*	*< 0.000005*	15.3	0.00886	15.3	0.00561	0.0205	16.1	0.000394	*< 0.05*	0.0000081	0.00169	0.00104	32.0	0.00171	5.49	*< 0.00001*	3.78	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000229	0.0234	0.000844	0.00044	0.00050	*< 0.00006*
ST	L2062788-10	3/1/2018 14:20	0.00022	*< 0.001*	*< 0.000005*	15.9	0.00913	16.8	0.00497	0.0196	17.3	0.000381	*< 0.05*	*< 0.000005*	0.00182	0.000979	31.9	0.000890	5.61	*< 0.00001*	4.09	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000203	0.0190	0.000836	0.00039	*< 0.0005*	*< 0.00006*
ST	L2068449-10	3/15/2018 12:25	0.00015	*< 0.001*	*< 0.000005*	15.5	0.00790	15.0	0.0151	0.0196	16.8	0.000403	*< 0.05*	*< 0.000005*	0.00202	0.000886	30.6	0.000906	5.69	*< 0.00001*	3.47	0.00024	*< 0.0001*	*< 0.0003*	0.0000191	0.0176	0.000844	0.00043	*< 0.0005*	*< 0.00006*
ST	L2074311-10	3/29/2018 12:15	0.00021	*< 0.001*	*< 0.000005*	14.9	0.00846	14.8	0.0106	0.0222	15.1	0.000403	*< 0.05*	*< 0.000005*	0.00180	0.000826	25.2	0.000349	5.29	*< 0.00001*	3.72	0.00021	*< 0.0001*	*< 0.0003*	0.0000198	0.0196	0.000832	0.00043	*< 0.001*	*< 0.00006*
ST	L2079620-10	4/12/2018 11:30	0.00016	*< 0.001*	*< 0.000005*	13.2	0.00749	12.9	0.0192	0.0223	14.1	0.000358	*< 0.05*	*< 0.000015*	0.00180	0.000796	23.9	0.000290	5.22	0.000011	3.28	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000217	0.0201	0.000742	0.00046	*< 0.001*	*< 0.00006*
ST	L2085708-10	4/26/2018 14:00	0.00015	*< 0.001*	*< 0.000005*	13.8	0.00683	13.3	0.0108	0.0209	13.8	0.000289	*< 0.05*	*< 0.000005*	0.00176	0.000700	23.1	0.000703	5.41	*< 0.00001*	3.29	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000202	0.0176	0.000767	0.00038	*< 0.001*	*< 0.00006*
ST	L2092801-10	5/10/2018 11:15	0.00016	*< 0.001*	*< 0.000005*	14.7	0.00845	13.5	0.0130	0.0219	14.1	0.000271	*< 0.05*	0.0000050	0.00199	0.000784	18.6	0.000283	5.37	*< 0.00001*	3.60	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000213	0.0184	0.000887	0.00040	*< 0.001*	*< 0.00006*
ST	L2100224-10	5/24/2018 14:00	0.00026	*< 0.001*	*< 0.000005*	14.4	0.00729	14.0	0.0194	0.0227	13.7	0.000229	*< 0.05*	*< 0.000005*	0.00204	0.000737	19.8	0.000295	5.55	*< 0.00001*	3.44	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000198	0.0177	0.000827	0.00040	*< 0.001*	*< 0.00006*
ST	L2108434-10	6/7/2018 14:00	0.00018	0.0039		14.8	0.00801	14.0	0.000888	0.0235	14.5	0.000267	*< 0.05*	0.0000116	0.00207	0.00183	20.7	0.000233	7.04	*< 0.00001*	3.59	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000209	0.0195	0.00134	0.00047	0.0090	*< 0.00006*
ST	L2116986-10	6/21/2018 14:00	0.00019	0.0014		15.3	0.00761	14.0	0.000836	0.0236	14.0	0.000235	*< 0.05*	0.0000074	0.00220	0.00237	18.2	0.000292	7.08	*< 0.00001*	3.56	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000215	0.0196	0.00264	0.00049	*< 0.001*	*< 0.00006*
ST	L2125321-10	7/6/2018 11:50	0.00012	0.0010		13.9	0.00706	12.8	0.00237	0.0269	12.8	0.000226	*< 0.05*	*< 0.000005*	0.00197	0.00272	17.3	0.000330	7.67	*< 0.00001*	3.36	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000197	0.0187	0.00314	0.00057	0.0020	*< 0.00006*
ST	L2132784-10	7/19/2018 15:15	0.00022	0.0014		14.7	0.00752	13.6	0.00144	0.0283	13.3	0.000224	*< 0.05*	*< 0.000005*	0.00216	0.00284	16.7	0.000371	7.78	*< 0.00001*	3.42	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000184	0.0206	0.00298	0.00063	*< 0.001*	*< 0.00006*
ST	L2140795-10	8/2/2018 13:45	0.00026	0.0017		15.3	0.00780	13.0	0.000619	0.0295	13.4	0.000177	*< 0.05*	*< 0.000005*	0.00236	0.00304	16.7	0.000444	7.56	*< 0.00001*	3.65	0.00023	*< 0.0001*	*< 0.0003*	0.0000192	0.0198	0.00363	0.00080	*< 0.001*	*< 0.00006*
ST	L2148482-10	8/16/2018	0.00023	0.0014		14.5	0.00737	13.6	0.000521	0.0305	13.1	0.000196	*< 0.05*	*< 0.000005*	0.00244	0.00317	14.8	0.000321	7.93	*< 0.00001*	3.75	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000209	0.0205	0.00378	0.00084	*< 0.001*	*< 0.00006*
ST	L2156461-10	8/30/2018 14:20	0.00029	*< 0.001*		14.9	0.00722	12.8	0.000824	0.0289	12.9	*< 0.00005*	*< 0.05*	*< 0.000015*	0.00245	0.00355	13.9	0.000403	8.38	0.000014	3.52	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000299	0.0200	0.00383	0.00091	*< 0.001*	*< 0.00006*
ST	L2164110-10	9/13/2018 11:45	0.00023	*< 0.002*		13.5	0.0070	12.4	0.00048	0.0285	12.0	0.00016	*< 0.1*	*< 0.00001*	0.00222	0.00313	14.1	0.000308	7.99	*< 0.00002*	3.29	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000164	0.0186	0.00392	0.00098	*< 0.002*	*< 0.00012*
ST	L2172409-10	9/27/2018 14:00	0.00030	*< 0.002*		12.4	0.0064	11.2	0.00065	0.0270	11.5	0.00017	*< 0.1*	*< 0.00001*	0.00189	0.00361	12.3	0.000354	8.40	*< 0.00002*	3.06	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000126	0.0166	0.00397	0.00095	*< 0.002*	*< 0.00012*
ST	L2180431-10	10/12/2018 14:10	0.00025	*< 0.002*		12.5	0.0063	11.6	0.00035	0.0292	10.8	0.00015	*< 0.1*	*< 0.00001*	0.00216	0.00368	12.9	0.000351	8.51	*< 0.00002*	3.18	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000100	0.0172	0.00454	0.00098	*< 0.002*	*< 0.00012*
ST	L2187510-10	10/25/2018 14:00	0.00028	*< 0.001*		12.3	0.00645	11.7	0.000174	0.0307	11.0	0.000165	*< 0.05*	*< 0.000005*	0.00207	0.00315	13.7	0.000360	8.25	*< 0.00001*	3.30	0.00022	*< 0.0001*	*< 0.0003*	0.0000087	0.0194	0.00455	0.00102	*< 0.001*	*< 0.00006*
ST	L2194529-10	11/8/2018 14:10	0.00024	*< 0.001*		13.1	0.00659	12.1	0.000343	0.0278	11.4	0.000191	*< 0.05*	*< 0.000005*	0.00211	0.00347	13.6	0.000362	8.98	*< 0.00001*	3.20	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000097	0.0195	0.00464	0.00097	*< 0.001*	*< 0.00006*
ST	L2200705-10	11/22/2018 11:55	0.00031	*< 0.001*		12.0	0.00625	11.5	0.00108	0.0268	10.2	0.000190	*< 0.05*	*< 0.000005*	0.00206	0.00331	12.9	0.000527	8.94	*< 0.00001*	3.05	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000087	0.0186	0.00509	0.00099	*< 0.001*	*< 0.00006*
ST	L2207335-10	12/6/2018 13:05	0.00036	*< 0.002*		12.1	0.0060	11.9	0.00027	0.0277	9.83	0.00014	*< 0.1*	*< 0.00001*	0.00204	0.00339	12.3	0.000384	8.63	*< 0.00002*	3.10	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000050	0.0172	0.00541	0.00105	*< 0.002*	*< 0.00012*
ST	L2213525-10	12/20/2018 14:45	0.00026	*< 0.002*		12.0	0.0060	10.5	0.00048	0.0279	10.6	0.00019	*< 0.1*	*< 0.00001*	0.00208	0.00388	11.6	0.000301	9.29	*< 0.00002*	3.07	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000075	0.0181	0.00534	0.00109	*< 0.002*	*< 0.00012*
ST	L2217203-10	1/5/2019 11:35	0.00034	*< 0.002*		12.1	0.0062	11.3	0.00032	0.0269	10.4	0.00024	*< 0.1*	*< 0.00001*	0.00230	0.00323	15.2	0.000331	8.57	*< 0.00002*	3.28	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000052	0.0189	0.00534	0.00106	*< 0.002*	*< 0.00012*
ST	L2222132-10	1/17/2019 11:45	0.00034	*< 0.001*		14.1	0.00696	16.2	0.00414	0.0238	11.6	0.000193	*< 0.05*	*< 0.000005*	0.00263	0.00282	39.9	0.000369	8.20	*< 0.00001*	4.64	0.00036	*< 0.0001*	*< 0.0003*	0.0000065	0.0195	0.00470	0.00082	*< 0.001*	*< 0.00006*
ST	L2227544-10	1/31/2019 10:30	0.00026	*< 0.002*		16.6	0.0086	27.9	0.0338	0.0176	14.2	0.00022	*< 0.1*	*< 0.00001*	0.00401	0.00181	99.1	0.000253	7.91	*< 0.00002*	8.67	0.00048	*< 0.0002*	*< 0.0006*	0.0000176	0.0258	0.00287	*< 0.0002*	*< 0.002*	*< 0.00012*
ST	L2233141-10	2/14/2019 14:20	*< 0.0002*	0.0049		21.9	0.0116	43.9	0.235	0.0125	15.6	0.00036	*< 0.1*	*< 0.00001*	0.00540	0.00127	171	0.000194	8.85	*< 0.00002*	12.5	0.00127	*< 0.0002*	*< 0.0006*	0.0000315	0.0378	0.00190	*< 0.0002*	*< 0.002*	*< 0.00012*
ST	L2238565-10	2/28/2019 15:15	*< 0.0005*	0.0091		21.9	0.0111	49.1	0.535	0.00735	14.2	0.00071	*< 0.25*	*< 0.000025*	0.0064	0.00081	204	*< 0.0002*	8.07	*< 0.00005*	15.3	0.0012	*< 0.0005*	*< 0.0015*	0.000052	0.0362	0.00089	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2244540-10	3/14/2019 14:30	*< 0.0005*	0.0136		25.5	0.0121	47.7	0.803	0.00541	13.6	0.00096	*< 0.25*	*< 0.000025*	0.0078	0.00066	241	0.00020	7.91	*< 0.00005*	17.1	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000053	0.0360	0.00074	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2250817-10	3/28/2019 15:00	*< 0.0005*	0.0089		24.7	0.0130	56.1	0.845	0.00447	15.2	0.00073	*< 0.25*	*< 0.000025*	0.0091	0.00044	274	0.00027	8.31	*< 0.00005*	17.8	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000044	0.0384	0.00049	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2257457-10	4/11/2019 15:00	*< 0.0005*	0.0140		24.3	0.0131	55.7	0.803	0.00394	13.9	0.00103	*< 0.25*	*< 0.000025*	0.0097	0.00058	282	*< 0.0002*	8.43	*< 0.00005*	19.0	0.0013	*< 0.0005*	*< 0.0015*	0.000050	0.0420	0.00041	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2263301-10	4/25/2019 14:45	*< 0.0005*	0.0124		25.2	0.0129	59.2	0.745	0.00335	14.5	0.00061	*< 0.25*	*< 0.000025*	0.0106	0.00048	294	*< 0.0002*	8.34	*< 0.00005*	19.2	0.0015	*< 0.0005*	*< 0.0015*	0.000054	0.0404	0.00049	*< 0.0005*	*< 0.005*	*< 0.0003*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B: Quality Assurance and Quality Control

GOLDCORP

APPENDIX B1: METHOD BLANK EFFLUENT RESULTS

Appendix B1: Method Blank Effluent Results

			pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**D-S**	**D-Sulphide**	**SO4**	**D-Br**	**D-Cl**
COL100	L1955324-1	7/7/2017 13:00	6.16	4.85	10	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0115	*< 0.5*	*< 0.0015*	0.44	*< 0.05*	*< 0.5*
COL100	L1969886-1	8/3/2017 13:50	6.18	5.01	37	*< 0.5*	0.0074	*< 0.001*	*< 0.005*	0.0119	*< 0.5*	*< 0.0015*	0.41	*< 0.05*	*< 0.5*
COL100	L1984768-1	8/31/2017 14:00	6.15	4.61	56	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0119	*< 0.5*	*< 0.0015*	0.43	*< 0.05*	*< 0.5*
COL100	L2000225-1	9/29/2017 10:50	6.11	4.67	44	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0127	*< 0.5*	*< 0.0015*	0.42	*< 0.05*	*< 0.5*
COL100	L2014332-1	10/26/2017 11:50	6.07	5.39	10	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0119	*< 0.5*	*< 0.0015*	0.43	*< 0.05*	*< 0.5*
COL100	L2027123-1	11/24/2017 14:35	6.2	5.35	10	0.66	*< 0.005*	*< 0.001*	*< 0.005*	0.0105	*< 0.5*	*< 0.0015*	0.48	*< 0.05*	*< 0.5*
COL100	L2038562-1	12/21/2017 13:50	6.03	4.47	9	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0115	*< 0.5*	*< 0.0015*	0.50	*< 0.05*	*< 0.5*
COL100	L2046870-1	1/18/2018 11:25	6.05	4.32	12	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0097	*< 0.5*	*< 0.0015*	0.53	*< 0.05*	*< 0.5*
COL100	L2057384-1	2/15/2018 11:35	5.97	4.3	10	0.81	*< 0.005*	*< 0.001*	*< 0.005*	0.0105	*< 0.5*	*< 0.0015*	0.51	*< 0.05*	*< 0.5*
COL100	L2068450-1	3/15/2018 11:40	5.99	4.07	10	*< 0.5*	0.0091	*< 0.001*	*< 0.005*	0.0119	*< 0.5*	*< 0.0015*	0.46	*< 0.05*	*< 0.5*
COL100	L2079621-1	4/12/2018 11:00	5.85	3.74	10	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0107	*< 0.5*	*< 0.0015*	0.45	*< 0.05*	*< 0.5*
COL100	L2092802-1	5/10/2018 11:15	5.9	3.13	13	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0079	*< 0.5*	*< 0.0015*	0.40	*< 0.05*	*< 0.5*
COL100	L2109214-1	6/8/2018 12:30	5.83	3.24	14	0.57	*< 0.005*	*< 0.001*	*< 0.005*	0.0097	*< 0.5*	*< 0.0015*	0.38	*< 0.05*	*< 0.5*
COL100	L2125319-1	7/6/2018 11:30	5.78	3.45	19	1.01	*< 0.005*	*< 0.001*	*< 0.005*	0.0110	*< 0.5*	*< 0.0015*	0.38	*< 0.05*	*< 0.5*
COL100	L2140796-1	8/2/2018 13:30	5.85	3.10	13	0.71	*< 0.005*	0.0011	*< 0.005*	0.0097	*< 0.5*	*< 0.0015*	0.35	*< 0.05*	*< 0.5*
COL100	L2156463-1	8/30/2018 14:20	5.73	3.11	7	0.54	*< 0.005*	*< 0.001*	*< 0.005*	0.0108	*< 0.5*	*< 0.0015*	0.30	*< 0.05*	*< 0.5*
COL100	L2171505-1	9/26/2018 15:20	5.77	3.73	6	*< 1*	*< 0.005*	*< 0.001*	*< 0.005*	0.0082	*< 0.5*	*< 0.0015*	0.32	*< 0.05*	*< 0.5*
COL100	L2186829-1	10/24/2018 13:40	5.82	3.23	7	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0086	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2200706-1	11/22/2018 10:45	5.7	3.81	5	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0095	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2213526-1	12/20/2018 14:45	5.86	2.78	6	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0107	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2222133-1	1/17/2019 11:45	5.73	2.89	7	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0093	*< 0.5*	*< 0.0067*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2233140-1	2/14/2019 14:20	5.79	2.69	5	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0071	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2244815-1	3/14/2019 14:30	5.7	2.58	5	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0079	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2257455-1	4/11/2019 15:00	5.6	2.9	6	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0084	*< 0.5*	*< 0.01*	*< 0.3*	*< 0.05*	*< 0.5*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B1: Method Blank Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
COL100	L1955324-1	7/7/2017 13:00	0.025	*< 0.000005*	0.00494	*< 0.00002*	*< 0.01*	0.576	*< 0.00001*	*< 0.000005*	0.330	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L1969886-1	8/3/2017 13:50	0.024	*< 0.000005*	0.00474	*< 0.00002*	*< 0.01*	0.550	*< 0.00001*	*< 0.000005*	0.334	*< 0.000005*	0.0000060	*< 0.0001*	*< 0.00001*
COL100	L1984768-1	8/31/2017 14:00	0.022	*< 0.000005*	0.00444	0.000216	*< 0.01*	0.590	*< 0.00001*	*< 0.000005*	0.301	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2000225-1	9/29/2017 10:50	0.031	*< 0.000005*	0.00502	*< 0.00002*	*< 0.01*	0.573	*< 0.00001*	*< 0.000005*	0.280	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2014332-1	10/26/2017 11:50	0.022	*< 0.000005*	0.00595	*< 0.00002*	*< 0.01*	0.577	*< 0.00001*	*< 0.000005*	0.266	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2027123-1	11/24/2017 14:35	0.052	*< 0.000005*	0.00424	*< 0.00002*	*< 0.01*	0.735	*< 0.00001*	0.0000062	0.382	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2038562-1	12/21/2017 13:50	0.024	*< 0.000005*	0.00545	*< 0.00002*	*< 0.01*	0.639	*< 0.00001*	*< 0.000005*	0.284	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2046870-1	1/18/2018 11:25	0.021	*< 0.000005*	0.00492	*< 0.00002*	*< 0.01*	0.755	*< 0.00001*	*< 0.000005*	0.238	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2057384-1	2/15/2018 11:35	*< 0.02*	*< 0.000005*	0.00479	*< 0.00002*	*< 0.01*	0.650	*< 0.00001*	*< 0.000005*	0.214	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2068450-1	3/15/2018 11:40	*< 0.02*	*< 0.000005*	0.00574	*< 0.00002*	*< 0.01*	0.647	*< 0.00001*	*< 0.000005*	0.178	*< 0.000005*	0.0000109	*< 0.0001*	*< 0.00001*
COL100	L2079621-1	4/12/2018 11:00	*< 0.02*	*< 0.000005*	0.00561	*< 0.00002*	*< 0.01*	0.552	*< 0.00001*	*< 0.000005*	0.175	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2092802-1	5/10/2018 11:15	*< 0.02*	*< 0.000005*	0.00783	0.000024	*< 0.01*	0.557	*< 0.00001*	*< 0.000005*	0.139	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2109214-1	6/8/2018 12:30	*< 0.02*	*< 0.000005*	0.00615	*< 0.00002*	*< 0.01*	0.534	*< 0.00001*	0.0000062	0.134	*< 0.000005*	0.0000056	*< 0.0001*	*< 0.00001*
COL100	L2125319-1	7/6/2018 11:30	*< 0.02*	*< 0.000005*	0.00405	*< 0.00002*	*< 0.01*	0.479	*< 0.00001*	*< 0.000005*	0.146	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2140796-1	8/2/2018 13:30	*< 0.02*	*< 0.000005*	0.00342	0.000028	*< 0.01*	0.401	*< 0.00001*	*< 0.000005*	0.163	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2156463-1	8/30/2018 14:20	*< 0.02*	*< 0.000005*	0.00402	*< 0.00002*	*< 0.01*	0.403	*< 0.00001*	*< 0.000005*	0.120	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2171505-1	9/26/2018 15:20	*< 0.02*	*< 0.000005*	0.00191	0.000040	*< 0.01*	0.372	*< 0.00001*	*< 0.000005*	0.114	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2186829-1	10/24/2018 13:40	*< 0.02*	*< 0.000005*	0.00224	*< 0.00002*	*< 0.01*	0.317	*< 0.00001*	*< 0.000005*	0.107	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2200706-1	11/22/2018 10:45	*< 0.02*	*< 0.000005*	0.00219	*< 0.00002*	*< 0.01*	0.370	*< 0.00001*	*< 0.000005*	0.102	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2213526-1	12/20/2018 14:45	*< 0.02*	*< 0.000005*	0.00216	*< 0.00002*	*< 0.01*	0.296	*< 0.00001*	*< 0.000005*	0.096	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2222133-1	1/17/2019 11:45	*< 0.02*	*< 0.000005*	0.00276	*< 0.00002*	*< 0.01*	0.276	*< 0.00001*	*< 0.000005*	0.087	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2233140-1	2/14/2019 14:20	*< 0.02*	*< 0.000005*	0.00217	0.000020	*< 0.01*	0.245	*< 0.00001*	*< 0.000005*	0.084	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2244815-1	3/14/2019 14:30	*< 0.02*	*< 0.000005*	0.00166	*< 0.00002*	*< 0.01*	0.236	*< 0.00001*	*< 0.000005*	0.077	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2257455-1	4/11/2019 15:00	*< 0.02*	*< 0.000005*	0.00218	*< 0.00002*	*< 0.01*	0.228	*< 0.00001*	*< 0.000005*	0.075	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B1: Method Blank Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**
COL100	L1955324-1	7/7/2017 13:00	0.00023	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.167	0.000068	*< 0.00005*	0.064	*< 0.00005*	*< 0.05*	0.0000544	*< 0.0002*	*< 0.00002*
COL100	L1969886-1	8/3/2017 13:50	0.00024	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.167	0.000055	*< 0.00005*	0.077	*< 0.00005*	*< 0.05*	0.0000064	*< 0.0002*	*< 0.00002*
COL100	L1984768-1	8/31/2017 14:00	0.00021	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.160	0.000489	*< 0.00005*	0.067	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2000225-1	9/29/2017 10:50	0.00020	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.148	*< 0.00005*	*< 0.00005*	0.067	*< 0.00005*	*< 0.05*	0.0000097	*< 0.0002*	*< 0.00002*
COL100	L2014332-1	10/26/2017 11:50	0.00022	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.135	*< 0.00005*	*< 0.00005*	0.058	0.000158	*< 0.05*	0.0000209	*< 0.0002*	*< 0.00002*
COL100	L2027123-1	11/24/2017 14:35	0.00011	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.238	0.00168	*< 0.00005*	0.091	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2038562-1	12/21/2017 13:50	0.00017	0.0049	*< 0.000005*	*< 0.05*	*< 0.0005*	0.152	0.000099	*< 0.00005*	0.149	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2046870-1	1/18/2018 11:25	*< 0.0001*	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.142	*< 0.00005*	*< 0.00005*	0.048	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2057384-1	2/15/2018 11:35	*< 0.0001*	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.133	*< 0.00005*	*< 0.00005*	0.062	*< 0.00005*	*< 0.05*	0.0000075	*< 0.0002*	*< 0.00002*
COL100	L2068450-1	3/15/2018 11:40	*< 0.0001*	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.117	0.000067	*< 0.00005*	0.043	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2079621-1	4/12/2018 11:00	0.00012	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.105	0.000068	*< 0.00005*	0.040	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2092802-1	5/10/2018 11:15	0.00015	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0876	0.000088	*< 0.00005*	0.037	*< 0.00005*	*< 0.05*	0.0000095	*< 0.0002*	0.000025
COL100	L2109214-1	6/8/2018 12:30	0.00024	0.0047	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0836	0.000120	*< 0.00005*	0.176	0.000054	*< 0.05*	0.0000145	*< 0.0002*	*< 0.00002*
COL100	L2125319-1	7/6/2018 11:30	0.00019	0.0013	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0898	*< 0.00005*	*< 0.00005*	0.131	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2140796-1	8/2/2018 13:30	0.00024	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.100	0.000078	*< 0.00005*	0.039	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2156463-1	8/30/2018 14:20	0.00025	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0865	0.000061	*< 0.00005*	0.073	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2171505-1	9/26/2018 15:20	0.00038	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0722	0.000086	*< 0.00005*	0.029	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2186829-1	10/24/2018 13:40	0.00022	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0702	0.000074	*< 0.00005*	0.028	*< 0.00005*	*< 0.05*	0.0000059	*< 0.0002*	*< 0.00002*
COL100	L2200706-1	11/22/2018 10:45	0.00023	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0705	0.000083	*< 0.00005*	0.030	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2213526-1	12/20/2018 14:45	0.00024	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0646	0.000062	*< 0.00005*	0.026	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2222133-1	1/17/2019 11:45	0.00025	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0592	0.000077	*< 0.00005*	0.021	*< 0.00005*	*< 0.05*	0.0000057	*< 0.0002*	*< 0.00002*
COL100	L2233140-1	2/14/2019 14:20	0.00022	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0556	0.000083	*< 0.00005*	0.029	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2244815-1	3/14/2019 14:30	0.00026	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0511	0.000089	*< 0.00005*	0.035	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2257455-1	4/11/2019 15:00	0.00027	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0568	*< 0.00005*	*< 0.00005*	0.030	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B1: Method Blank Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
COL100	L1955324-1	7/7/2017 13:00	*< 0.00004*	0.085	0.000012	0.00624	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00139	*< 0.00006*
COL100	L1969886-1	8/3/2017 13:50	*< 0.00004*	0.116	0.000014	0.00677	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	0.0000241	*< 0.00005*	*< 0.0001*	0.00127	*< 0.00006*
COL100	L1984768-1	8/31/2017 14:00	*< 0.00004*	0.092	*< 0.00001*	0.00643	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	0.0000027	*< 0.00005*	*< 0.0001*	0.00125	*< 0.00006*
COL100	L2000225-1	9/29/2017 10:50	*< 0.00004*	0.099	0.000011	0.00658	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0015*	*< 0.00006*
COL100	L2014332-1	10/26/2017 11:50	*< 0.00004*	0.088	0.000019	0.00603	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00105	*< 0.00006*
COL100	L2027123-1	11/24/2017 14:35	*< 0.00004*	0.109	0.000010	0.00746	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	0.0000021	*< 0.00005*	*< 0.0001*	0.00187	*< 0.00006*
COL100	L2038562-1	12/21/2017 13:50	*< 0.00004*	0.104	0.000010	0.00768	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00151	*< 0.00006*
COL100	L2046870-1	1/18/2018 11:25	*< 0.00004*	0.090	*< 0.00001*	0.00842	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00130	*< 0.00006*
COL100	L2057384-1	2/15/2018 11:35	*< 0.00004*	0.101	0.000012	0.00753	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00129	*< 0.00006*
COL100	L2068450-1	3/15/2018 11:40	*< 0.00004*	0.098	*< 0.00001*	0.00709	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00093	*< 0.00006*
COL100	L2079621-1	4/12/2018 11:00	*< 0.00004*	0.092	*< 0.00001*	0.00645	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0011	*< 0.00006*
COL100	L2092802-1	5/10/2018 11:15	*< 0.00004*	0.080	0.000011	0.00641	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	0.000097	*< 0.0001*	*< 0.001*	0.000323
COL100	L2109214-1	6/8/2018 12:30	*< 0.00004*	0.083	*< 0.00001*	0.00582	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0053	*< 0.00006*
COL100	L2125319-1	7/6/2018 11:30	*< 0.00004*	0.097	*< 0.00001*	0.00562	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2140796-1	8/2/2018 13:30	0.000088	0.093	0.000011	0.00504	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0012	*< 0.00006*
COL100	L2156463-1	8/30/2018 14:20	*< 0.00004*	0.098	0.000010	0.00447	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2171505-1	9/26/2018 15:20	*< 0.00004*	0.101	0.000010	0.00404	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2186829-1	10/24/2018 13:40	*< 0.00004*	0.093	*< 0.00001*	0.00391	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2200706-1	11/22/2018 10:45	*< 0.00004*	0.099	*< 0.00001*	0.00367	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2213526-1	12/20/2018 14:45	*< 0.00004*	0.104	*< 0.00001*	0.00348	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2222133-1	1/17/2019 11:45	*< 0.00004*	0.095	0.000010	0.00310	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2233140-1	2/14/2019 14:20	*< 0.00004*	0.099	*< 0.00001*	0.00272	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2244815-1	3/14/2019 14:30	*< 0.00004*	0.087	*< 0.00001*	0.00254	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2257455-1	4/11/2019 15:00	*< 0.00004*	0.097	*< 0.00001*	0.00260	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX B2: BOTTLE BLANK RESULTS

Appendix B2: Bottle Blank Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**NO2-N**	**NO3-N**	**D-S**	**SO4**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**	**D-Cu**	**D-Fe**	**D-K**	**D-Li**
Bottle-BL	L1955323-5	7/7/2017 13:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1961404-11	7/19/2017 10:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1966755-5	7/28/2017 12:25	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L1969885-5	8/3/2017 13:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	0.000028	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1973928-5	8/11/2017 13:40	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L1977047-11	8/17/2017 12:25	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1981592-5	8/25/2017 10:50	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L1984769-5	8/31/2017 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1988664-5	9/8/2017 14:50	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L1992088-11	9/14/2017 14:55	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1996212-5	9/22/2017 14:20	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L2000226-7	9/29/2017 10:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.00075*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2003949-5	10/6/2017 11:25	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L2006427-11	10/12/2017 12:25	*< 0.001*	0.0062	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2009523-4	10/18/2017 14:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2014692-7	10/27/2017	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L2018104-2	11/3/2017 13:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	0.000024	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2021295-7	11/10/2017 13:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2023647-3	11/16/2017 15:30	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L2026623-11	11/23/2017 14:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00067	*< 0.00002*	*< 0.01*	0.000024	*< 0.00001*	*< 0.000005*	0.038	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2032658-6	12/7/2017 11:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2038563-11	12/21/2017 13:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	0.00051
Bottle-BL	L2041649-10	1/4/2018 13:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00006*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2044152-2	1/11/2018 10:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.03*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	0.0120	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2046871-11	1/18/2018 11:25	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2049910-2	1/26/2018 9:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2052061-12	2/1/2018 12:10	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2057381-11	2/15/2018 11:35	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2062788-11	3/1/2018 13:25	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2065563-2	3/8/2018 11:10	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2068449-11	3/15/2018 11:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2074311-12	3/29/2018 11:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2077059-5	4/5/2018 14:35	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00060	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2079620-11	4/12/2018 11:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	0.0000070	0.00061	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2082507-5	4/19/2018 13:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2085708-11	4/26/2018 13:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2092801-11	5/10/2018 11:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2096840-5	5/17/2018 11:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.001*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2100224-11	5/24/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2108434-11	6/7/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	0.00033	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2116986-12	6/21/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00110	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2119305-8	6/26/2018 15:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00050	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2122741-8	7/3/2018 15:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00053	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	0.0015	*< 0.05*	*< 0.0005*
Bottle-BL	L2126886-8	7/10/2018 14:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	0.000026	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2132784-12	7/19/2018 14:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2136922-5	7/26/2018 11:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2140794-23	8/1/2018 19:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	0.0070	*< 0.05*	*< 0.0005*
Bottle-BL	L2144304-5	8/9/2018 8:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2148482-12	8/16/2018	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00072	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2156461-11	8/30/2018 14:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2160020-5	9/6/2018 9:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.00001*	*< 0.001*	*< 0.0001*	*< 0.01*	*< 0.0001*	*< 0.00002*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0001*	*< 0.0001*		*< 0.0002*	*< 0.01*	*< 0.1*	*< 0.001*
Bottle-BL	L2164110-12	9/13/2018 11:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*

Appendix B2: Bottle Blank Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**NO2-N**	**NO3-N**	**D-S**	**SO4**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**	**D-Cu**	**D-Fe**	**D-K**	**D-Li**
Bottle-BL	L2168278-5	9/20/2018 14:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.00001*	*< 0.001*	*< 0.0001*	*< 0.01*	*< 0.0001*	*< 0.00002*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0001*	*< 0.0001*		*< 0.0002*	*< 0.01*	*< 0.1*	*< 0.001*
Bottle-BL	L2172409-11	9/27/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2178842-8	10/10/2018 10:25	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2187510-11	10/25/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2191054-5	11/1/2018 12:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2194529-12	11/8/2018 13:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2200705-11	11/22/2018 10:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2203820-5	11/29/2018 13:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00263	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2207335-12	12/6/2018 13:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2210418-5	12/13/2018 14:26	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2213525-11	12/20/2018 14:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2215086-5	12/28/2018 11:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2217203-12	1/5/2019 11:35	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2222132-11	1/17/2019 11:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2224812-5	1/24/2019 15:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00061	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2227544-12	1/31/2019 10:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2230256-5	2/7/2019 14:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2233141-12	2/14/2019 14:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2235634-5	2/21/2019	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2238565-12	2/28/2019 15:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2241519-5	3/7/2019 10:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2244540-11	3/14/2019 14:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2247733-5	3/21/2019 14:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2250817-12	3/28/2019 15:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00080	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2253941-5	4/4/2019 15:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2257457-11	4/11/2019 15:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2259905-6	4/17/2019 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2263301-12	4/25/2019 14:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B2: Bottle Blank Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
Bottle-BL	L1955323-5	7/7/2017 13:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1961404-11	7/19/2017 10:30	*< 0.005*	*< 0.00005*	*< 0.00005*	0.011	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1966755-5	7/28/2017 12:25																						
Bottle-BL	L1969885-5	8/3/2017 13:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1973928-5	8/11/2017 13:40																						
Bottle-BL	L1977047-11	8/17/2017 12:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1981592-5	8/25/2017 10:50																						
Bottle-BL	L1984769-5	8/31/2017 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	0.0000060	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1988664-5	9/8/2017 14:50																						
Bottle-BL	L1992088-11	9/14/2017 14:55	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1996212-5	9/22/2017 14:20																						
Bottle-BL	L2000226-7	9/29/2017 10:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	0.000013	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2003949-5	10/6/2017 11:25																						
Bottle-BL	L2006427-11	10/12/2017 12:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2009523-4	10/18/2017 14:15	*< 0.005*	*< 0.00005*	*< 0.00005*	0.017	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2014692-7	10/27/2017																						
Bottle-BL	L2018104-2	11/3/2017 13:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2021295-7	11/10/2017 13:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2023647-3	11/16/2017 15:30																						
Bottle-BL	L2026623-11	11/23/2017 14:15	*< 0.005*	0.000069	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	0.0000057	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	0.00017	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00056	*< 0.00006*
Bottle-BL	L2032658-6	12/7/2017 11:30	*< 0.005*	*< 0.00006*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2038563-11	12/21/2017 13:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.03*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2041649-10	1/4/2018 13:05	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.00003*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2044152-2	1/11/2018 10:40	*< 0.005*	*< 0.00005*	0.000097	*< 0.01*	0.000093	*< 0.05*	0.000646	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	0.00012	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00910	*< 0.00006*
Bottle-BL	L2046871-11	1/18/2018 11:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2049910-2	1/26/2018 9:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2052061-12	2/1/2018 12:10	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2057381-11	2/15/2018 11:35	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2062788-11	3/1/2018 13:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2065563-2	3/8/2018 11:10	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2068449-11	3/15/2018 11:40	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	0.0000055	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2074311-12	3/29/2018 11:20	*< 0.005*	*< 0.00005*	*< 0.00005*	0.015	*< 0.00005*	*< 0.05*	0.0000135	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2077059-5	4/5/2018 14:35	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	0.000051	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2079620-11	4/12/2018 11:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2082507-5	4/19/2018 13:40	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.03*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	0.0000021	0.000053	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2085708-11	4/26/2018 13:40	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2092801-11	5/10/2018 11:15	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2096840-5	5/17/2018 11:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2100224-11	5/24/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2108434-11	6/7/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	0.019	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2116986-12	6/21/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2119305-8	6/26/2018 15:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2122741-8	7/3/2018 15:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2126886-8	7/10/2018 14:20	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	0.00012	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2132784-12	7/19/2018 14:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0011	*< 0.00006*
Bottle-BL	L2136922-5	7/26/2018 11:15	*< 0.005*	*< 0.00005*	*< 0.00005*	0.014	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2140794-23	8/1/2018 19:15	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2144304-5	8/9/2018 8:05	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2148482-12	8/16/2018	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2156461-11	8/30/2018 14:20	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2160020-5	9/6/2018 9:30	*< 0.1*	*< 0.0001*	*< 0.00005*	*< 0.05*	*< 0.0005*	*< 0.05*	*< 0.00005*		*< 0.0001*	*< 0.00005*	*< 0.05*	*< 0.0001*	*< 0.0002*			*< 0.0003*	*< 0.00001*	*< 0.00001*	*< 0.0005*		*< 0.001*	*< 0.0003*
Bottle-BL	L2164110-12	9/13/2018 11:45	*< 0.005*	*< 0.00005*	*< 0.00005*	0.795	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.134	*< 0.00006*

Appendix B2: Bottle Blank Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
Bottle-BL	L2168278-5	9/20/2018 14:30	*< 0.1*	*< 0.0001*	*< 0.00005*	*< 0.05*	*< 0.0005*	*< 0.05*	*< 0.00005*		*< 0.0001*	*< 0.00005*	*< 0.05*	*< 0.0001*	*< 0.0002*			*< 0.0003*	*< 0.00001*	*< 0.00001*	*< 0.0005*		*< 0.001*	*< 0.0003*
Bottle-BL	L2172409-11	9/27/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2178842-8	10/10/2018 10:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2187510-11	10/25/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2191054-5	11/1/2018 12:20	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2194529-12	11/8/2018 13:40	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2200705-11	11/22/2018 10:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2203820-5	11/29/2018 13:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2207335-12	12/6/2018 13:05	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2210418-5	12/13/2018 14:26	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2213525-11	12/20/2018 14:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2215086-5	12/28/2018 11:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2217203-12	1/5/2019 11:35	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2222132-11	1/17/2019 11:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2224812-5	1/24/2019 15:00	*< 0.005*	*< 0.00005*	*< 0.00005*	0.019	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0043	*< 0.00006*
Bottle-BL	L2227544-12	1/31/2019 10:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	0.0000060	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0030	*< 0.00006*
Bottle-BL	L2230256-5	2/7/2019 14:05	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2233141-12	2/14/2019 14:20	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2235634-5	2/21/2019	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2238565-12	2/28/2019 15:15	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2241519-5	3/7/2019 10:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0011	*< 0.00006*
Bottle-BL	L2244540-11	3/14/2019 14:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2247733-5	3/21/2019 14:05	*< 0.005*	*< 0.00005*	*< 0.00005*	0.029	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0036	*< 0.00006*
Bottle-BL	L2250817-12	3/28/2019 15:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2253941-5	4/4/2019 15:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2257457-11	4/11/2019 15:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2259905-6	4/17/2019 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2263301-12	4/25/2019 14:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	0.00011	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*

Notes:
Results in blue italics are below the indicated detection limit

Appendix C: Solid Phase Analytical Data

GOLDCORP

APPENDIX C1: ABA RESULTS OF SATURATED COLUMN SOLID PHASE

Appendix C1: ABA Results of Saturated Column Solid Phase

Sample ID	Final Dry Wt (kg)	Paste pH	TIC %	CaCO3 NP	C(T) %	S(T) %	S(SO4) %	S(S-2) %	Insoluble S %	AP	Sobek NP	Net Sobek NP	Fizz Test
Method Code	Sobek	Sobek	CSB02V	Calc.	CSA06V	CSA06V	CSA07V	CSA08D	Calc.	Calc.	Sobek	Calc.	Sobek
LOD	0.20	0.20	0.01		0.005	0.005	0.01	0.01			0.5	Sobek	
Col 7	4.33	6.62	0.01	0.8	0.018	0.022	*< 0.01*	*< 0.01*	0.02	*< 0.3*	1.5	1.5	None
Col 8	4.36	5.49	*< 0.01*	*< 0.8*	0.027	0.154	0.01	0.11	0.03	3.4	1.0	-2.4	None
Col 13	9.97	7.40	*< 0.01*	*< 0.8*	0.014	0.017	*< 0.01*	0.01	*< 0.01*	0.3	3.4	3.1	None
Col 14	9.94	8.26	0.1	8.3	0.111	0.031	*< 0.01*	0.03	*< 0.01*	0.9	6.3	5.4	None

Duplicates													
Col 7		6.70			0.014	0.019					1.6		None
Col 8			*< 0.01*				0.01						
Col 13								0.01					

Sample ID	Rinse pH	Paste pH	TIC %	CaCO3 NP	C(T) %	S(T) %	S(SO4) %	S(S-2) %	Insoluble S %	AP	Siderite Corr. NP	Net Siderite Corr. NP	Sobek NP	Net Sobek NP	Fizz Test
Method Code	Sobek	Sobek	CSB02V	Calc.	CSA06V	CSA06V	CSA07V	CSA08D	Calc.	Calc.	Siderite Corr.	Calc.	Sobek	Calc.	Sobek
LOD	0.20	0.20	0.01		0.005	0.005	0.01	0.01			0.5	Sobek	0.5	Sobek	
FB-GS-res	8.12	7.86	0.58	48.3	0.569	0.177	0.02	0.16	*< 0.01*	5.0	55.2	50.2	52.0	47.0	Slight
FB-GT-res	8.30	7.88	0.42	35.0	0.419	0.084	0.01	0.07	*< 0.01*	2.2	38.5	36.3	36.2	34.0	Slight
FB-GO-res	8.39	8.01	0.24	20.0	0.237	0.012	*< 0.01*	0.01	*< 0.01*	0.3	27.1	26.8	23.6	23.3	Slight
FB-SS-res	8.27	8.15	2.14	178.3	2.18	0.414	0.02	0.35	0.04	10.9	212.3	201.4	200.6	189.7	Moderate
FB-ST-res	8.33	8.28	1.45	120.8	1.46	0.088	0.01	0.06	0.02	1.9	171.6	169.7	158.0	156.1	Moderate
FB-SO-res	8.09	8.04	0.9	75.0	0.921	0.035	0.01	0.02	*< 0.01*	0.6	78.3	77.7	76.2	75.6	Slight

Duplicates															
GS	8.22	8.28	0.66	55.0	0.672	0.21	*< 0.01*	0.18	0.03	5.6	51.7	56.9	46.1	51.3	Slight
GT	8.00	8.59	0.48	40.0	0.488	0.083	*< 0.01*	0.07	0.013	2.2	32.9	40.8	30.7	38.6	Slight
GO	8.46	8.43	0.23	19.2	0.258	0.016	*< 0.01*	0.01	0.006	0.3	22.7	26.5	22.4	26.2	Slight
SS	8.49	8.40	2.09	174.2	2.13	0.421	*< 0.01*	0.35	0.071	10.9	180.5	200.1	169.6	189.2	Moderate
ST	8.41	8.28	1.58	131.7	1.62	0.101	0.01	0.05	0.041	1.6	172.9	192.6	171.3	191.0	Moderate
SO	8.35	8.25	0.93	77.5	0.958	0.031	*< 0.01*	0.01	0.021	0.3	74.9	75.9	74.6	75.6	Slight

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX C2: AQUA REGIA METALS RESULTS OF SATURATED COLUMN SOLID PHASE

Appendix C2: Aqua Regia Metals Results of Saturated Column Solid Phase

Sample ID	Ag	Al	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Sr	Ti
	ppm	%	ppm	%	ppm	ppm	%	%	ppm	%	ppm	%	ppm	%	%	ppm	%
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.01	0.01	5	0.01	1	0.5	0.01	0.01	1	0.01	2	0.01	0.5	0.005	0.01	0.5	0.01
Col 7	0.1	0.42	67	0.05	106	6.5	1.47	0.13	2	0.02	187	*< 0.01*	3.1	0.01	0.02	16.2	*< 0.01*
Col 8	0.07	0.35	46	0.03	116	4.1	1.38	0.14	2	0.01	201	*< 0.01*	2.6	0.01	0.16	16.9	*< 0.01*
Col 13	0.05	0.38	49	0.04	126	4	0.84	0.15	6	0.06	334	0.01	2.9	0.01	0.02	7.4	0.02
Col 14	*< 0.01*	0.37	60	0.09	122	4.2	1.09	0.19	8	0.11	679	0.02	2.4	0.02	0.04	3.7	0.03
FB-SO-res	0.21	0.47	358	2.46	79	31.1	2.66	0.15	1	0.4	535	0.01	29.9	0.05	0.04	65.5	*< 0.01*
FB-ST-res	0.04	1.15	350	5	137	15.9	2.1	0.69	14	1.01	572	0.04	40.4	0.04	0.09	689	0.1
FB-SS-res	0.13	1.19	357	5.86	107	18.6	2.5	0.77	12	1.39	666	0.04	54.3	0.06	0.43	202	0.08
FB-GO-res	0.15	0.48	92	0.7	84	10.5	1.27	0.17	1	0.19	278	0.01	9.1	0.03	0.02	21.7	*< 0.01*
FB-GT-res	0.04	0.53	202	0.91	77	8.7	1.22	0.18	1	0.33	278	0.02	5.6	0.02	0.08	38.4	0.01
FB-GS-res	0.08	1.02	135	1.54	89	8.4	1.85	0.49	6	0.69	350	0.03	13.9	0.04	0.18	60.2	0.05

Duplicates

Sample ID	Ag	Al	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Sr	Ti
	ppm	%	ppm	%	ppm	ppm	%	%	ppm	%	ppm	%	ppm	%	%	ppm	%
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
Col 13	0.03	0.38	49	0.04	123	5.8	0.84	0.16	6	0.06	338	0.01	2.6	0.01	0.02	7.4	0.02
SO	0.17	0.49	336	2.33	125	24.1	2.89	0.16	2	0.48	530	0.01	27.4	0.048	0.01	56.9	*< 0.01*
ST	0.05	1.52	542	4.86	190	16.1	2.57	0.83	13	1.21	589	0.04	49.6	0.048	0.09	778	0.11
SS	0.11	1.37	327	5.03	145	18	2.87	0.68	10	1.44	660	0.03	53.9	0.063	0.43	243	0.06
GO	0.17	0.58	106	0.68	142	9.8	1.5	0.21	2	0.21	339	0.02	9.7	0.03	0.01	25	*< 0.01*
GT	0.03	0.47	162	0.96	122	5.9	1.18	0.19	2	0.35	280	0.02	5.7	0.022	0.07	38.1	*< 0.01*
GS	0.03	0.92	120	1.57	112	6.7	1.81	0.41	5	0.6	373	0.02	12.8	0.034	0.2	55.3	0.03

Notes:
Results in blue italics are below the indicated detection limit

Appendix C2: Aqua Regia Metals Results of Saturated Column Solid Phase

Sample ID	V	Zn	Zr	As	Be	Bi	Cd	Ce	Co	Cs	Ga	Ge	Hf	Hg	In	La	Lu
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	1	1	0.5	1	0.1	0.02	0.01	0.05	0.1	0.05	0.1	0.1	0.05	0.01	0.02	0.1	0.01
Col 7	9	44	10.1	3240	0.6	0.1	0.25	26.2	1.7	1.29	1.6	*< 0.1*	0.31	0.82	0.02	14	0.15
Col 8	9	15	9.3	6310	0.3	0.12	0.03	24.5	1.6	1.13	1.4	*< 0.1*	0.26	4.67	0.03	13	0.11
Col 13	5	31	8.7	265	0.4	0.22	0.08	45.6	1.5	2.73	2	*< 0.1*	0.37	0.15	*< 0.02*	24.7	0.21
Col 14	7	31	8.9	53	0.3	0.11	0.04	47.2	1.7	2.91	2.4	*< 0.1*	0.38	0.07	*< 0.02*	25.5	0.22
FB-SO-res	33	45	5.3	348	0.8	0.49	0.14	58.5	11.7	1.13	1.8	*< 0.1*	0.14	0.45	0.03	29.4	0.24
FB-ST-res	38	39	6.4	42	0.7	0.18	0.05	38.4	11	3.6	4.9	*< 0.1*	0.26	0.08	*< 0.02*	20.7	0.19
FB-SS-res	43	54	3.9	23	0.8	0.4	0.08	58.9	12.4	3.32	5.7	*< 0.1*	0.09	0.12	0.03	29.7	0.21
FB-GO-res	14	19	11	168	0.8	0.35	0.03	57.6	4.5	1.19	1.8	*< 0.1*	0.31	0.15	*< 0.02*	33.3	0.2
FB-GT-res	9	19	9.7	167	0.7	0.23	0.03	73.2	3.7	1.27	1.9	*< 0.1*	0.33	0.23	*< 0.02*	41.7	0.2
FB-GS-res	24	21	6.8	59	0.9	0.48	0.01	61.1	7.8	2.42	4	*< 0.1*	0.22	0.08	0.02	33.7	0.22

Duplicates

Sample ID	V	Zn	Zr	As	Be	Bi	Cd	Ce	Co	Cs	Ga	Ge	Hf	Hg	In	La	Lu
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
Col 13	6	26	8.4	257	0.4	0.2	0.07	45.6	1.5	2.88	2	*< 0.1*	0.34	0.14	*< 0.02*	24.8	0.2
SO	32	41	4.5	369	0.8	0.48	0.14	55.6	12.6	1.21	1.9	*< 0.1*	0.14	0.44	0.03	27.3	0.24
ST	42	43	4.8	67	0.7	0.25	0.07	38.7	15.1	3.7	5.8	*< 0.1*	0.17	0.03	0.02	22.7	0.19
SS	43	58	3	30	0.9	0.45	0.1	57.5	14.2	3.62	5.9	*< 0.1*	0.08	0.12	0.04	28	0.23
GO	17	21	11.2	218	0.8	0.35	0.07	62.7	6.2	1.57	2.3	*< 0.1*	0.32	0.15	*< 0.02*	33.3	0.23
GT	9	16	8.9	182	0.7	0.2	0.05	58.8	4.1	1.21	1.9	*< 0.1*	0.28	0.24	*< 0.02*	32.1	0.19
GS	18	19	6.7	86	0.7	0.47	0.03	65.4	8	2.07	3.6	*< 0.1*	0.22	0.07	*< 0.02*	33.4	0.22

Notes:
Results in blue italics are below the indicated detection limit

Appendix C2: Aqua Regia Metals Results of Saturated Column Solid Phase

Sample ID	Mo	Nb	Pb	Rb	Sb	Sc	Se	Sn	Ta	Tb	Te	Th	Tl	U	W	Y	Yb
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.05	0.05	0.2	0.2	0.05	0.1	1	0.3	0.05	0.02	0.05	0.1	0.02	0.05	0.1	0.05	0.1
Col 7	3.41	0.27	36.5	12	38.7	2.6	*< 1*	0.4	*< 0.05*	0.25	*< 0.05*	20.6	0.66	11	0.3	7.55	0.9
Col 8	3.75	0.25	17	10.3	162	2.5	*< 1*	0.3	*< 0.05*	0.2	0.05	18.2	1.53	9	0.1	6.14	0.7
Col 13	3.3	0.99	19.3	18.5	1.75	1.4	*< 1*	0.6	*< 0.05*	0.39	*< 0.05*	29.2	0.21	7.12	*< 0.1*	12.2	1.4
Col 14	3.29	1.63	10.2	26.6	0.57	1.8	*< 1*	0.8	*< 0.05*	0.41	*< 0.05*	29.3	0.3	5.96	*< 0.1*	12.9	1.5
FB-SO-res	1.8	*< 0.05*	19.7	7.8	37.6	6.4	*< 1*	0.6	*< 0.05*	0.62	*< 0.05*	13.2	0.4	2.78	0.3	15.3	1.6
FB-ST-res	2.76	0.82	7.8	48	1.73	5.2	*< 1*	1.3	*< 0.05*	0.4	*< 0.05*	17.3	0.43	3.21	0.7	11.7	1.3
FB-SS-res	2.43	0.38	13.2	46.8	2.25	5.9	*< 1*	1.3	*< 0.05*	0.58	*< 0.05*	13.2	0.33	3.07	2.4	15.9	1.5
FB-GO-res	2.1	0.07	9.7	14.1	8.7	2.4	*< 1*	0.8	*< 0.05*	0.42	0.13	32	0.24	5.15	1	11.9	1.3
FB-GT-res	3.26	0.15	7.7	16.5	7.52	1.9	*< 1*	0.9	*< 0.05*	0.44	*< 0.05*	33.6	0.26	7.14	0.2	12.1	1.3
FB-GS-res	2.85	0.33	5.2	34.8	1.88	4.3	*< 1*	1.1	*< 0.05*	0.53	0.07	23.3	0.3	5.63	0.2	14.6	1.4

Duplicates

Sample ID	Mo	Nb	Pb	Rb	Sb	Sc	Se	Sn	Ta	Tb	Te	Th	Tl	U	W	Y	Yb
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
Col 13	3.64	1.02	20.1	19	1.7	1.5	*< 1*	0.6	*< 0.05*	0.38	*< 0.05*	29.1	0.22	6.99	*< 0.1*	11.6	1.3
SO	3.84	*< 0.05*	17	8.4	32.6	7	*< 1*	0.4	*< 0.05*	0.63	0.06	11.8	0.44	2.55	0.4	15	1.6
ST	5.49	0.73	9.3	52.2	1.86	5.7	*< 1*	1.1	*< 0.05*	0.41	0.07	15.1	0.48	2.71	1.4	11.9	1.3
SS	3.25	0.29	15	43.1	2.59	6.8	*< 1*	1.1	*< 0.05*	0.61	*< 0.05*	12.3	0.37	3.24	0.6	16.2	1.6
GO	4.98	0.1	10.8	18	12.1	3	*< 1*	0.6	*< 0.05*	0.49	0.1	35.2	0.32	5.53	1.3	13	1.5
GT	4.89	0.11	7.4	15.7	6.89	2	*< 1*	0.6	*< 0.05*	0.41	*< 0.05*	30.6	0.26	6.32	0.2	11	1.3
GS	4.49	0.27	6	29.9	2.58	3.7	*< 1*	0.7	*< 0.05*	0.55	0.13	21.5	0.27	6.05	0.2	14.3	1.5

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX C3: SFE RESULTS OF SATURATED COLUMN SOLID PHASE

Appendix C3: SFE Results of Saturated Column Solid Phase

Sample ID			Col 7	Col 8	Col 13	Col 14	FB-SO-res	FB-ST-res	FB-SS-res	FB-GO-res	FB-GT-res	FB-GS-res
Parameter	**Method**	**Units**										
Volume Nanopure Water		mL	750	750	750	750	750	750	750	750	750	750
Sample Weight		g	250	250	250	250	250	250	250	250	250	250
pH	meter		7.53	4.80	7.14	7.22	8.00	8.13	8.14	8.20	7.98	8.21
Redox	meter	mV	509	595	509	518	338	341	341	341	357	344
Conductivity	meter	uS/cm	11	25	25	39	126	165	258	110	211	111
Acidity (to pH 4.5)	titration	mg CaCO3/L	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Total Acidity (to pH 8.3)	titration	mg CaCO3/L	4.5	8.3	4.5	4.0	3.1	2.8	3.0	2.7	3.6	2.6
Alkalinity	titration	mg CaCO3/L	6.6	0.1	6.4	15.1	46.3	41.4	47.4	40.3	34.1	39.8
Sulphate	Turbidity	mg/L	5	5	6	6	13	39	79	13	64	145
Ion Balance												
Major Anions	Calc	meq/L	0.24	0.11	0.25	0.43	1.20	1.64	2.59	1.08	2.02	3.82
Major Cations	Calc	meq/L	0.17	0.21	0.21	0.39	1.30	1.86	2.85	1.05	1.98	3.67
Difference	Calc	meq/L	0.07	-0.11	0.04	0.03	-0.10	-0.21	-0.26	0.03	0.04	0.14
Balance (%)	Calc	%	17.4%	-33.6%	8.1%	4.1%	-4.0%	-6.1%	-4.7%	1.3%	1.0%	1.9%
Dissolved Metals												
Hardness CaCO3		mg/L	2.5	3.2	1.8	11.1	50.3	73.2	120	34.8	85.0	160
Aluminum Al	ICP-MS	mg/L	0.005	*< 0.001*	0.003	*< 0.001*	0.025	0.056	0.033	0.068	0.051	0.030
Antimony Sb	ICP-MS	mg/L	0.0203	0.0175	0.0040	0.0020	0.0070	0.0009	0.0096	0.0026	0.0039	0.0059
Arsenic As	ICP-MS	mg/L	0.469	2.47	0.135	0.0369	0.0247	0.0098	0.0071	0.0647	0.0609	0.0229
Barium Ba	ICP-MS	mg/L	0.00147	0.00028	0.00121	0.00439	0.0604	0.0409	0.0406	0.0206	0.0414	0.0172
Beryllium Be	ICP-MS	mg/L	0.000019	0.000113	0.000016	0.000018	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*
Bismuth Bi	ICP-MS	mg/L	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*
Boron B	ICP-MS	mg/L	0.025	0.016	0.031	0.031	0.020	0.011	0.009	0.015	0.020	0.009
Cadmium Cd	ICP-MS	mg/L	0.000003	0.000017	0.000004	0.000004	*< 0.000003*	0.000006	0.000009	0.000013	0.000038	0.000013
Calcium Ca	ICP-MS	mg/L	0.64	0.88	0.49	3.40	13.7	20.0	27.4	9.63	22.6	38.8
Chromium Cr	ICP-MS	mg/L	0.00008	0.00009	*< 0.00003*	0.00011	0.00083	0.00021	0.00006	0.00035	0.00006	*< 0.00003*
Cobalt Co	ICP-MS	mg/L	0.000065	0.00384	0.000176	0.000179	0.000018	0.000021	0.000017	0.000025	0.000014	0.000014
Copper Cu	ICP-MS	mg/L	0.00086	0.00294	0.00041	0.00037	0.00080	0.00098	0.00066	0.00129	0.00092	0.00096
Iron Fe	ICP-MS	mg/L	0.120	0.112	0.083	0.129	0.009	0.022	*< 0.007*	0.027	*< 0.007*	*< 0.007*
Lead Pb	ICP-MS	mg/L	0.00028	0.00008	0.00178	0.00048	0.00001	0.00005	0.00002	0.00006	0.00046	0.00016
Lithium Li	ICP-MS	mg/L	0.0004	0.0004	0.0019	0.0018	0.0017	0.0028	0.0030	0.0011	0.0012	0.0022
Magnesium Mg	ICP-MS	mg/L	0.210	0.238	0.150	0.630	3.94	5.67	12.6	2.61	6.97	15.4
Manganese Mn	ICP-MS	mg/L	0.670	0.105	0.0284	0.0754	0.00021	0.00158	0.00433	0.00110	0.00203	0.00522
Mercury Hg	ICP-MS	ug/L	0.04	0.02	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*
Molybdenum Mo	ICP-MS	mg/L	0.00035	0.00004	0.00156	0.00063	0.00340	0.00556	0.00221	0.0109	0.0111	0.00941
Nickel Ni	ICP-MS	mg/L	*< 0.0001*	0.0012	*< 0.0001*	*< 0.0001*	*< 0.0001*	0.0002	0.0004	0.0002	*< 0.0001*	0.0002
Phosphorus P	ICP-MS	mg/L	0.018	0.014	0.015	*< 0.003*	*< 0.003*	*< 0.003*	*< 0.003*	0.034	0.010	*< 0.003*
Potassium K	ICP-MS	mg/L	1.11	0.984	3.35	3.04	3.08	6.32	9.46	3.62	5.38	7.27
Selenium Se	ICP-MS	mg/L	0.00004	0.00009	0.00008	0.00007	0.00008	0.00022	0.00009	0.00008	0.00014	0.00013
Silicon Si	ICP-MS	mg/L	2.14	0.78	5.09	4.86	2.44	2.36	0.86	3.34	2.35	1.78
Silver Ag	ICP-MS	mg/L	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*
Sodium Na	ICP-MS	mg/L	0.71	0.32	1.66	1.72	4.83	4.52	4.01	6.00	3.07	6.33
Strontium Sr	ICP-MS	mg/L	0.00448	0.00415	0.00240	0.00964	0.0852	1.43	1.33	0.0483	0.111	0.245
Sulphur (S)	ICP-MS	mg/L	0.4	2.0	1.5	1.0	4.6	12.1	24.1	4.1	21.1	46.7
Thallium Tl	ICP-MS	mg/L	0.000039	0.000211	0.000034	0.000045	0.000036	*< 0.000005*	0.000027	0.000020	0.000151	0.000031
Tin Sn	ICP-MS	mg/L	0.00007	0.00005	0.00007	0.00010	*< 0.00001*	0.00002	0.00002	0.00003	0.00010	*< 0.00001*
Titanium Ti	ICP-MS	mg/L	0.00576	0.00014	0.00285	0.00440	0.00011	0.00095	0.00011	0.00059	0.00017	0.00010
Uranium U	ICP-MS	mg/L	0.000292	0.000766	0.000310	0.001519	0.000894	0.00338	0.00584	0.0124	0.0266	0.0267
Vanadium V	ICP-MS	mg/L	0.00038	0.00014	0.00027	0.00066	0.00019	0.00131	0.00034	0.00052	0.00025	0.00059
Zinc Zn	ICP-MS	mg/L	*< 0.002*	0.012	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	0.005	*< 0.002*
Zirconium Zr	ICP-MS	mg/L	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX C4: QEMSCAN RESULTS OF SATURATED COLUMN SOLID PHASE

QEMSCAN DATA

prepared for:

Lorax Enviromental Services

16607-101
MI7007-MAR18
May 27, 2019

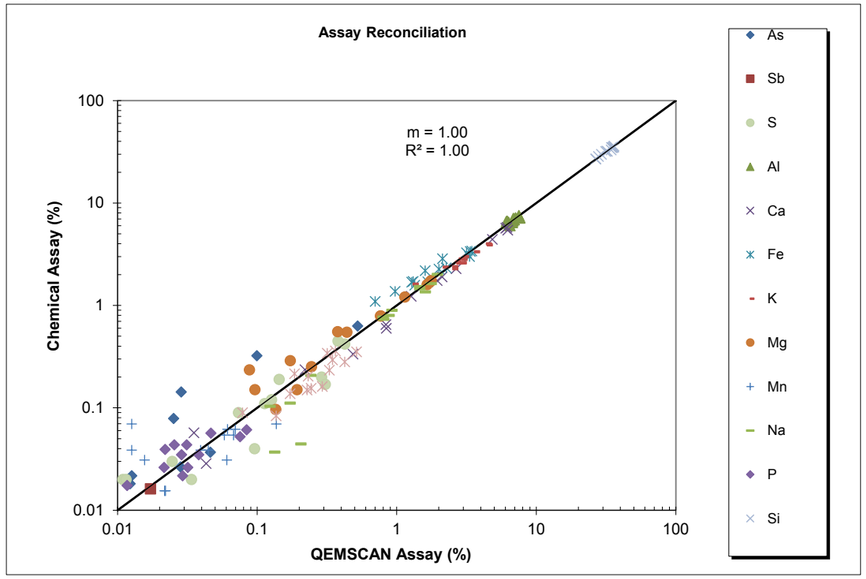
Prepared by:

Lain Glossop/Sarah Prout
Senior Mineralogist/Senior Mineralogist

SGS Canada
3260 Production Way
Burnaby, BC
Canada, V5A 4W4

Lorax Enviromental Services
16607-101
MI7007-MAR18

Elemental Mass (%)



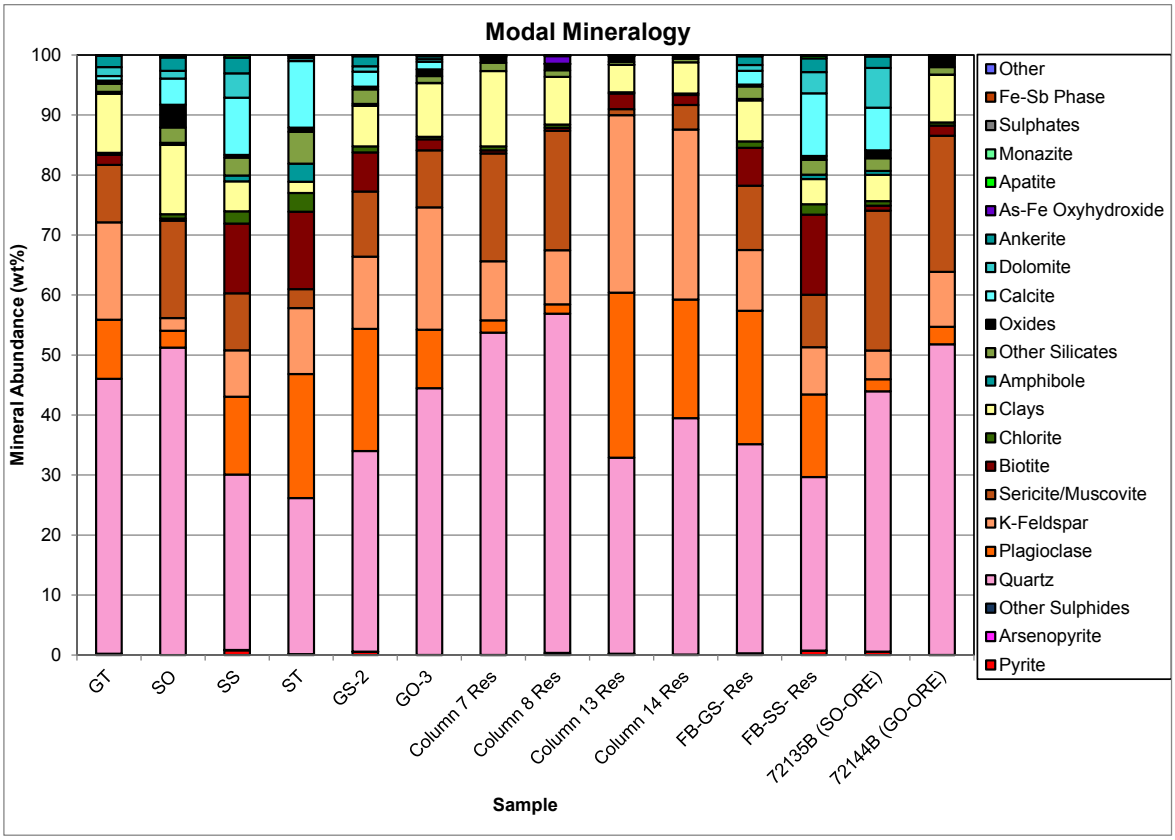
Elemental Mass (%) Absolute

	Client Assays		Client Assays											
	Arsenic		**Antimony**		**Sulphur**		**Aluminum**		**Calcium**		**Iron**		**Potassium**	
Mineral Name	As (QEMSCAN)	As (Chemical)	Sb (QEMSCAN)	Sb (Chemical)	S (QEMSCAN)	S (Chemical)	Al (QEMSCAN)	Al (Chemical)	Ca (QEMSCAN)	Ca (Chemical)	Fe (QEMSCAN)	Fe (Chemical)	K (QEMSCAN)	K (Chemical)
GT	0.01	0.02	0.00	0.00	0.11	0.11	6.81	6.72	1.27	1.23	1.28	1.69	3.01	3.01
SO	0.05	0.04	0.00	0.00	0.02	0.03	6.32	6.51	2.66	2.29	3.16	3.27	1.31	1.62
SS	0.02	0.00	0.00	0.00	0.42	0.42	6.28	6.35	6.04	5.69	3.36	3.38	2.70	2.60
ST	0.01	0.01	0.00	0.00	0.07	0.09	6.18	6.67	6.16	5.79	3.32	3.01	2.90	2.61
GS-2	0.02	0.01	0.00	0.00	0.29	0.20	7.64	7.15	2.11	1.91	2.26	2.33	2.93	2.81
GO-3	0.01	0.02	0.00	0.00	0.00	0.03	6.94	6.88	0.84	0.65	1.31	1.72	3.60	3.35
Column 7 Res	0.10	0.32	0.00	0.00	0.01	0.02	7.49	7.57	0.04	0.06	1.34	1.58	2.52	2.40
Column 8 Res	0.52	0.63	0.02	0.02	0.13	0.12	6.75	6.46	0.04	0.03	1.67	1.71	2.51	2.28
Column 13 Res	0.03	0.03	0.00	0.00	0.10	0.04	7.08	7.20	0.84	0.60	0.97	1.38	4.45	3.91
Column 14 Res	0.02	0.01	0.00	0.00	0.03	0.02	6.84	7.09	0.49	0.34	0.70	1.10	4.38	4.01
FB-GS- Res	0.02	0.00	0.00	0.00	0.14	0.19	7.59	7.30	1.95	1.75	2.01	2.27	2.64	2.66
FB-SS- Res	0.02	0.00	0.00	0.00	0.38	0.45	6.08	6.62	6.23	5.43	3.45	3.40	2.84	2.62
72135B (SO-ORE)	0.03	0.14	0.00	0.00	0.31	0.17	6.48	6.03	4.83	4.42	2.13	2.87	2.15	2.37
72144B (GO-ORE)	0.03	0.08	0.00	0.00	0.01	0.02	7.54	7.15	0.22	0.24	1.60	2.19	2.81	2.86

	Magnesium		**Manganese**		**Sodium**		**Phosphorus**		**Silicon**		**Titanium**	
Mineral Name	Mg (QEMSCAN)	Mg (Chemical)	Mn (QEMSCAN)	Mn (Chemical)	Na (QEMSCAN)	Na (Chemical)	P (QEMSCAN)	P (Chemical)	Si (QEMSCAN)	Si (Chemical)	Ti (QEMSCAN)	Ti (Chemical)
GT	0.44	0.55	0.06	0.03	0.80	0.77	0.02	0.03	34.3	33.1	0.17	0.14
SO	0.38	0.55	0.07	0.05	0.21	0.04	0.05	0.06	32.3	32.0	0.52	0.35
SS	1.77	1.76	0.07	0.06	0.88	0.80	0.08	0.05	26.7	27.0	0.32	0.34
ST	1.65	1.60	0.01	0.07	1.46	1.53	0.03	0.04	27.8	28.5	0.35	0.29
GS-2	0.77	0.79	0.04	0.04	1.60	1.36	0.04	0.03	31.4	32.0	0.23	0.20
GO-3	0.25	0.25	0.02	0.02	0.81	0.73	0.03	0.03	34.7	35.0	0.23	0.15
Column 7 Res	0.10	0.15	0.02	0.02	0.17	0.11	0.00	0.02	35.7	35.1	0.24	0.16
Column 8 Res	0.09	0.24	0.03	0.01	0.12	0.10	0.00	0.02	36.0	36.0	0.29	0.16
Column 13 Res	0.19	0.15	0.14	0.07	1.95	2.01	0.03	0.02	34.7	34.9	0.08	0.09
Column 14 Res	0.14	0.10	0.02	0.03	1.46	1.46	0.01	0.02	35.7	35.3	0.14	0.08
FB-GS- Res	0.76	0.79	0.04	0.04	1.76	1.64	0.03	0.03	32.0	32.1	0.19	0.22
FB-SS- Res	1.73	1.69	0.06	0.06	0.92	0.90	0.08	0.06	26.6	26.9	0.36	0.36
72135B (SO-ORE)	1.14	1.21	0.06	0.05	0.13	0.04	0.03	0.04	29.3	30.0	0.42	0.28
72144B (GO-ORE)	0.17	0.29	0.01	0.04	0.24	0.21	0.02	0.04	35.1	34.8	0.33	0.23

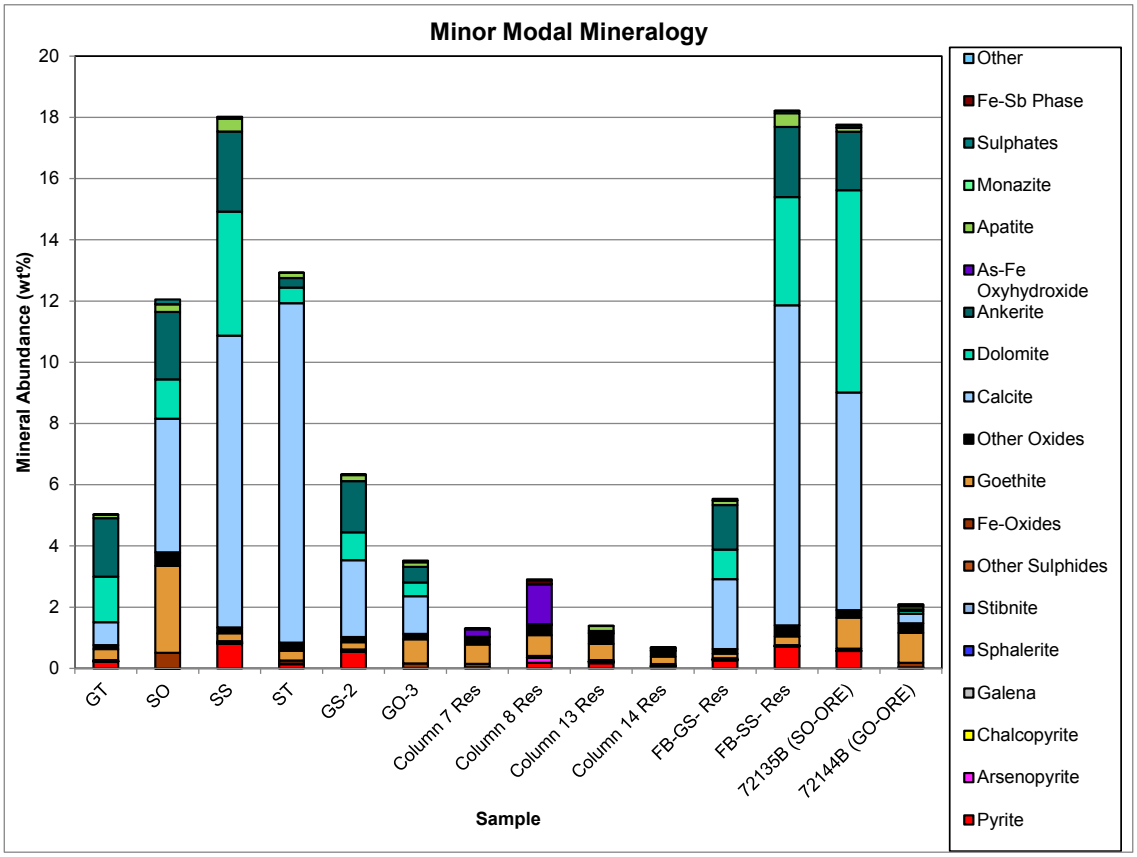
Lorax Enviromental Services
16607-101
MI7007-MAR18

Mineral Mass %	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.22	0.00	0.80	0.14	0.55	0.01	0.01	0.18	0.17	0.05	0.25	0.72	0.57	0.01
Arsenopyrite	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.18	0.04	0.02	0.03	0.00	0.00	0.02
Other Sulphides	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00
Quartz	45.8	51.2	29.2	26.0	33.4	44.5	53.7	56.5	32.7	39.4	34.9	28.9	43.4	51.8
Plagioclase	9.84	2.79	13.0	20.7	20.4	9.75	2.04	1.54	27.5	19.8	22.2	13.8	2.00	2.89
K-Feldspar	16.2	2.15	7.71	11.0	12.0	20.4	9.86	9.04	29.6	28.4	10.1	7.88	4.78	9.16
Sericite/Muscovite	9.59	16.2	9.53	3.18	10.9	9.52	17.9	19.9	1.02	4.06	10.7	8.73	23.3	22.7
Biotite	1.67	0.33	11.6	12.9	6.51	1.81	0.55	0.49	2.60	1.68	6.30	13.4	0.85	1.69
Chlorite	0.33	0.74	2.05	3.10	1.01	0.43	0.65	0.56	0.20	0.25	1.09	1.75	0.77	0.51
Clays	9.86	11.5	5.01	1.90	6.77	8.94	12.6	7.92	4.58	5.20	6.81	4.17	4.36	7.97
Amphibole	0.30	0.37	0.97	3.02	0.29	0.04	0.00	0.00	0.01	0.00	0.25	0.73	0.64	0.01
Other Silicates	1.36	2.57	2.97	5.30	2.42	1.15	1.39	1.12	0.50	0.60	2.07	2.48	2.14	1.24
Oxides	0.52	3.78	0.46	0.68	0.45	1.11	0.99	1.04	0.88	0.49	0.34	0.65	1.32	1.43
Calcite	0.75	4.36	9.53	11.1	2.51	1.23	0.01	0.01	0.03	0.02	2.28	10.5	7.11	0.31
Dolomite	1.49	1.29	4.05	0.51	0.91	0.45	0.00	0.00	0.00	0.00	0.97	3.54	6.61	0.09
Ankerite	1.91	2.20	2.62	0.31	1.67	0.51	0.00	0.02	0.06	0.00	1.45	2.29	1.91	0.06
As-Fe Oxyhydroxide	0.00	0.00	0.00	0.00	0.00	0.00	0.24	1.30	0.00	0.01	0.00	0.00	0.00	0.00
Apatite	0.11	0.25	0.41	0.17	0.20	0.15	0.00	0.01	0.16	0.05	0.15	0.45	0.13	0.09
Monazite	0.00	0.01	0.00	0.00	0.01	0.04	0.02	0.01	0.00	0.02	0.01	0.00	0.01	0.04
Sulphates	0.01	0.15	0.06	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.05	0.07	0.08	0.01
Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.03	0.00	0.02	0.00	0.01	0.01	0.02
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**



Lorax Enviromental Services
16607-101
MI7007-MAR18

Mineral Mass %	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.22	0.00	0.80	0.14	0.55	0.01	0.01	0.18	0.17	0.05	0.25	0.72	0.57	0.01
Arsenopyrite	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.18	0.04	0.02	0.03	0.00	0.00	0.02
Chalcopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Galena	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphalerite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stibnite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Sulphides	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00
Quartz/Feldspar	71.9	56.2	49.9	57.7	65.8	74.6	65.6	67.1	89.7	87.5	67.2	50.6	50.2	63.8
Mica	11.3	16.6	21.1	16.1	17.4	11.3	18.5	20.4	3.62	5.74	17.0	22.1	24.2	24.4
Chlorite	0.33	0.74	2.05	3.10	1.01	0.43	0.65	0.56	0.20	0.25	1.09	1.75	0.77	0.51
Clays	9.86	11.5	5.01	1.90	6.77	8.94	12.6	7.92	4.58	5.20	6.81	4.17	4.36	7.97
Amphibole	0.30	0.37	0.97	3.02	0.29	0.04	0.00	0.00	0.01	0.00	0.25	0.73	0.64	0.01
Other Silicates	1.36	2.57	2.97	5.30	2.42	1.15	1.39	1.12	0.50	0.60	2.07	2.48	2.14	1.24
Fe-Oxides	0.04	0.51	0.02	0.10	0.04	0.15	0.12	0.04	0.05	0.07	0.04	0.02	0.07	0.15
Goethite	0.36	2.84	0.26	0.32	0.24	0.79	0.63	0.68	0.53	0.24	0.15	0.28	1.01	0.98
Other Oxides	0.13	0.44	0.19	0.27	0.17	0.18	0.24	0.33	0.33	0.18	0.15	0.36	0.24	0.31
Calcite	0.75	4.36	9.53	11.1	2.51	1.23	0.01	0.01	0.03	0.02	2.28	10.5	7.11	0.31
Dolomite	1.49	1.29	4.05	0.51	0.91	0.45	0.00	0.00	0.00	0.00	0.97	3.54	6.61	0.09
Ankerite	1.91	2.20	2.62	0.31	1.67	0.51	0.00	0.02	0.06	0.00	1.45	2.29	1.91	0.06
As-Fe Oxyhydroxide	0.00	0.00	0.00	0.00	0.00	0.00	0.24	1.30	0.00	0.01	0.00	0.00	0.00	0.00
Apatite	0.11	0.25	0.41	0.17	0.20	0.15	0.00	0.01	0.16	0.05	0.15	0.45	0.13	0.09
Monazite	0.00	0.01	0.00	0.00	0.01	0.04	0.02	0.01	0.00	0.02	0.01	0.00	0.01	0.04
Sulphates	0.01	0.15	0.06	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.05	0.07	0.08	0.01
Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.03	0.00	0.02	0.00	0.01	0.01	0.02
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**



Lorax Enviromental Services
16607-101
MI7007-MAR18

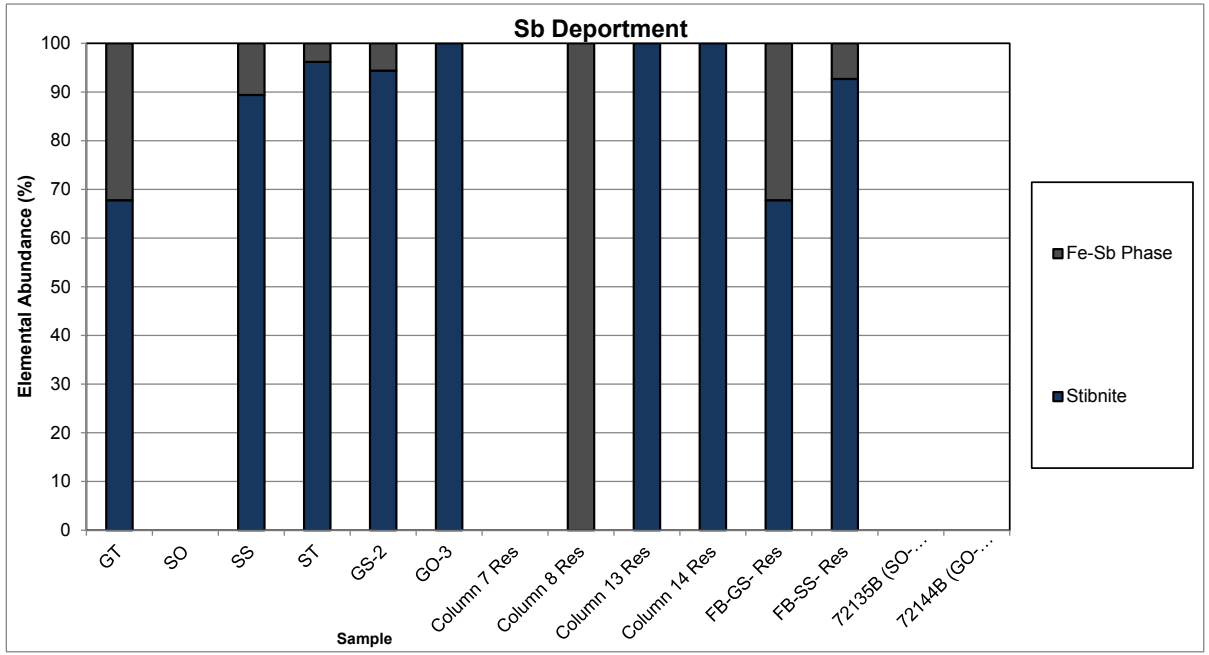
Sb Deportment

Absolute

Mineral Mass	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Stibnite	0.00033	0.00000	0.00244	0.00241	0.00157	0.00039	0.00000	0.00000	0.00089	0.00020	0.00127	0.00143	0.00000	0.00000
Fe-Sb Phase	0.00016	0.00000	0.00029	0.00010	0.00009	0.00000	0.00000	0.01718	0.00000	0.00000	0.00061	0.00011	0.00000	0.00000
Total	0.00048	0.00000	0.00273	0.00250	0.00166	0.00039	0.00000	0.01718	0.00089	0.00020	0.00188	0.00155	0.00000	0.00000

Normalized

Mineral Mass	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Stibnite	67.8	0.00	89.4	96.2	94.4	100.0	0.00	0.00	100.0	100.0	67.8	92.7	0.00	0.00
Fe-Sb Phase	32.2	0.00	10.6	3.81	5.61	0.00	0.00	100.0	0.00	0.00	32.2	7.34	0.00	0.00
Total	100	0	100	100	100	100	0	100	100	100	100	100	0	0



Lorax Enviromental Services
16607-101
MI7007-MAR18

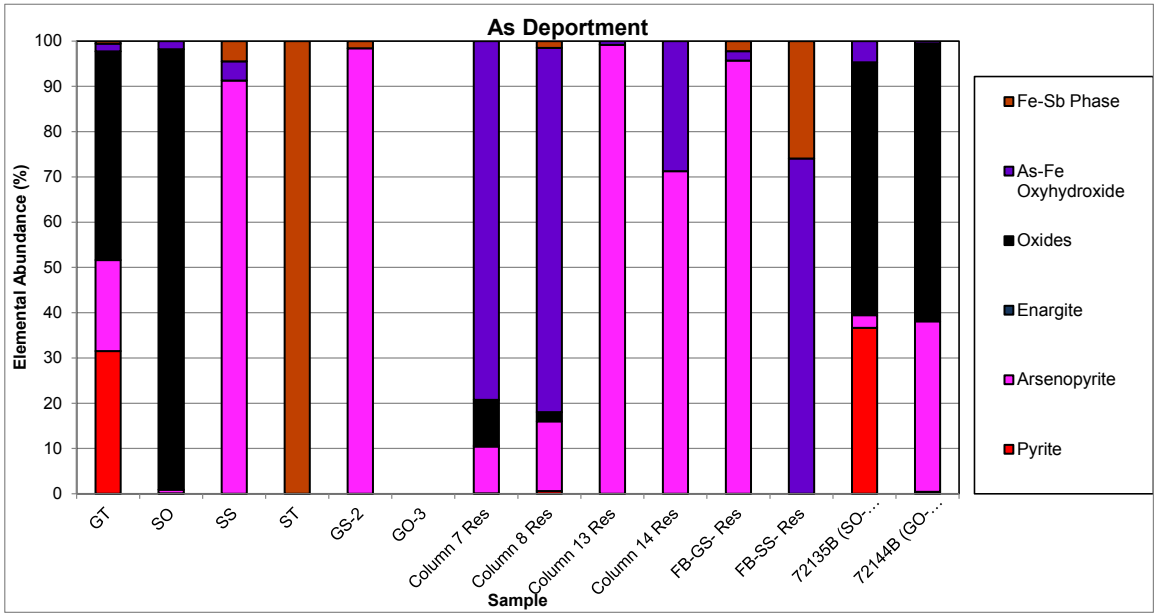
As Deportment

Absolute

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.00389	0.00004	0.00000	0.00000	0.00000	0.00008	0.00010	0.00307	0.00000	0.00000	0.00000	0.00000	0.01046	0.00010
Arsenopyrite	0.00248	0.00037	0.00274	0.00000	0.00264	0.00000	0.01028	0.08088	0.01680	0.00810	0.01216	0.00000	0.00080	0.00951
Enargite	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00023	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Oxides	0.00570	0.04492	0.00000	0.00000	0.00000	0.01250	0.01003	0.01072	0.00000	0.00000	0.00000	0.00000	0.01595	0.01547
As-Fe Oxyhydroxide	0.00020	0.00083	0.00013	0.00000	0.00000	0.00000	0.07877	0.42211	0.00014	0.00327	0.00027	0.00015	0.00133	0.00013
Fe-Sb Phase	0.00007	0.00000	0.00013	0.00004	0.00004	0.00000	0.00000	0.00793	0.00000	0.00000	0.00028	0.00005	0.00000	0.00000
Total	0.00845	0.04613	0.00300	0.00004	0.00269	0.01250	0.09932	0.52164	0.01694	0.01137	0.01270	0.00020	0.01808	0.02511

Normalized

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	31.5	0.09	0.00	0.00	0.00	0.00	0.10	0.58	0.00	0.00	0.00	0.00	36.7	0.41
Arsenopyrite	20.1	0.81	91.3	0.00	98.4	0.00	10.3	15.4	99.2	71.3	95.7	0.00	2.79	37.7
Enargite	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oxides	46.1	97.3	0.00	0.00	0.00	0.00	10.1	2.04	0.00	0.00	0.00	0.00	55.9	61.4
As-Fe Oxyhydroxide	1.66	1.81	4.24	0.00	0.00	0.00	79.2	80.4	0.82	28.7	2.09	74.1	4.67	0.52
Fe-Sb Phase	0.58	0.00	4.46	100.0	1.60	0.00	0.00	1.51	0.00	0.00	2.20	25.9	0.00	0.00
	100	100	100	100	100	0	100	100	100	100	100	100	100	100



Lorax Enviromental Services
16607-101
MI7007-MAR18

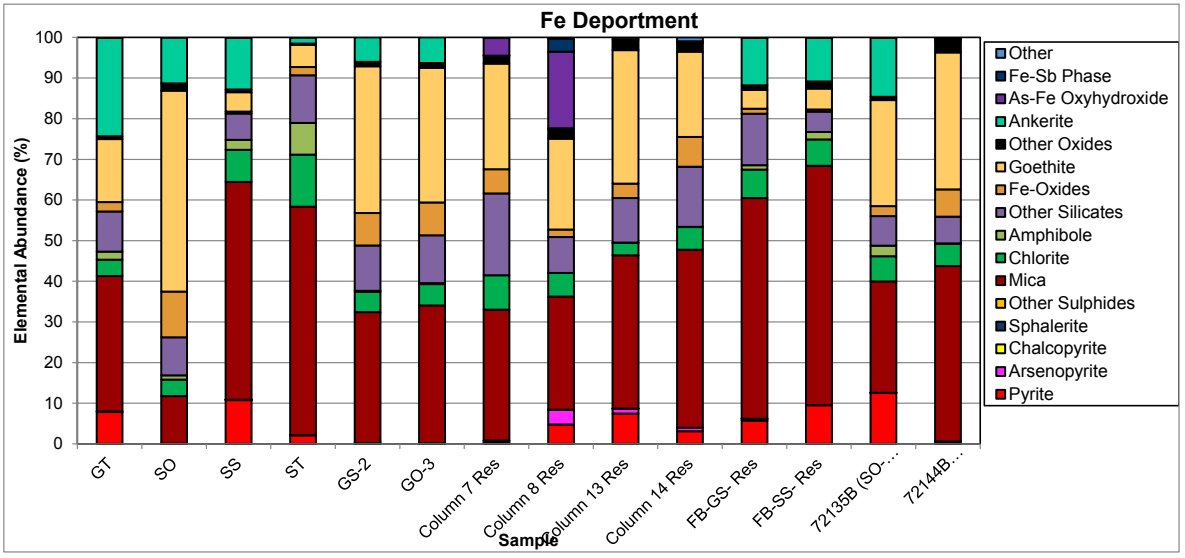
Fe Deportment

Absolute

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.100	0.001	0.364	0.071	0.002	0.002	0.003	0.080	0.076	0.022	0.115	0.331	0.266	0.002
Arsenopyrite	0.002	0.000	0.002	0.000	0.000	0.000	0.008	0.060	0.013	0.006	0.009	0.000	0.001	0.007
Chalcopyrite	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000
Sphalerite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other Sulphides	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mica	0.426	0.369	1.815	1.870	0.444	0.444	0.433	0.465	0.384	0.316	1.097	2.045	0.583	0.689
Chlorite	0.051	0.130	0.267	0.426	0.069	0.069	0.113	0.097	0.031	0.040	0.142	0.225	0.132	0.088
Amphibole	0.026	0.032	0.083	0.259	0.003	0.003	0.000	0.000	0.001	0.000	0.022	0.063	0.055	0.000
Other Silicates	0.126	0.296	0.220	0.390	0.154	0.154	0.271	0.148	0.112	0.107	0.255	0.174	0.155	0.105
Fe-Oxides	0.030	0.355	0.016	0.068	0.110	0.106	0.080	0.031	0.036	0.053	0.026	0.018	0.052	0.107
Goethite	0.198	1.562	0.162	0.181	0.497	0.435	0.349	0.373	0.335	0.151	0.093	0.179	0.555	0.538
Other Oxides	0.009	0.057	0.022	0.010	0.015	0.015	0.026	0.041	0.026	0.016	0.023	0.061	0.017	0.045
Ankerite	0.310	0.356	0.434	0.051	0.083	0.083	0.000	0.002	0.006	0.000	0.236	0.376	0.309	0.008
As-Fe Oxyhydroxide	0.000	0.001	0.000	0.000	0.000	0.000	0.059	0.315	0.000	0.002	0.000	0.000	0.001	0.000
Fe-Sb Phase	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.054	0.000	0.000	0.002	0.000	0.000	0.000
Other	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.000	0.007	0.000	0.000	0.002	0.006
Total	1.278	3.158	3.387	3.327	1.377	1.310	1.344	1.670	1.020	0.721	2.021	3.473	2.127	1.596

Normalized

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	7.83	0.03	10.8	2.14	0.18	0.18	0.24	4.77	7.44	3.11	5.70	9.53	12.5	0.15
Arsenopyrite	0.14	0.01	0.06	0.00	0.00	0.00	0.57	3.61	1.23	0.84	0.45	0.00	0.03	0.44
Chalcopyrite	0.00	0.01	0.02	0.02	0.01	0.01	0.00	0.02	0.01	0.02	0.04	0.02	0.01	0.00
Sphalerite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Sulphides	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Mica	33.3	11.7	53.6	56.2	32.2	33.8	32.2	27.8	37.7	43.8	54.3	58.9	27.4	43.1
Chlorite	4.02	4.10	7.87	12.8	5.01	5.27	8.44	5.79	3.02	5.54	7.04	6.48	6.21	5.52
Amphibole	2.00	1.00	2.45	7.80	0.23	0.24	0.00	0.01	0.11	0.04	1.08	1.81	2.59	0.03
Other Silicates	9.85	9.36	6.48	11.7	11.2	11.7	20.1	8.85	10.9	14.8	12.6	5.02	7.27	6.60
Fe-Oxides	2.36	11.3	0.49	2.04	7.97	8.08	5.98	1.84	3.57	7.32	1.27	0.51	2.43	6.70
Goethite	15.5	49.5	4.78	5.45	36.1	33.2	26.0	22.3	32.9	21.0	4.61	5.16	26.1	33.7
Other Oxides	0.71	1.80	0.65	0.29	1.10	1.16	1.93	2.46	2.53	2.20	1.13	1.74	0.78	2.83
Ankerite	24.2	11.3	12.8	1.52	6.00	6.30	0.02	0.11	0.57	0.03	11.7	10.8	14.5	0.49
As-Fe Oxyhydroxide	0.01	0.02	0.00	0.00	0.00	0.00	4.37	18.8	0.01	0.34	0.01	0.00	0.05	0.01
Fe-Sb Phase	0.04	0.00	0.03	0.01	0.00	0.00	0.00	3.23	0.00	0.00	0.09	0.01	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.29	0.00	0.96	0.00	0.00	0.07	0.36
	100	100	100	100	100	100	100	100	100	100	100	100	100	100



Lorax Enviromental Services
16607-101
MI7007-MAR18

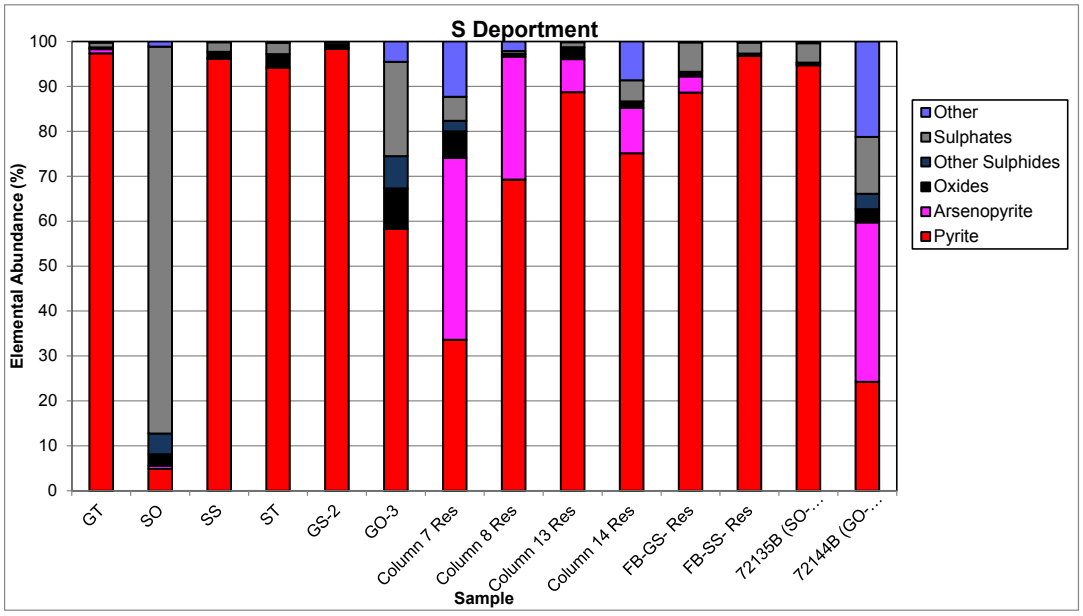
S Deportment

Absolute

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.11007	0.00120	0.41704	0.07036	0.29144	0.00256	0.00365	0.08774	0.08649	0.02577	0.12978	0.37625	0.29088	0.00278
Arsenopyrite	0.00106	0.00016	0.00117	0.00000	0.00113	0.00000	0.00440	0.03462	0.00719	0.00347	0.00520	0.00000	0.00034	0.00407
Other Sulphides	0.00022	0.00063	0.00558	0.00224	0.00171	0.00040	0.00064	0.00053	0.00256	0.00049	0.00154	0.00195	0.00103	0.00034
Oxides	0.00014	0.00114	0.00000	0.00000	0.00000	0.00032	0.00025	0.00027	0.00000	0.00000	0.00000	0.00000	0.00040	0.00039
Sulphates	0.00121	0.02116	0.00916	0.00191	0.00149	0.00092	0.00058	0.00078	0.00109	0.00161	0.00954	0.00949	0.01331	0.00145
Other	0.00034	0.00028	0.00078	0.00021	0.00059	0.00020	0.00134	0.00270	0.00017	0.00296	0.00033	0.00092	0.00114	0.00243
Total	0.11304	0.02457	0.43373	0.07472	0.29636	0.00440	0.01087	0.12664	0.09749	0.03430	0.14639	0.38861	0.30710	0.01146

Normalized

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	97.4	4.89	96.2	94.2	98.3	58.3	33.6	69.3	88.7	75.1	88.7	96.8	94.7	24.2
Arsenopyrite	0.94	0.65	0.27	0.00	0.38	0.00	40.5	27.3	7.37	10.1	3.55	0.00	0.11	35.5
Oxides	0.19	2.57	1.29	2.99	0.58	9.03	5.89	0.42	2.63	1.44	1.05	0.50	0.33	2.96
Other Sulphides	0.19	4.62	0.00	0.00	0.00	7.18	2.34	0.21	0.00	0.00	0.00	0.00	0.13	3.41
Sulphates	1.07	86.1	2.11	2.56	0.50	21.0	5.38	0.62	1.12	4.69	6.52	2.44	4.33	12.7
Other	0.30	1.16	0.18	0.27	0.20	4.53	12.3	2.13	0.17	8.63	0.22	0.24	0.37	21.2
	100	100	100	100	100	100	100	100	100	100	100	100	100	100



Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
Accelerating potential = 15 kV; beam current = 20 nA; focused beam.
Standards for pyrite: natural pyrite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Standards for arsenopyrite: synthetic pyrrhotite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Precision and detection limit are calculated at far right of sheet.

Pyrite

	Element Weight %									Normalised Weight %							
Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.03	0.03	0.03	0.03		0.07	0.03	0.04	0.03	0.03	0.03	0.03	
1	GT pyrite 01	44.3	0.00	0.00	3.79	50.7	0.32	0.00	99.1	44.7	0.00	0.00	3.82	51.1	0.32	0.00	100.0
2	GT pyrite 02	46.0	0.00	0.02	0.35	52.8	0.07	0.02	99.3	46.4	0.00	0.02	0.35	53.2	0.07	0.02	100.0
3	GT pyrite 03	43.8	0.00	0.00	6.03	48.6	0.06	0.05	98.6	44.4	0.00	0.00	6.12	49.3	0.06	0.05	100.0
4	GT pyrite 04	45.4	0.00	0.00	0.02	53.0	0.18	0.01	98.6	46.0	0.00	0.00	0.02	53.8	0.18	0.01	100.0
5	GT pyrite 05	46.4	0.01	0.00	0.36	53.3	0.00	0.01	100.0	46.4	0.01	0.00	0.36	53.3	0.00	0.01	100.0
6	GT pyrite 06	44.0	0.00	0.01	6.01	48.1	0.23	0.02	98.3	44.7	0.00	0.01	6.11	48.9	0.24	0.02	100.0
7	GT pyrite 07	46.7	0.01	0.00	0.00	53.8	0.00	0.03	100.5	46.5	0.01	0.00	0.00	53.5	0.00	0.03	100.0
8	GT pyrite 08	41.3	0.02	0.01	7.49	47.0	0.39	0.00	96.2	42.9	0.03	0.01	7.79	48.9	0.41	0.00	100.0
9	GT pyrite 09	46.4	0.00	0.05	0.03	53.6	0.01	0.00	100.2	46.3	0.00	0.05	0.03	53.6	0.01	0.00	100.0
10	GT pyrite 10	45.4	0.00	0.02	1.26	52.9	0.14	0.18	99.9	45.5	0.00	0.02	1.26	52.9	0.14	0.18	100.0
11	GT pyrite 11	46.9	0.01	0.00	0.40	53.0	0.01	0.02	100.3	46.8	0.01	0.00	0.40	52.8	0.01	0.02	100.0
12	GT pyrite 12	46.6	0.00	0.02	0.59	52.5	0.01	0.00	99.8	46.7	0.00	0.02	0.59	52.6	0.01	0.00	100.0
13	GT pyrite 13	44.6	0.00	0.00	4.49	49.6	0.07	0.00	98.8	45.2	0.00	0.00	4.55	50.2	0.07	0.00	100.0
14	GT pyrite 14	46.7	0.00	0.00	0.02	53.4	0.02	0.00	100.2	46.6	0.00	0.00	0.02	53.3	0.02	0.00	100.0
15	GT pyrite 15	42.7	0.00	0.00	7.63	46.9	0.89	0.00	98.1	43.5	0.00	0.00	7.78	47.8	0.91	0.00	100.0
16	GT pyrite 16	45.9	0.01	0.02	0.62	52.9	0.00	0.00	99.4	46.2	0.01	0.02	0.63	53.2	0.00	0.00	100.0
17	GT pyrite 17	47.3	0.04	0.01	0.00	53.3	0.00	0.00	100.7	47.0	0.04	0.01	0.00	53.0	0.00	0.00	100.0
18	GT pyrite 18	46.5	0.00	0.00	0.05	53.4	0.01	0.00	99.9	46.5	0.00	0.00	0.05	53.4	0.01	0.00	100.0
19	GT pyrite 19	45.6	0.02	0.00	2.91	51.6	0.02	0.02	100.1	45.5	0.02	0.00	2.91	51.5	0.02	0.02	100.0
20	GT pyrite 20	46.2	0.00	0.03	0.00	53.3	0.05	0.00	99.6	46.4	0.00	0.03	0.00	53.5	0.05	0.00	100.0
21	GT pyrite 21	46.6	0.00	0.00	0.01	53.6	0.03	0.01	100.2	46.5	0.00	0.00	0.01	53.5	0.03	0.01	100.0
22	GT pyrite 22	45.1	0.03	0.04	0.88	52.3	0.06	0.01	98.4	45.8	0.03	0.04	0.90	53.2	0.06	0.01	100.0
23	GT pyrite 23	46.0	0.00	0.02	0.36	53.1	0.03	0.02	99.6	46.2	0.00	0.02	0.36	53.3	0.03	0.02	100.0
24	GT pyrite 24	44.3	0.02	0.01	6.61	48.3	0.02	0.04	99.3	44.6	0.02	0.01	6.66	48.6	0.02	0.04	100.0
25	GT pyrite 25	46.5	0.01	0.00	0.27	53.3	0.00	0.00	100.1	46.4	0.01	0.00	0.27	53.3	0.00	0.00	100.0
	Max	47.3	0.04	0.05	7.63	53.8	0.89	0.18	100.7	47.0	0.04	0.05	7.79	53.8	0.91	0.18	100.0
	Min	41.3	0.00	0.00	0.00	46.9	0.00	0.00	96.2	42.9	0.00	0.00	0.00	47.8	0.00	0.00	100.0
	Ave	45.5	0.01	0.01	2.01	51.8	0.11	0.02	99.4	45.8	0.01	0.01	2.04	52.1	0.11	0.02	100.0

Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.03	0.03	0.03	0.03		0.07	0.03	0.04	0.03	0.03	0.03	0.03	
26	ST pyrite 01	46.4	0.01	0.40	0.04	53.7	0.01	0.01	100.5	46.1	0.01	0.40	0.04	53.4	0.01	0.01	100.0
27	ST pyrite 02	47.1	0.12	0.04	0.01	53.8	0.02	0.00	101.0	46.6	0.12	0.04	0.01	53.2	0.02	0.00	100.0
28	ST pyrite 03	46.9	0.02	0.00	0.00	53.5	0.01	0.01	100.4	46.7	0.02	0.00	0.00	53.2	0.01	0.00	100.0
29	ST pyrite 04	46.5	0.00	0.08	0.02	53.6	0.01	0.01	100.2	46.4	0.00	0.08	0.02	53.5	0.01	0.01	100.0
30	ST pyrite 05	46.5	0.01	0.11	0.00	53.6	0.03	0.03	100.3	46.3	0.01	0.11	0.00	53.5	0.03	0.03	100.0
31	ST pyrite 06	46.0	0.04	0.02	0.00	53.6	0.02	0.02	99.7	46.2	0.04	0.02	0.00	53.7	0.02	0.02	100.0
32	ST pyrite 07	46.3	0.03	0.43	0.03	53.3	0.00	0.01	100.1	46.2	0.03	0.43	0.03	53.3	0.00	0.01	100.0
33	ST pyrite 08	46.4	0.00	0.05	0.12	53.3	0.02	0.08	100.0	46.4	0.00	0.05	0.12	53.3	0.02	0.08	100.0
34	ST pyrite 09	45.7	0.00	0.04	0.41	53.3	0.06	0.00	99.5	46.0	0.00	0.04	0.42	53.5	0.06	0.00	100.0
35	ST pyrite 10	46.5	0.09	0.04	0.00	53.8	0.01	0.05	100.5	46.3	0.09	0.04	0.00	53.5	0.01	0.05	100.0
36	ST pyrite 11	46.4	0.01	0.03	0.00	53.6	0.00	0.03	100.0	46.3	0.01	0.03	0.00	53.6	0.00	0.03	100.0
37	ST pyrite 12	46.5	0.20	0.03	0.01	53.6	0.02	0.02	100.4	46.3	0.20	0.03	0.01	53.4	0.02	0.02	100.0
38	ST pyrite 13	46.9	0.01	0.04	0.09	53.7	0.01	0.02	100.8	46.5	0.01	0.04	0.09	53.3	0.01	0.01	100.0
39	ST pyrite 14	46.2	0.01	0.02	0.00	53.6	0.04	0.27	100.1	46.1	0.01	0.02	0.00	53.5	0.04	0.27	100.0
40	ST pyrite 15	45.7	0.14	0.04	0.01	53.5	0.01	0.02	99.4	45.9	0.14	0.04	0.01	53.8	0.01	0.02	100.0
	Max	47.1	0.20	0.43	0.41	53.8	0.06	0.27	101.0	46.7	0.20	0.43	0.42	53.8	0.06	0.27	100.0
	Min	45.7	0.00	0.00	0.00	53.3	0.00	0.00	99.4	45.9	0.00	0.00	0.00	53.2	0.00	0.00	100.0
	Ave	46.4	0.05	0.09	0.05	53.6	0.02	0.04	100.2	46.3	0.05	0.09	0.05	53.5	0.02	0.04	100.0

Pyrite

	Element Weight %								Normalised Weight %							
Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.03	0.03	0.03	0.03		0.07	0.03	0.04	0.03	0.03	0.03	0.03	
41	Column 13 pyrite 01	45.6	0.00	0.00	0.06	52.2	0.11	0.00	97.9	46.5	0.00	0.00	0.06	53.3	0.12	0.00	100.0
42	Column 13 pyrite 02	45.5	0.00	0.01	0.01	53.7	0.09	0.00	99.3	45.8	0.00	0.01	0.01	54.1	0.09	0.00	100.0
43	Column 13 pyrite 03	45.4	0.00	0.00	0.58	53.0	0.09	0.01	99.1	45.8	0.00	0.00	0.59	53.5	0.09	0.01	100.0
44	Column 13 pyrite 04	46.2	0.01	0.00	0.99	53.1	0.02	0.00	100.4	46.1	0.01	0.00	0.99	52.9	0.02	0.00	100.0
45	Column 13 pyrite 05	45.5	0.00	0.00	0.19	52.8	0.20	0.04	98.7	46.1	0.00	0.00	0.20	53.5	0.20	0.04	100.0
46	Column 13 pyrite 06	46.0	0.00	0.01	0.14	53.6	0.06	0.00	99.8	46.1	0.00	0.01	0.14	53.7	0.06	0.00	100.0
47	Column 13 pyrite 07	46.0	0.00	0.03	0.03	53.9	0.01	0.00	100.0	46.0	0.00	0.03	0.03	53.9	0.01	0.00	100.0
	Max	46.2	0.01	0.03	0.99	53.9	0.20	0.04	100.4	46.5	0.01	0.03	0.99	54.1	0.20	0.04	100.0
	Min	45.4	0.00	0.00	0.01	52.2	0.01	0.00	97.9	45.8	0.00	0.00	0.01	52.9	0.01	0.00	100.0
	Ave	45.7	0.00	0.01	0.29	53.2	0.08	0.01	99.3	46.1	0.00	0.01	0.29	53.6	0.08	0.01	100.0

Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.03	0.03	0.03	0.03		0.07	0.03	0.04	0.03	0.03	0.03	0.03	
48	SS pyrite 01	46.5	0.10	0.02	0.00	53.9	0.00	0.00	100.5	46.2	0.10	0.02	0.00	53.7	0.00	0.00	100.0
49	SS pyrite 02	46.2	0.08	0.05	0.00	54.3	0.00	0.01	100.6	45.9	0.08	0.05	0.00	53.9	0.00	0.01	100.0
50	SS pyrite 03	46.3	0.40	0.02	0.00	53.6	0.00	0.04	100.3	46.1	0.40	0.02	0.00	53.4	0.00	0.04	100.0
51	SS pyrite 04	46.3	0.21	0.03	0.00	53.7	0.01	0.00	100.3	46.2	0.21	0.03	0.00	53.6	0.01	0.00	100.0
52	SS pyrite 05	46.9	0.01	0.11	0.00	53.6	0.01	0.02	100.6	46.6	0.01	0.11	0.00	53.3	0.01	0.02	100.0
53	SS pyrite 06	44.0	0.00	0.85	1.75	52.4	0.08	0.00	99.0	44.4	0.00	0.86	1.77	52.9	0.08	0.00	100.0
54	SS pyrite 07	46.1	0.04	0.01	0.01	53.7	0.00	0.00	99.9	46.2	0.04	0.01	0.01	53.8	0.00	0.00	100.0
55	SS pyrite 08	46.1	0.01	0.01	0.02	54.0	0.00	0.03	100.1	46.0	0.01	0.01	0.02	53.9	0.00	0.03	100.0
56	SS pyrite 09	45.7	0.02	0.00	0.87	52.6	0.08	0.02	99.2	46.0	0.02	0.00	0.87	53.0	0.08	0.02	100.0
57	SS pyrite 10	45.8	0.01	0.00	0.01	53.7	0.01	0.01	99.6	46.0	0.01	0.00	0.01	53.9	0.01	0.01	100.0
58	SS pyrite 11	45.9	0.00	0.01	0.00	53.9	0.01	0.02	99.9	46.0	0.00	0.01	0.00	54.0	0.01	0.02	100.0
59	SS pyrite 12	46.7	0.03	0.04	0.00	53.9	0.01	0.00	100.7	46.4	0.03	0.04	0.00	53.5	0.01	0.00	100.0
60	SS pyrite 13	45.7	0.00	0.00	1.73	52.7	0.02	0.02	100.2	45.6	0.00	0.00	1.73	52.6	0.02	0.02	100.0
61	SS pyrite 14	46.2	0.00	0.00	0.00	53.6	0.00	0.03	99.8	46.3	0.00	0.00	0.00	53.7	0.00	0.03	100.0
62	SS pyrite 15	46.2	0.56	0.02	0.00	53.6	0.01	0.02	100.4	46.0	0.56	0.02	0.00	53.4	0.01	0.02	100.0
63	SS pyrite 16	46.0	0.07	0.00	0.00	53.5	0.00	0.01	99.6	46.2	0.07	0.00	0.00	53.7	0.00	0.01	100.0
64	SS pyrite 17	46.5	0.01	0.05	0.00	54.2	0.00	0.07	100.8	46.1	0.01	0.05	0.00	53.7	0.00	0.07	100.0
65	SS pyrite 18	46.7	0.01	0.01	0.00	53.7	0.00	0.01	100.5	46.5	0.01	0.01	0.00	53.5	0.00	0.01	100.0
66	SS pyrite 19	46.6	0.01	0.01	0.00	54.0	0.00	0.01	100.6	46.4	0.01	0.01	0.00	53.6	0.00	0.01	100.0
67	SS pyrite 20	46.3	0.03	0.01	0.00	53.9	0.00	0.01	100.2	46.2	0.03	0.01	0.00	53.7	0.00	0.01	100.0
68	SS pyrite 21	46.5	0.00	0.09	0.02	53.7	0.03	0.04	100.4	46.3	0.00	0.09	0.02	53.5	0.02	0.04	100.0
	Max	46.9	0.56	0.85	1.75	54.3	0.08	0.07	100.8	46.6	0.56	0.86	1.77	54.0	0.08	0.07	100.0
	Min	44.0	0.00	0.00	0.00	52.4	0.00	0.00	99.0	44.4	0.00	0.00	0.00	52.6	0.00	0.00	100.0
	Ave	46.1	0.08	0.06	0.21	53.6	0.01	0.02	100.2	46.1	0.08	0.06	0.21	53.5	0.01	0.02	100.0

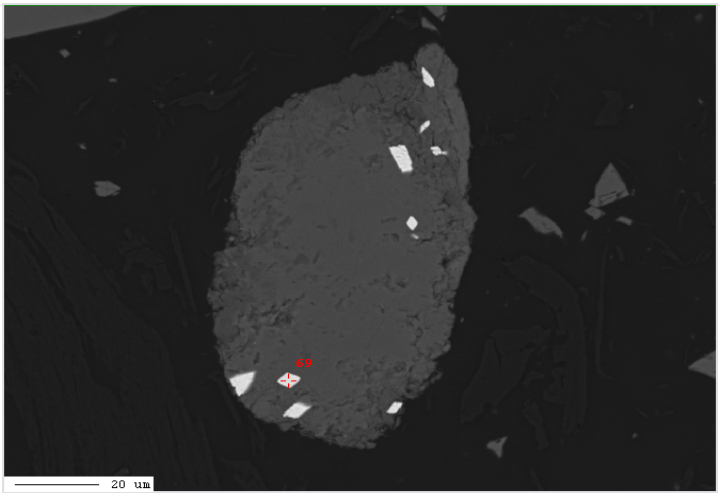
Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)

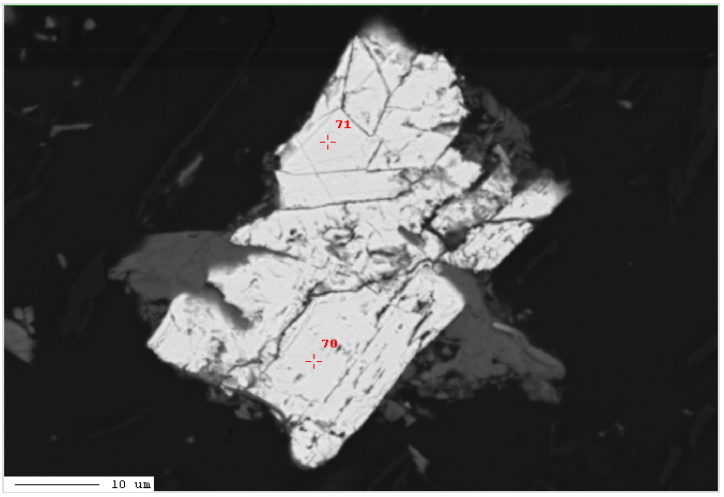
Accelerating potential = 15 kV; beam current = 20 nA; focused beam.
Standards for pyrite: natural pyrite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Standards for arsenopyrite: synthetic pyrrhotite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Precision and detection limit are calculated at far right of sheet.

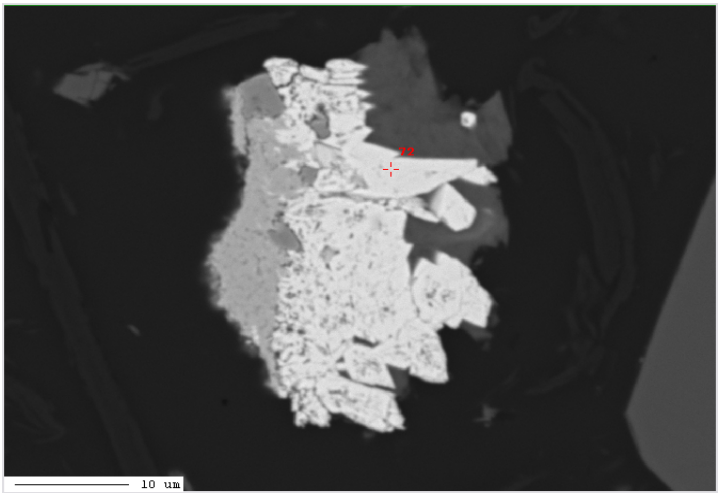
0.07 0.03 0.04 0.11 0.03 0.04 0.03

Arsenopyrite:

		Element Weight %									Normalised Weight %							
Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total		Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.11	0.03	0.04	0.03			0.07	0.03	0.04	0.11	0.03	0.04	0.03	
69	Column 13 arsenopyrite 01	33.6	0.00	0.01	44.7	20.9	0.14	0.00	99.4		33.8	0.00	0.01	45.0	21.0	0.14	0.00	100.0
70	Column 13 arsenopyrite 02	34.9	0.00	0.02	44.7	20.6	0.01	0.00	100.3		34.8	0.00	0.02	44.6	20.6	0.01	0.00	100.0
71	Column 13 arsenopyrite 03	35.5	0.02	0.00	42.9	22.2	0.02	0.00	100.6		35.3	0.02	0.00	42.6	22.1	0.02	0.00	100.0
72	Column 13 arsenopyrite 04	34.3	0.00	0.00	45.2	20.5	0.02	0.00	100.1		34.3	0.00	0.00	45.2	20.5	0.02	0.00	100.0
73	Column 13 arsenopyrite 05	34.2	0.00	0.00	44.3	20.9	0.00	0.00	99.4		34.4	0.00	0.00	44.6	21.0	0.00	0.00	100.0
74	Column 13 arsenopyrite 06	34.3	0.00	0.02	44.7	20.8	0.01	0.00	99.8		34.3	0.00	0.02	44.8	20.8	0.01	0.00	100.0
75	Column 13 arsenopyrite 07	35.0	0.00	0.00	43.2	21.7	0.02	0.01	99.8		35.0	0.00	0.00	43.2	21.7	0.02	0.01	100.0
76	Column 13 arsenopyrite 08	34.7	0.00	0.00	44.5	21.6	0.10	0.00	100.8		34.4	0.00	0.00	44.1	21.4	0.10	0.00	100.0
77	Column 13 arsenopyrite 09	34.6	0.01	0.00	44.3	21.3	0.03	0.01	100.2		34.6	0.01	0.00	44.2	21.2	0.03	0.01	100.0
	Max	35.5	0.02	0.02	45.2	22.2	0.14	0.01	100.8		35.3	0.02	0.02	45.2	22.1	0.14	0.01	100.0
	Min	33.6	0.00	0.00	42.9	20.5	0.00	0.00	99.4		33.8	0.00	0.00	42.6	20.5	0.00	0.00	100.0
	Ave	34.6	0.00	0.01	44.3	21.2	0.04	0.00	100.0		34.5	0.00	0.01	44.3	21.2	0.04	0.00	100.0

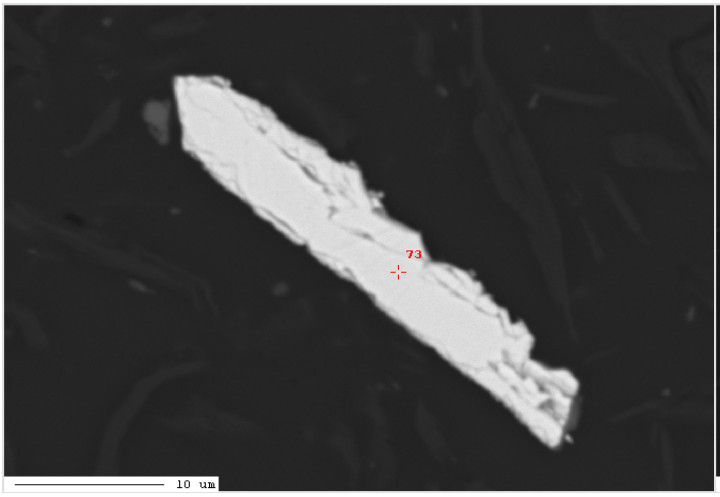


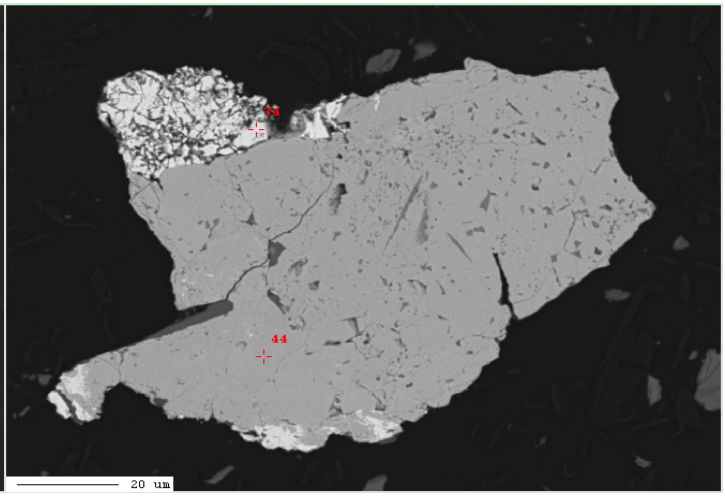


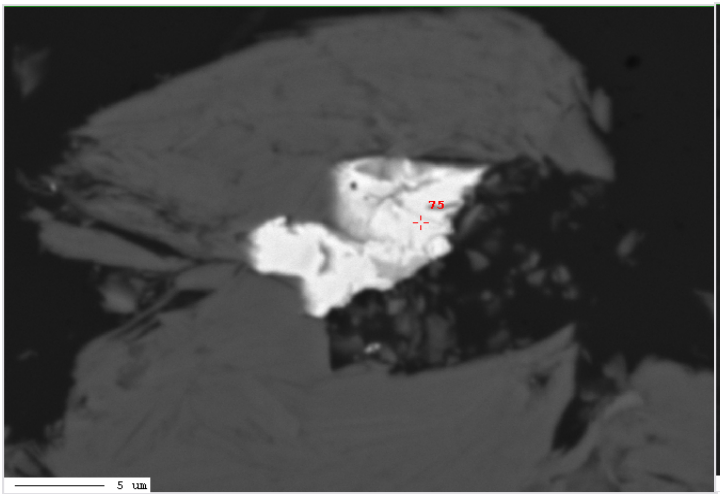


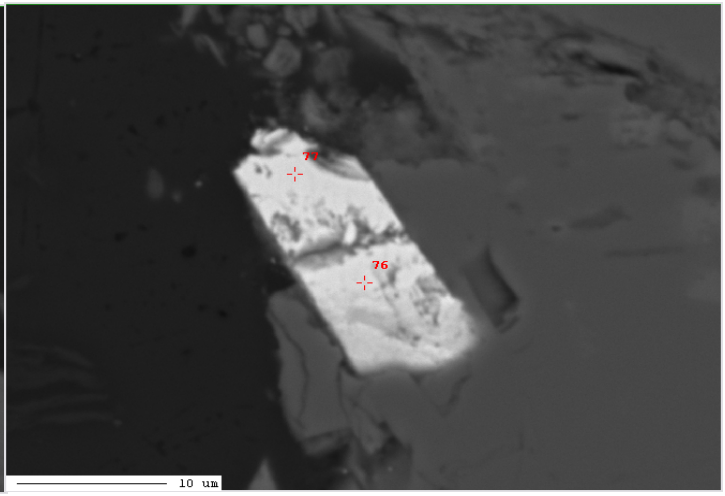
Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)

Accelerating potential = 15 kV; beam current = 20 nA; focused beam.
Standards for pyrite: natural pyrite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Standards for arsenopyrite: synthetic pyrrhotite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Precision and detection limit are calculated at far right of sheet.









Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
Accelerating potential = 15 kV; beam current = 20 nA; beam diameter = 5 microns.
Standards: natural forsterite (Si, Mg), natural rutile (Ti), natural anorthite (Al, Ca), synthetic magnetite (Fe), natural rhodonite (Mn), natural albite (Na), natural adularia (K), synthetic Ca2P2O7 (P), synthetic loellingite (As), natural anhydrite (S)
Precision and detection limit are calculated at far right of sheet.

		Oxide Weight %														Normalised Weight %												Oxide Mole % excluding H2O											
Point	**Comment**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**H2O (by difference)**	**Total**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**H2O (by difference)**	**Total**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**Total**
1	GT Fe oxide 01	6.22	0.00	0.91	78.1	0.06	0.38	0.49	0.04	0.03	0.44	1.35	0.02	12.0	100.0	6.22	0.00	0.91	78.1	0.06	0.38	0.49	0.04	0.03	0.44	1.35	0.02	12.0	100.0	9.09	0.00	1.56	85.9	0.08	0.83	0.77	0.12	0.05	0.55	1.03	0.02	100.0
2	GT Fe oxide 02	3.37	0.84	1.25	88.8	0.00	0.01	0.07	0.09	0.06	0.00	0.49	0.02	4.98	100.0	3.37	0.84	1.25	88.8	0.00	0.01	0.07	0.09	0.06	0.00	0.49	0.02	4.98	100.0	4.62	0.87	2.02	91.6	0.00	0.01	0.11	0.24	0.11	0.00	0.35	0.02	100.0
3	GT Fe oxide 03	4.46	0.00	2.48	74.0	0.05	0.42	0.48	0.03	0.06	0.44	0.92	0.14	16.5	100.0	4.46	0.00	2.48	74.0	0.05	0.42	0.48	0.03	0.06	0.44	0.92	0.14	16.5	100.0	6.83	0.00	4.47	85.2	0.06	0.95	0.79	0.10	0.12	0.57	0.74	0.17	100.0
4	GT Fe oxide 04	8.00	0.00	3.74	67.9	0.07	0.45	1.01	0.01	0.51	0.12	2.85	0.11	15.3	100.0	8.00	0.00	3.74	67.8	0.07	0.45	1.01	0.01	0.51	0.12	2.85	0.11	15.3	100.0	11.8	0.00	6.51	75.5	0.09	0.99	1.61	0.03	0.96	0.15	2.20	0.12	100.0
5	GT Fe oxide 05	3.07	0.00	0.33	83.4	0.03	0.67	0.36	0.02	0.00	0.36	0.50	0.16	11.1	100.0	3.07	0.00	0.33	83.4	0.03	0.67	0.36	0.02	0.00	0.36	0.50	0.16	11.1	100.0	4.50	0.00	0.57	91.8	0.04	1.46	0.56	0.05	0.00	0.44	0.38	0.18	100.0
6	GT Fe oxide 06	2.87	0.00	1.15	75.4	0.04	0.35	0.87	0.04	0.00	0.44	2.81	0.07	15.9	100.0	2.87	0.00	1.15	75.4	0.04	0.35	0.87	0.04	0.00	0.44	2.81	0.07	15.9	100.0	4.44	0.00	2.10	88.1	0.05	0.81	1.44	0.13	0.01	0.58	2.28	0.08	100.0
7	GT Fe oxide 07	2.82	0.00	0.84	72.6	0.02	0.34	1.31	0.07	0.01	0.99	4.29	0.09	16.7	100.0	2.82	0.00	0.84	72.6	0.02	0.34	1.31	0.07	0.01	0.99	4.29	0.09	16.6	100.0	4.43	0.00	1.56	85.8	0.03	0.79	2.21	0.22	0.01	1.32	3.52	0.11	100.0
8	GT Fe oxide 08	5.30	0.02	2.74	75.5	0.04	0.35	0.24	0.01	0.06	0.20	0.37	0.04	15.1	100.0	5.30	0.02	2.74	75.5	0.04	0.35	0.24	0.01	0.06	0.20	0.37	0.04	15.1	100.0	7.95	0.02	4.84	85.3	0.05	0.79	0.38	0.02	0.11	0.25	0.29	0.04	100.0
9	GT Fe oxide 09	6.04	0.00	0.76	73.6	0.02	0.25	0.83	0.02	0.04	0.44	2.57	0.00	15.4	100.0	6.04	0.00	0.76	73.6	0.02	0.25	0.83	0.02	0.04	0.44	2.57	0.00	15.4	100.0	9.22	0.00	1.38	84.7	0.03	0.58	1.36	0.05	0.09	0.57	2.05	0.00	100.0
10	GT Fe oxide 10	3.25	0.02	0.16	86.6	0.01	0.26	0.49	0.00	0.01	0.33	0.76	0.36	7.74	100.0	3.25	0.02	0.16	86.6	0.01	0.26	0.49	0.00	0.01	0.33	0.76	0.36	7.74	100.0	4.61	0.02	0.27	92.4	0.01	0.55	0.74	0.00	0.02	0.39	0.56	0.39	100.0
11	GT Fe oxide 11	1.41	0.00	2.46	72.7	0.19	0.77	1.22	0.03	0.02	0.56	4.06	0.04	16.6	100.0	1.41	0.00	2.46	72.7	0.19	0.77	1.22	0.03	0.02	0.56	4.06	0.04	16.5	100.0	2.20	0.00	4.51	85.0	0.25	1.78	2.04	0.10	0.04	0.74	3.29	0.05	100.0
12	GT Fe oxide 12	8.16	0.01	0.65	78.5	0.24	0.49	0.97	0.01	0.09	0.10	0.28	0.15	10.4	100.0	8.16	0.01	0.65	78.4	0.24	0.49	0.97	0.01	0.09	0.10	0.28	0.15	10.4	100.0	11.6	0.01	1.09	83.8	0.29	1.04	1.48	0.02	0.16	0.12	0.20	0.16	100.0
13	GT Fe oxide 13	0.49	0.88	0.24	95.1	0.03	0.13	0.03	0.03	0.04	0.00	0.00	0.02	3.06	100.0	0.49	0.88	0.24	95.1	0.03	0.13	0.03	0.03	0.04	0.00	0.00	0.02	3.05	100.0	0.67	0.91	0.39	97.5	0.03	0.26	0.04	0.07	0.07	0.00	0.00	0.02	100.0
14	GT Fe oxide 14	2.72	0.01	1.34	74.0	0.05	0.34	1.60	0.01	0.08	0.45	4.50	0.13	14.7	100.0	2.72	0.01	1.34	74.0	0.05	0.34	1.60	0.01	0.08	0.45	4.50	0.13	14.7	100.0	4.17	0.02	2.43	85.4	0.07	0.78	2.62	0.04	0.17	0.59	3.60	0.15	100.0
15	GT Fe oxide 15	0.14	0.00	0.00	101.3	0.03	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.00	101.6	0.14	0.00	0.00	99.8	0.03	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.00	100.0	0.19	0.00	0.00	99.7	0.04	0.00	0.02	0.02	0.03	0.00	0.01	0.01	100.0
16	GT Fe oxide 16	2.51	0.00	0.04	84.5	0.04	0.52	0.64	0.01	0.01	0.04	0.36	0.26	11.1	100.0	2.51	0.00	0.04	84.5	0.04	0.52	0.64	0.01	0.01	0.04	0.36	0.26	11.1	100.0	3.68	0.00	0.07	93.4	0.04	1.14	1.01	0.03	0.02	0.05	0.28	0.28	100.0
17	GT Fe oxide 17	1.56	0.00	1.69	71.0	0.16	0.31	1.62	0.03	0.00	1.29	5.40	0.09	16.9	100.0	1.56	0.00	1.69	71.0	0.16	0.31	1.62	0.03	0.00	1.29	5.40	0.09	16.9	100.0	2.46	0.00	3.14	84.3	0.21	0.73	2.73	0.10	0.01	1.73	4.46	0.10	100.0
18	GT Fe oxide 18	1.45	0.00	1.52	71.6	0.14	0.32	1.55	0.07	0.01	1.14	5.26	0.11	16.8	100.0	1.45	0.00	1.52	71.6	0.14	0.32	1.55	0.07	0.01	1.14	5.26	0.11	16.8	100.0	2.29	0.01	2.82	85.1	0.19	0.74	2.63	0.22	0.03	1.53	4.34	0.13	100.0
19	GT Fe oxide 19	4.86	0.00	1.33	72.6	0.06	0.54	0.64	0.00	0.03	0.58	2.01	0.02	17.4	100.0	4.86	0.00	1.33	72.6	0.06	0.54	0.64	0.00	0.03	0.58	2.01	0.02	17.3	100.0	7.57	0.00	2.45	85.1	0.07	1.26	1.06	0.00	0.06	0.77	1.64	0.02	100.0
20	GT Fe oxide 20	4.45	0.01	0.98	76.3	0.09	0.57	1.10	0.00	0.03	0.55	3.07	0.16	12.7	100.0	4.45	0.01	0.98	76.3	0.09	0.57	1.10	0.00	0.03	0.55	3.07	0.16	12.7	100.0	6.60	0.01	1.72	85.3	0.11	1.25	1.74	0.00	0.07	0.69	2.38	0.18	100.0
	Max	8.16	0.88	3.74	101.3	0.24	0.77	1.62	0.09	0.51	1.29	5.40	0.36	17.4	101.6	8.16	0.88	3.74	99.8	0.24	0.77	1.62	0.09	0.51	1.29	5.40	0.36	17.3	100.0	11.8	0.91	6.51	99.7	0.29	1.78	2.73	0.24	0.96	1.73	4.46	0.39	100.0
	Min	0.14	0.00	0.00	67.9	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	100.0	0.14	0.00	0.00	67.8	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	100.0	0.19	0.00	0.00	75.5	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	100.0
	Ave	3.66	0.09	1.23	78.7	0.07	0.37	0.78	0.03	0.06	0.42	2.09	0.10	12.5	100.1	3.66	0.09	1.23	78.6	0.07	0.37	0.78	0.03	0.06	0.42	2.09	0.10	12.5	100.0	5.45	0.09	2.19	87.5	0.09	0.84	1.27	0.08	0.11	0.55	1.68	0.11	100.0

Point	**Comment**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**H2O (by difference)**	**Total**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**H2O (by difference)**	**Total**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**Total**
21	ST Fe oxide 01	2.91	0.00	0.00	83.4	0.00	0.26	0.37	0.00	0.01	0.01	0.02	2.84	10.2	100.0	2.91	0.00	0.00	83.4	0.00	0.26	0.37	0.00	0.01	0.01	0.02	2.84	10.2	100.0	4.25	0.00	0.00	91.5	0.00	0.56	0.58	0.00	0.02	0.01	0.01	3.11	100.0
22	ST Fe oxide 02	3.37	0.00	0.31	87.5	0.00	0.21	0.45	0.03	0.01	0.03	0.24	0.14	7.69	100.0	3.37	0.00	0.31	87.5	0.00	0.21	0.45	0.03	0.01	0.03	0.24	0.14	7.69	100.0	4.76	0.00	0.51	93.1	0.00	0.44	0.69	0.07	0.02	0.03	0.18	0.15	100.0
23	ST Fe oxide 03	6.99	0.01	1.22	73.3	0.12	0.40	0.61	0.05	0.00	0.03	0.75	0.18	16.3	100.0	6.99	0.01	1.22	73.3	0.12	0.40	0.61	0.05	0.00	0.03	0.75	0.18	16.3	100.0	10.7	0.02	2.19	84.1	0.16	0.91	0.99	0.15	0.00	0.04	0.60	0.20	100.0
24	ST Fe oxide 04	4.62	0.04	0.72	84.1	0.00	0.17	0.45	0.00	0.02	0.03	0.33	0.20	9.37	100.0	4.62	0.04	0.72	84.1	0.00	0.17	0.45	0.00	0.02	0.03	0.33	0.20	9.37	100.0	6.62	0.05	1.21	90.5	0.00	0.37	0.68	0.00	0.04	0.03	0.24	0.22	100.0
25	ST Fe oxide 05	7.08	0.09	0.63	70.3	2.56	1.03	0.53	0.00	0.04	0.29	0.10	0.03	17.3	100.0	7.08	0.09	0.63	70.3	2.56	1.03	0.53	0.00	0.04	0.29	0.10	0.03	17.3	100.0	10.8	0.10	1.14	80.8	3.32	2.36	0.86	0.00	0.08	0.38	0.08	0.03	100.0
26	ST Fe oxide 06	0.06	0.00	0.02	101.1	0.02	0.01	0.05	0.00	0.01	0.01	0.02	0.00	0.00	101.3	0.06	0.00	0.02	99.8	0.02	0.01	0.05	0.00	0.01	0.01	0.02	0.00	0.00	100.0	0.08	0.00	0.03	99.7	0.02	0.02	0.07	0.00	0.02	0.01	0.02	0.00	100.0
27	ST Fe oxide 08	2.97	0.02	0.21	86.7	0.08	0.13	0.60	0.05	0.01	0.06	1.19	0.13	7.84	100.0	2.97	0.02	0.21	86.7	0.08	0.13	0.60	0.05	0.01	0.06	1.19	0.13	7.84	100.0	4.22	0.02	0.34	92.9	0.10	0.27	0.92	0.13	0.02	0.07	0.88	0.14	100.0
28	ST Fe oxide 09	3.12	0.00	0.10	84.1	0.05	0.19	0.40	0.00	0.02	0.04	0.02	0.08	11.9	100.0	3.12	0.00	0.10	84.0	0.05	0.19	0.40	0.00	0.02	0.04	0.02	0.08	11.9	100.0	4.63	0.00	0.17	93.9	0.06	0.41	0.64	0.00	0.05	0.05	0.02	0.09	100.0
29	ST Fe oxide 10	4.10	0.01	0.09	84.6	0.19	0.26	0.54	0.08	0.01	0.15	0.09	0.37	9.57	100.0	4.10	0.01	0.09	84.6	0.19	0.26	0.54	0.08	0.01	0.15	0.09	0.37	9.57	100.0	5.88	0.01	0.15	91.5	0.23	0.56	0.83	0.22	0.02	0.18	0.07	0.40	100.0
30	ST Fe oxide 11	17.1	0.20	1.92	44.8	0.05	0.00	1.08	0.03	0.24	0.24	0.00	0.01	34.4	100.0	17.1	0.20	1.92	44.8	0.05	0.00	1.08	0.02	0.24	0.24	0.00	0.01	34.4	100.0	31.1	0.27	4.10	61.3	0.07	0.01	2.10	0.09	0.55	0.37	0.00	0.01	100.0
31	ST Fe oxide 12	3.71	0.00	0.20	85.7	0.13	0.13	0.49	0.02	0.02	0.14	0.30	0.07	9.10	100.0	3.71	0.00	0.20	85.7	0.13	0.13	0.49	0.02	0.02	0.14	0.30	0.07	9.10	100.0	5.34	0.00	0.33	92.6	0.16	0.27	0.75	0.04	0.03	0.17	0.22	0.07	100.0
32	ST Fe oxide 13	4.54	0.01	0.80	75.6	0.75	0.54	0.32	0.01	0.00	0.05	0.19	0.07	17.1	100.0	4.54	0.01	0.80	75.6	0.75	0.54	0.32	0.01	0.00	0.05	0.19	0.07	17.1	100.0	7.06	0.02	1.47	88.4	0.98	1.24	0.53	0.04	0.00	0.07	0.15	0.08	100.0
33	ST Fe oxide 14	3.07	0.02	0.16	83.5	0.07	0.23	0.42	0.02	0.00	0.06	0.09	0.14	12.2	100.0	3.07	0.02	0.16	83.5	0.07	0.23	0.42	0.02	0.00	0.06	0.09	0.14	12.2	100.0	4.57	0.02	0.28	93.5	0.09	0.50	0.67	0.05	0.01	0.07	0.07	0.16	100.0
34	ST Fe oxide 15	5.46	0.02	0.43	75.2	0.07	0.55	0.37	0.00	0.03	0.02	0.23	0.18	17.5	100.0	5.46	0.02	0.43	75.2	0.07	0.55	0.37	0.00	0.03	0.02	0.23	0.18	17.5	100.0	8.52	0.02	0.80	88.2	0.09	1.28	0.62	0.00	0.06	0.03	0.19	0.22	100.0
35	ST Fe oxide 16	3.89	0.00	0.08	85.0	0.05	0.21	0.41	0.00	0.00	0.06	0.05	0.11	10.2	100.0	3.89	0.00	0.08	85.0	0.05	0.21	0.41	0.00	0.00	0.06	0.05	0.11	10.2	100.0	5.65	0.00	0.13	92.9	0.06	0.45	0.63	0.00	0.00	0.07	0.04	0.12	100.0
36	ST Fe oxide 17	3.66	0.00	0.00	84.6	0.00	0.23	0.60	0.04	0.02	0.03	0.00	0.47	10.4	100.0	3.66	0.00	0.00	84.6	0.00	0.23	0.60	0.04	0.02	0.03	0.00	0.47	10.4	100.0	5.32	0.00	0.00	92.6	0.00	0.49	0.93	0.11	0.03	0.04	0.00	0.51	100.0
37	ST Fe oxide 18	0.13	0.33	0.07	0.33	89.2	2.59	2.99	0.19	1.77	0.04	0.00	0.06	2.28	100.0	0.13	0.33	0.07	0.33	89.2	2.59	2.99	0.19	1.77	0.04	0.00	0.06	2.27	100.0	0.16	0.29	0.09	0.29	87.8	4.48	3.72	0.43	2.63	0.04	0.00	0.05	100.0
38	ST Fe oxide 19	3.61	0.02	0.07	85.7	0.08	0.11	0.45	0.00	0.01	0.03	0.08	0.08	9.74	100.0	3.61	0.02	0.07	85.7	0.08	0.11	0.45	0.00	0.01	0.03	0.08	0.08	9.74	100.0	5.23	0.02	0.11	93.4	0.10	0.25	0.70	0.00	0.01	0.04	0.06	0.08	100.0
39	ST Fe oxide 20	2.58	0.02	0.19	83.9	0.21	0.53	0.48	0.00	0.01	0.03	0.20	0.21	11.7	100.0	2.58	0.02	0.19	83.9	0.21	0.53	0.48	0.00	0.01	0.03	0.20	0.21	11.7	100.0	3.81	0.02	0.32	93.2	0.26	1.16	0.76	0.00	0.02	0.04	0.16	0.23	100.0
40	ST Fe oxide 21	2.89	0.00	0.00	81.0	0.02	0.16	0.28	0.03	0.01	0.01	0.03	0.23	15.4	100.0	2.89	0.00	0.00	81.0	0.02	0.16	0.28	0.03	0.01	0.01	0.03	0.23	15.3	100.0	4.47	0.00	0.00	94.3	0.03	0.36	0.47	0.09	0.02	0.01	0.03	0.27	100.0
41	ST Fe oxide 22	3.98	0.01	0.68	84.5	0.07	0.12	0.45	0.00	0.00	0.03	0.03	0.09	10.0	100.0	3.98	0.01	0.68	84.5	0.07	0.12	0.45	0.00	0.00	0.03	0.03	0.09	10.00	100.0	5.75	0.01	1.16	91.9	0.09	0.27	0.69	0.00	0.00	0.04	0.02	0.10	100.0
42	ST Fe oxide 23	3.50	0.02	0.42	82.9	0.03	0.28	0.41	0.01	0.01	0.06	0.21	0.22	11.9	100.0	3.50	0.02	0.42	82.9	0.03	0.28	0.41	0.01	0.01	0.06	0.21	0.22	11.9	100.0	5.18	0.02	0.73	92.3	0.04	0.62	0.65	0.01	0.01	0.07	0.16	0.24	100.0
	Max	17.1	0.33	1.92	101.1	89.2	2.59	2.99	0.19	1.77	0.29	1.19	2.84	34.4	101.3	17.1	0.33	1.92	99.8	89.2	2.59	2.99	0.19	1.77	0.29	1.19	2.84	34.4	100.0	31.1	0.29	4.10	99.7	87.8	4.48	3.72	0.43	2.63	0.38	0.88	3.11	100.0
	Min	0.06	0.00	0.00	0.33	0.00	0.00	0.05	0.00	0.00	0.01	0.00	0.00	0.00	100.0	0.06	0.00	0.00	0.33	0.00	0.00	0.05	0.00	0.00	0.01	0.00	0.00	0.00	100.0	0.08	0.29	0.00	0.29	0.00	0.01	0.07	0.00	0.00	0.01	0.00	0.00	100.0
	Ave	4.24	0.04	0.38	77.6	4.26	0.38	0.58	0.02	0.10	0.06	0.19	0.27	11.9	100.1	4.24	0.04	0.38	77.6	4.26	0.38	0.58	0.02	0.10	0.06	0.19	0.27	11.9	100.0	6.55	0.04	0.69	86.0	4.26	0.79	0.89	0.07	0.17	0.08	0.15	0.29	100.0

Point	**Comment**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**H2O (by difference)**	**Total**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**H2O (by difference)**	**Total**	**SiO2**	**TiO2**	**Al2O3**	**Fe2O3**	**MnO**	**MgO**	**CaO**	**Na2O**	**K2O**	**P2O5**	**As2O5**	**SO3**	**Total**
43	Column 13 Fe oxide 01	3.18	0.10	0.12	92.9	0.16	0.00	0.05	0.00	0.00	0.04	0.00	0.01	3.42	100.0	3.18	0.10	0.12	92.9	0.16	0.00	0.05	0.00	0.00	0.04	0.00	0.01	3.42	100.0	4.32	0.11	0.19	95.1	0.18	0.00	0.07	0.00	0.00	0.04	0.00	0.01	100.0
44	Column 13 Fe oxide 02	0.03	0.05	0.13	98.7	0.10	0.00	0.03	0.03	0.00	0.01	0.00	0.00	0.91	100.0	0.03	0.05	0.13	98.7	0.10	0.00	0.03	0.03	0.00	0.01	0.00	0.00	0.91	100.0	0.04	0.05	0.20	99.5	0.11	0.00	0.04	0.08	0.00	0.01	0.00	0.00	100.0
45	Column 13 Fe oxide 03	0.25	0.05	0.20	92.0	1.47	0.05	0.17	0.01	0.00	0.00	0.00	0.01	5.82	100.0	0.25	0.05	0.20	92.0	1.47	0.05	0.17	0.01	0.00	0.00	0.00	0.01	5.82	100.0	0.35	0.05	0.34	97.1	1.75	0.10	0.25	0.02	0.00	0.00	0.00	0.01	100.0
46	Column 13 Fe oxide 04	0.49	0.24	0.48	95.6	0.10	0.00	0.03	0.01	0.01	0.05	0.09	0.00	2.96	100.0	0.49	0.24	0.48	95.5	0.10	0.00	0.03	0.01	0.01	0.05	0.09	0.00	2.96	100.0	0.66	0.24	0.76	98.0	0.12	0.00	0.04	0.02	0.02	0.06	0.07	0.00	100.0
47	Column 13 Fe oxide 05	4.75	0.14	0.16	90.2	0.40	0.10	0.26	0.00	0.04	0.03	0.03	0.02	3.90	100.0	4.75	0.14	0.16	90.2	0.40	0.10	0.26	0.00	0.04	0.03	0.03	0.02	3.90	100.0	6.44	0.14	0.26	92.0	0.46	0.21	0.37	0.00	0.07	0.03	0.02	0.02	100.0
48	Column 13 Fe oxide 06	0.10	0.04	0.19	98.4	0.07	0.02	0.00	0.00	0.03	0.04	0.00	0.00	1.14	100.0	0.10	0.04	0.19	98.4	0.07	0.02	0.00	0.00	0.03	0.04	0.00	0.00	1.14	100.0	0.13	0.04	0.30	99.3	0.07	0.03	0.00	0.00	0.04	0.04	0.00	0.00	100.0
49	Column 13 Fe oxide 07	9.71	0.00	3.94	55.8	0.11	0.14	0.52	2.54	4.45	2.67	0.17	2.19	17.7	100.0	9.71	0.00	3.94	55.8	0.11	0.14	0.52	2.54	4.45	2.67	0.17	2.19	17.7	100.0	13.5	0.00	6.47	58.5	0.13	0.

Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
ım current = 20 nA; beam diameter = 5 microns.
rhodonite (Mn), natural albite (Na), natural adularia (K), synthetic Ca2P2O7 (P), synthetic loellingite (As), natural anhydrite (S)
mit are calculated at far right of sheet.

		Oxide Weight %														Normalised Weight %												
Point	**Comment**	**Si**	**Ti**	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**Na**	**K**	**P**	**As**	**S**	**H**	**Total**	**Si**	**Ti**	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**Na**	**K**	**P**	**As**	**S**	**H**	**Total**
1	GT Fe oxide 01	2.91	0.00	0.48	54.6	0.05	0.23	0.35	0.03	0.02	0.19	1.02	0.01	1.34	61.2	2.91	0.00	0.48	54.6	0.05	0.23	0.35	0.03	0.02	0.19	1.02	0.01	1.34	61.2
2	GT Fe oxide 02	1.58	0.51	0.66	62.1	0.00	0.00	0.05	0.07	0.05	0.00	0.37	0.01	0.56	66.0	1.58	0.51	0.66	62.1	0.00	0.00	0.05	0.07	0.05	0.00	0.37	0.01	0.56	66.0
3	GT Fe oxide 03	2.08	0.00	1.31	51.8	0.04	0.25	0.35	0.02	0.05	0.19	0.70	0.06	1.84	58.7	2.08	0.00	1.31	51.8	0.04	0.25	0.35	0.02	0.05	0.19	0.70	0.06	1.84	58.7
4	GT Fe oxide 04	3.74	0.00	1.98	47.5	0.06	0.27	0.72	0.01	0.42	0.05	2.16	0.04	1.71	58.6	3.74	0.00	1.98	47.5	0.06	0.27	0.72	0.01	0.42	0.05	2.16	0.04	1.71	58.6
5	GT Fe oxide 05	1.44	0.00	0.17	58.3	0.02	0.40	0.26	0.01	0.00	0.16	0.38	0.06	1.24	62.5	1.44	0.00	0.17	58.3	0.02	0.40	0.26	0.01	0.00	0.16	0.38	0.06	1.24	62.5
6	GT Fe oxide 06	1.34	0.00	0.61	52.8	0.03	0.21	0.62	0.03	0.00	0.19	2.13	0.03	1.78	59.7	1.34	0.00	0.61	52.8	0.03	0.21	0.62	0.03	0.00	0.19	2.13	0.03	1.78	59.7
7	GT Fe oxide 07	1.32	0.00	0.44	50.8	0.02	0.20	0.94	0.05	0.00	0.43	3.25	0.04	1.86	59.3	1.32	0.00	0.44	50.8	0.02	0.20	0.94	0.05	0.00	0.43	3.25	0.04	1.86	59.3
8	GT Fe oxide 08	2.48	0.01	1.45	52.8	0.03	0.21	0.17	0.00	0.05	0.09	0.28	0.02	1.69	59.3	2.48	0.01	1.45	52.8	0.03	0.21	0.17	0.00	0.05	0.09	0.28	0.02	1.69	59.3
9	GT Fe oxide 09	2.82	0.00	0.40	51.5	0.02	0.15	0.59	0.01	0.04	0.19	1.95	0.00	1.72	59.4	2.82	0.00	0.40	51.5	0.02	0.15	0.59	0.01	0.04	0.19	1.95	0.00	1.72	59.4
10	GT Fe oxide 10	1.52	0.01	0.09	60.6	0.01	0.16	0.35	0.00	0.01	0.14	0.58	0.15	0.86	64.4	1.52	0.01	0.09	60.6	0.01	0.16	0.35	0.00	0.01	0.14	0.58	0.15	0.86	64.4
11	GT Fe oxide 11	0.66	0.00	1.30	50.8	0.15	0.46	0.87	0.02	0.02	0.25	3.08	0.02	1.85	59.5	0.66	0.00	1.30	50.8	0.15	0.46	0.87	0.02	0.02	0.25	3.07	0.02	1.85	59.5
12	GT Fe oxide 12	3.81	0.01	0.34	54.9	0.19	0.30	0.70	0.01	0.07	0.04	0.21	0.06	1.16	61.8	3.81	0.01	0.34	54.9	0.19	0.30	0.70	0.01	0.07	0.04	0.21	0.06	1.16	61.8
13	GT Fe oxide 13	0.23	0.53	0.13	66.5	0.02	0.08	0.02	0.02	0.04	0.00	0.00	0.01	0.34	67.9	0.23	0.53	0.13	66.5	0.02	0.08	0.02	0.02	0.04	0.00	0.00	0.01	0.34	67.9
14	GT Fe oxide 14	1.27	0.01	0.71	51.8	0.04	0.21	1.14	0.01	0.07	0.20	3.41	0.05	1.65	60.5	1.27	0.01	0.71	51.8	0.04	0.21	1.14	0.01	0.07	0.20	3.41	0.05	1.65	60.5
15	GT Fe oxide 15	0.07	0.00	0.00	70.9	0.03	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00	71.0	0.07	0.00	0.00	69.8	0.03	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00	69.9
16	GT Fe oxide 16	1.17	0.00	0.02	59.1	0.03	0.31	0.46	0.01	0.01	0.02	0.27	0.10	1.24	62.7	1.17	0.00	0.02	59.1	0.03	0.31	0.46	0.01	0.01	0.02	0.27	0.10	1.24	62.7
17	GT Fe oxide 17	0.73	0.00	0.89	49.6	0.12	0.19	1.16	0.03	0.00	0.57	4.09	0.03	1.89	59.3	0.73	0.00	0.89	49.6	0.12	0.19	1.16	0.03	0.00	0.57	4.09	0.03	1.89	59.3
18	GT Fe oxide 18	0.68	0.00	0.80	50.1	0.11	0.19	1.11	0.05	0.01	0.50	3.98	0.04	1.88	59.4	0.68	0.00	0.80	50.1	0.11	0.19	1.11	0.05	0.01	0.50	3.98	0.04	1.88	59.4
19	GT Fe oxide 19	2.27	0.00	0.71	50.8	0.04	0.33	0.46	0.00	0.03	0.25	1.52	0.01	1.94	58.3	2.27	0.00	0.71	50.8	0.04	0.33	0.46	0.00	0.03	0.25	1.52	0.01	1.94	58.3
20	GT Fe oxide 20	2.08	0.01	0.52	53.4	0.07	0.34	0.78	0.00	0.03	0.24	2.33	0.06	1.42	61.3	2.08	0.01	0.52	53.4	0.07	0.34	0.78	0.00	0.03	0.24	2.32	0.06	1.42	61.3
	Max	3.81	0.53	1.98	70.9	0.19	0.46	1.16	0.07	0.42	0.57	4.09	0.15	1.94	71.0	3.81	0.53	1.98	69.8	0.19	0.46	1.16	0.07	0.42	0.57	4.09	0.15	1.94	69.9
	Min	0.07	0.00	0.00	47.5	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	58.3	0.07	0.00	0.00	47.5	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	58.3
	Ave	1.71	0.05	0.65	55.0	0.05	0.22	0.56	0.02	0.05	0.19	1.58	0.04	1.40	61.5	1.71	0.05	0.65	55.0	0.05	0.22	0.56	0.02	0.05	0.19	1.58	0.04	1.40	61.5

Point	**Comment**	**Si**	**Ti**	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**Na**	**K**	**P**	**As**	**S**	**H**	**Total**	**Si**	**Ti**	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**Na**	**K**	**P**	**As**	**S**	**H**	**Total**
21	ST Fe oxide 01	1.36	0.00	0.00	58.3	0.00	0.16	0.26	0.00	0.01	0.00	0.01	1.14	1.14	62.4	1.36	0.00	0.00	58.3	0.00	0.16	0.26	0.00	0.01	0.00	0.01	1.14	1.14	62.4
22	ST Fe oxide 02	1.58	0.00	0.16	61.2	0.00	0.13	0.32	0.02	0.01	0.01	0.18	0.05	0.86	64.6	1.58	0.00	0.16	61.2	0.00	0.13	0.32	0.02	0.01	0.01	0.18	0.05	0.86	64.5
23	ST Fe oxide 03	3.27	0.01	0.64	51.3	0.09	0.24	0.43	0.04	0.00	0.01	0.57	0.07	1.82	58.5	3.27	0.01	0.64	51.3	0.09	0.24	0.43	0.04	0.00	0.01	0.57	0.07	1.82	58.5
24	ST Fe oxide 04	2.16	0.03	0.38	58.8	0.00	0.11	0.32	0.00	0.02	0.01	0.25	0.08	1.05	63.2	2.16	0.03	0.38	58.8	0.00	0.11	0.32	0.00	0.02	0.01	0.25	0.08	1.05	63.2
25	ST Fe oxide 05	3.31	0.05	0.34	49.2	1.98	0.62	0.38	0.00	0.03	0.13	0.08	0.01	1.93	58.0	3.31	0.05	0.34	49.2	1.98	0.62	0.38	0.00	0.03	0.13	0.08	0.01	1.93	58.0
26	ST Fe oxide 06	0.03	0.00	0.01	70.7	0.01	0.01	0.04	0.00	0.01	0.00	0.02	0.00	0.00	70.9	0.03	0.00	0.01	69.8	0.01	0.01	0.03	0.00	0.01	0.00	0.02	0.00	0.00	69.9
27	ST Fe oxide 08	1.39	0.01	0.11	60.6	0.07	0.08	0.43	0.04	0.01	0.02	0.90	0.05	0.88	64.6	1.39	0.01	0.11	60.6	0.07	0.08	0.43	0.04	0.01	0.02	0.90	0.05	0.88	64.6
28	ST Fe oxide 09	1.46	0.00	0.05	58.8	0.04	0.11	0.29	0.00	0.02	0.02	0.02	0.03	1.33	62.2	1.46	0.00	0.05	58.8	0.04	0.11	0.29	0.00	0.02	0.02	0.02	0.03	1.33	62.2
29	ST Fe oxide 10	1.92	0.01	0.05	59.1	0.15	0.16	0.38	0.06	0.01	0.06	0.07	0.15	1.07	63.2	1.92	0.01	0.05	59.1	0.15	0.16	0.38	0.06	0.01	0.06	0.07	0.15	1.07	63.2
30	ST Fe oxide 11	7.99	0.12	1.02	31.3	0.04	0.00	0.77	0.02	0.20	0.11	0.00	0.00	3.84	45.4	7.99	0.12	1.02	31.3	0.04	0.00	0.77	0.02	0.20	0.11	0.00	0.00	3.84	45.4
31	ST Fe oxide 12	1.73	0.00	0.10	59.9	0.10	0.08	0.35	0.01	0.02	0.06	0.22	0.03	1.02	63.7	1.73	0.00	0.10	59.9	0.10	0.08	0.35	0.01	0.02	0.06	0.22	0.03	1.02	63.7
32	ST Fe oxide 13	2.12	0.01	0.43	52.9	0.58	0.32	0.23	0.01	0.00	0.02	0.14	0.03	1.91	58.7	2.12	0.01	0.43	52.9	0.58	0.32	0.23	0.01	0.00	0.02	0.14	0.03	1.91	58.7
33	ST Fe oxide 14	1.44	0.01	0.08	58.4	0.05	0.14	0.30	0.01	0.00	0.03	0.07	0.06	1.36	62.0	1.44	0.01	0.08	58.4	0.05	0.14	0.30	0.01	0.00	0.03	0.07	0.06	1.36	62.0
34	ST Fe oxide 15	2.55	0.01	0.23	52.6	0.05	0.33	0.27	0.00	0.02	0.01	0.18	0.07	1.95	58.2	2.55	0.01	0.23	52.6	0.05	0.33	0.27	0.00	0.02	0.01	0.18	0.07	1.95	58.2
35	ST Fe oxide 16	1.82	0.00	0.04	59.5	0.04	0.12	0.29	0.00	0.00	0.02	0.04	0.04	1.13	63.0	1.82	0.00	0.04	59.5	0.04	0.12	0.29	0.00	0.00	0.02	0.04	0.04	1.13	63.0
36	ST Fe oxide 17	1.71	0.00	0.00	59.1	0.00	0.14	0.43	0.03	0.01	0.01	0.00	0.19	1.16	62.8	1.71	0.00	0.00	59.1	0.00	0.14	0.43	0.03	0.01	0.01	0.00	0.19	1.16	62.8
38	ST Fe oxide 19	1.69	0.01	0.04	60.0	0.06	0.07	0.32	0.00	0.01	0.01	0.06	0.03	1.09	63.3	1.69	0.01	0.04	60.0	0.06	0.07	0.32	0.00	0.01	0.01	0.06	0.03	1.09	63.3
39	ST Fe oxide 20	1.21	0.01	0.10	58.7	0.16	0.32	0.35	0.00	0.01	0.01	0.15	0.08	1.30	62.4	1.21	0.01	0.10	58.7	0.16	0.32	0.35	0.00	0.01	0.01	0.15	0.08	1.30	62.4
40	ST Fe oxide 21	1.35	0.00	0.00	56.6	0.02	0.09	0.20	0.02	0.01	0.00	0.02	0.09	1.71	60.2	1.35	0.00	0.00	56.6	0.02	0.09	0.20	0.02	0.01	0.00	0.02	0.09	1.71	60.2
41	ST Fe oxide 22	1.86	0.01	0.36	59.1	0.05	0.07	0.32	0.00	0.00	0.01	0.02	0.04	1.12	63.0	1.86	0.01	0.36	59.1	0.05	0.07	0.32	0.00	0.00	0.01	0.02	0.04	1.12	63.0
42	ST Fe oxide 23	1.64	0.01	0.22	58.0	0.03	0.17	0.29	0.00	0.01	0.02	0.16	0.09	1.33	62.0	1.64	0.01	0.22	58.0	0.03	0.17	0.29	0.00	0.01	0.02	0.16	0.09	1.33	62.0
	Max	7.99	0.12	1.02	70.7	1.98	0.62	0.77	0.06	0.20	0.13	0.90	1.14	3.84	70.9	7.99	0.12	1.02	69.8	1.98	0.62	0.77	0.06	0.20	0.13	0.90	1.14	3.84	69.9
	Min	0.03	0.00	0.00	31.3	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	45.4	0.03	0.00	0.00	31.3	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	45.4
	Ave	2.07	0.01	0.21	56.9	0.17	0.16	0.33	0.01	0.02	0.03	0.15	0.11	1.38	61.5	2.07	0.01	0.21	56.8	0.17	0.16	0.33	0.01	0.02	0.03	0.15	0.11	1.38	61.5

Point	**Comment**	**Si**	**Ti**	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**Na**	**K**	**P**	**As**	**S**	**H**	**Total**	**Si**	**Ti**	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**Na**	**K**	**P**	**As**	**S**	**H**	**Total**
43	Column 13 Fe oxide 01	1.49	0.06	0.06	65.0	0.12	0.00	0.03	0.00	0.00	0.02	0.00	0.01	0.38	67.2	1.49	0.06	0.06	65.0	0.12	0.00	0.03	0.00	0.00	0.02	0.00	0.01	0.38	67.2
44	Column 13 Fe oxide 02	0.01	0.03	0.07	69.0	0.08	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.10	69.4	0.01	0.03	0.07	69.0	0.08	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.10	69.4
45	Column 13 Fe oxide 03	0.11	0.03	0.11	64.3	1.14	0.03	0.12	0.01	0.00	0.00	0.00	0.00	0.65	66.5	0.11	0.03	0.11	64.3	1.14	0.03	0.12	0.01	0.00	0.00	0.00	0.00	0.65	66.5
46	Column 13 Fe oxide 04	0.23	0.14	0.25	66.8	0.08	0.00	0.02	0.01	0.01	0.02	0.07	0.00	0.33	68.0	0.23	0.14	0.25	66.8	0.08	0.00	0.02	0.01	0.01	0.02	0.07	0.00	0.33	68.0
47	Column 13 Fe oxide 05	2.22	0.08	0.09	63.1	0.31	0.06	0.18	0.00	0.03	0.01	0.02	0.01	0.44	66.5	2.22	0.08	0.09	63.1	0.31	0.06	0.18	0.00	0.03	0.01	0.02	0.01	0.44	66.5
48	Column 13 Fe oxide 06	0.05	0.03	0.10	68.8	0.05	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.13	69.2	0.05	0.03	0.10	68.8	0.05	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.13	69.2
49	Column 13 Fe oxide 07	4.54	0.00	2.09	39.0	0.09	0.08	0.37	1.88	3.69	1.17	0.13	0.88	1.98	55.9	4.54	0.00	2.09	39.0	0.09	0.08	0.37	1.88	3.69	1.17	0.13	0.88	1.98	55.9
50	Column 13 Fe oxide 08	1.75	0.02	0.06	64.1	0.10	0.00	0.20	0.05	0.02	0.01	0.02	0.00	0.44	66.8	1.75	0.02	0.06	64.1	0.10	0.00	0.20	0.05	0.02	0.01	0.02	0.00	0.44	66.8
51	Column 13 Fe oxide 09	0.74	0.10	0.14	65.5	0.09	0.00	0.07	0.00	0.03	0.14	0.02	0.01	0.42	67.2	0.74	0.10	0.14	65.5	0.09	0.00	0.07	0.00	0.03	0.14	0.02	0.01	0.42	67.2
52	Column 13 Fe oxide 10	1.08	0.28	0.19	64.9	0.07	0.03	0.07	0.06	0.05	0.03	0.02	0.00	0.40	67.2	1.08	0.28	0.19	64.9	0.07	0.03	0.07	0.06	0.05	0.03	0.02	0.00	0.40	67.2
53	Column 13 Fe oxide 11	6.75	0.14	5.61	43.1	0.01	0.02	0.28	0.06	0.03	0.24	0.10	0.01	1.32	57.7	6.75	0.14	5.61	43.1	0.01	0.02	0.28	0.06	0.03	0.24	0.10	0.01	1.32	57.7
54	Column 13 Fe oxide 12	0.64	0.07	0.48	63.5	0.04	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.74	65.6	0.64	0.07	0.48	63.5	0.04	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.74	65.6
55	Column 13 Fe oxide 13	0.86	0.06	0.04	67.3	0.08	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.18	68.5	0.86	0.06	0.04	67.2	0.08	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.18	68.5
	Max	6.75	0.28	5.61	69.0	1.14	0.08	0.37	1.88	3.69	1.17	0.13	0.88	1.98	70.9	6.75	0.28	5.61	69.0	1.14	0.08	0.37	1.88	3.69	1.17	0.13	0.88	1.98	69.9
	Min	0.01	0.00	0.04	39.0	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	45.4	0.01	0.00	0.04	39.0	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	45.4
	Ave	1.57	0.08	0.71	61.9	0.17	0.02	0.11	0.16	0.30	0.13	0.03	0.07	0.58	64.0	1.57	0.08	0.71	61.9	0.17	0.02	0.11	0.16	0.30	0.13	0.03	0.07	0.58	64.0

Point	**Comment**	**Si**	**Ti**	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**Na**	**K**	**P**	**As**	**S**	**H**	**Total**	**Si**	**Ti**	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**Na**	**K**	**P**	**As**	**S**	**H**	**Total**
56	SS Fe oxide 01	2.34	0.37	1.12	60.1	0.02	0.01	0.15	0.03	0.09	0.03	0.30	0.00	0.61	65.2	2.34	0.37	1.12	60.1	0.02	0.01	0.15	0.03	0.09	0.03	0.30	0.00	0.61	65.2
57	SS Fe oxide 02	0.02	0.02	0.01	72.1	0.04	0.00	0.04	0.00	0.03	0.01	0.01	0.00	0.00	72.3	0.02	0.02	0.01	69.8	0.04	0.00	0.04	0.00	0.03	0.01	0.01	0.00	0.00	69.9
58	SS Fe oxide 03	2.42	0.62	1.48	58.1	0.00	0.17	0.08	0.07	0.46	0.05	0.06	0.02	0.74	64.3	2.42	0.62	1.48	58.1	0.00	0.17	0.08	0.07	0.46	0.05	0.06	0.02	0.74	64.3
59	SS Fe oxide 04	3.29	0.56	2.31	58.0	0.03	0.10	0.15	0.05	0.25	0.01	0.17	0.00	0.41	65.3	3.29	0.56	2.31	58.0	0.03	0.10	0.15	0.05	0.25	0.01	0.17	0.00	0.41	65.3
	Max	3.29	0.62	2.31	72.1	0.04	0.17	0.15	0.07	0.46	0.05	0.30	0.02	0.74	72.3	6.75	0.62	5.61	69.8	1.14	0.17	0.37	1.88	3.69	1.17	0.30	0.88	1.98	69.9
	Min	0.02	0.02	0.01	58.0	0.00	0.00	0.04	0.00	0.03	0.01	0.01	0.00	0.00	64.3	0.01	0.00	0.01	39.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.4
	Ave	2.02	0.39	1.23	62.1	0.02	0.07	0.10	0.04	0.21	0.03	0.13	0.01	0.44	66.8	1.84	0.15	1.03	61.0	0.18	0.03	0.11	0.21	0.44	0.15	0.05	0.10	0.60	65.0

Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
Accelerating potential = 15 kV; beam current = 40 nA; beam diameter = 5 microns.
Standards: natural zircon NMNH 117288-3 (Si, Zr, Hf), synthetic UO2 (U), synthetic YPO4 USNM 168499 (Y), synthetic CeO2 (Ce), natural hematite (Fe), natural apatite (Ca)
Precision and detection limit are calculated at far right of sheet.

Zircon:

	Oxide Weight %										Normalised Oxide Weight %									
Point	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**	**Point**	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**
	DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03			DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03	
1	GT zircon 01	32.5	66.4	1.29	0.20	0.11	0.04	0.09	0.02	100.7	1	GT zircon 01	32.3	66.0	1.28	0.20	0.11	0.04	0.09	0.02	100.0
2	GT zircon 02	32.3	65.8	2.12	0.51	0.10	0.02	0.07	0.02	100.9	2	GT zircon 02	32.0	65.2	2.10	0.51	0.10	0.02	0.07	0.02	100.0
3	GT zircon 03	32.7	66.5	1.61	0.06	0.03	0.00	0.10	0.02	101.0	3	GT zircon 03	32.4	65.8	1.59	0.06	0.03	0.00	0.10	0.02	100.0
4	GT zircon 04	29.8	62.5	1.38	0.69	0.94	0.13	0.29	0.67	96.3	4	GT zircon 04	30.9	64.8	1.43	0.72	0.97	0.13	0.30	0.70	100.0
5	GT zircon 05	32.6	67.0	1.31	0.01	0.00	0.00	0.01	0.03	101.0	5	GT zircon 05	32.3	66.3	1.30	0.01	0.00	0.00	0.01	0.03	100.0
6	GT zircon 06	32.5	66.4	1.20	0.15	0.20	0.00	0.04	0.01	100.4	6	GT zircon 06	32.3	66.1	1.20	0.15	0.20	0.00	0.04	0.01	100.0
7	GT zircon 07	32.0	64.6	0.94	0.48	1.18	0.07	0.05	0.01	99.4	7	GT zircon 07	32.2	65.1	0.95	0.48	1.18	0.07	0.05	0.01	100.0
8	GT zircon 08	32.5	65.9	1.32	0.15	0.15	0.01	0.06	0.01	100.1	8	GT zircon 08	32.5	65.8	1.32	0.15	0.15	0.01	0.06	0.01	100.0
9	GT zircon 09	32.6	65.9	1.19	0.10	0.07	0.01	0.02	0.01	99.9	9	GT zircon 09	32.6	66.0	1.19	0.10	0.07	0.01	0.02	0.01	100.0
10	GT zircon 10	31.8	64.9	1.41	0.33	0.43	0.02	0.11	0.11	99.1	10	GT zircon 10	32.1	65.5	1.42	0.33	0.43	0.02	0.11	0.11	100.0
11	GT zircon 11	32.5	65.4	1.53	0.28	0.15	0.02	0.10	0.02	100.0	11	GT zircon 11	32.5	65.4	1.53	0.28	0.15	0.02	0.10	0.02	100.0
12	GT zircon 12	32.4	65.9	1.33	0.24	0.16	0.03	0.06	0.03	100.1	12	GT zircon 12	32.3	65.8	1.33	0.24	0.16	0.03	0.06	0.03	100.0
13	GT zircon 13	32.6	65.8	1.12	0.16	0.17	0.00	0.04	0.00	99.8	13	GT zircon 13	32.6	65.9	1.12	0.16	0.17	0.00	0.04	0.00	100.0
14	GT zircon 14	32.3	64.9	2.06	0.30	0.09	0.00	0.03	0.02	99.7	14	GT zircon 14	32.4	65.1	2.07	0.31	0.09	0.00	0.03	0.02	100.0
15	GT zircon 15	32.5	66.3	1.15	0.13	0.13	0.00	0.08	0.00	100.3	15	GT zircon 15	32.5	66.1	1.14	0.13	0.13	0.00	0.08	0.00	100.0
	Max	32.7	67.0	2.12	0.69	1.18	0.13	0.29	0.67	101.0		Max	32.6	66.3	2.10	0.72	1.18	0.13	0.30	0.70	100.0
	Min	29.8	62.5	0.94	0.01	0.00	0.00	0.01	0.00	96.3		Min	30.9	64.8	0.95	0.01	0.00	0.00	0.01	0.00	100.0
	Ave	32.2	65.6	1.40	0.25	0.26	0.02	0.08	0.07	99.9		Ave	32.3	65.7	1.40	0.25	0.26	0.02	0.08	0.07	100.0

Point	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**	**Point**	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**
	DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03			DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03	
16	ST zircon 02	33.0	66.4	1.27	0.10	0.12	0.02	0.13	0.01	101.0	16	ST zircon 02	32.6	65.8	1.26	0.10	0.12	0.02	0.13	0.01	100.0
17	ST zircon 03	32.5	66.4	1.32	0.05	0.08	0.01	0.07	0.00	100.5	17	ST zircon 03	32.4	66.1	1.31	0.05	0.08	0.01	0.07	0.00	100.0
18	ST zircon 04	32.6	66.6	1.06	0.06	0.35	0.01	0.06	0.01	100.7	18	ST zircon 04	32.3	66.1	1.05	0.06	0.34	0.01	0.06	0.01	100.0
19	ST zircon 06	32.8	66.4	1.56	0.03	0.01	0.03	0.05	0.01	100.9	19	ST zircon 06	32.5	65.8	1.55	0.03	0.01	0.03	0.05	0.01	100.0
20	ST zircon 07	33.3	65.5	1.52	0.07	0.05	0.01	0.04	0.00	100.5	20	ST zircon 07	33.1	65.2	1.51	0.07	0.05	0.01	0.04	0.00	100.0
21	ST zircon 08	32.5	65.8	1.48	0.50	0.25	0.01	0.05	0.03	100.6	21	ST zircon 08	32.3	65.4	1.47	0.49	0.25	0.01	0.05	0.03	100.0
22	ST zircon 10	32.5	66.2	1.24	0.11	0.14	0.00	0.09	0.03	100.3	22	ST zircon 10	32.4	66.0	1.24	0.11	0.14	0.00	0.09	0.03	100.0
	Max	33.3	66.6	1.56	0.50	0.35	0.03	0.13	0.03	101.0		Max	33.1	66.1	1.55	0.49	0.34	0.03	0.13	0.03	100.0
	Min	32.5	65.5	1.06	0.03	0.01	0.00	0.04	0.00	100.3		Min	32.3	65.2	1.05	0.03	0.01	0.00	0.04	0.00	100.0
	Ave	32.7	66.2	1.35	0.13	0.14	0.01	0.07	0.02	100.7		Ave	32.5	65.8	1.34	0.13	0.14	0.01	0.07	0.01	100.0

Point	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**	**Point**	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**
	DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03			DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03	
23	Column 13 zircon 01	31.3	63.8	1.51	0.79	0.61	0.04	0.07	0.05	98.2	23	Column 13 zircon 01	31.9	65.0	1.54	0.80	0.62	0.04	0.07	0.05	100.0
24	Column 13 zircon 02	32.6	64.9	1.34	0.32	0.23	0.00	0.07	0.05	99.5	24	Column 13 zircon 02	32.7	65.3	1.35	0.32	0.23	0.00	0.07	0.05	100.0
25	Column 13 zircon 03	32.7	65.7	1.22	0.18	0.18	0.00	0.04	0.02	100.0	25	Column 13 zircon 03	32.7	65.7	1.22	0.18	0.18	0.00	0.04	0.02	100.0
26	Column 13 zircon 04	32.0	65.5	1.34	0.18	0.17	0.00	0.03	0.03	99.3	26	Column 13 zircon 04	32.2	66.0	1.35	0.18	0.17	0.00	0.03	0.03	100.0
27	Column 13 zircon 05	32.0	64.1	1.52	0.78	0.64	0.01	0.02	0.00	99.0	27	Column 13 zircon 05	32.3	64.7	1.54	0.78	0.64	0.01	0.02	0.00	100.0
28	Column 13 zircon 06	32.1	64.1	0.88	0.46	0.92	0.02	0.86	0.07	99.4	28	Column 13 zircon 06	32.3	64.4	0.88	0.46	0.93	0.02	0.87	0.07	100.0
29	Column 13 zircon 07	30.6	60.4	1.24	1.13	1.86	0.10	1.22	0.50	97.1	29	Column 13 zircon 07	31.5	62.2	1.28	1.16	1.92	0.11	1.26	0.51	100.0
30	Column 13 zircon 08	32.1	64.0	1.58	0.96	0.52	0.00	0.04	0.06	99.3	30	Column 13 zircon 08	32.4	64.4	1.59	0.97	0.52	0.00	0.04	0.06	100.0
	Max	32.7	65.7	1.58	1.13	1.86	0.10	1.22	0.50	100.0		Max	32.7	66.0	1.59	1.16	1.92	0.11	1.26	0.51	100.0
	Min	30.6	60.4	0.88	0.18	0.17	0.00	0.02	0.00	97.1		Min	31.5	62.2	0.88	0.18	0.17	0.00	0.02	0.00	100.0
	Ave	31.9	64.1	1.33	0.60	0.64	0.02	0.30	0.10	99.0		Ave	32.2	64.7	1.34	0.61	0.65	0.02	0.30	0.10	100.0

Point	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**	**Point**	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**
	DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03			DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03	
31	SS zircon 01	32.6	65.8	1.09	0.20	0.46	0.01	0.06	0.02	100.2	31	SS zircon 01	32.5	65.7	1.09	0.20	0.46	0.01	0.06	0.02	100.0
32	SS zircon 02	32.4	66.1	1.10	0.13	0.24	0.00	0.05	0.02	100.0	32	SS zircon 02	32.4	66.0	1.10	0.13	0.24	0.00	0.05	0.02	100.0
33	SS zircon 03	32.9	66.8	1.14	0.06	0.13	0.02	0.23	0.09	101.4	33	SS zircon 03	32.5	65.9	1.13	0.06	0.12	0.01	0.23	0.09	100.0
34	SS zircon 04	32.7	66.3	1.29	0.14	0.14	0.00	0.04	0.02	100.6	34	SS zircon 04	32.5	65.8	1.28	0.13	0.14	0.00	0.04	0.02	100.0
35	SS zircon 05	32.8	66.0	1.44	0.19	0.25	0.00	0.03	0.01	100.8	35	SS zircon 05	32.6	65.5	1.43	0.19	0.25	0.00	0.03	0.01	100.0
36	SS zircon 06	32.7	66.3	1.31	0.00	0.03	0.00	0.05	0.01	100.3	36	SS zircon 06	32.5	66.1	1.31	0.00	0.03	0.00	0.05	0.01	100.0
37	SS zircon 07	32.5	65.3	0.98	0.24	0.77	0.00	0.15	0.03	99.9	37	SS zircon 07	32.5	65.3	0.98	0.24	0.77	0.00	0.15	0.03	100.0
38	SS zircon 08	33.5	66.4	0.89	0.02	0.15	0.00	0.30	0.07	101.3	38	SS zircon 08	33.0	65.6	0.88	0.02	0.14	0.00	0.29	0.07	100.0
39	SS zircon 09	32.7	66.1	1.64	0.08	0.20	0.00	0.06	0.04	100.8	39	SS zircon 09	32.4	65.6	1.63	0.08	0.20	0.00	0.06	0.04	100.0
40	SS zircon 10	33.0	66.6	1.44	0.03	0.03	0.01	0.19	0.04	101.2	40	SS zircon 10	32.5	65.7	1.42	0.03	0.03	0.01	0.19	0.04	100.0
41	SS zircon 11	32.9	65.9	1.05	0.20	0.41	0.03	0.03	0.03	100.6	41	SS zircon 11	32.7	65.6	1.04	0.19	0.40	0.03	0.03	0.03	100.0
	Max	33.5	66.8	1.64	0.24	0.77	0.03	0.30	0.09	101.4		Max	33.0	66.1	1.63	0.24	0.77	0.03	0.29	0.09	100.0
	Min	32.4	65.3	0.89	0.00	0.03	0.00	0.03	0.01	99.9		Min	32.4	65.3	0.88	0.00	0.03	0.00	0.03	0.01	100.0
	Ave	32.8	66.1	1.21	0.12	0.25	0.01	0.11	0.04	100.7		Ave	32.6	65.7	1.21	0.12	0.25	0.01	0.11	0.04	100.0

Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
Accelerating potential = 15 kV; beam current = 20 nA; beam diameter = 10 microns.
Standards: natural zircon NMNH 117288-3 (Si), synthetic ThO2 (Th), synthetic UO2 (U), synthetic YPO4 USNM 168499 (Y), synthetic CeO2 (Ce), natural hematite (Fe), natural rhodonite Harvard 104791 (Mn), synthetic Ca2P2O7 (Ca, P), natural albite (Na), synthetic loellingite (As), natural apatite (F), natural tugtupite ROM M32790 (Cl)
Precision and detection limit are calculated at far right of sheet.

		Weight % oxide or element															
Point	**Comment**	**SiO2**	**ThO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**MnO**	**CaO**	**Na2O**	**P2O5**	**As2O5**	**F**	**Cl**	**O = F**	**O = Cl**	**Total**
	DL	0.03	0.07	0.03	0.05	0.09	0.04	0.04	0.05	0.05	0.06	0.05	0.15	0.01			
1	GT apatite 01	0.09	0.01	0.00	0.09	0.00	0.03	0.08	55.2	0.00	42.1	0.00	3.86	0.00	1.63	0.00	99.8
2	GT apatite 02	0.45	0.01	0.00	0.51	0.17	0.05	0.13	55.0	0.01	41.7	0.00	3.64	0.00	1.53	0.00	100.2
3	GT apatite 03	0.04	0.00	0.00	0.15	0.02	0.03	0.04	55.4	0.00	42.3	0.00	4.27	0.01	1.80	0.00	100.4
4	GT apatite 04	0.00	0.00	0.00	0.00	0.02	0.01	0.02	55.8	0.00	42.6	0.01	3.59	0.03	1.51	0.01	100.6
5	GT apatite 05	0.01	0.01	0.00	0.02	0.00	0.05	0.10	55.3	0.01	42.5	0.00	3.35	0.01	1.41	0.00	99.9
6	GT apatite 06	0.02	0.00	0.00	0.02	0.00	0.01	0.03	55.2	0.00	42.2	0.00	3.19	0.02	1.34	0.00	99.3
7	GT apatite 07	0.03	0.02	0.03	0.06	0.02	0.02	0.04	55.5	0.00	41.9	0.05	4.13	0.01	1.74	0.00	100.1
8	ST apatite 01	0.04	0.03	0.02	0.00	0.03	0.08	0.03	55.7	0.00	42.6	0.00	3.14	0.03	1.32	0.01	100.3
9	ST apatite 02	0.00	0.00	0.00	0.00	0.00	0.02	0.02	55.6	0.00	42.6	0.02	3.87	0.05	1.63	0.01	100.5
10	ST apatite 03	0.02	0.00	0.00	0.03	0.02	0.04	0.00	55.6	0.02	42.5	0.01	3.75	0.01	1.58	0.00	100.4
11	Column 13 apatite 01	0.27	0.00	0.00	0.42	0.07	0.11	0.25	53.7	0.07	42.1	0.02	4.28	0.01	1.80	0.00	99.4
12	Column 13 apatite 02	0.51	0.02	0.00	0.77	0.02	0.04	0.13	54.3	0.05	41.7	0.02	4.36	0.02	1.84	0.00	100.1
13	Column 13 apatite 03	0.72	0.04	0.01	0.86	0.33	0.07	0.36	53.6	0.09	40.8	0.00	3.78	0.02	1.59	0.01	99.1
14	Column 13 apatite 04	0.18	0.01	0.00	0.43	0.01	0.04	0.20	54.3	0.07	42.0	0.01	4.41	0.03	1.86	0.01	99.9
15	SS apatite 01	0.03	0.00	0.00	0.00	0.00	0.05	0.08	55.3	0.00	42.4	0.00	3.98	0.01	1.68	0.00	100.2
16	SS apatite 02	0.04	0.00	0.00	0.05	0.05	0.05	0.03	55.2	0.00	42.4	0.01	3.45	0.02	1.45	0.01	99.9
17	SS apatite 03	0.00	0.00	0.00	0.01	0.00	0.05	0.00	55.4	0.00	42.3	0.00	3.89	0.05	1.64	0.01	100.0
18	SS apatite 04	0.06	0.01	0.00	0.01	0.00	0.10	0.06	55.2	0.00	42.3	0.00	4.46	0.01	1.88	0.00	100.3
19	SS apatite 05	0.02	0.00	0.01	0.04	0.00	0.04	0.04	55.8	0.00	42.7	0.02	3.56	0.03	1.50	0.01	100.7
29	SS apatite 06	0.01	0.00	0.00	0.01	0.04	0.00	0.03	55.6	0.00	42.6	0.00	4.46	0.01	1.88	0.00	100.9
21	SS apatite 07	0.00	0.00	0.00	0.00	0.00	0.07	0.02	55.8	0.00	42.5	0.00	3.74	0.04	1.57	0.01	100.6
22	SS apatite 08	0.00	0.00	0.00	0.05	0.03	0.07	0.05	55.5	0.00	42.6	0.00	3.14	0.02	1.32	0.00	100.1
23	SS apatite 09	0.00	0.03	0.00	0.03	0.00	0.05	0.03	55.2	0.02	42.3	0.00	4.56	0.02	1.92	0.00	100.3
24	SS apatite 10	0.02	0.00	0.00	0.00	0.00	0.06	0.02	55.6	0.00	42.5	0.00	3.93	0.02	1.65	0.00	100.5
	Max	0.72	0.04	0.03	0.86	0.33	0.11	0.36	55.8	0.09	42.7	0.05	4.56	0.05	1.92	0.01	100.9
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.6	0.00	40.8	0.00	3.14	0.00	1.32	0.00	99.1
	Ave	0.11	0.01	0.00	0.15	0.03	0.05	0.08	55.2	0.01	42.3	0.01	3.87	0.02	1.63	0.00	100.1

		Normalised weight % oxide or element															
Point	**Comment**	**SiO2**	**ThO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**MnO**	**CaO**	**Na2O**	**P2O5**	**As2O5**	**F**	**Cl**	**O = F**	**O = Cl**	**Total**
	DL	0.03	0.07	0.03	0.05	0.09	0.04	0.04	0.05	0.05	0.06	0.05	0.15	0.01			
1	GT apatite 01	0.09	0.01	0.00	0.09	0.00	0.03	0.08	55.3	0.00	42.2	0.00	3.87	0.00	1.63	0.00	100.0
2	GT apatite 02	0.45	0.01	0.00	0.51	0.17	0.05	0.13	54.9	0.01	41.7	0.00	3.63	0.00	1.53	0.00	100.0
3	GT apatite 03	0.04	0.00	0.00	0.15	0.02	0.03	0.04	55.1	0.00	42.1	0.00	4.25	0.01	1.79	0.00	100.0
4	GT apatite 04	0.00	0.00	0.00	0.00	0.02	0.01	0.02	55.5	0.00	42.4	0.01	3.57	0.03	1.50	0.01	100.0
5	GT apatite 05	0.01	0.01	0.00	0.02	0.00	0.05	0.10	55.3	0.01	42.5	0.00	3.35	0.01	1.41	0.00	100.0
6	GT apatite 06	0.02	0.00	0.00	0.02	0.00	0.01	0.03	55.6	0.00	42.5	0.00	3.21	0.02	1.35	0.00	100.0
7	GT apatite 07	0.03	0.02	0.03	0.06	0.02	0.02	0.04	55.4	0.00	41.9	0.05	4.13	0.01	1.74	0.00	100.0
8	ST apatite 01	0.04	0.03	0.02	0.00	0.03	0.08	0.03	55.5	0.00	42.5	0.00	3.13	0.03	1.32	0.01	100.0
9	ST apatite 02	0.00	0.00	0.00	0.00	0.00	0.02	0.02	55.3	0.00	42.4	0.02	3.85	0.05	1.62	0.01	100.0
10	ST apatite 03	0.02	0.00	0.00	0.03	0.02	0.04	0.00	55.4	0.02	42.3	0.01	3.73	0.01	1.57	0.00	100.0
11	Column 13 apatite 01	0.27	0.00	0.00	0.42	0.07	0.11	0.26	54.0	0.07	42.3	0.02	4.30	0.01	1.81	0.00	100.0
12	Column 13 apatite 02	0.51	0.02	0.00	0.77	0.02	0.04	0.13	54.3	0.05	41.6	0.02	4.35	0.02	1.83	0.00	100.0
13	Column 13 apatite 03	0.72	0.04	0.01	0.87	0.33	0.08	0.37	54.1	0.10	41.2	0.00	3.82	0.02	1.61	0.01	100.0
14	Column 13 apatite 04	0.18	0.01	0.00	0.43	0.01	0.04	0.20	54.4	0.07	42.1	0.01	4.42	0.03	1.86	0.01	100.0
15	SS apatite 01	0.03	0.00	0.00	0.00	0.00	0.05	0.08	55.2	0.00	42.3	0.00	3.97	0.01	1.67	0.00	100.0
16	SS apatite 02	0.04	0.00	0.00	0.05	0.05	0.05	0.03	55.3	0.00	42.5	0.01	3.45	0.02	1.45	0.01	100.0
17	SS apatite 03	0.00	0.00	0.00	0.01	0.00	0.05	0.00	55.4	0.00	42.3	0.00	3.89	0.05	1.64	0.01	100.0
18	SS apatite 04	0.06	0.01	0.00	0.01	0.00	0.10	0.06	55.0	0.00	42.2	0.00	4.45	0.01	1.87	0.00	100.0
19	SS apatite 05	0.02	0.00	0.01	0.04	0.00	0.04	0.04	55.4	0.00	42.4	0.02	3.53	0.03	1.49	0.01	100.0
29	SS apatite 06	0.01	0.00	0.00	0.01	0.04	0.00	0.03	55.1	0.00	42.2	0.00	4.42	0.01	1.86	0.00	100.0
21	SS apatite 07	0.00	0.00	0.00	0.00	0.00	0.07	0.02	55.4	0.00	42.3	0.00	3.72	0.04	1.56	0.01	100.0
22	SS apatite 08	0.00	0.00	0.00	0.05	0.03	0.07	0.05	55.4	0.00	42.5	0.00	3.14	0.02	1.32	0.00	100.0
23	SS apatite 09	0.00	0.03	0.00	0.03	0.00	0.05	0.03	55.0	0.02	42.2	0.00	4.54	0.02	1.91	0.00	100.0
24	SS apatite 10	0.02	0.00	0.00	0.00	0.00	0.06	0.02	55.4	0.00	42.3	0.00	3.91	0.02	1.65	0.00	100.0
	Max	0.72	0.04	0.03	0.87	0.33	0.11	0.37	55.6	0.10	42.5	0.05	4.54	0.05	1.91	0.01	100.0
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.0	0.00	41.2	0.00	3.13	0.00	1.32	0.00	100.0
	Ave	0.11	0.01	0.00	0.15	0.03	0.05	0.08	55.1	0.01	42.2	0.01	3.86	0.02	1.63	0.00	100.0

Lorax Enviromental Services
16607-101
MI7007-MAR18
5/5/2018

Sample +x µm +x µm +x µm +x µm

Data															
		GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Modals	Pyrite	0.22	0	0.8	0.14	0.55	0.01	0.01	0.18	0.17	0.05	0.25	0.72	0.57	0.01
	Arsenopyrite	0.01	0	0.01	0	0.01	0	0.02	0.18	0.04	0.02	0.03	0	0	0.02
	Other Sulphides	0	0	0.03	0.01	0.01	0	0	0	0.01	0	0.01	0.01	0	0
	Quartz	45.8	51.24	29.23	26.03	33.43	44.45	53.71	56.54	32.68	39.4	34.87	28.92	43.39	51.77
	Plagioclase	9.84	2.79	12.99	20.66	20.37	9.75	2.04	1.54	27.5	19.78	22.21	13.79	2	2.89
	K-Feldspar	16.23	2.15	7.71	10.98	12.03	20.4	9.86	9.04	29.56	28.35	10.14	7.88	4.78	9.16
	Sericite/Muscovite	9.59	16.22	9.53	3.18	10.86	9.52	17.94	19.89	1.02	4.06	10.72	8.73	23.31	22.7
	Biotite	1.67	0.33	11.6	12.89	6.51	1.81	0.55	0.49	2.6	1.68	6.3	13.35	0.85	1.69
	Chlorite	0.33	0.74	2.05	3.1	1.01	0.43	0.65	0.56	0.2	0.25	1.09	1.75	0.77	0.51
	Clays	9.86	11.53	5.01	1.9	6.77	8.94	12.56	7.92	4.58	5.2	6.81	4.17	4.36	7.97
	Amphibole	0.3	0.37	0.97	3.02	0.29	0.04	0	0	0.01	0	0.25	0.73	0.64	0.01
	Other Silicates	1.36	2.57	2.97	5.3	2.42	1.15	1.39	1.12	0.5	0.6	2.07	2.48	2.14	1.24
	Oxides	0.52	3.78	0.46	0.68	0.45	1.11	0.99	1.04	0.88	0.49	0.34	0.65	1.32	1.43
	Calcite	0.75	4.36	9.53	11.09	2.51	1.23	0.01	0.01	0.03	0.02	2.28	10.45	7.11	0.31
	Dolomite	1.49	1.29	4.05	0.51	0.91	0.45	0	0	0	0	0.97	3.54	6.61	0.09
	Ankerite	1.91	2.2	2.62	0.31	1.67	0.51	0	0.02	0.06	0	1.45	2.29	1.91	0.06
	As-Fe Oxyhydroxide	0	0	0	0	0	0	0.24	1.3	0	0.01	0	0	0	0
	Apatite	0.11	0.25	0.41	0.17	0.2	0.15	0	0.01	0.16	0.05	0.15	0.45	0.13	0.09
	Monazite	0	0.01	0	0	0.01	0.04	0.02	0.01	0	0.02	0.01	0	0.01	0.04
	Sulphates	0.01	0.15	0.06	0.01	0.01	0.01	0	0	0.01	0.01	0.05	0.07	0.08	0.01
	Fe-Sb Phase	0	0	0	0	0	0	0	0.11	0	0	0	0	0	0
	Other	0	0	0.01	0	0	0	0.01	0.03	0	0.02	0	0.01	0.01	0.02
As Deportment															
	Pyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	Arsenopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.02	0.01	0.01	0.00	0.00	0.01
	Enargite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Oxides	0.01	0.04	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.02
	As-Fe Oxyhydroxide	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.42	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
S Deportment															
	Pyrite	0.11	0.00	0.42	0.07	0.29	0.00	0.00	0.09	0.09	0.03	0.13	0.38	0.29	0.00
	Arsenopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.01	0.00	0.00	0.00
	Other Sulphides	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sulphates	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sb Deportment															
	Stibnite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	Al (QEMSCAN)	6.81	6.32	6.28	6.18	7.64	6.94	7.49	6.75	7.08	6.84	7.59	6.08	6.48	7.54
	Al (Chemical)	6.72	6.51	6.35	6.67	7.15	6.88	7.57	6.46	7.20	7.09	7.30	6.62	6.03	7.15
Elemental Mass (%)	As (QEMSCAN)	0.01	0.05	0.02	0.01	0.02	0.01	0.10	0.52	0.03	0.02	0.02	0.02	0.03	0.03
	As (Chemical)	0.02	0.04	0.00	0.01	0.01	0.02	0.32	0.63	0.03	0.01	0.00		0.14	0.08
	Ca (QEMSCAN)	1.27	2.66	6.04	6.16	2.11	0.84	0.04	0.04	0.84	0.49	1.95	6.23	4.83	0.22
	Ca (Chemical)	1.23	2.29	5.69	5.79	1.91	0.65	0.06	0.03	0.60	0.34	1.75	5.43	4.42	0.24
	Fe (QEMSCAN)	1.28	3.16	3.36	3.32	2.26	1.31	1.34	1.67	0.97	0.70	2.01	3.45	2.13	1.60
	Fe (Chemical)	1.69	3.27	3.38	3.01	2.33	1.72	1.58	1.71	1.38	1.10	2.27	3.40	2.87	2.19
	K (QEMSCAN)	3.01	1.31	2.70	2.90	2.93	3.60	2.52	2.51	4.45	4.38	2.64	2.84	2.15	2.81
	K (Chemical)	3.01	1.62	2.60	2.61	2.81	3.35	2.40	2.28	3.91	4.01	2.66	2.62	2.37	2.86
	Mg (QEMSCAN)	0.44	0.38	1.77	1.65	0.77	0.25	0.10	0.09	0.19	0.14	0.76	1.73	1.14	0.17
	Mg (Chemical)	0.55	0.55	1.76	1.60	0.79	0.25	0.15	0.24	0.15	0.10	0.79	1.69	1.21	0.29
	Mn (QEMSCAN)	0.06	0.07	0.07	0.01	0.04	0.02	0.02	0.03	0.14	0.02	0.04	0.06	0.06	0.01
	Mn (Chemical)	0.03	0.05	0.06	0.07	0.04	0.02	0.02	0.01	0.07	0.03	0.04	0.06	0.05	0.04
	Na (QEMSCAN)	0.80	0.21	0.88	1.46	1.60	0.81	0.17	0.12	1.95	1.46	1.76	0.92	0.13	0.24
	Na (Chemical)	0.77	0.04	0.80	1.53	1.36	0.73	0.11	0.10	2.01	1.46	1.64	0.90	0.04	0.21
	P (QEMSCAN)	0.02	0.05	0.08	0.03	0.04	0.03	0.00	0.00	0.03	0.01	0.03	0.08	0.03	0.02
	P (Chemical)	0.03	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.06	0.04	0.04
	S (QEMSCAN)	0.11	0.02	0.42	0.07	0.29	0.00	0.01	0.13	0.10	0.03	0.14	0.38	0.31	0.01
	S (Chemical)	0.11	0.03	0.42	0.09	0.20	0.03	0.02	0.12	0.04	0.02	0.19	0.45	0.17	0.02
	Sb (QEMSCAN)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	Sb (Chemical)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00		0.00	0.00
	Si (QEMSCAN)	34.33	32.33	26.70	27.82	31.42	34.68	35.73	36.00	34.70	35.68	31.97	26.64	29.28	35.11
	Si (Chemical)	33.14	32.02	27.02	28.51	31.97	34.96	35.06	36.04	34.91	35.34	32.11	26.88	30.01	34.82
	Ti (QEMSCAN)	0.17	0.52	0.32	0.35	0.23	0.23	0.24	0.29	0.08	0.14	0.19	0.36	0.42	0.33

Lorax Enviromental Services
16607-101
MI7007-MAR18
5/5/2018

Sample +x µm +x µm +x µm +x µm

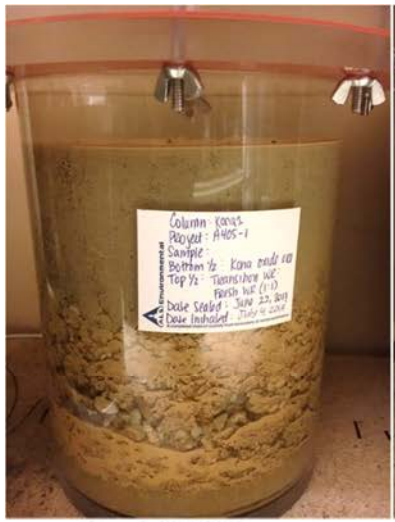
Data															
		GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
	Ti (Chemical)	0.14	0.35	0.34	0.29	0.20	0.15	0.16	0.16	0.09	0.08	0.22	0.36	0.28	0.23
	Pyrite	0.2193	0.0025	0.7952	0.1431	0.5505	0.0052	0.0078	0.1751	0.1687	0.0486	0.2529	0.7187	0.5744	0.0055
	Arsenopyrite	0.0054	0.0008	0.0059	0.0000	0.0057	0.0000	0.0224	0.1758	0.0365	0.0176	0.0264	0.0000	0.0017	0.0207
	Chalcopyrite	0.0002	0.0010	0.0024	0.0025	0.0021	0.0011	0.0000	0.0011	0.0007	0.0006	0.0025	0.0021	0.0007	0.0003
	Galena	0.0001	0.0000	0.0182	0.0002	0.0005	0.0004	0.0002	0.0002	0.0008	0.0001	0.0004	0.0006	0.0006	0.0004
	Sphalerite	0.0000	0.0011	0.0040	0.0020	0.0014	0.0000	0.0000	0.0006	0.0011	0.0007	0.0005	0.0017	0.0017	0.0000
	Stibnite	0.0005	0.0000	0.0034	0.0034	0.0022	0.0005	0.0000	0.0000	0.0012	0.0003	0.0018	0.0020	0.0000	0.0000
	Other Sulphides	0.0000	0.0000	0.0018	0.0000	0.0000	0.0000	0.0019	0.0000	0.0074	0.0000	0.0000	0.0000	0.0004	0.0006
	Quartz/Feldspar	71.8587	56.1869	49.9289	57.6690	65.8253	74.5950	65.6127	67.1276	89.7397	87.5266	67.2129	50.5928	50.1616	63.8208
	Mica	11.2639	16.5504	21.1246	16.0714	17.3769	11.3369	18.4834	20.3880	3.6194	5.7353	17.0137	22.0764	24.1593	24.3862
	Chlorite	0.3305	0.7403	2.0454	3.1032	1.0097	0.4334	0.6456	0.5628	0.1985	0.2502	1.0939	1.7548	0.7731	0.5125
	Clays	9.8577	11.5331	5.0103	1.9014	6.7690	8.9435	12.5579	7.9184	4.5785	5.2015	6.8088	4.1705	4.3586	7.9665
	Amphibole	0.2986	0.3693	0.9683	3.0235	0.2896	0.0367	0.0000	0.0028	0.0130	0.0031	0.2549	0.7330	0.6419	0.0054
	Other Silicates	1.3608	2.5746	2.9674	5.3023	2.4151	1.1541	1.3856	1.1158	0.4957	0.5989	2.0722	2.4816	2.1387	1.2400
	Fe-Oxides	0.0432	0.5091	0.0227	0.0971	0.0402	0.1516	0.1152	0.0440	0.0502	0.0729	0.0356	0.0244	0.0742	0.1532
	Goethite	0.3602	2.8399	0.2555	0.3193	0.2408	0.7901	0.6344	0.6783	0.5305	0.2396	0.1479	0.2849	1.0093	0.9781
	Other Oxides	0.1256	0.4420	0.1936	0.2673	0.1686	0.1754	0.2444	0.3316	0.3293	0.1768	0.1541	0.3636	0.2434	0.3102
	Calcite	0.7497	4.3558	9.5260	11.0865	2.5062	1.2312	0.0070	0.0124	0.0286	0.0156	2.2845	10.4500	7.1127	0.3115
	Dolomite	1.4883	1.2919	4.0452	0.5107	0.9117	0.4456	0.0000	0.0000	0.0034	0.0002	0.9683	3.5357	6.6146	0.0866
	Ankerite	1.9040	2.1875	2.6053	0.3118	1.6628	0.5078	0.0017	0.0066	0.0308	0.0010	1.4501	2.2726	1.8985	0.0436
	As-Fe Oxyhydroxide	0.0006	0.0026	0.0004	0.0000	0.0000	0.0000	0.2426	1.3003	0.0004	0.0101	0.0008	0.0005	0.0041	0.0004
	Apatite	0.1140	0.2456	0.4075	0.1667	0.2017	0.1471	0.0034	0.0120	0.1570	0.0510	0.1516	0.4543	0.1329	0.0905
	Monazite	0.0030	0.0090	0.0000	0.0031	0.0055	0.0356	0.0176	0.0071	0.0014	0.0177	0.0053	0.0000	0.0066	0.0389
	Sulphates	0.0072	0.1503	0.0595	0.0138	0.0084	0.0063	0.0031	0.0042	0.0058	0.0090	0.0536	0.0680	0.0795	0.0081
	Fe-Sb Phase	0.0010	0.0000	0.0018	0.0006	0.0006	0.0000	0.0000	0.1079	0.0000	0.0000	0.0038	0.0007	0.0000	0.0000
	Other	0.0074	0.0063	0.0067	0.0013	0.0054	0.0025	0.0132	0.0275	0.0011	0.0227	0.0034	0.0108	0.0115	0.0200
Fe Deportment															
	Pyrite	0.10	0.00	0.36	0.07	0.25	0.00	0.00	0.08	0.07	0.02	0.11	0.33	0.27	0.00
	Arsenopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.01	0.01	0.01	0.00	0.00	0.01
	Chalcopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sphalerite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Sulphides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mica	0.43	0.37	1.82	1.87	1.13	0.44	0.43	0.47	0.38	0.32	1.10	2.05	0.58	0.69
	Chlorite	0.05	0.13	0.27	0.43	0.13	0.07	0.11	0.10	0.03	0.04	0.14	0.22	0.13	0.09
	Amphibole	0.03	0.03	0.08	0.26	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.06	0.00
	Other Silicates	0.13	0.30	0.22	0.39	0.27	0.15	0.27	0.15	0.11	0.11	0.26	0.17	0.15	0.11
	Fe-Oxides	0.03	0.36	0.02	0.07	0.03	0.11	0.08	0.03	0.04	0.05	0.02	0.02	0.05	0.11
	Goethite	0.20	1.56	0.14	0.18	0.13	0.43	0.35	0.37	0.29	0.13	0.08	0.16	0.56	0.54
	Other Oxides	0.01	0.06	0.02	0.01	0.02	0.02	0.03	0.04	0.03	0.02	0.02	0.06	0.02	0.05
	Ankerite	0.31	0.36	0.43	0.05	0.27	0.08	0.00	0.00	0.01	0.00	0.24	0.38	0.31	0.01
	As-Fe Oxyhydroxide	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.31	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	Total	1.28	3.16	3.36	3.32	2.26	1.31	1.34	1.67	0.97	0.70	2.01	3.45	2.13	1.60

Mineral List	Sample ID	Data Values
Pyrite	GT	Sb Deportment
Arsenopyrite	SO	
Other Sulphides	SS	
Quartz	ST	
Plagioclase	GS-2	
K-Feldspar	GO-3	
Sericite/Muscovite	Column 7 Res	
Biotite	Column 8 Res	
Chlorite	Column 13 Res	
Clays	Column 14 Res	
Amphibole	FB-GS- Res	
Other Silicates	FB-SS- Res	
Oxides	72135B (SO-ORE)	
Calcite	72144B (GO-ORE)	
Dolomite		
Ankerite		
As-Fe Oxyhydroxide		
Apatite		
Monazite		
Sulphates		
Fe-Sb Phase		
Other		
Al (QEMSCAN)		
Al (Chemical)		
As (QEMSCAN)		
As (Chemical)		
Ca (QEMSCAN)		
Ca (Chemical)		
Fe (QEMSCAN)		
Fe (Chemical)		
K (QEMSCAN)		
K (Chemical)		
Mg (QEMSCAN)		
Mg (Chemical)		
Mn (QEMSCAN)		
Mn (Chemical)		
Na (QEMSCAN)		
Na (Chemical)		
P (QEMSCAN)		
P (Chemical)		
S (QEMSCAN)		
S (Chemical)		
Sb (QEMSCAN)		
Sb (Chemical)		
Si (QEMSCAN)		
Si (Chemical)		
Ti (QEMSCAN)		
Ti (Chemical)		
Mass %		
Stibnite		
Fe-Sb Phase		
Pyrite		
Arsenopyrite		
Enargite		
Oxides		
As-Fe Oxyhydroxide		
Fe-Sb Phase		
Pyrite		
Arsenopyrite		
Other Sulphides		
Oxides		
Sulphates		
Other		
Pyrite		
Arsenopyrite		
Chalcopyrite		
Galena		
Sphalerite		
Stibnite		
Other Sulphides		
Quartz/Feldspar		
Mica		
Chlorite		
Clays		
Amphibole		
Other Silicates		
Fe-Oxides		
Goethite		
Other Oxides		
Calcite		
Dolomite		
Ankerite		
As-Fe Oxyhydroxide		
Apatite		
Monazite		
Sulphates		
Fe-Sb Phase		
Other		
Pyrite		
Arsenopyrite		
Chalcopyrite		
Sphalerite		
Other Sulphides		
Mica		
Chlorite		
Amphibole		
Other Silicates		
Fe-Oxides		
Goethite		
Other Oxides		
Ankerite		
As-Fe Oxyhydroxide		
Fe-Sb Phase		
Other		

Appendix D: Photographs of Saturated Columns in Phase 1 through 3

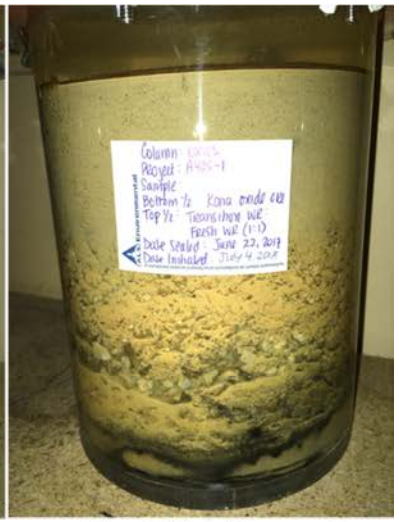
GOLDCORP

KONA 1


Phase 1: Week 12 (pre-seq.)


Phase 2: Week 11 (post-seq.)


Phase 3: Week 38 (post-seq.)


Phase 3: Week 46 (post-seq.)

KONA 2


Phase 1: Week 12 (pre-seq.)


Phase 2: Week 11 (post-seq.)


Phase 3: Week 38 (post-seq.)


Phase 3: Week 46 (post-seq.)

KONA 3



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 16 (post-seq.)



Phase 3: Week 38 (post-seq.)

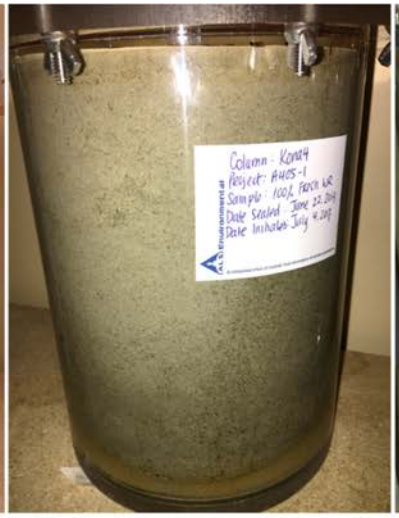


Phase 3: Week 46 (post-seq.)

KONA 4



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 16 (post-seq.)



Phase 3: Week 38 (post-seq.)



Phase 3: Week 46 (post-seq.)

GO



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)

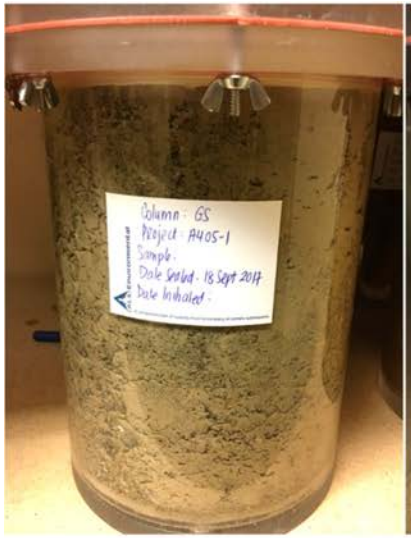


Phase 3: Week 38 (post-seq.)

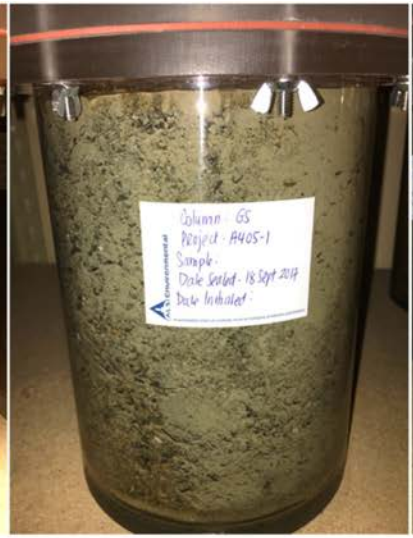


Phase 3: Week 46 (post-seq.)

GS



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)

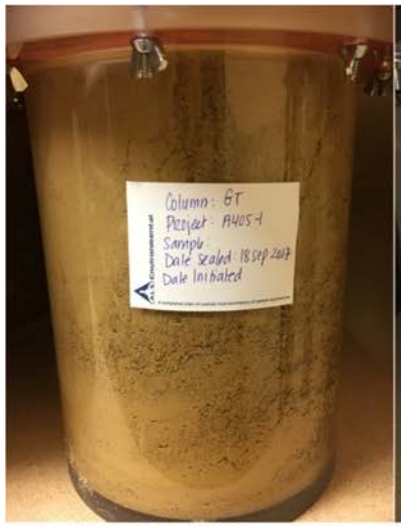


Phase 3: Week 38 (post-seq.)

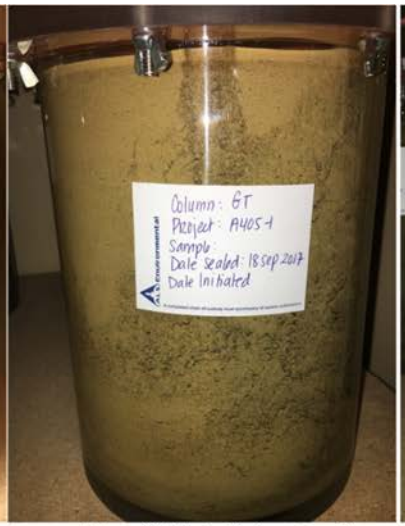


Phase 3: Week 46 (post-seq.)

GT



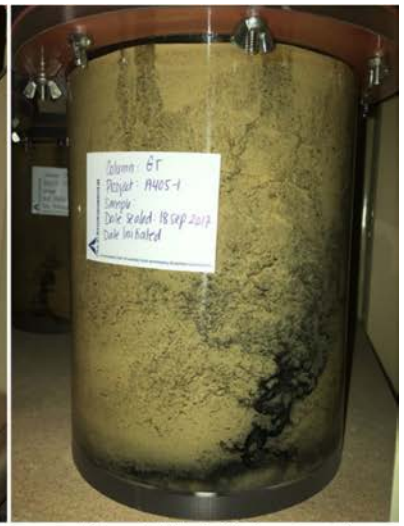
Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)



Phase 3: Week 38 (post-seq.)



Phase 3: Week 46 (post-seq.)

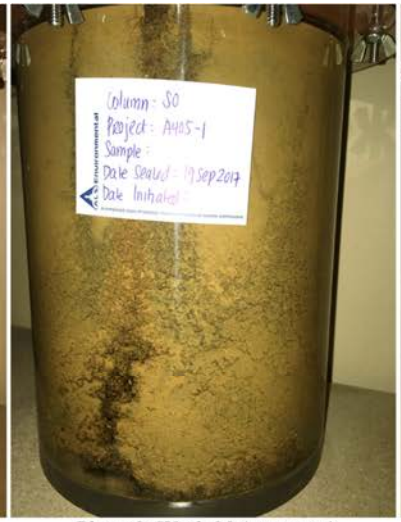
SO



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)

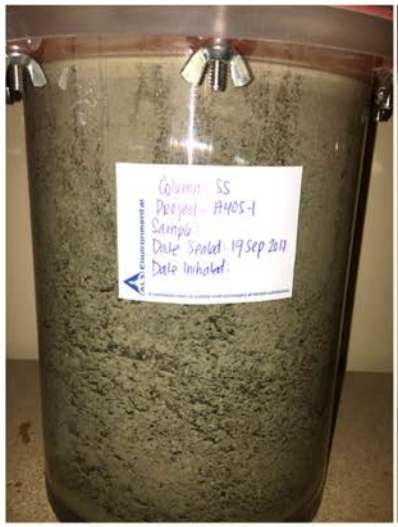


Phase 3: Week 38 (post-seq.)



Phase 3: Week 46 (post-seq.)

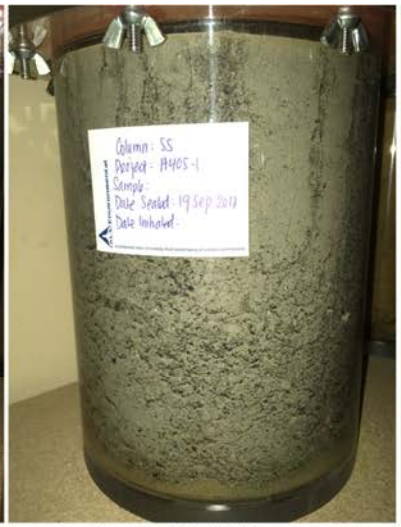
SS



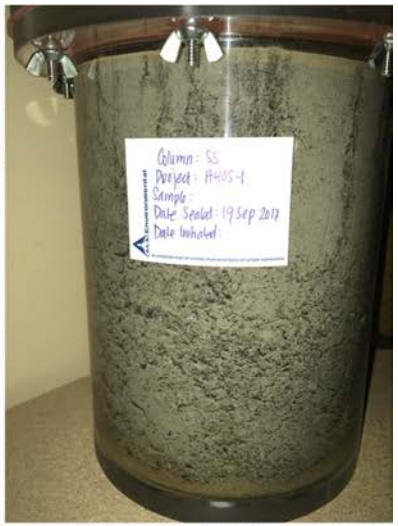
Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)

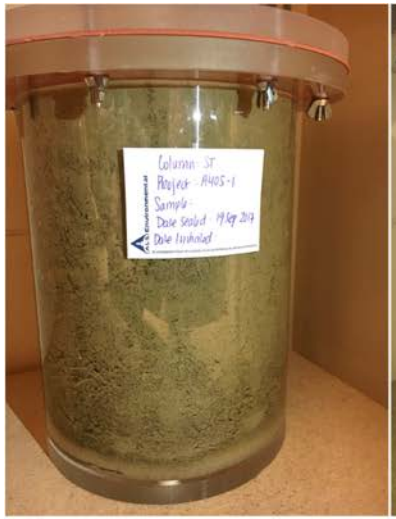


Phase 3: Week 38 (post-seq.)

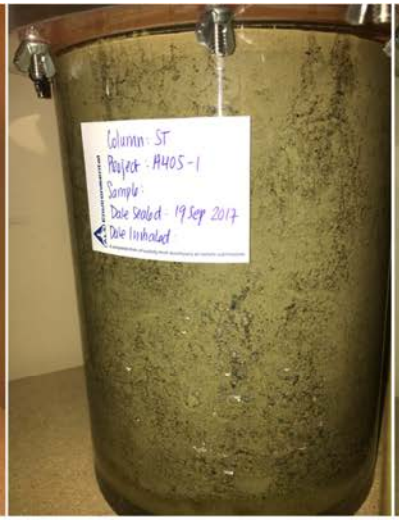


Phase 3: Week 46 (post-seq.)

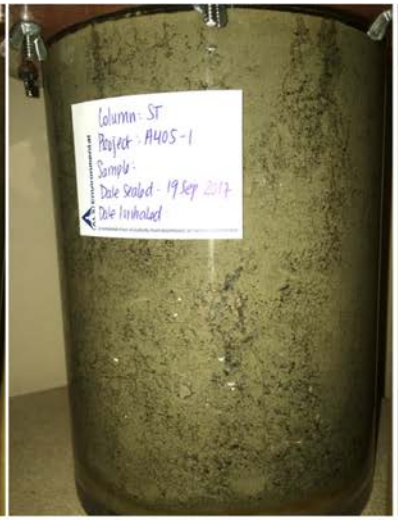
ST



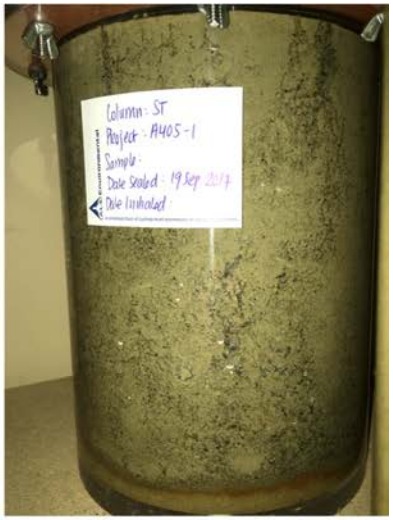
Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)



Phase 3: Week 38 (post-seq.)



Phase 3: Week 46 (post-seq.)

Appendix E: PHREEQC Input File

GOLDCORP

Appendix E: Phreeqc Input

```
SELECTED_OUTPUT 1
   -file              selected.out
   -pH                 true
   -pe                true
   -charge_balance      true
   -totals             Fe(2) Fe(3) Mn(2) Mn(6) U(4) U(6) As(3)
                      As(5)
   -saturation_indices  Gypsum Fe(OH)3 Dolomite Jarosite
                      Siderite Rhodochrosite Manganite Gibbsite
                      Alunite SiO2(am) Celestite Goethite
                      Hydroxylapatite

SOLUTION                          1
   temp      25
pH                              7.08
   pe        4
   redox
   units     mg/l
   density   1

N(-3)                          0.117
Br                              0.05
Cl                              4.25
F                              0.215
P                             0.0228
S(6)                            11.8
S(-2)                         0.0015
Al                           0.00468
Sb                           0.00415
As                              1.67
Ba                           0.00142
Be                           0.00001
B                              0.077
Cd                         0.0000097
Ca                              8.66
Cr                            0.0001
Co                           0.00205
Cu                           0.00019
Fe                            0.0064
Pb                         0.0000181
Mg                              2.08
Mn                             0.994
Hg                         0.0000106
Mo                           0.00164
Ni                          0.000477
N(5)                           0.005
N(3)                          0.0011
K                               7.42
Se                          0.000085
Si                              7.05
Na                              7.81
Sr                            0.0427
U                            0.00125
Zn                           0.00209
Alkalinity                        46
 -water    1 # kg
end
```

Appendix D: Loading Rates

Newmont™
COFFEE

Test ID	Statistic	Sulphate	Al	Ag	As	Ca	Cd	Co	Cr	Cu	Fe	Hg	K
		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
FB-GO	Cumulative	1.14E-01	5.36E-05	2.24E-08	8.52E-05	2.05E-02	2.26E-08	4.42E-07	3.05E-06	2.98E-06	3.75E-05	1.03E-08	9.70E-03
FB-GS	Cumulative	2.98E-01	3.08E-06	9.24E-09	2.48E-05	6.47E-02	1.15E-08	1.95E-07	3.29E-07	1.04E-06	1.21E-05	3.64E-09	1.19E-02
FB-GT	Cumulative	9.97E-01	3.43E-06	1.30E-08	1.06E-05	1.96E-01	1.28E-08	3.19E-07	5.47E-07	8.62E-07	1.52E-05	4.99E-09	1.94E-02
FB-SO	Cumulative	6.53E-02	7.68E-06	9.79E-09	5.77E-06	1.37E-02	4.76E-09	1.85E-07	8.43E-07	7.17E-07	1.68E-05	7.21E-09	3.39E-03
FB-SS	Cumulative	5.38E-01	6.54E-06	1.72E-08	3.52E-06	1.10E-01	1.26E-08	2.65E-07	8.60E-07	1.15E-06	2.07E-05	6.19E-09	2.16E-02
FB-ST	Cumulative	6.95E-01	4.53E-06	1.35E-08	7.89E-06	1.21E-01	6.24E-09	5.93E-07	6.82E-07	8.59E-07	1.59E-05	5.00E-09	2.84E-02
FB-GGT	Cumulative	7.59E-01	1.58E-04	6.56E-08	1.01E-04	1.53E-01	3.72E-07	7.40E-05	1.02E-06	4.87E-05	4.00E-05	6.24E-09	4.12E-02
FB-GGS	Cumulative	4.73E-01	1.68E-05	2.14E-08	6.32E-05	1.24E-01	8.94E-08	3.93E-06	8.09E-07	1.23E-06	2.58E-05	7.29E-09	2.51E-02
HC 2	P75	2.44E+00	2.50E-02	1.00E-06	5.30E-03	5.37E+00	1.98E-06	3.06E-05	2.45E-05	2.25E-04	3.47E-03	4.95E-03	1.40E+00
HC 4	P75	1.48E+00	2.37E-02	9.90E-07	3.88E-03	4.42E+00	1.50E-06	1.12E-05	1.74E-05	2.47E-04	3.47E-03	4.95E-03	9.92E-01
HC 6	P75	1.07E+00	2.48E-02	5.88E-06	7.56E-03	1.37E+00	2.44E-06	3.68E-05	2.54E-05	1.52E-04	7.63E-03	4.95E-03	4.76E-01
Col 3	P75	1.52E-01	6.19E-05	8.13E-07	1.80E-04	5.41E-01	9.10E-08	7.29E-07	2.08E-05	1.55E-05	1.18E-04	1.68E-04	1.05E-01
Col 4	P75	9.59E-01	6.31E-05	8.41E-07	1.23E-04	7.06E-01	1.59E-07	1.20E-06	1.90E-05	2.27E-05	1.25E-04	1.78E-04	2.41E-01
Col 5	P75	2.03E-01	6.08E-05	7.75E-07	2.99E-04	4.82E-01	2.17E-07	9.27E-07	1.54E-05	1.85E-05	1.16E-04	1.66E-04	1.37E-01
Col 6	P75	2.92E-01	8.81E-05	7.88E-07	8.53E-04	5.69E-01	1.33E-07	7.73E-07	4.77E-06	1.50E-05	1.16E-04	1.65E-04	1.43E-01
Col 7	P75	9.63E-02	3.17E-03	2.52E-07	8.44E-03	4.57E-02	9.69E-08	1.90E-06	2.06E-06	2.35E-05	5.06E-04	3.08E-04	2.55E-02
Col 8	P75	1.27E+00	4.17E-03	1.51E-07	2.23E-01	3.43E-01	1.56E-06	1.52E-03	1.77E-06	3.08E-04	3.04E-03	2.28E-04	8.73E-02
Col 9	P75	1.58E+00	9.94E-05	1.90E-06	3.80E-03	1.32E+00	2.27E-07	2.15E-06	9.38E-06	2.55E-05	2.98E-04	3.85E-04	1.28E-01
Col 10	P75	3.94E+00	1.31E-04	1.85E-06	4.93E-03	1.95E+00	1.44E-07	1.14E-05	5.97E-06	2.21E-05	2.63E-04	3.75E-04	1.39E-01
Col 11	P75	2.28E-01	1.06E-04	1.88E-06	4.79E-03	8.81E-01	2.49E-07	1.62E-06	1.28E-05	1.99E-05	2.73E-04	3.95E-04	1.29E-01
Col 12	P75	1.92E+00	1.43E-04	2.25E-06	1.55E-02	1.55E+00	2.94E-07	3.38E-06	9.79E-06	2.16E-05	3.25E-04	4.56E-04	2.12E-01
Col 13	P75	5.15E-01	8.44E-05	5.76E-07	1.80E-03	5.01E-02	9.10E-08	1.48E-05	2.39E-06	1.10E-05	9.80E-05	1.40E-04	1.03E-01
HC 2	P50	1.00E+00	2.21E-02	9.90E-07	3.32E-03	4.84E+00	1.49E-06	2.30E-05	1.49E-05	1.62E-04	3.45E-03	4.93E-03	9.07E-01
HC 4	P50	9.90E-01	2.02E-02	9.80E-07	2.68E-03	3.91E+00	1.47E-06	7.84E-06	1.49E-05	1.73E-04	3.43E-03	4.90E-03	6.92E-01
HC 6	P50	9.90E-01	1.39E-02	1.49E-06	3.85E-03	9.09E-01	1.49E-06	3.02E-05	1.49E-05	1.11E-04	4.75E-03	4.90E-03	3.10E-01
Col 3	P50	9.93E-02	3.30E-05	4.76E-08	1.66E-04	5.00E-01	4.99E-08	3.64E-07	1.71E-05	9.58E-06	1.12E-04	1.60E-04	9.65E-02
Col 4	P50	8.24E-01	3.98E-05	7.60E-08	1.05E-04	5.61E-01	9.46E-08	4.48E-07	1.51E-05	1.51E-05	1.21E-04	1.70E-04	2.29E-01
Col 5	P50	1.30E-01	3.38E-05	4.68E-08	2.77E-04	4.60E-01	1.36E-07	4.79E-07	1.14E-05	1.24E-05	1.10E-04	1.59E-04	1.30E-01
Col 6	P50	1.57E-01	6.60E-05	3.83E-08	7.81E-04	5.26E-01	8.25E-08	3.43E-07	2.21E-06	9.93E-06	1.10E-04	1.58E-04	1.25E-01
Col 7	P50	5.78E-02	2.19E-03	7.70E-08	7.43E-03	3.96E-02	5.85E-08	6.65E-07	1.33E-06	1.38E-05	3.80E-04	1.90E-04	2.24E-02
Col 8	P50	1.01E+00	3.12E-03	4.03E-08	1.68E-01	2.58E-01	1.36E-06	1.08E-03	1.41E-06	2.79E-04	1.91E-03	1.96E-04	6.76E-02
Col 9	P50	6.46E-01	7.40E-05	5.13E-07	3.12E-03	1.20E+00	1.33E-07	1.13E-06	4.91E-06	1.65E-05	2.66E-04	3.78E-04	1.13E-01
Col 10	P50	2.11E+00	7.50E-05	2.73E-07	4.63E-03	1.49E+00	1.13E-07	7.66E-06	2.41E-06	1.59E-05	2.59E-04	3.70E-04	1.20E-01
Col 11	P50	1.55E-01	7.13E-05	2.90E-07	4.39E-03	8.40E-01	1.50E-07	1.03E-06	7.21E-06	1.31E-05	2.66E-04	3.80E-04	1.19E-01
Col 12	P50	1.05E+00	9.12E-05	2.31E-07	1.46E-02	1.42E+00	1.80E-07	1.57E-06	2.74E-06	1.96E-05	3.15E-04	4.50E-04	1.69E-01
Col 13	P50	3.50E-01	5.46E-05	5.03E-08	1.69E-03	3.84E-02	5.30E-08	1.06E-05	8.25E-07	7.02E-06	9.19E-05	1.31E-04	8.42E-02

Test ID	Statistic	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn
		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
FB-GO	Cumulative	7.34E-03	4.91E-06	1.40E-04	6.57E-02	1.12E-06	5.16E-06	5.87E-06	2.09E-07	1.86E-07	9.82E-05	6.48E-06
FB-GS	Cumulative	3.04E-02	2.09E-06	3.28E-05	3.15E-02	5.51E-07	1.52E-07	5.34E-06	2.53E-07	1.21E-07	3.06E-04	3.32E-05
FB-GT	Cumulative	1.22E-01	5.05E-06	2.57E-05	4.96E-02	2.52E-06	1.54E-06	9.23E-06	7.19E-07	1.14E-07	4.08E-04	2.14E-05
FB-SO	Cumulative	5.99E-03	1.06E-05	2.83E-06	2.49E-02	4.90E-07	8.17E-07	1.85E-06	3.12E-07	9.51E-08	2.63E-06	6.11E-05
FB-SS	Cumulative	5.94E-02	6.21E-06	2.58E-05	4.61E-02	1.32E-06	2.41E-06	1.82E-06	1.33E-06	1.30E-07	4.80E-05	5.43E-05
FB-ST	Cumulative	9.62E-02	1.67E-05	8.32E-06	4.45E-02	1.27E-05	1.75E-06	2.29E-05	6.22E-07	1.18E-07	1.81E-04	2.51E-05
FB-GGT	Cumulative	3.38E-02	4.32E-02	8.32E-07	6.89E-02	3.20E-05	5.81E-07	7.21E-06	3.95E-07	3.67E-07	3.43E-06	4.50E-04
FB-GGS	Cumulative	2.15E-02	5.34E-03	1.15E-05	4.88E-02	1.13E-06	4.39E-07	7.51E-06	1.08E-07	2.02E-07	4.49E-05	1.69E-05
HC 2	P75	2.05E+00	6.67E-03	2.18E-04	1.07E-01	3.00E-04	1.49E-05	6.64E-03	1.68E-04	5.00E-06	4.17E-03	4.96E-04
HC 4	P75	1.75E+00	4.71E-03	4.70E-04	1.56E-01	5.00E-05	9.80E-06	1.91E-03	1.07E-04	5.00E-06	4.39E-03	4.95E-04
HC 6	P75	2.28E-01	4.66E-02	4.18E-04	1.55E-01	4.95E-05	4.91E-05	3.71E-04	3.45E-05	5.21E-06	4.08E-04	9.85E-04
Col 3	P75	2.16E-01	8.32E-06	6.71E-05	2.09E-02	4.93E-06	8.82E-07	8.09E-05	6.22E-06	1.26E-06	8.05E-05	3.30E-05
Col 4	P75	2.95E-01	2.79E-05	3.20E-04	1.04E-01	1.74E-05	6.18E-07	3.30E-05	9.04E-06	2.43E-07	5.77E-04	3.55E-05
Col 5	P75	1.70E-01	7.22E-06	3.66E-04	8.46E-02	5.18E-06	4.91E-07	4.31E-05	2.31E-06	4.52E-07	1.36E-03	3.33E-05
Col 6	P75	2.34E-01	4.90E-06	2.81E-04	2.05E-02	5.19E-06	4.90E-07	1.66E-04	3.33E-06	2.25E-06	3.38E-03	3.28E-05
Col 7	P75	1.27E-02	3.64E-04	4.22E-05	1.01E-01	4.03E-06	2.33E-06	4.25E-04	1.87E-06	7.63E-07	1.36E-05	4.22E-05
Col 8	P75	8.27E-02	5.25E-02	8.01E-06	1.24E-02	3.91E-04	2.75E-06	1.44E-04	1.14E-05	7.70E-06	2.63E-05	2.12E-03
Col 9	P75	5.08E-01	9.88E-05	9.59E-05	3.44E-02	3.24E-05	1.54E-06	1.26E-04	2.06E-05	2.29E-06	4.35E-05	7.70E-05
Col 10	P75	5.37E-01	1.00E-03	1.05E-04	2.30E-02	8.88E-05	1.64E-06	6.30E-04	3.59E-05	4.14E-06	1.58E-04	7.50E-05
Col 11	P75	2.33E-01	3.90E-05	3.31E-04	4.16E-02	3.90E-06	1.49E-06	2.00E-04	3.04E-06	3.73E-06	1.02E-03	7.60E-05
Col 12	P75	4.56E-01	6.67E-04	5.38E-04	2.22E-02	1.33E-05	1.37E-06	2.06E-03	1.23E-05	5.18E-06	8.94E-04	9.01E-05
Col 13	P75	1.30E-02	6.96E-03	4.43E-05	2.19E-01	5.00E-06	1.04E-06	1.10E-04	1.35E-06	7.71E-07	1.43E-05	5.50E-05
HC 2	P50	1.47E+00	5.84E-03	1.44E-04	5.94E-02	2.40E-04	5.00E-06	4.41E-03	2.97E-05	3.47E-06	2.85E-03	4.95E-04
HC 4	P50	1.28E+00	4.17E-03	3.69E-04	7.43E-02	4.90E-05	4.95E-06	1.47E-03	2.50E-05	2.96E-06	3.64E-03	4.90E-04
HC 6	P50	1.53E-01	3.81E-02	1.64E-04	9.63E-02	4.91E-05	2.91E-05	2.48E-04	1.98E-05	3.43E-06	2.71E-04	9.60E-04
Col 3	P50	2.04E-01	3.64E-06	6.31E-05	7.21E-03	2.93E-06	4.52E-07	7.18E-05	2.83E-06	1.18E-06	7.36E-05	3.10E-05
Col 4	P50	2.83E-01	3.37E-06	2.16E-04	2.02E-02	1.30E-05	3.38E-07	2.94E-05	3.94E-06	1.74E-07	5.28E-04	3.40E-05
Col 5	P50	1.64E-01	3.11E-06	2.94E-04	2.03E-02	3.20E-06	3.00E-07	3.99E-05	1.01E-06	4.01E-07	1.30E-03	3.15E-05
Col 6	P50	2.19E-01	2.13E-06	1.84E-04	1.05E-02	3.30E-06	2.47E-07	1.45E-04	2.06E-06	2.07E-06	2.86E-03	3.11E-05
Col 7	P50	1.09E-02	2.05E-04	1.82E-05	5.45E-02	1.93E-06	1.64E-06	3.08E-04	1.20E-06	5.18E-07	8.14E-06	3.70E-05
Col 8	P50	6.22E-02	4.56E-02	2.66E-06	4.64E-03	2.86E-04	1.42E-06	1.30E-04	6.96E-06	4.68E-06	2.31E-05	1.97E-03
Col 9	P50	4.37E-01	5.03E-05	7.72E-05	9.25E-03	2.56E-05	7.50E-07	1.16E-04	1.52E-05	1.63E-06	2.09E-05	7.50E-05
Col 10	P50	4.13E-01	6.96E-04	8.33E-05	9.36E-03	6.57E-05	1.20E-06	5.44E-04	2.85E-05	3.30E-06	7.62E-05	7.30E-05
Col 11	P50	2.22E-01	1.80E-05	2.48E-04	9.13E-03	3.80E-06	8.23E-07	1.79E-04	2.12E-06	3.28E-06	7.84E-04	7.50E-05
Col 12	P50	3.95E-01	1.80E-04	3.37E-04	9.82E-03	6.44E-06	6.76E-07	1.78E-03	1.01E-05	4.12E-06	4.65E-04	8.89E-05
Col 13	P50	1.06E-02	5.62E-03	3.68E-05	1.56E-01	3.60E-06	7.50E-07	9.50E-05	9.10E-07	5.92E-07	1.20E-05	4.05E-05

Appendix E:
Active Treatment Testing Report

Newmont™
COFFEE



COFFEE PROJECT WATER TREATMENT:

FROM FEASIBILITY STUDIES TO A CONCEPTUAL SYSTEM DESIGN

Comprehensive Report

Prepared For:
Newmont Mining

Prepared By:
WesTech Engineering

September 2021

WESTECH®

ENVIRONMENTAL INNOVATIONS INOTEC

TABLE OF CONTENTS

LIST OF FIGURES 2

LIST OF TABLES 4

EXECUTIVE SUMMARY 5

INTRODUCTION 7

TIMELINE OF EVALUATIONS, TESTING, CONSULTATIONS, AND PROCESS DESIGN 7

PREDICTED WATER QUALITY AND TREATMENT NEEDS 8

TREATMENT PROCESSES 10

ELECTRO-BIOCHEMICAL REACTOR 10

ARSENIC REMOVAL BY FERRIC COAGULATION/PRECIPITATION 10

SULFATE PRECIPITATION 11

IN-SITU BIOREMEDIATION 11

TESTWORK 12

TESTING PHASES AND OBJECTIVES 12

EXPERIMENTAL DESIGN AND PROCEDURES 13

Microbial Screening *13*
Phase I Feasibility Testing *13*
Phase I In-Situ Feasibility Testing *14*
Phase II Bench-Scale Testing *15*

SAMPLING AND ANALYSIS 16

Feasibility Testing *16*
Bench-Scale Testing *17*
Data Analysis, Interpretation, and Quality Control *18*

RESULTS 19

PHASE I FEASIBILITY RESULTS 19

Chemistry and Treatability Assessment *19*
Microbial Screening and Assessment Results *19*
Feasibility Treatment of Contaminants of Interest *21*
Feasibility Treatment of Other Contaminants and By-Product Formation *23*
Feasibility of In-Situ Denitrification *24*

PHASE I FEASIBILITY CONSULTATIONS, FEEDBACK, AND INFORMATION REQUESTS 25

PHASE II BENCH-SCALE TESTING RESULTS 33

Preliminary Assessments *33*
Bench-Scale Testing *37*

PRELIMINARY DESIGN AND OPERATIONAL PARAMETERS 60

CONCLUSIONS 61

List of Figures

Figure 1. Feasibility testing and consultations timeline. 8

Figure 2. Process flow diagram of the Phase I feasibility test system. 13

Figure 3. Process flow diagram of a Phase I feasibility in-situ testing; test stage #1....14

Figure 4. Process flow diagram of a Phase I feasibility in-situ testing; test stage #2....14

Figure 5. Process flow diagram of the Phase II bench-scale Coffee treatment systems. 15

Figure 6. Phase II bench-scale setup of treatment train A. 16

Figure 7. Phase II bench-scale sampling locations. 17

Figure 8. Phase I feasibility EBR nitrate-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once. 21

Figure 9. Phase I feasibility EBR nitrite-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once. 21

Figure 10. Phase I feasibility EBR arsenic removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once. 22

Figure 11. Phase I feasibility EBR uranium removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once. 22

Figure 12. Phase I feasibility in-situ denitrification from Coffee Gold spent ore and water. The dashed vertical line corresponds to the day when the column influent was switched from the EBR effluent to deionized water. 25

Figure 13. Arsenic ferric co-precipitation jar test results. 35

Figure 14. Sulfate precipitation jar tests with barium chloride and barium hydroxide salts. 35

Figure 15. Selected snapshots of denitrification and sulfate reduction microbial screening tests using various denitrifying (A – J) and sulfate-reducing (1 – 9) strains. 37

Figure 16. Phase II bench-scale denitrification results: System A validation. 37

Figure 17. Phase II bench-scale sulfate results: System A validation. 38

Figure 18. Phase II bench-scale uranium results: System A validation. 38

Figure 19. Phase II bench-scale arsenic results: System A validation. 39

Figure 20. Phase II bench-scale denitrification results: System B validation. 39

Figure 21. Phase II bench-scale sulfate results: System B validation. 40

Figure 22. Phase II bench-scale uranium results: System B validation. 40

Figure 23. Phase II bench-scale arsenic results: System B validation. 41

Figure 24. Phase II bench-scale denitrification results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. The bottom graph focuses on nitrate-N results below 20 mg/L. 42

FIGURE 25. PHASE II BENCH-SCALE NITRITE RESULTS: SYSTEM A OVERALL NITRITE RESULTS. DASHED VERTICAL LINES REPRESENT THE MAJOR HRT REDUCTION EVENTS, WHILE SOLID VERTICAL LINES INDICATE THE MAJOR NUTRIENT ADJUSTMENTS. 42

FIGURE 26. PHASE II BENCH-SCALE SULFATE RESULTS: SYSTEM A OVERALL RESULTS. DASHED VERTICAL LINES REPRESENT THE MAJOR HRT REDUCTION EVENTS, WHILE SOLID VERTICAL LINES INDICATE THE MAJOR NUTRIENT ADJUSTMENTS. 43

FIGURE 27. PHASE II BENCH-SCALE URANIUM RESULTS: SYSTEM A OVERALL RESULTS. DASHED VERTICAL LINES REPRESENT THE MAJOR HRT REDUCTION EVENTS, WHILE SOLID VERTICAL LINES INDICATE THE MAJOR NUTRIENT ADJUSTMENTS. 44

FIGURE 28. PHASE II BENCH-SCALE ARSENIC RESULTS: SYSTEM A OVERALL RESULTS. DASHED VERTICAL LINES REPRESENT THE MAJOR HRT REDUCTION EVENTS, WHILE SOLID VERTICAL LINES INDICATE THE MAJOR NUTRIENT ADJUSTMENTS. 45

FIGURE 29. PHASE II BENCH-SCALE ARSENIC SPECIATION RESULTS: SYSTEM A. VALUES AVERAGED OVER THREE DATA POINTS. 46

FIGURE 30. PHASE II BENCH-SCALE RESULTS: SYSTEM A OVERALL BOD DATA. DASHED VERTICAL LINES REPRESENT THE MAJOR HRT REDUCTION EVENTS, WHILE SOLID VERTICAL LINES INDICATE THE MAJOR NUTRIENT ADJUSTMENTS. 52

FIGURE 31. PHASE II BENCH-SCALE RESULTS: SYSTEM A OVERALL COD DATA. DASHED VERTICAL LINES REPRESENT THE MAJOR HRT REDUCTION EVENTS, WHILE SOLID VERTICAL LINES INDICATE THE MAJOR NUTRIENT ADJUSTMENTS. 52

FIGURE 32. PHASE II BENCH-SCALE RESULTS: SYSTEM A OVERALL PHOSPHATE-P DATA. DASHED VERTICAL LINES REPRESENT THE MAJOR HRT REDUCTION EVENTS, WHILE SOLID VERTICAL LINES INDICATE THE MAJOR NUTRIENT ADJUSTMENTS. 53

FIGURE 33. PHASE II BENCH-SCALE RESULTS: SYSTEM A GROSS RADIATION RESULTS. 53

FIGURE 34. PHASE II BENCH-SCALE RESULTS: SYSTEM A RADIUM-226 RESULTS. 54

FIGURE 35. PHASE II BENCH-SCALE RESULTS: SYSTEM A SOLIDS RADIATION RESULTS. 56

FIGURE 36. QUALITY CONTROL RESULTS FOR TOTAL ARSENIC ANALYSIS. 57

FIGURE 37. QUALITY CONTROL RESULTS FOR TOTAL URANIUM ANALYSIS. 58

FIGURE 38. QUALITY CONTROL RESULTS FOR NITRATE-N ANALYSIS. 59

FIGURE 39. QUALITY CONTROL RESULTS FOR SULFATE ANALYSIS. 59

List of Tables

Table 1. Criteria for a three-phase water treatment technology selection process. 8

Table 2. Water quality predictions of the HLF rinse solutions. 9

Table 3. Analytes and analytical methods used in the EBR bench-scale tests. 16

Table 4. Water chemistry of Coffee Gold leach solutions used during feasibility testing. 20

Table 5. Average Phase I feasibility treatment performance. 23

Table 6. Average Phase I feasibility in-situ denitrification performance. 24

Table 7. Feedback and information requests obtained through the consultations with the stakeholders. 25

Table 8. Water chemistry comparison of the modeling predictions and the received solutions. Treatment targets provided as a reference. 33

Table 9. Sulfate precipitation with barium salts. Reagent dosage, sludge volume, and water loss comparison. 36

Table 10. Arsenic speciation results, including the following arsenic species: As(V) – arsenate, As(III) – arsenite, MM-As – monomethylarsonic acid, DM-As – dimethylarsonic acid, and a sum of unknown species. 45

Table 11. The average concentration of anions throughout the Phase II bench-scale testing. Three-point average. 46

Table 12. The average concentration of metals throughout the Phase II bench-scale testing. Three-point average. 48

Table 13. Selenium speciation results, including the following arsenic species: Se(VI) – selenate, Se(IV) – selenite, Se-CN – selenocyanate, MeSe(IV) – methylselenic acid, Se-Met – selenomethionine, $SeSO_3$ – selenosulfate, and a sum of unknown species. 50

Table 14. The average concentration of cyanides throughout the Phase II bench-scale testing. Three-point average. 50

Table 15. The average concentration of nutrients throughout the Phase II bench-scale testing. 51

Table 16. Phase II bench-scale results: Radiochemistry analysis of water samples collected from all the treatment stages. One data point. 54

Table 17. Phase II bench-scale results: Radiochemistry analysis of solids samples collected from all the treatment stages. One data point. 55

Table 18. Toxicity characteristic leaching procedure (TCLP) results. 56

Table 19. Analytical precision and accuracy during bench-scale testing of Coffee waters. 58

Table 20. Summary of the design and operational parameters for pilot-scale testing. 60

EXECUTIVE SUMMARY

WesTech Engineering (formerly Inotec) was contracted to develop a conceptual water treatment system for the Coffee Mine's heap leach rinse waters. In order to increase confidence in the proposed treatment, reduce uncertainty and risks, and develop a site-specific approach for the treatment of the Coffee waters, the testing was designed in three phases. This report conglomerates the results of Phase I feasibility evaluations and Phase II bench-scale laboratory testing and summarizes the feedback obtained from the stakeholders (Newmont, Tr'ondek Hwech'in, and the Canadian regulatory agencies). Once the mine is operational, and heap waters are available, the system design and expected performance will be demonstrated during the Phase III pilot-scale trial.

The Phase I feasibility testing successfully demonstrated the removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Even though arsenic removal was demonstrated with the biological treatment, the feasibility testing proved that long retention times and high nutrient doses would be required to meet the required discharge levels. The Phase I recommendation was to investigate phys-chem arsenic removal options.

Upon completing Phase I feasibility testing, WesTech and Newmont sought out feedback from the stakeholders through a series of water-treatment-focused workshops. The consultations yielded positive feedback, identified additional contaminants of interest, and resulted in the addition of several analytical parameters to the monitoring list, strengthening the testing design and outcomes. Sulfate and antimony were identified as potential additional contaminants of interest. Thiocyanate, sulfide, arsenic and selenium speciation, and radiochemistry were added to the analytical schedule.

The Phase II bench-scale testing removed all contaminants of interest to below their respective discharge targets. The best approach for the Coffee Mine water treatment was confirmed to be a multi-stage treatment train, consisting of a phys-chem pretreatment for arsenic and sulfate precipitation, biological EBR treatment for denitrification and metals polishing, and a small aerobic post-treatment for removal of residual nutrients and reintroduction of dissolved oxygen. **The demonstrated benefits of the tested treatment train included:**

1) **a significantly smaller biological EBR system footprint;**
2) **no need for complex organic nutrient addition;**
3) **lower organic carbon requirement, thus lower residual nutrient concentrations; and**
4) **continuous removal of some radioisotopes in the pretreatment, which resulted in little to no accumulation of gross radiation within the EBR bioreactor matrix.**

Arsenic was removed to below the discharge target of 0.035 mg/L using ferric co-precipitation. Barium precipitation of sulfate was demonstrated to be dose-dependent and was optimized to target sulfate discharge target of 1,500 mg/L. The limited evaluation of only two barium salts resulted in residual chloride concentrations; further jar tests will be required once the mine is operational and actual site waters are available to establish the most suitable reagent dose to avoid generating excess chlorides.

The EBR treatment successfully removed nitrate-N to below the detection limit of 0.3 mg/L and uranium to less than 0.1 mg/L (its discharge target) with ethanol as a sole nutrient source and a hydraulic retention time of 7 to 11 hours. Once optimized to target only nitrate and uranium, the EBR system was demonstrated to allow residual arsenic and sulfate to pass through without further reducing either one. The speciation results showed that the EBR system did not produce any methylated arsenic species, even during the preliminary testing stages, when residual arsenic was biologically removed. Several other metals (Sb, Cu, Hg, Mo, and Ni) were reduced by the EBR system from elevated levels to below

their discharge targets, while some multivalent metals (Fe and Mn) were not targeted and passed through the EBR system unchanged. Hardness minerals (Ca, Mg) were shown to be present at elevated concentrations in the Coffee waters and will likely need to be removed by a water softening pretreatment to meet their discharge limits. The EBR system also polished WAD cyanide to below the detection limit of 0.006 mg/L.

Once the pretreatment was optimized, ethanol was used as a sole nutrient source for the EBR treatment, resulting in a low residual nutrient generation. BOD and ammonia were removed in the aerobic post-treatment step, but a spike of phosphate and manganese was experienced in the aerobic column effluent, which can only be attributed to the leaching of these metals from the pumice support matrix. Quality control will be conducted on the media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of metals occurs.

A set of preliminary design and operational parameters was developed for a pilot-scale trial based on the results obtained from bench-scale testing. Conducted over a minimum of three months, the on-site demonstration trial is a required last step before the preliminary engineering of the water treatment plant can be completed. The testwork and analytical plan will include, at the minimum, the same level of detail as the Phase II bench-scale program.

INTRODUCTION

TIMELINE OF EVALUATIONS, TESTING, CONSULTATIONS, AND PROCESS DESIGN

The proposed Coffee Gold project is located in the west-central Yukon Territory, approximately 130 km south of Dawson City. Acquired in 2016 by Goldcorp (subsequently, Newmont), Coffee is a high-grade potential open pit and heap leach development project that lies within the traditional territory of Tr'ondek Hwech'in (TH).

WesTech Engineering (formerly Inotec) was contracted to develop a treatment system for the Coffee Mine's heap leach rinse waters. In order to increase confidence in the proposed treatment, reduce uncertainty and risks, and develop a site-specific treatment approach for the treatment of the Coffee waters, the testing was designed in three phases.

Phase I - Treatability assessment and proof-of-concept, conducted in 2016, consisted of laboratory assessment tests and evaluation of site water chemistry. Tests included column heap leach to generate water for treatment, site water chemistry evaluation, microbial screening tests, and treatment effectiveness assessment.

Phase II - Continuous flow laboratory column tests, conducted in 2020, were used to develop an overall treatment approach for the Coffee Gold heap leach rinse waters and to develop operational parameters for on-site pilot-scale tests.

Phase III – On-site pilot tests, to be conducted once mine is operational, are needed to validate the selected unit processes for treatment of all the contaminants of interest in the actual Coffee Gold heap leach rinse waters and to develop operational parameters, design criteria, and preliminary CAPEX/OPEX estimates for a full-scale facility.

This tiered approach was developed based on the EPA's Guide for Conducting Treatability Studies Under CERCLA: Biodegradation Remedy Selection (EPA/540/R-93/519b). The specific characteristics of each phase are provided in Table 1.

WesTech has worked with the project since 2015. Our main objective has been to design a water treatment system that meets the discharge limits using a phased feasibility testing approach that de-risks the process and considers input from all the stakeholders. Several treatment methods have been considered to meet the treatment objectives, and the resulting treatment train utilizes multiple unit processes, including phys-chem and biological methods. The overall timeline of feasibility testing and consultations is summarized in Figure 1. Ample time was allocated after each testing phase for consultations with Tr'ondek Hwech'in and the Canadian regulatory agencies to identify areas of concern and develop appropriate protocols for future testing to address them.

Table 1. Criteria for a three-phase water treatment technology selection process.

Phase/Scale	Phase I: Feasibility Study (completed)	Phase II: Lab Bench-Scale Test (completed)	Phase III: On-Site Pilot Demo (to be completed)
Goal	Process screening	Process selection	Process design
Degradation of the contaminant of interest	Positive degradation	Meets effluent compliance standards under test conditions	Meets compliance standards under site conditions
Extent of treatment	Estimate/ Qualitative	Measure/ Quantitative	Measure/ Quantitative
Biodegradation rate	Crude estimate	Defensible estimate	Quantified
Process control and reliability	Not available	Assess potential	Demonstrate
Process optimization	Not available	Estimate	Refined estimate/ Demonstrate
Study time	2-8 weeks	2-6 months	2-6 months
Full-scale cost estimate	Not available	Rough	Detailed/ Refined

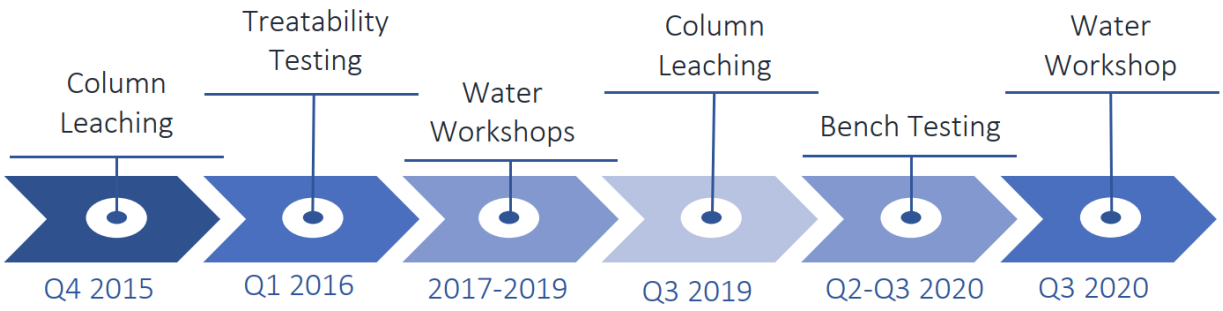


Figure 1. Feasibility testing and consultations timeline.

Predicted Water Quality and Treatment Needs

Developing a conceptual water treatment design for a prospective mine is challenging as without an operational mine, no heap leach rinse waters exist for treatment evaluations. Predicting water quality generated by the heap leach facility (HLF) during rinsing is crucial for identifying the parameters of concern and developing a treatment system with appropriate unit processes. Water modeling, performed by Lorax Environmental Services, identified the target parameters for Phase I treatability testing as nitrate/nitrite, arsenic, and uranium (Table 2). Additionally, sulfate and antimony were added to the list of target parameters for Phase II bench-scale testing based on the input from TH. The treatment targets were based on a back-calculation approach to arrive at allowable concentrations in the discharge to achieve Use-Protection water quality objectives in Halfway Creek.

Table 2. Water quality predictions of the HLF rinse solutions.

Parameter [mg/L]	HLF Rinse Modeling	Treatment Target
NH_3-N	0.025-0.06	8
NO_3-N	275-307	3
NO_2-N	1.6-1.9	0.09
Cl	115-123	290
SO_4	2300-2516	1500
Alkalinity, as $CaCO_3$	47-87	500
WAD-CN	0.09-0.2	0.025
Al	0.06-0.2	0.06
Ag	0.00009-0.00125	0.00009
As	0.66-2	0.035
Ca	204-350	180
Cd	0.00004-0.00013	0.00004
Cr	0.004-0.014	0.001
Cu	0.004-0.014	0.004
Fe	0.15-0.5	0.05
Hg	0.0001-0.00026	0.0001
Mg	117-155	50
Mn	0.016-0.06	0.016
Mo	0.033-0.105	0.033
Na	890-1168	890
K	8-11	8
Ni	0.002-0.006	0.002
Pb	0.00032-0.0013	0.0032
Sb	0.17-0.5	0.07
Se	0.0015-0.005	0.0015
Tl	0.0015-0.004	0.0015
U	0.3-0.685	0.1
Zn	0.02-0.052	0.02

TREATMENT PROCESSES

ELECTRO-BIOCHEMICAL REACTOR

Microbes mediate the removal of metal and inorganic contaminants through electron transfer (redox processes). For example, denitrification can be described by the following redox reaction:

$$NO_3^- + 5e^- + 6H^+ \rightarrow \frac{1}{2}N_2 + 3H_2O \quad (1)$$

The biotransformation shown in Reaction 1 occurs under anaerobic, reductive conditions, requiring low dissolved oxygen (DO) levels and a negative oxidation-reduction potential (ORP) environment. Five electrons are needed to reduce one molecule of nitrate to nitrogen gas. Other constituents, such as dissolved oxygen, nitrite, arsenate, selenate, chromate, sulfate, etc., add to the electron demand.

In conventional biological treatment systems, the electrons required for contaminant transformation are supplied in the form of excess nutrients added to the system. Conventional biotreatment systems require excess nutrients/chemicals to compensate for inefficient and variable electron availability to adjust reactor ORP chemistry and for contaminant removal (electron release from organic nutrients requires nutrient metabolism that proceeds at a variable rate). Excess nutrients used to compensate for system sensitivity lead to significantly increased biomass production, resulting in additional CAPEX and OPEX (higher nutrient consumption and management of the excess biomass production).

The Electro-Biochemical Reactor (EBR) technology overcomes these shortcomings by decoupling the electron provision from organic carbon metabolism. The electrons are directly supplied to the reactor and microbes, using a low applied potential (1-3V) across the bioreactor at low milli-Amp levels. The current of 1 mA provides 6.2×10^{15} electrons per second. In contrast, one molecule of acetic acid, commonly used as a nutrient in the water treatment processes, provides only eight electrons under complete metabolism. These electrons replace and supplement the electrons customarily supplied to the conventional bioreactor system by excess nutrients, with considerable savings and multiple reactor, microbial, and environmental benefits. The directly supplied electrons are readily available to the microbes in a consistent, controllable manner without metabolic energy expenditure. Moreover, these "free electrons," from the microbes' standpoint, make the EBR bioreactors more robust and less sensitive to wide fluctuations in water chemistries than the past generations of conventional biotreatments.

ARSENIC REMOVAL BY FERRIC COAGULATION/PRECIPITATION

Even though the EBR technology was validated for arsenic removal to concentrations of less than 0.015 mg/L from initial values in excess of 1.0 mg/L (i.e., > 98.8% removal), evaluation of other arsenic removal methods and integration into the proposed treatment train was recommended. The initial bench-scale treatability assessments indicated that a relatively long retention time and high nutrient loading would be required to target arsenic biologically.

Ferric-based coagulation and flocculation is a widely used arsenic removal method in wastewater and drinking water treatment. It uses a metal-based coagulant, such as ferric chloride ($FeCl_3$), which hydrolyzes in water to form positively charged ferric hydroxide [$Fe(OH)_3$]. Dissolved arsenic oxyanions are negatively charged and readily sorb to the positively charged ferric hydroxide particles. The process is sensitive to the oxidative state of arsenic; if any reduced arsenic oxyanions, such as arsenite, are present, they must be oxidized to arsenate first for the ferric coagulation step to be effective.

Sulfate Precipitation

In contrast to contaminants such as nitrate, arsenic, and heavy metals, sulfate has no primary standard for drinking water or aquatic life. Numerous treatment technologies for efficient sulfate removal exist, including biological and physical processes. As an alternative option for biological sulfate removal, sulfate precipitation using physicochemical methods was evaluated. The most commonly used technology for reducing high sulfate concentrations is lime precipitation, which generates calcium sulfate (gypsum). This method is effective for sulfate concentrations higher than the gypsum solubility limit of 1,500-2,000 mg/L. As a polishing step for sulfate removal, barium sulfate precipitation can be applied. Barium sulfate has very low solubility in water (~ 2.5 mg/L), with the final sulfate concentration limited only by the amount of barium added and reaction time.

In-Situ Bioremediation

The basic premise of bioremediation is to accelerate microbial activity using nutrients (carbon, phosphorus, nitrogen, etc.) to create conditions conducive to biodegradation of target contaminants. In general, in-situ bioremediation is designed to modify the environmental conditions, typically through oxidation/reduction manipulation, to create an environment that stimulates the growth of indigenous and added microbes and the subsequent degradation of the target contaminants via microbial catalyzed reactions.

This testing focused on in-situ denitrification (nitrate reduction). Nitrate is an important co-contaminant because it is a preferred electron acceptor that needs to be reduced or removed before metal removal is effectively targeted. Nitrate is the most ubiquitous groundwater contaminant in North America and is common at many mining sites due to the use of ammonium nitrate in blasting. Nitrate is non-sorptive and does not exchange on many surfaces. It has a very low probability of retardation onto soil colloids. Nitrate reduction occurs during anaerobic respiration; in the absence of oxygen (<2 mg/L dissolved oxygen) and the presence of a carbon source, bacteria utilize nitrates as electron acceptors during respiration.

In mining waters, nitrate-N is typically found at tens or hundreds ppm levels as compared to ppb concentrations most metals like arsenic and uranium are present at. Since nitrate is a preferred electron acceptor and is typically present in mining waters several orders of magnitude higher than dissolved metals, the majority of the retention time required for an active biological treatment is spent on denitrification. Longer retention times require larger bioreactors, which in turn means higher CAPEX (capital expenditures). A holistic mine site water management and treatment should include in-situ denitrification within the heap followed by a smaller active treatment for metals removal.

TESTWORK

TESTING PHASES AND OBJECTIVES

WesTech has completed Phases I and II of feasibility and system design stages. The objectives of the two phases were as follows:

Phase I:

Provide **a proof-of-concept** for removal of nitrate, arsenic, and uranium from the Coffee Mine heap leach rinse waters.

- Task 1 – Spent Ore Column Leaching Tests. Task 1 was used to generate leach waters for Tasks 2 through 4.
- Task 2 – Microbial Screening and Treatability Assessment. The goal of Task 2 was to develop microbial consortia for Tasks 3 and 4.
- Task 3 – EBR Validation Testing. The goal of Task 3 was to provide a proof-of-concept evaluation of the EBR technology for the treatment of the Coffee Gold leach waters.
- Task 4 – In-Situ Testing. The goal of Task 4 was to evaluate microbial in-situ denitrification of the Coffee Gold spent ore materials.

Phase II:

Develop and **optimize a systems approach** to treating all parameters present above the discharge standards in the Coffee Mine heap leach rinse waters

- Task 1 – Side-by-side evaluations of two treatment approaches. The goal was to determine the optimal process design for nitrate, uranium, sulfate, and arsenic removal to below the discharge objectives.
- Task 2 – System stress-testing to determine the optimal system configuration and operational conditions (including required chemical doses and hydraulic retention times).
- Task 3 – Treatment train design to meet all discharge requirements (including required pretreatment, e.g., for cyanide destruction, and any needed post-treatment, e.g., for aeration and BOD and ammonia oxidation).
- Task 4 – Development of the required design information for Phase III testing.

Experimental Design and Procedures

Microbial Screening

Microbial isolation and screening tests were conducted on solutions received and initial column materials at 5ºC and 20 ºC. Microbes isolated from the Coffee Mine waters and spent ore materials were tested for their ability to remove arsenic, uranium, nitrate, sulfate, and antimony. These isolates were tested in direct comparative screening tests alongside WesTech's repository microbes to select a site-specific inoculum for the removal of contaminants of interest.

These tests provided the microbes for Phase I and Phase II testing. A microbial population screened to be effective at removing arsenic, uranium, nitrate, sulfate, and antimony was grown into an inoculum for feasibility and bench-scale testing.

Phase I Feasibility Testing

The process flow diagram for the feasibility testing is shown in Figure 2. The feasibility setup consisted of a two-stage, up-flow, fixed bed EBR system. The tests were conducted under continuous flow conditions, i.e., the water was treated 24 hours per day, seven days per week. The system was operated using a total hydraulic retention time (HRT) of 44 hours. The bioreactors were provided with laboratory-grade nutrients (tryptic soy broth) rich in macro- and micro-elements. The long HRT and laboratory-grade nutrients were chosen to ensure that no limiting conditions (e.g., nutrient-limited) occurred that could affect the proof-of-concept testing.

The column tests were conducted continuously for two months for process assessment and validation testing. The goal of validation testing was to generate sufficient compliance data (i.e., nitrate, arsenic, and uranium concentrations in the treatment effluent below desired levels). The system initially treated leach waters pumped twice through the Coffee Gold spent ore columns. However, since uranium concentrations have decreased after the second pass through the spent ore columns, it was decided to treat first pass leach solutions instead.

Prior to the biological EBR treatment, cyanide destruction in the leachate solutions was performed using hydrogen peroxide treatment; nitrate-N was readjusted to at least 150 mg/L, and pH of the water was dropped to about 6.5.

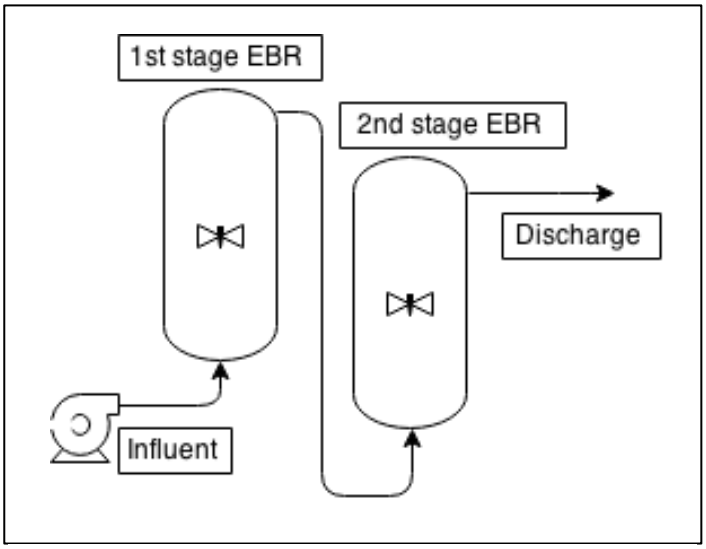


Figure 2. Process flow diagram of the Phase I feasibility test system.

Phase I In-Situ Feasibility Testing

Two 100-kg test columns were constructed, each containing three lithologies and two weathering zones of mined materials that represent thoroughly mixed Coffee Gold leach pad materials in the following percentages: 80% Supremo, 18% Latte, and 2% Kona. The columns went through a series of conditioning steps to ensure the effluent water chemistries from both columns were similar. One of the constructed columns was used as a test column; the other one was used as a control (baseline) column. The in-situ testing progressed in two testing stages:

1. Application of the EBR effluent spiked with 150 mg/L nitrate-N at a flowrate of 1L per day. The in-situ column influent was supplemented with nutrients, while the control column influent was filtered to remove microbial cells and residual nutrients. The process flow diagram is shown in Figure 3.
2. Application of DI water spiked with 150 mg/L nitrate-N at a flowrate of 1L per day. The in-situ column influent was supplemented with nutrients, but the control column was not. The process flow diagram is shown in Figure 4.

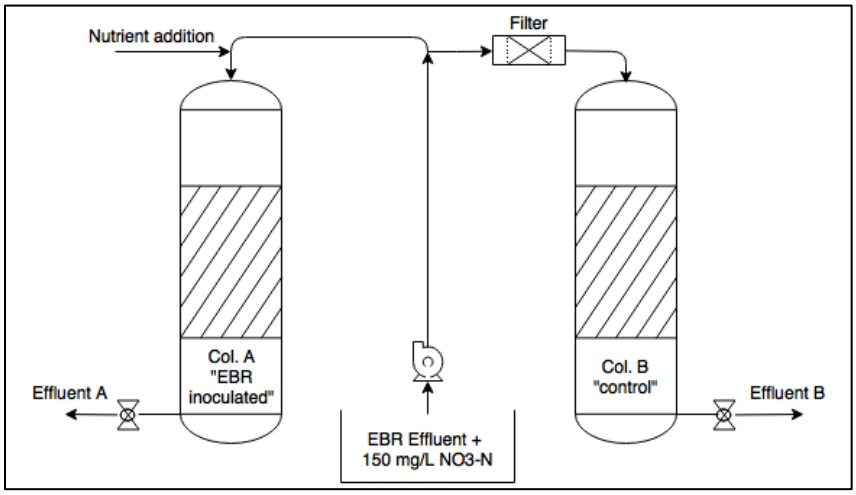


Figure 3. Process flow diagram of a Phase I feasibility in-situ testing; test stage #1.

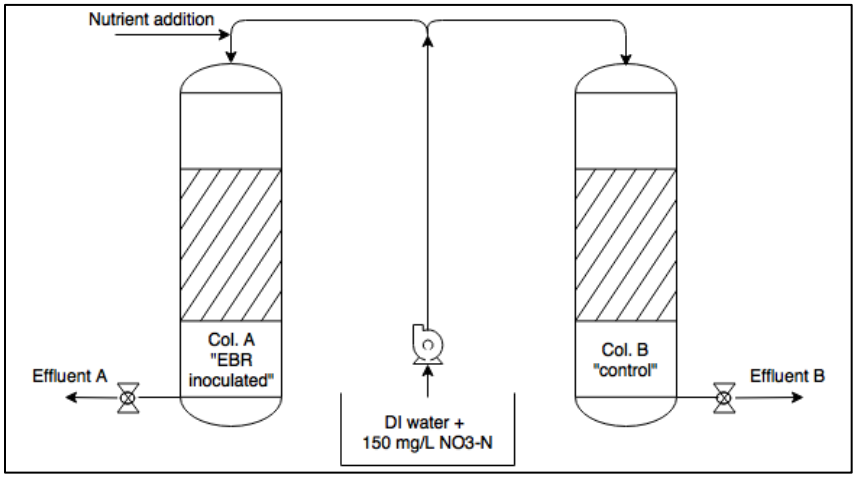


Figure 4. Process flow diagram of a Phase I feasibility in-situ testing; test stage #2.

Phase II Bench-Scale Testing

Leach and rinse waters were generated by Kappes, Cassiday & Associates at their metallurgical laboratory in Reno, NV, and shipped to WesTech. The process flow diagram for the bench-scale setup is shown in Figure 5. The required pretreatments included cyanide destruction and pH adjustment; both were performed as batch treatments. Two treatment trains were evaluated concurrently as a core treatment. In system A, chemical precipitation methods (ferric coagulation for arsenic removal and barium precipitation of sulfate) were tested in conjunction with a two-stage EBR system for denitrification, uranium reduction, and metals polishing. System B targeted all contaminants with the EBR treatment alone. Following the core treatments, aerobic post-treatments were tested for the removal of residual nutrients.

Both treatment trains utilized up-flow, fixed bed EBR bioreactors. Each EBR column was equipped with sampling ports halfway up the column and at the effluent point. The tests were conducted under continuous flow conditions, and the systems were initially operated using a 24-hr HRT per reactor, with samples collected from sampling ports correlating to 12-hr HRT intervals. The bench-scale EBRs had an empty bed volume of 1,610 mL (per reactor). The activated carbon used to fill the columns had a pore space of 42%.

The photograph in Figure 6 shows the bench-scale setup for treatment train A. Not pictured are the chemical pretreatments that were performed in batches. The system was initially designed to use only one pump and gravity flow between the reactor stages (as can be still seen in Figure 6 from the differences in elevation between the test columns). However, since large sample volumes were required for the routine internal and external analyses, and the forward flow was only 1.0 - 1.5 mL/min, an intermediary sample storage jug was placed between the reactor stages and a second pump was installed.

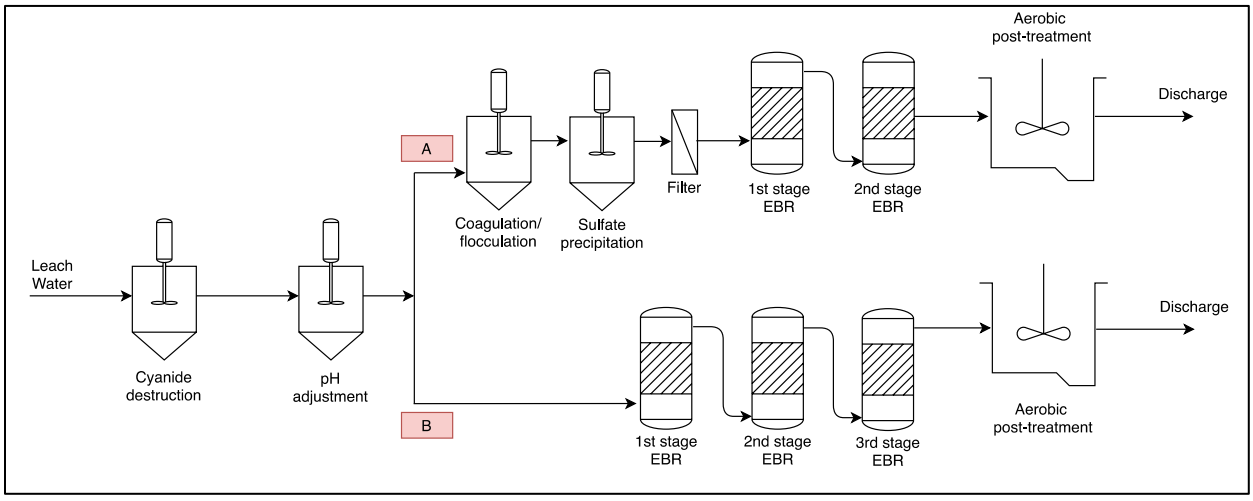


Figure 5. Process flow diagram of the Phase II bench-scale Coffee treatment systems.



Figure 6. Phase II bench-scale setup of treatment train A.

SAMPLING AND ANALYSIS

Feasibility Testing

Daily in-house measurements included flowrate, pH, ORP, DO, temperature, nutrient addition, conductivity, and nitrate-N. Influent and EBR effluent samples were collected in 5-day intervals and sent out to ALS Analytical Laboratories in Vancouver, Canada, for a complete suite analysis (Table 3).

Table 3. Analytes and analytical methods used in the EBR bench-scale tests.

Analyte	Method	Method Number
Hardness	EDTA Titration	APHA 2340B
pH	Automated pH meter	APHA 4500-H pH Value
TDS	Gravimetric	APHA 2540 C
Alkalinity	Titration	APHA 2320 Alkalinity
Bromide	Ion Chromatography (IC)	EPA 300.1
Chloride	Ion Chromatography (IC)	EPA 300.1
Fluoride	Ion Chromatography (IC)	EPA 300.1

Analyte	Method	Method Number
Total Nitrogen	Colorimetric	APHA Method 4500-P (J) / NEMI 5735
Ammonia-Nitrogen	Fluorescence	J. ENVIRON. MONIT., 2005
Nitrite-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Nitrate-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Total Phosphorus	Colorimetric	APHA 4500-P Phosphorus
Orthophosphate	Colorimetric	APHA 4500-P Phosphorus
Sulfate	Ion Chromatography (IC)	EPA 300.1
Total Cyanide	Continuous Flow Analyzer (CFA)	ISO 14403:2002
WAD Cyanide	Continuous Flow Analyzer (CFA)	APHA 4500-CN CYANIDE
Total Metals	Collision/Reaction Cell – Inductively Coupled Plasma (CRC-ICP)	EPA 200.2/6020A
Total Mercury	Cold Vapor Atomic Absorption Spectrophotometry (CVAAS)	EPA 1631E

Bench-Scale Testing

Sampling locations are marked in Figure 7. For process assessment, raw waters, pretreated waters, EBR sampling locations, and post-treatment were analyzed. The in-house analysis included pH, ORP, DO, conductivity, temperature, nitrate, nitrite, sulfate, and COD. These measurements were taken three times a week. Routine metals analyses were performed by a certified independent analytical laboratory, American West Analytical Labs (AWAL) in Salt Lake City, UT, using Ion-Coupled Plasma/Mass-Spec (ICP-MS), method EPA 200.8. In addition to these frequently monitored parameters, a chemistry suite analysis was performed on system influents and effluents once per month by AWAL. Samples for arsenic and selenium speciation were submitted once per month to Brooks Applied Labs in Bothell, WA. Upon completion of testing, the system was taken apart, and any accumulated or generated solids, including the activated carbon media, were sampled and sent to AWAL for TCLP analysis and Pace Analytical Laboratories for rad-chemistry analysis.

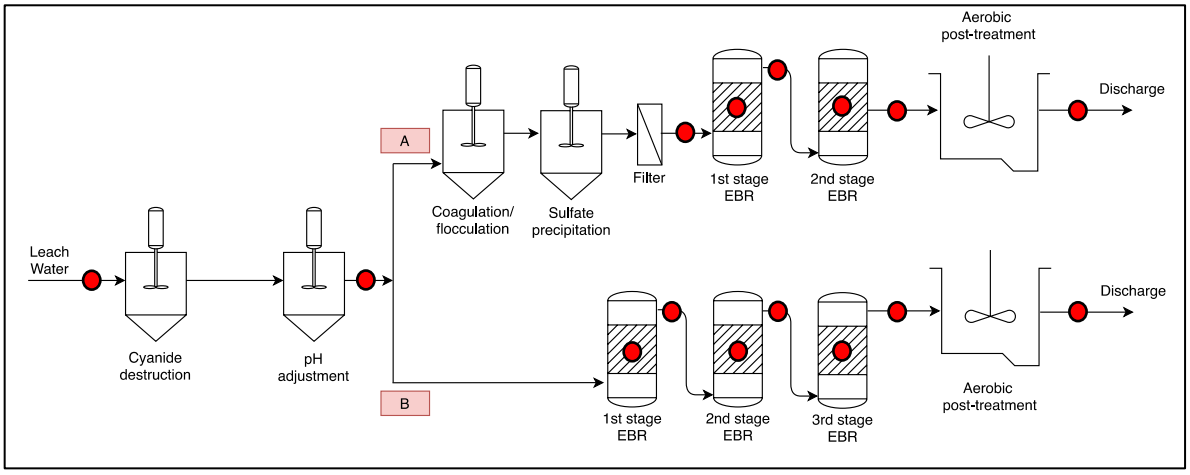


Figure 7. Phase II bench-scale sampling locations.

Data Analysis, Interpretation, and Quality Control

The influent and effluent nitrate, sulfate, uranium, and arsenic concentrations were measured, which allowed the calculation of percent removals and treatment efficiencies. A 30-day continuous operation was required to demonstrate the repeatability of results and reliability of the treatment process. Taking measurements at different sampling points (corresponding to different retention times) determined the removal kinetics.

Quality control was performed on all analyses. As part of the internal quality control testing, AWAL Laboratories performed method blanks (MB), laboratory control samples (LCS), matrix spikes (MS), and matrix spike duplicates (MSD) on the submitted samples. The recoveries of the spiked analyte are evaluated to determine the accuracy in a given matrix, while the comparison between the MS and MSD shows how precise the procedure is in a given matrix.

RESULTS

PHASE I FEASIBILITY RESULTS

Chemistry and Treatability Assessment

The leachate solution chemistry treated by the feasibility test system is shown in Table 4. Nitrate-N (105 mg/L) and uranium (144 µg/L) concentrations were within the biological treatability range. Arsenic levels of 1.1 mg/L were at the upper limit of biological treatability. Compounds that often compete with nitrate, arsenic, and uranium for electrons during biotreatments, e.g., nitrite, and other metal oxyanions, such as selenate or chromate, were not present at concentrations that would impact the biological treatment performance.

Inorganic parameters that often have an inhibitory effect on microbial metabolism, such as chlorides, were present at low levels. Total and WAD cyanides were elevated and needed to be destroyed prior to the biological treatment. Due to the nature of the spent ore, the generated leach solutions had pH of about 8.7 and needed to be adjusted to 6.5 for optimal denitrification and As/U removal.

Water chemistry assessment strongly suggested that the biological treatment would be effective at removing the contaminants of concern. Additionally, the EBR technology also reduced the concentration of some other metals, such as aluminum, antimony, cadmium, chromium, copper, mercury, molybdenum, nickel, and tin.

Microbial Screening and Assessment Results

Nitrate-, arsenic-, and uranium-reducing microorganisms were isolated from the Coffee Gold waters and spent ore materials received and screened with WesTech's repository strains to examine their bioremediation potential in the site waters at 5°C and 20°C. The microbial screening is used to 1) determine whether a given contaminant is easy or difficult to remove in given water chemistry using the EBR technology; 2) identify a best performing microbial population in the given water chemistry (contaminant transformation, temperature dependence, performance robustness); 3) select an adjusted/enhanced microbial consortium that is the most compatible with the unadjusted native population; and 4) condition the selected microbial consortia for optimal biological performance.

With an evaluation of the obtained wastewater chemistry, good positive denitrification and microbial arsenic/uranium reduction screening results were obtained. Selected microbes were further screened, conditioned, and characterized to develop the inocula for the feasibility tests. From the various consortia tested in the Coffee Gold waters, the best inoculum was selected based on:

- Nitrate/As/U reduction potential at low and high temperatures.
- Robustness in the Coffee Gold waters at low and high temperatures.
- Compatibility with indigenous microbes present in the Coffee Gold waters.
- The ability to maintain an integrated biofilm with desired contaminant removal characteristics.

Table 4. Water chemistry of Coffee Gold leach solutions used during feasibility testing.

Parameter	Concentration
Metals	
Aluminum	1.5 mg/L
Antimony	30.8 µg/L
Arsenic	1.1 mg/L
Barium	70.5 µg/L
Cadmium	3.7 µg/L
Calcium	37.5 mg/L
Chromium	10.3 µg/L
Cobalt	239 µg/L
Copper	0.5 mg/L
Iron	0.5 mg/L
Lead	1.1 µg/L
Magnesium	5.9 mg/L
Manganese	32 µg/L
Mercury	3.7 µg/L
Molybdenum	75 µg/L
Nickel	118 µg/L
Potassium	83 mg/L
Selenium	2.1 µg/L
Silver	5.2 µg/L
Sodium	234 mg/L
Strontium	186 µg/L
Thallium	0.88 µg/L
Tin	7.7 µg/L
Titanium	9.3 µg/L
Uranium	144 µg/L
Vanadium	1.2 µg/L
Zinc	187 µg/L
Inorganics	
pH	8.7
Hardness, Total (as $CaCO_3$)	118 mg/L
Alkalinity, Total (as $CaCO_3$)	188 mg/L
Ammonia as N	13 mg/L
Chloride	6.8 mg/L
Fluoride	0.35 mg/L
Cyanide, Total	24 mg/L
Cyanide, WAD	25 mg/L
Nitrate as N	105 mg/L
Nitrite as N	0.3 mg/L
Total N	130 mg/L
Sulfate	160 mg/L
Dissolved Orthophosphate	0.13 mg/L

Feasibility Treatment of Contaminants of Interest

The feasibility testing validated the biological treatment for the removal of nitrate, arsenic, and uranium from Coffee Gold heap leach rinse waters. Figure 8 and Figure 9 show the reduction of nitrate-N and nitrite-N by the feasibility test system. Nitrate-N concentrations were spiked to a minimum of 150 mg/L in the influent waters and averaged 188 mg/L during the 2-month test period. **The feasibility EBR system consistently removed both nitrate-N and nitrite-N to below detection limits** (0.19 mg/L and 0.04 mg/L, respectively).

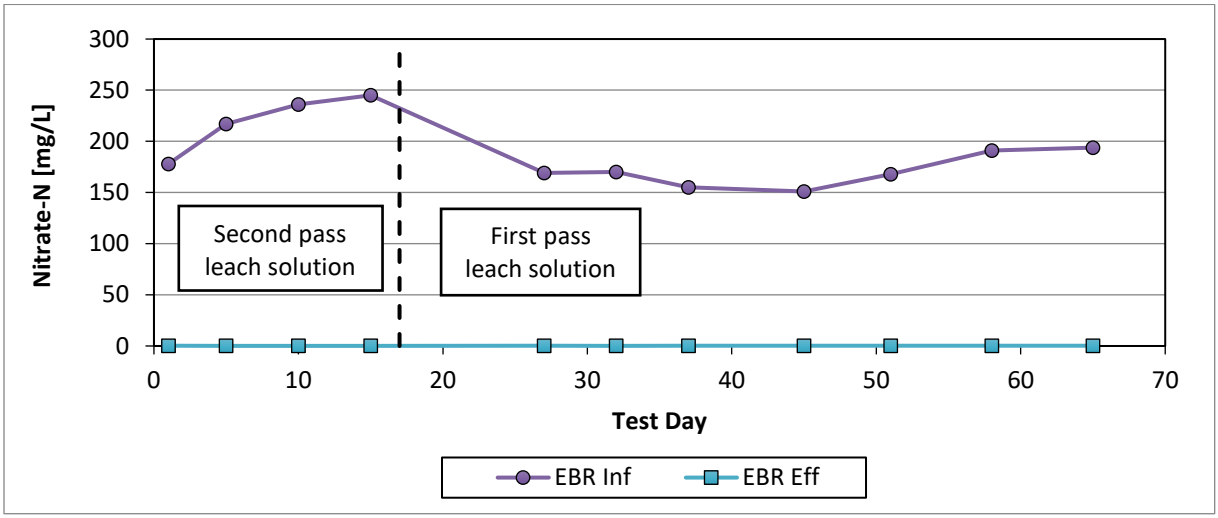


Figure 8. Phase I feasibility EBR nitrate-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

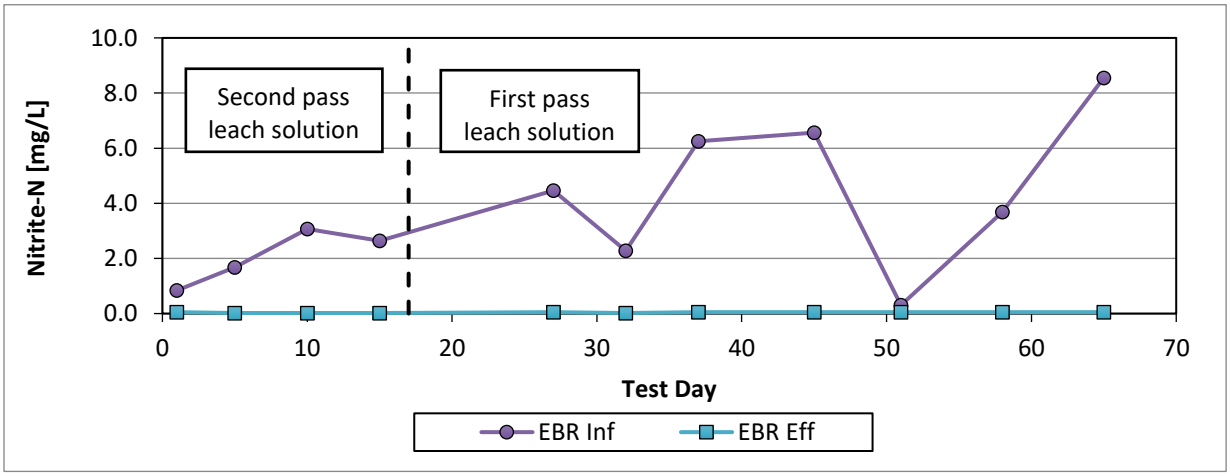


Figure 9. Phase I feasibility EBR nitrite-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Arsenic removal for the initial two weeks averaged 60% (Figure 10). Process and bioreactor operation were adjusted to improve the EBR performance. **After system modifications were implemented, arsenic removal increased to an average of 98.8%.** Total arsenic was removed from the average of 1,113 µg/L in the leach waters to an average of 12.9 µg/L in the EBR system effluent.

Uranium removal averaged 99.1%, with the EBR system effluent concentrations averaging 0.8 µg/L (Figure 11). Influent uranium levels varied between 34 µg/L and 154 µg/L, with the average concentrations of 92.5 µg/L. Table 5 summarizes the feasibility performance.

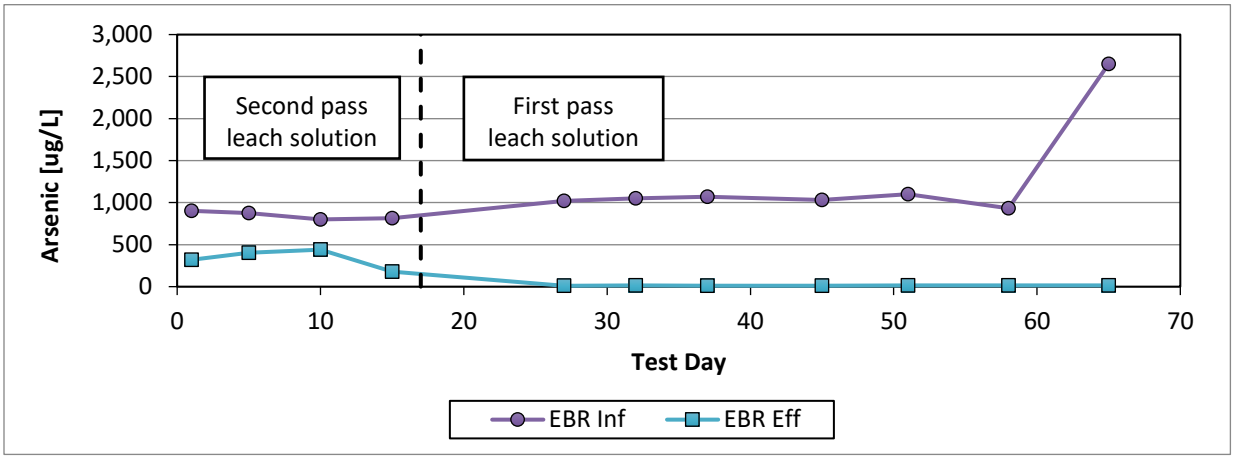


Figure 10. Phase I feasibility EBR arsenic removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

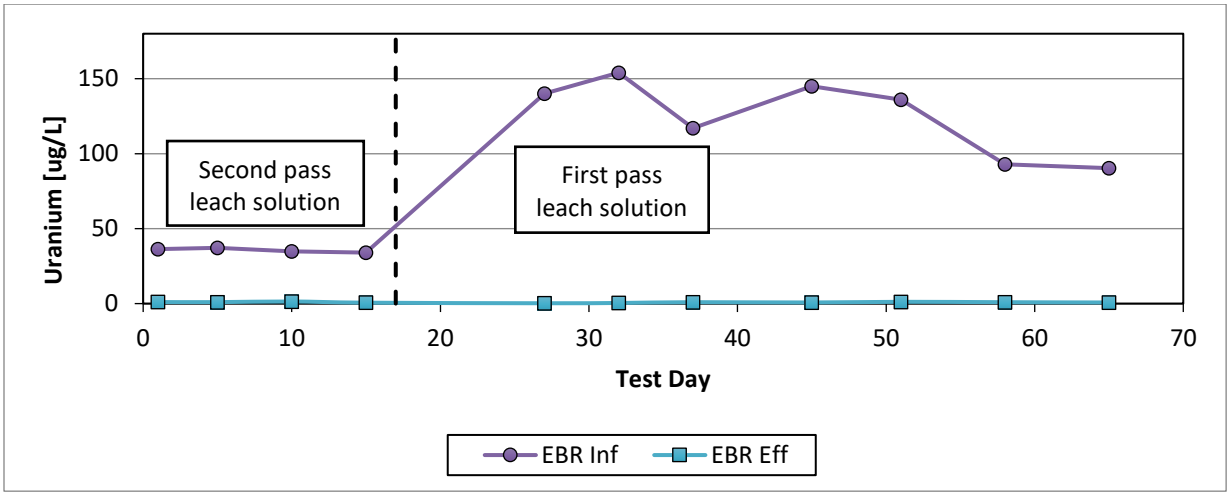


Figure 11. Phase I feasibility EBR uranium removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Table 5. Average Phase I feasibility treatment performance.

Parameter	Average Influent	Average Effluent	% Removal
Nitrate-N [mg/L]	188	< 0.19	> 99.9%
Nitrite-N [mg/L]	3.7	< 0.04	> 98.9%
As [µg/L]	1,113	12.9*	98.8%
U [µg/L]	92.5	0.8	99.1%
Al [µg/L]	737	< 35.8	> 95.1%
Sb [µg/L]	33.2	< 0.35	> 98.9%
Cd [µg/L]	1.3	< 0.02	> 98.5%
Cr [µg/L]	10.7	< 0.66	> 93.8%
Co [µg/L]	269	122	54.6%
Cu [µg/L]	267	< 2.4	> 99.1%
Fe [µg/L]	2.2	0.23	89.5%
Pb [µg/L]	1.9	< 0.17	> 91.0%
Hg [µg/L]	1.6	0.03	98.1%
Mo [µg/L]	59.5	< 6.9	> 88.4%
Ni [µg/L]	75.1	< 2.3	> 96.9%
Se [µg/L]	2.9	1.2	58.6%
Ag [µg/L]	3.9	< 0.06	> 98.5%
Tl [µg/L]	0.8	< 0.03	> 96.2%
Sn [µg/L]	32.5	0.8	97.5%
Zn [µg/L]	76.1	38.1	49.9%
WAD Cyanide [mg/L]	0.03	< 0.007	> 76.7%
Total Cyanide [mg/L]	0.48	0.16	66.7%
Ammonia-N [mg/L]	15.3	208	NA
Orthophosphate [mg/L]	0.2	47.1	NA

*after process adjustment

NA – not applicable

Feasibility Treatment of Other Contaminants and By-Product Formation

Besides arsenic and uranium, the feasibility test system removed other metals to various degrees (Table 5). **Over 90% average removal efficiencies were achieved for Al, Sb, Cd, Cr, Cu, Pb, Hg, Ni, Sn, Ag, and Tl.** Total and WAD cyanide were still present in the leach waters after cyanide destruction with peroxide, albeit at much lower concentrations (0.48 mg/L and 0.03 mg/L, respectively). The EBR system degraded WAD cyanide to below the detection limit of 0.007 mg/L and total cyanide to average levels of 0.16 mg/L (Table 5).

As expected in this preliminary treatability evaluation, nutrient levels (e.g., ammonia-N and orthophosphate) were elevated in the test system effluent. The scope of work for the feasibility phase was focused on the initial validation of the biological process for removal of contaminants of interest (i.e., proof-of-concept) and not on process optimization. In field applications, minimum nutrient additions to the biological system are established and balanced, often resulting in minimal (if any) increases in residual nutrients in the system effluent. However, if ultra-low levels of ammonia or BOD are required in the system effluent, a conventional aerobic bioreactor polishing step can be used. Aerobic bioreactors are a well-established technology for nutrient removal from municipal wastewaters, where they have been successfully implemented for over a century. Phase II bench-scale testing will investigate the optimal nutrient composition and dosage to more accurately define what levels of residual nutrients can be expected in the full-scale plant effluent.

Feasibility of In-Situ Denitrification

Table 6 summarizes average nitrate-N concentrations during two in-situ testing phases. Figure 12 shows the results of in-situ denitrification in the Coffee Gold spent ore materials.

For the initial three weeks of operation, both columns were irrigated with 1 L/day of the EBR effluent spiked with about 150 mg/L nitrate-N; the influent to the control column was filtered before it was applied to the top of the column. During test stage 1, the average in situ test column effluent contained 13.9 mg/L NO_3-N, while the average control column effluent was 103 mg/L NO_3-N. It should be noted that nitrate-N concentrations in the control column decreased with time to about 50 mg/L, which can be explained by the fact that the EBR effluent applied to the top of this column, although filtered, still contained excess nutrients in the form of organic carbon, nitrogen, and phosphorus, that allowed the native denitrifying population to carry out partial denitrification.

For the following four weeks, both columns were irrigated with 1 L/day of deionized (DI) water spiked with about 150 mg/L nitrate-N. The in-situ test column was provided with the required nutrients daily. During test stage 2, the average in-situ test column effluent contained 26.4 mg/L NO_3-N, while the average control column effluent was 146 mg/L NO_3-N. The negligible nitrate removal in the control column as compared to the in-situ column demonstrated the effectiveness of in-situ denitrification.

The feasibility testing proved the in-situ treatment to be a feasible approach to controlling nitrates within the heap environment. Lowering the nitrate concentrations in the heap leach rinse solutions in-situ would significantly impact the size, capital cost, and operating expenditures of the active water treatment system.

Table 6. Average Phase I feasibility in-situ denitrification performance.

	Control	In Situ	Control	In Situ
	EBR Effluent + 150 mg/L NO_3-N		DI Water + 150 mg/L NO_3-N	
NO_3-N [mg/L]	103	13.9	146	26.4

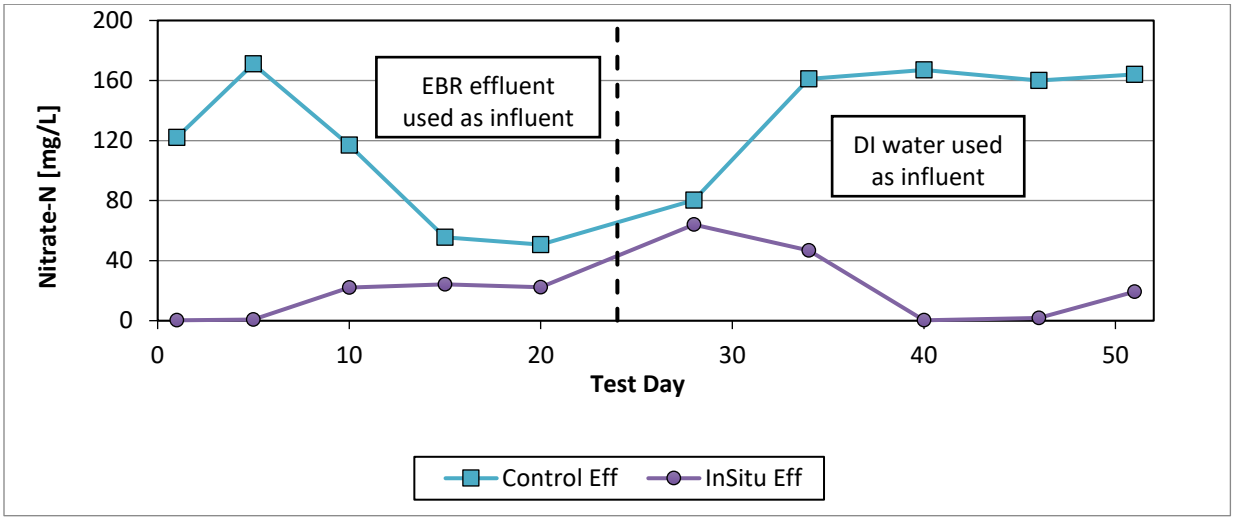


Figure 12. Phase I feasibility in-situ denitrification from Coffee Gold spent ore and water. The dashed vertical line corresponds to the day when the column influent was switched from the EBR effluent to deionized water.

Phase I Feasibility Consultations, Feedback, and Information Requests

The feasibility testing concluded with a final report submitted to Newmont (then Goldcorp) in August 2016. Following the report submittal, Newmont elicited feedback from the stakeholders, most notably the First Nations and their representatives (Tr'ondek Hwech'in and Source Environmental Associates) in 2017, as well as the Canadian and local regulatory agencies through the YESAB review process in 2018. Several technical meetings and workshops were held for consultations. WesTech participated in the meetings to provide clarifications and adjust the planned Phase II testwork based on the feedback. Table 7 lists the feedback and action items identified through the process.

Table 7. Feedback and information requests, obtained through consultations with the stakeholders.

Requested by/ Reference	Issue and Rationale	Feedback and Information Request	Solution & Action Item
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Will the Heap Leach Facility pose a concern for long-term water quality downstream of the proposed project? Are water treatment plans for the active closure phase and the post-closure phase sufficient?	The information provided is not adequate to assess the short-term and long-term water quality associated with the Heap Leach Facility. Additional information is required. The descriptions of the active and passive treatment design plans in the submission are not sufficient for EA-level review.	Phase I Feasibility was a "proof-of-concept" test focused on establishing whether or not the waters can be treated and on identifying suitable treatment options. Phase II testing will define the required treatment train in more detail.

Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Residual Ammonia and Ortho-phosphate across Active Treatment. Appendix A of the EBR feasibility report shows the change in concentrations of a variety of constituents across the system.	What level of residual orthophosphate and ammonia could be expected in the EBR effluent after nutrient dosage has been optimized?	The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations would not affect the evaluated treatment approach. Data from other testing were shared to show what residual nutrient levels were generated in the past by the EBR system. Phase II testing will use commercial-grade nutrients and will optimize nutrient addition to demonstrate what residual nutrient levels can be expected from a full-scale treatment system at the Coffee Mine.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Residue Characterization and Management. The EBR system is a biological system and so biosolids waste residue will be generated. No information on the characterization and handling of this waste is presented in the documentation.	Elaborate on the residue characterization, geochemical stability, disposal/handling plan, and long-term management plan.	The preliminary residue characterization will be performed in the form of TCLP testing of the reactor's support media upon the completion of Phase II testing. On-site Phase II pilot-scale demonstration testing will define the volume and inform a long-term management plan.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Adaptability. Three things must be achieved for the water treatment to be a success - denitrification with no residual ammonia/other	The level of nitrate in the plant feed will decrease over time as CN is washed out of the HLF as there is a finite load of N on site. On the other hand, As and U will persist on a longer time scale. As such, it is likely that later in the	From the ORP-ladder perspective, uranium bioreduction occurs at similar if not more energetically favorable ORP ranges than denitrification. The process will be staged, and the denitrification reactor-stage will never be driven to low

	nutrients, metal reduction, and conversion of sufficient sulphate to sulphide to precipitate metals without leaving residual sulphide in solution.	project, the influent concentration of NO3 will be low while influent As and U will be high. Can the EBR system effectively achieve the three goals described with only a single lever of control, ORP?	enough ORPs to generate ammonia. After cyanides/nitrates are washed out from the HLF, the redundant denitrification reactors can either be taken offline, adapted to treat more volume for uranium removal, or used for other metals polishing. Phase II bench-scale testing will also evaluate alternative treatment options for Arsenic removal.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Residual Chloride from Active Treatment. Appendix A of the EBR feasibility report shows an increase in chloride.	Why is chloride being added across the circuit? Can this addition be mitigated in some way? Is there a minimum level of chloride that must be present for the EBR system to be effective?	Chlorides are not required for the bioreactors and were a byproduct of a laboratory-grade nutrient mixture used. The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations would not affect the evaluated treatment approach, but it resulted in increases in parameters, such as chlorides, that will not be present in commercial-grade nutrients. Phase II bench-scale testing will use commercial-grade nutrients to demonstrate that no chloride increases are expected from the full-scale facility.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Sulphur Deportment across Active Treatment. Appendix A of the EBR feasibility report shows sulphate removal of 100-150 mg/L across the system	What is the form of the sulphur removed from the system using the SBR?	Sulfur undergoes a number of biochemical transformations within the bioreactor, depending on the treatment conditions, with hydrogen sulfide gas generation as the most dominant pathway. Phase II bench-scale testing will evaluate two options for

	and simultaneous generation of 3-4 mg/L of sulphide. Given that only trace levels of metals are removed by the system, there is a gap between the influent and effluent total sulphur.		sulfate removal: 1) EBR treatment with expected H_2S gas generation, and 2) chemical precipitation pre-treatment.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Bioavailability of Metals across Active Treatment. The bioavailability of dissolved metals can be enhanced through contact with reductive biological treatment systems which generate species such as methylated arsenic species. These organic-metal complexes can be significantly more bioavailable than their inorganic counterparts.	Has Inotec analyzed the speciation of residual metal that is not removed through the EBR for this project or any others? Particularly arsenic, as this is a key constituent of concern in the project.	Arsenic and selenium speciation will be included in the Phase II bench-scale testing analytical plan. Methylated arsenic species have never been observed in our past testing.
Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Deportment of Cyanide Residue across Active Treatment. Oxidative treatment of cyanide can lead to the formation of cyanate, and reductive treatment of cyanide and cyanide degradation products can lead to formation of thiocyanate.	How do cyanate/thiocyanate behave in the EBR system? Are either removed/generated in the process? Given the amount of sulphate reduction occurring in the system (see previous point about sulphur deportment), the formation of thiocyanate may be occurring simultaneously.	Thiocyanate analysis will be included in the Phase II bench-scale testing analytical plan.

Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Startup/Shutdown. The EBR system is a biological system that is to be run seasonally for 6 months of the year. The startup/shutdown of biological processes can be lengthy.	How long is the startup period before the EBR is system is generating effluent meeting discharge targets? Does plant shutdown have an impact on effluent discharge quality?	Generally, the EBR system has been shown to require 5-14 days to reach steady-state during the initial start-up of a new facility and less than an hour to 7 days after long-term shutdowns. Shutdowns are not expected to have an impact on the effluent discharge quality
Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Variability with Flow. The rate of EBR treatment is expected to vary between 4 and 10 L/s. The Inotec document describes a 44h hydraulic retention time (HRT) in the system.	How sensitive to HRT is the discharge quality of the plant? Will performance change if HRT varies because there is excess water on site (or not enough)? If this risk is significant, is a surge pond available to modulate variability in water availability?	Phase I Feasibility was a "proof-of-concept" test focused on establishing whether or not the waters can be treated and on identifying suitable treatment options. The HRTs used were far from optimized and were long enough as not to affect the treatment efficacy. Phase II bench-scale testing will optimize the HRT range, which we expect to be several times shorter. Based on the variable flow expectations, an equilibration basin or tank is expected to be required for a full-scale facility.
Environment and Climate Change Canada – YESAB, 02/2018	The Proponent states that for heap leach solutions only, cyanide destruction followed by an Electrochemical Biological Reactor (EBR) will be employed to treat water to discharge quality. EBRs have not typically been proposed nor used for Yukon projects and their suitability	Clarify whether the proposed water treatment system has been tested (bench-scale) using a synthesized heap leach solution (of the characteristics expected for this project) to proof of concept level and its applicability in a Northern context. If this has yet to be demonstrated, provide clarification whether the Proponent is planning on conducting bench-scale	The proposed phased testing approach includes feasibility (proof-of-concept) testing and bench-scale testing on heap leach solutions generated from the Coffee Project ore materials. The on-site pilot-scale demonstration will be conducted as a final step of a full-scale water treatment design. The phased testing and process development approach minimizes the risks associated with technology

	/ performance in a Northern context remains uncertain. It is not clear what testing has been conducted to suggest suitability for this aspect of the project in particular.	testing as part of the water treatment system finalization, as well as characterizing the resulting effluent prior to implementation.	selection and treatment implementation.
Environment and Climate Change Canada – YESAB, 02/2018	Elevated uranium concentrations in both groundwater quality and surface water quality baseline have been identified. Radium 226 (Ra226) is a daughter isotope resulting from the radioactive disintegration series (decay) of uranium. Given that uranium is a parameter of concern and has been shown to be present and in exceedance as per the above-mentioned, it is not without reason to assume that Ra226 concentrations may end up in the receiving environment throughout the life of the project.	Ra226 is a deleterious substance as set out in Schedule 4 of the MMER. Predictions for Ra226 have been generated by the water quality model for pit lakes and settling ponds. Demonstrate that a non-acutely toxic effluent as required by the MMER will be met throughout the life of the project (i.e. construction, operation, and closure).	Radium-226, as well as other radiochemistry parameters, will be included in the Phase II bench-scale testing analytical plan.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in,	The test work for the biological treatment proposed (EBR) shows a very significant increase in phosphate,	The Inotec EBR work plan authored Oct 30, 2017 included an objective in Phase 2 of determining the optimal dosage of nutrients to minimize	The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations

Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	ammonia and chloride across the treatment system. These increases are not accounted for in the WQ model. These will be ecologically significant because of the low nutrient levels in northern water courses. The increase in chloride across the system is relevant both because of the direct toxicity of salinity on freshwater species and the corrosive impact for metal release in the rock drain.	residual nutrients in the effluent. Phase 2 also includes development of an integrated treatment train include pre-treatment (ex. cyanide destruction) and post-treatment (nutrient polishing). The minimum residual nutrient levels in EBR effluent while still reaching nitrate/arsenic/uranium levels can be assessed. Following this, the requirement of nutrient polishing systems can be evaluated and supported through testing or other reference sites.	would not affect the evaluated treatment approach, but it resulted in increases in parameters, such as chlorides, that will not be present in commercial-grade nutrients. Phase II testing will use commercial-grade nutrients to demonstrate ammonia, phosphate, and chloride levels more representative of the proposed full-scale treatment system.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	The active water treatment system will produce some quantity of waste biomass and carbon, likely both as a periodic bleed from the system and during the final reclamation of the system after shutdown of the EBR. Plans for characterizing this material were not covered in the EBR workplan.	The upcoming Phase 2 EBR test work is a good opportunity to characterize waste and help inform disposal plans. TCLP is one option for characterization, but depending on residue disposal options that are on the table and the amount of material generated during Phase 2 testing, different characterization could be done.	TCLP analysis will be added to the Phase 2 test work, but the pilot test materials would provide better data as they would represent testing conducted with actual wastewaters. TCLP tests will be done on both sets of test materials.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in,	Arsenic speciation in the feed	The Phase II work plan describes use of ferric coagulation to remove arsenic from water. Arsenic removal in this way will depend on	Arsenic speciation of the influent waters will be included in Phase II testing.

Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018		arsenic speciation – As(V) is more amenable to ferric than As(III). Arsenic in the HLF water may be more reduced (from the reductive conditions in the heap) or more oxidized (from use of peroxide to destroy cyanide upsteam of the EBR) or a mix of the two. Consideration of speciation in the test plan/analytics is recommended.	
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	Organo-arsenic complexes in EBR effluent	The EBR systems involve biological activity and therefore have the potential to convert inorganic arsenic species to organic species. Organic arsenic species can be more bio-accumulative. It is recommended that arsenic speciation analysis be conducted on treatment effluent in future testing campaigns so as to better evaluate the impact of the project on biota in the receiving environment.	Arsenic speciation of the effluent waters will be included in Phase II testing.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	Cyanate formation potential	Cyanate is a likely byproduct of cyanide destruction with peroxide and so should be expected in the EBR feed. It is recommended that cyanate assay be incorporated into the Phase 2 laboratory program (in addition to the thiocyanate as was noted in the Oct 30, 2017 Phase 2 EBR workplan).	Thiocyanate analysis will be included in Phase II testing. Cyanate analysis is not available through the selected analytical laboratory. Cyanate will be added to the pilot-scale analytical plan.

PHASE II BENCH-SCALE TESTING RESULTS

Preliminary Assessments

The Obtained Leach Water Chemistry and Experimental Implications

The chemistry of the waters generated by Kappes, Cassiday & Associates in the leach testing differed from the water modeling performed by Lorax Environmental (Table 8), as was discussed by WesTech and Lorax when deciding how to best approach the needed chemistry adjustments. Limitations of an accelerated leaching procedure, as well as scaling issues of a small-scale leach column, likely contributed to the discrepancies.

Batches of the waters delivered to WesTech's laboratories were spiked with the parameters of concern (NO_3, SO_4, As, U, and Sb) to match the upper modeling predictions. These parameters are highlighted in blue in Table 8. Counter ions were chosen with a goal to balance the major ion chemistry and included Ca, Mg, Na, and Cl.

Certain other influent water chemistry parameters exceeded the predicted levels by up to several orders of magnitude (NH_3, alkalinity, Al, Ag, and Cu). They are highlighted in yellow in Table 8. Except for alkalinity, **these concentrations in the generated waters exceeded their respective treatment targets. Water chemistry was not adjusted to lower their concentrations.**

Table 8. Water chemistry comparison of the modeling predictions and the received solutions. Treatment targets are provided as a reference.

Parameter [mg/L]	HLF Rinse Modeling	Coffee Waters	Treatment Target
NH_3-N	0.025-0.06	19	8
NO_3-N	275-307	117	3
NO_2-N	1.6-1.9	0.9	0.09
Cl	115-123	12	290
SO_4	2300-2516	105	1500
Alkalinity, as $CaCO_3$	47-87	284	500
WAD-CN	0.09-0.2	0.03	0.025
Al	0.06-0.2	5.7	0.06
Ag	0.00009-0.00125	0.027	0.00009
As	0.66-2	0.559	0.035
Ca	204-350	12	180
Cd	0.00004-0.00013	0.00012	0.00004
Cr	0.004-0.014	0.0012	0.001
Cu	0.004-0.014	0.029	0.004
Fe	0.15-0.5	0.077	0.05
Hg	0.0001-0.00026	0.000013	0.0001
Mg	117-155	1.6	50
Mn	0.016-0.06	0.025	0.016
Mo	0.033-0.105	0.035	0.033
Na	890-1168	238	890
K	8-11	6.5	8

Parameter [mg/L]	HLF Rinse Modeling	Coffee Waters	Treatment Target
Ni	0.002-0.006	0.006	0.002
Pb	0.00032-0.0013	0.0006	0.0032
Sb	0.17-0.5	0.084	0.07
Se	0.0015-0.005	0.0008	0.0015
Tl	0.0015-0.004	0.0006	0.0015
U	0.3-0.685	0.306	0.1
Zn	0.02-0.052	0.005	0.02

Chemistry Assessment

Evaluation of the chemistries suggested that most of the parameters of interest were well within the treatability range. A discussion of the treatability assessment and the identified potential issues are presented below.

Nitrate-N, uranium, and sulfate concentrations of 300 mg/L, 600 µg/L, and 2,500 mg/L, respectively, were within the biological treatability range. Inorganic parameters, such as chlorides and cyanides, which often have an inhibitory effect on microbial metabolism, were present at low levels. Additionally, the elevated alkalinity and presence of nitrates would benefit the biological treatment approach, maintaining an optimum pH of the system. No microbial inhibitory parameters were identified.

In terms of potential issues, as demonstrated in the Phase I feasibility testing, arsenic concentrations were present at the upper margin of biological treatability. What is more, the compounds that often compete for electrons during biotreatments, e.g., nitrate, nitrite, sulfate, and other metal oxyanions, such as arsenate, were present at elevated concentrations, complicating the treatment approach. Finally, from the system design perspective, due to the concentrations of sulfate, aluminum, calcium, and other water hardness parameters, bioreactor operation must be conducted within design specifications to prevent the potential for excessive precipitation formation. **The chemistry assessment concluded that, while treatable, the complexity of the Coffee waters presents a challenging scenario for full-scale system design based solely on biological treatment.**

Jar Testing

The generated waters contained only 0.5 mg/L total As. The solutions were spiked with sodium arsenite to reach the forecasted As levels of 2 mg/L. Arsenite is the less oxidized species of As, and it is more difficult to remove using ferric co-precipitation. **Arsenite was chosen for this testing as "the worst-case scenario" for chemical pretreatment.** The actual As speciation in the future Coffee waters is uncertain, but arsenate is generally a more prevalent species in mining environments.

Ferric co-precipitation tests demonstrated the impact of arsenic speciation on the performance (Figure 13). When no oxidizing agent was present, negligible arsenic removal was achieved. **Once arsenic was oxidized, ferric co-precipitation decreased As concentrations to at or below the treatment target.** Permanganate was used in the jar testing procedure as a strong oxidizer. Since the proposed treatment includes the destruction of cyanide by oxidation with hydrogen peroxide, it is expected that most of arsenic present will be converted to arsenate, rendering the ferric co-precipitation a suitable option for As pretreatment.

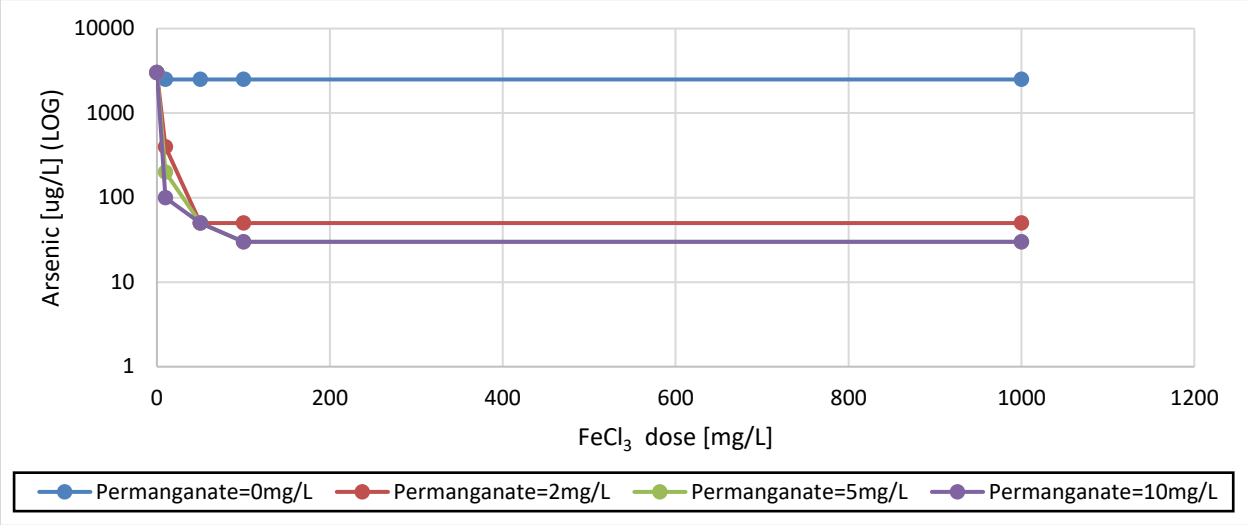


Figure 13. Arsenic ferric co-precipitation jar test results.

Sulfate is forecasted to be present at approximately 2,300-2,500 mg/L in Coffee Mine waters, which is a threshold of gypsum solubility. At such high concentrations, under specific conditions, a portion of sulfate might be expected to precipitate out of solution within the bioreactor – a scenario that should be avoided.

Sulfate precipitation pretreatment with barium salts (barium chloride and barium hydroxide) was investigated in the absence and presence of lime additions (Figure 14).

- **Treatment efficiency was shown to be directly proportional to the barium dose.**
- **Lime additions improved sulfate precipitation, but only at higher Ba doses. With the sulfate treatment target of 1,500 mg/L, lime addition was shown not to be needed.**

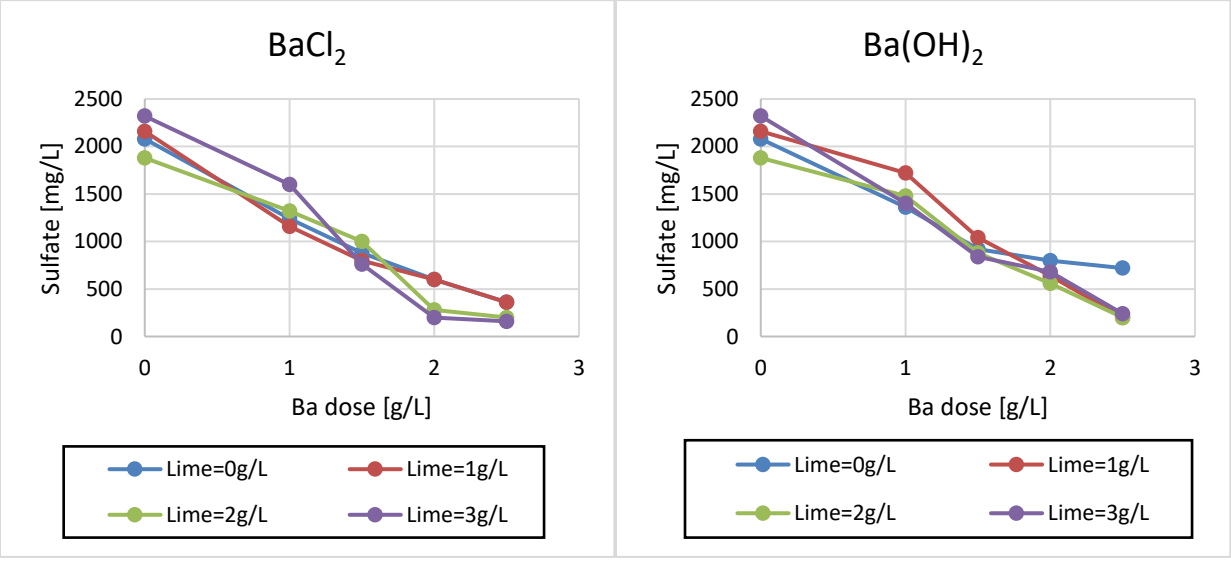


Figure 14. Sulfate precipitation jar tests with barium chloride and barium hydroxide salts.

As both evaluated barium salts proved to be effective for sulfate precipitation from the Coffee waters, other treatment parameters were considered (Table 9). Precipitated sludge resulting from barium hydroxide addition was more amorphous, took longer to settle, and generated more sludge volume than barium chloride treatment. **Barium chloride was initially chosen as a precipitation reagent for the bench-scale testing** because it yielded better results per Ba dose than $Ba(OH)_2$, the produced sludge had more beneficial characteristics, and barium chloride addition would not require an additional pH adjustment step.

Table 9. Sulfate precipitation with barium salts. Reagent dosage, sludge volume, and water loss comparison.

	$BaCl_2$	**$Ba(OH)_2$**
Min. Ba dose to meet discharge target	0.72 g/L	0.83 g/L
Equivalent reagent dose	1.28 g/L	1.91 g/L
Sludge volume	10 mL/L treated	23 mL/ L treated
Sludge volume (extrapolated)	10 L/m^3 treated	23 L/m^3 treated
Sludge weight (extrapolated)	12.6 kg/m^3 treated	25.6 kg/m^3 treated
Dry sludge weight (extrapolated)	3.5 kg/m^3 treated	4.2 kg/m^3 treated
Water loss (extrapolated)	9.1 kg/m^3 treated	21.5 kg/m^3 treated

Microbial Screening and Assessment

Microbes present in the received water samples were cultured. This task provided information about concentrations and colony types of microbes present (i.e., microbial diversity). Understanding the native population is as crucial as understanding water chemistry since indigenous microbes can either hinder or enhance the biotreatment.

The microorganisms isolated from the waters received were screened with WesTech's repository strains to examine their contaminant-reducing potential in the site waters. The microbial screening was performed as a batch, qualitative assessment toward a selection of a robust microbial population. It was used 1) to determine whether a given contaminant was easy or difficult to remove in the given water chemistry using biological treatment; 2) to identify the best performing microbial population in the given water chemistry (contaminant transformation, performance robustness, etc.); 3) to select an adjusted/enhanced microbial consortium that was the most compatible with the unadjusted native population; and 4) to condition the selected microbial consortia for optimal EBR performance.

The microbes screened included denitrifiers, uranium reducers, arsenic reducers, antimony reducers, and sulfate reducers, matched with the indigenous microbial population. **With an evaluation of the obtained water chemistry, microbial screening tests demonstrated favorable biological treatment of all contaminants of concern.** Figure 15 shows a snapshot of the screening results of denitrification and sulfate reduction. Only a few microbial strains tested are shown in the figures to help with legibility. Out of dozens of microbial strains tested, selected few were further screened to develop the inocula for bench-scale tests.

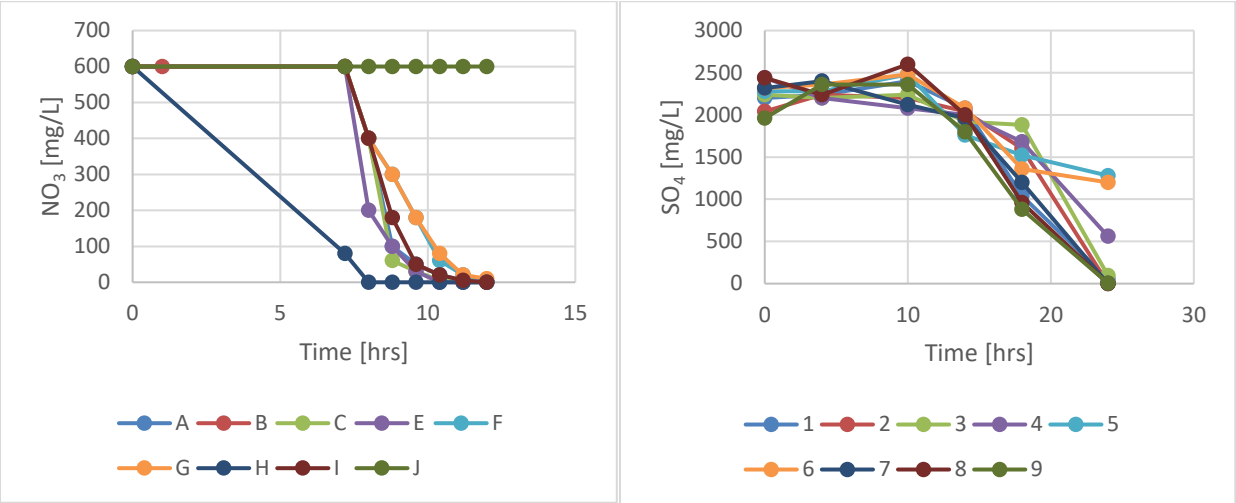


Figure 15. Selected snapshots of denitrification and sulfate reduction microbial screening tests using various denitrifying (A – J) and sulfate-reducing (1 – 9) strains.

Bench-Scale Testing

System A: Validation Results of Contaminants of Interest

The validation phase of the bench-scale EBR testing with System A was completed successfully for all contaminants of concern. Nitrate-N was consistently removed to below the detection limit of 0.5 mg/L within the first EBR stage and remained nondetectable throughout the treatment (Figure 16).

Sulfate was successfully removed to below the discharge target of 1,500 mg/L in the phys-chem pretreatment stage and remained within compliance throughout the treatment (Figure 17). Sulfate removal in the pretreatment can be adjusted further based on Ba dose. The increase in sulfate concentration observed in the aerobic column during the post-treatment optimization was expected. The post-treatment's main goal was residual COD/BOD oxidation; once that goal was achieved, system optimization in terms of the HRT and the required aeration was performed to avoid re-oxidizing reduced species.

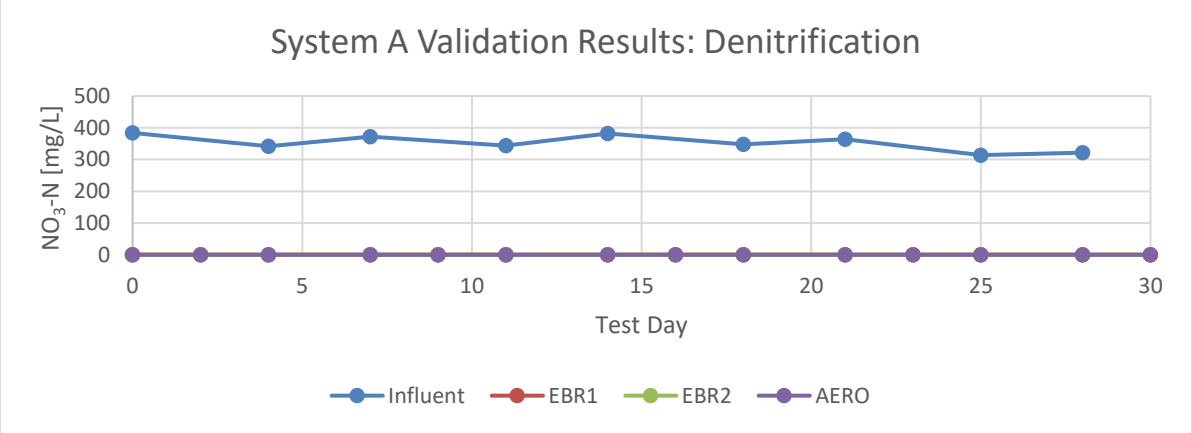


Figure 16. Phase II bench-scale denitrification results: System A validation.

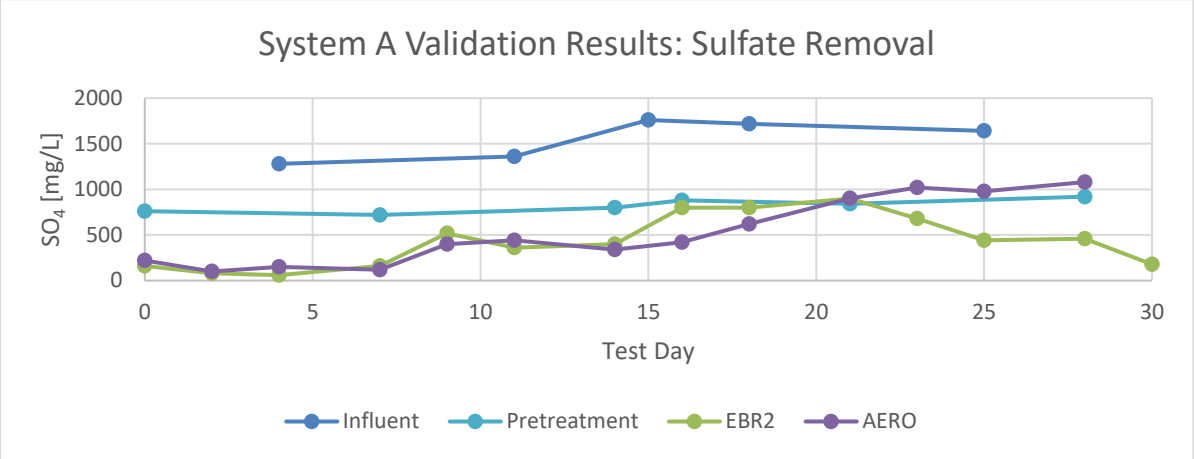


Figure 17. Phase II bench-scale sulfate results: System A validation.

A 30% total uranium reduction was achieved in the phys-chem pretreatment. The EBR system further reduced uranium to below the detection limit of 0.002 mg/L (Figure 18). Uranium removal kinetics followed linear fit in the first-stage EBR, designed for denitrification, and an exponential fit in the second-stage EBR, designed for metals removal.

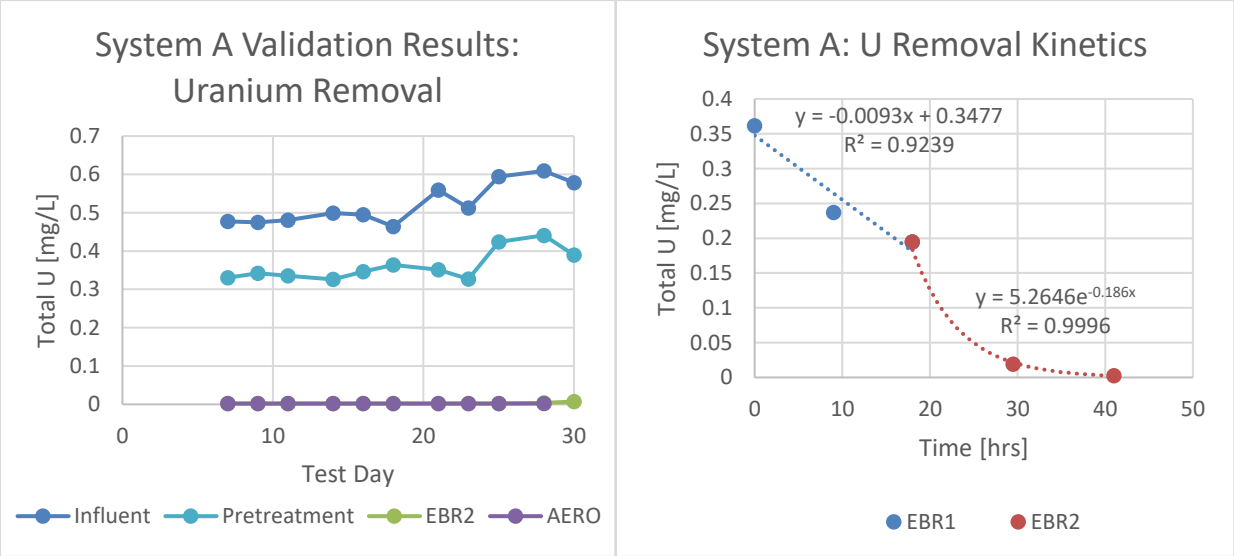


Figure 18. Phase II bench-scale uranium results: System A validation.

Total arsenic was removed to an average of 0.4 mg/L in the phys-chem pretreatment using a 20 mg/L $FeCl_3$ dose (Figure 19). Further pretreatment optimization was needed to lower the As level in the pretreatment step. The goal of the optimization was to demonstrate that the arsenic discharge target can be achieved with the ferric co-precipitation alone, without the need for a biological polishing step. The EBR system polished arsenic levels to an average of 0.009 mg/L.

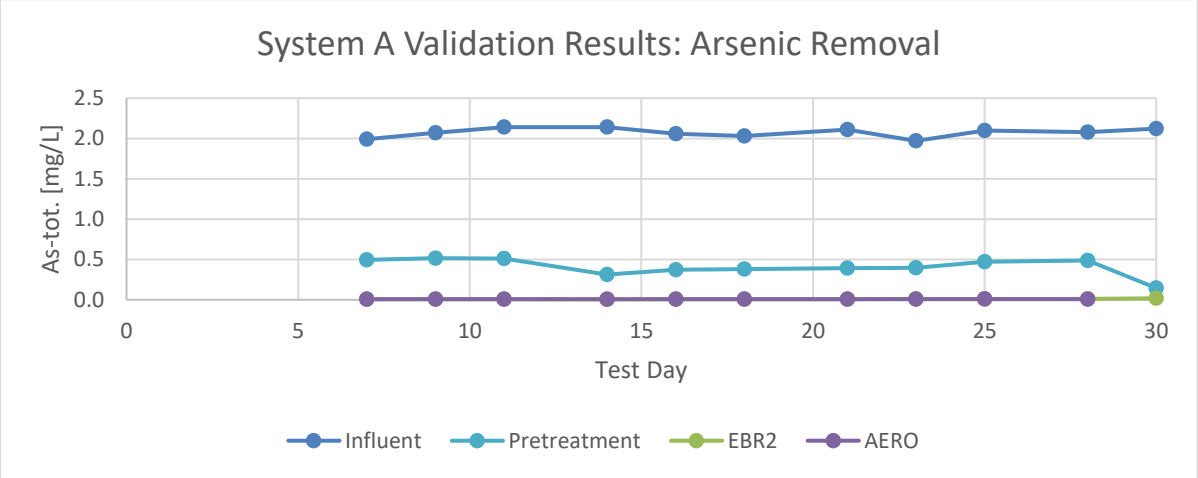


Figure 19. Phase II bench-scale arsenic results: System A validation.

System B: Validation Results of Contaminants of Interest

The validation phase of the bench-scale EBR testing with System B was completed successfully for nitrate, sulfate, and uranium removal. Successful arsenic removal was achieved during start-up and the first couple of weeks of steady-state operation, but a troubling upward trend in As concentrations was observed with time.

Nitrate-N was removed on average to 1.6 mg/L within the first EBR stage (average 16-hr HRT) and remained nondetectable throughout the rest of the treatment (Figure 20).

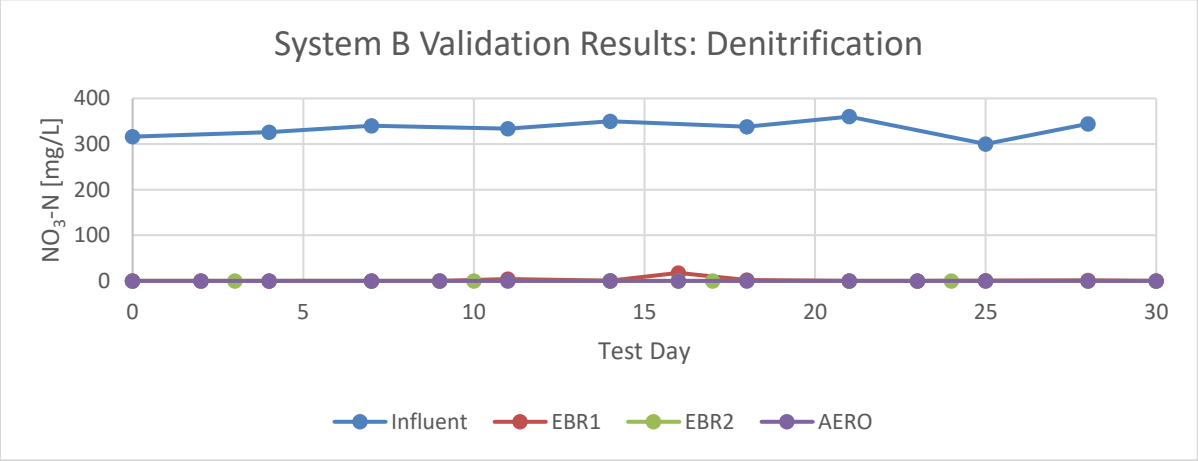


Figure 20. Phase II bench-scale denitrification results: System B validation.

Sulfate was successfully removed to below the discharge target of 1,500 mg/L in the second EBR stage (average 30-hr HRT) and remained within compliance throughout the treatment (Figure 21). Based on the first month of data, the influent's sulfate spike was adjusted further to match the upper modeling predictions.

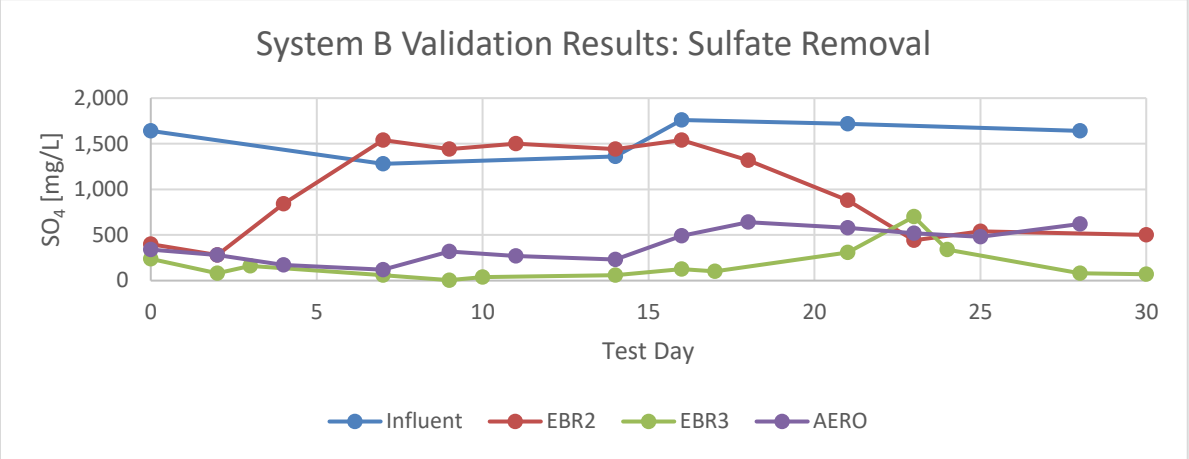


Figure 21. Phase II bench-scale sulfate results: System B validation.

The EBR system consistently reduced total uranium to below the detection limit of 0.002 mg/L (Figure 22). Average U-total concentrations of 0.14 mg/L, 0.007 mg/L, and <0.002 mg/L were achieved in the consecutive EBR reactor stages.

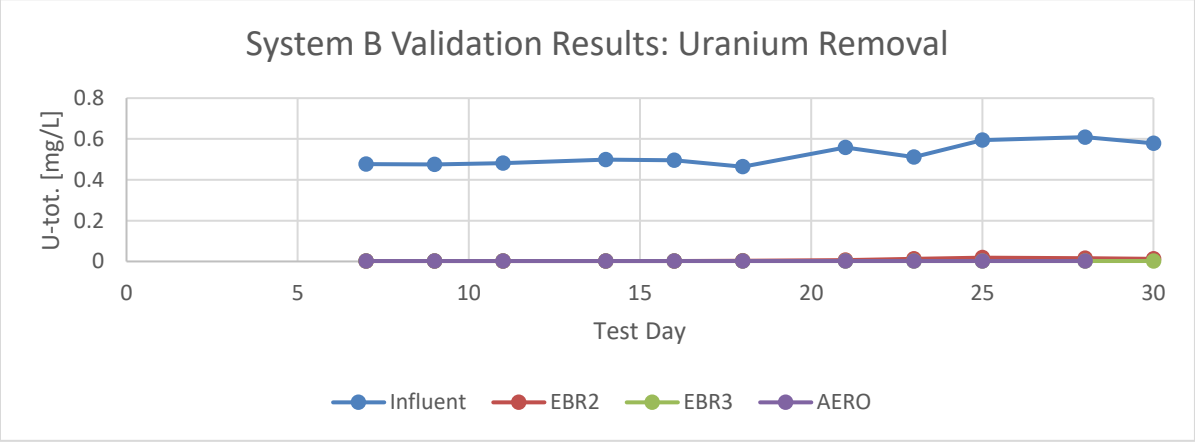


Figure 22. Phase II bench-scale uranium results: System B validation.

Total arsenic was removed to an average of 0.03 mg/L in the EBR system effluent; however, As concentrations had steadily increased throughout the validation phase (Figure 23). Arsenic levels in the system effluent during the last week of validation testing averaged 0.048 mg/L.

Based on the chemistry assessment results indicating a high load of oxyanions acting as competing electron-acceptors and the degrading As removal performance in the continuous-flow bench tests, System B treatment approach was deemed unsuitable for the Coffee Gold waters. Testing of System B was discontinued, and further testing focused on optimization and stress-testing of System A.

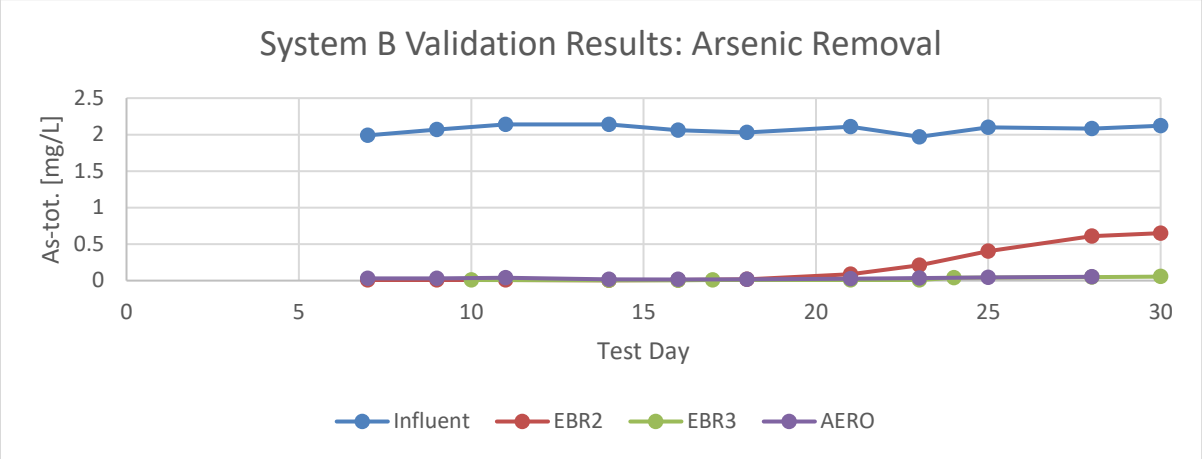


Figure 23. Phase II bench-scale arsenic results: System B validation.

System A: Stress-Testing Results of Contaminants of Interest

System stress-testing included changing the nutrient type and concentration (from the mixture of molasses and ethanol to ethanol alone) and increasing flowrates to evaluate different hydraulic retention times.

The stress-testing events yielded observable responses in nitrate concentrations in the mid-point sampling port of the first-stage EBR but had little to no effect on EBR1 effluent concentrations (Figure 24). Even though the denitrification performance was not driven to failure during stress-testing, the obtained data is sufficient to aid the pilot-scale system design. During the final four weeks of testing, the first stage EBR was operated at an average HRT of 7-hours and provided with average ethanol (nutrient) concentration of 0.6 mL/L. **Except for a stress response on test day 88, the average resulting nitrate-N concentrations in EBR1 effluent were non-detectable (<0.3 mg/L), meeting the discharge target of 3 mg/L.**

Each EBR stress-testing event affected the aerobic post-treatment performance and required system optimization (bottom graph in Figure 24). For example, as nutrient additions were lowered, the BOD loading into the aerobic column decreased as well, rendering it oversized. With extra dissolved oxygen no longer consumed by residual organics, the intermediary denitrification by-products (e.g., NO_2^-, NO, N_2O) were oxidized back to nitrate. Since reducing the aerobic post-treatment size was not feasible on the bench-scale once the columns were constructed, the post-treatment was optimized by balancing the frequency and intensity of oxygen gas additions. At the end of the testing, the aeration was only turned on for one minute every three hours instead of running continuously, meaning that the aerobic post-treatment column was significantly oversized.

Nitrite removal followed a similar trend to nitrate (Figure 25). **While the samples collected from the mid-point EBR1 showed elevated nitrite-N concentration in response to stress-testing events, the average EBR1 effluent was 0.037 mg/L, and the EBR2 effluent was non-detectable (<0.01 mg/L).** During the final four weeks of testing, after the required oxygen gas addition optimization, the average nitrite-N discharge from the aerobic post-treatment column was 0.02 mg/L. The treatment target for NO_2-N is 0.09 mg/L.

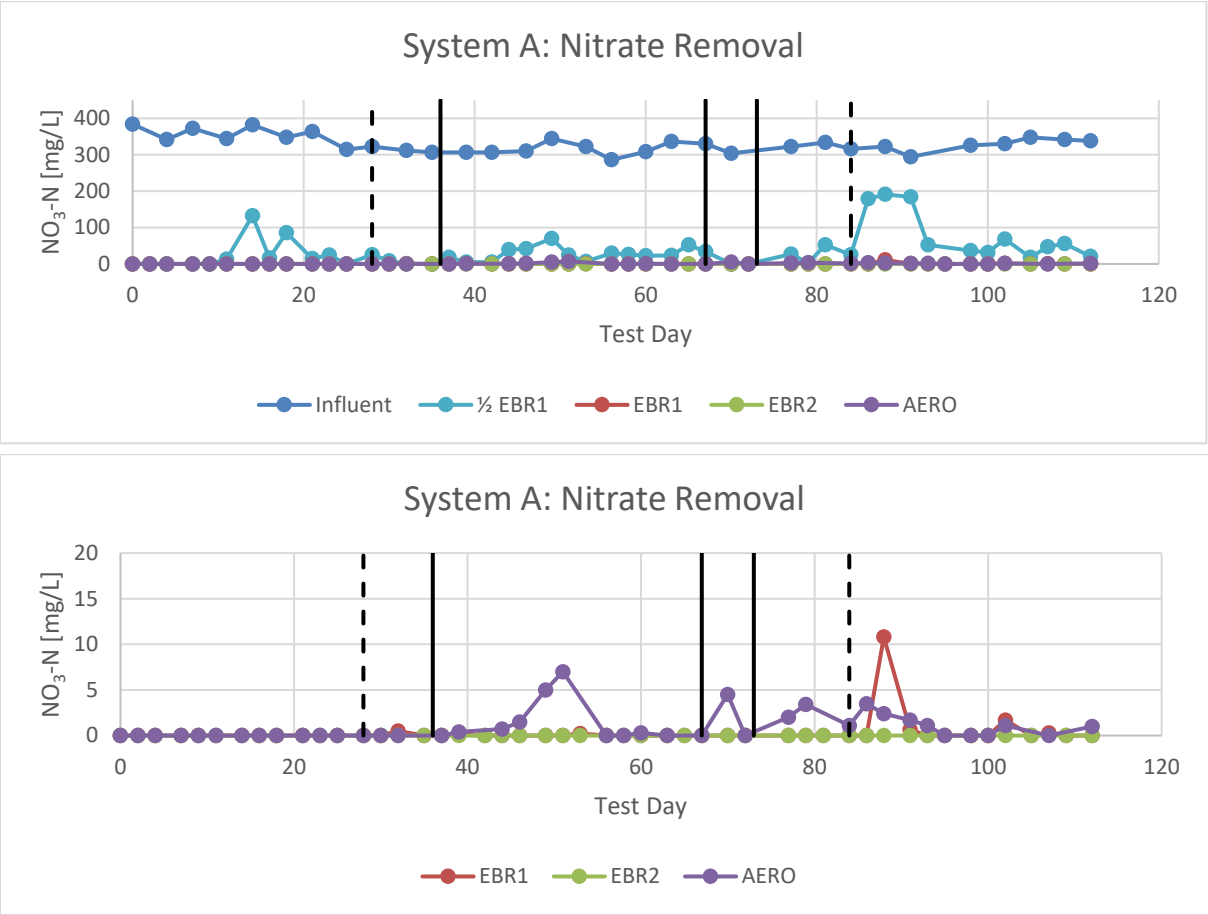


Figure 24. Phase II bench-scale denitrification results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. The bottom graph focuses on nitrate-N results below 20 mg/L.

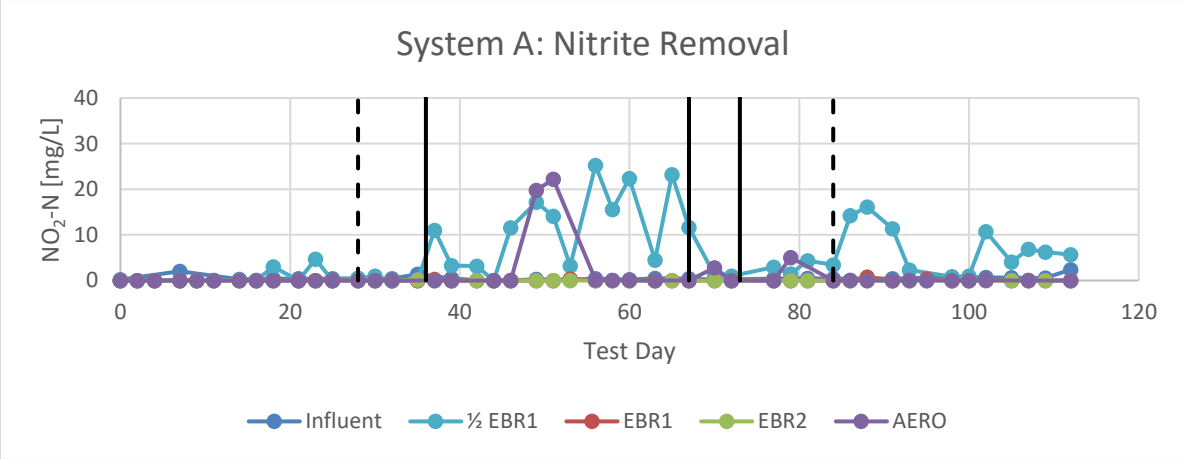


Figure 25. Phase II bench-scale nitrite results: System A overall nitrite results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

The sulfate spike in the influent waters was increased after the initial 30-day operation period to match the upper modeling predictions. After the adjustment, influent sulfate levels varied between 2,340-3,350 mg/L. The average influent concentration of 2,820 mg/L slightly exceeded the upper modeling prediction of 2,500 mg/L.

Barium precipitation pretreatment target was set at 1,500 mg/L - the treatment target. **The average sulfate concentration in the pretreatment effluent was 1,513 mg/L** (Figure 26). The preliminary jar test experiments showed that the final sulfate concentration was directly correlated to the barium dose, i.e., lower sulfate concentrations can be achieved with higher barium doses if needed.

During stress-testing, various operating conditions were evaluated to establish the optimal conditions to ensure that the EBR system reduced no or little additional sulfate. Short HRT, lack of complex nutrient additions, and balanced nutrient concentrations were found to be the most optimal operating conditions to limit sulfate bioreduction. **Since both arsenic and sulfate were removed to below their respective discharge limits in the chemical pretreatment steps, biological EBR treatment could be maintained at higher ORP ranges without using excess nutrients and thus limiting the creation of problematic by-products, such as hydrogen sulfide or methyl-arsonic acids.**

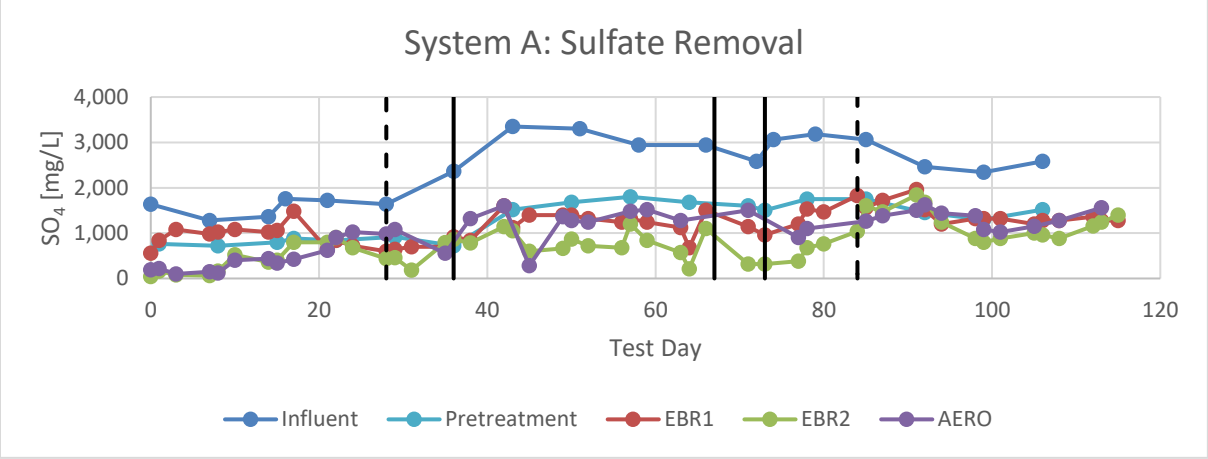


Figure 26. Phase II bench-scale sulfate results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

An average total uranium removal of 39% was achieved with the chemical precipitation pretreatment alone (Figure 27). The average total uranium influent concentrations were reduced from 0.56 mg/L in the raw Coffee water (after spiking) to an average of 0.34 mg/L in the pretreatment effluent. Uranium co-precipitation with barium sulfate has been known and studied for decades. The proposed chemical structure of the resulting precipitate is a double potassium sulfate complex of U(IV) or $K_2Ba[U(SO_4)_4]$. That is supported by a decrease in potassium concentrations in the pretreatment effluents. Since the co-precipitation mechanisms depend on uranium speciation, the actual pretreatment efficiency for uranium removal will be determined during on-site pilot-scale testing of the Coffee Mine waters.

Further removal of total uranium to below the discharge target 0.1 mg/L was achieved with the first-stage EBR treatment during test days 37 through 79 (Figure 27). The average HRT of EBR1 during that time was 11 hours, and the average ethanol nutrient concentration was 0.9 mL/L. Once the nutrient

additions to EBR1 were lowered to 0.6 mL/L and the HRT of the system was reduced to 7 hours, the resulting EBR1 effluent contained, on average, 0.17 mg/L total uranium. The second EBR stage maintained total uranium concentrations at or below the discharge target throughout the test's entire duration. The aerobic post-treatment did not affect total uranium concentrations.

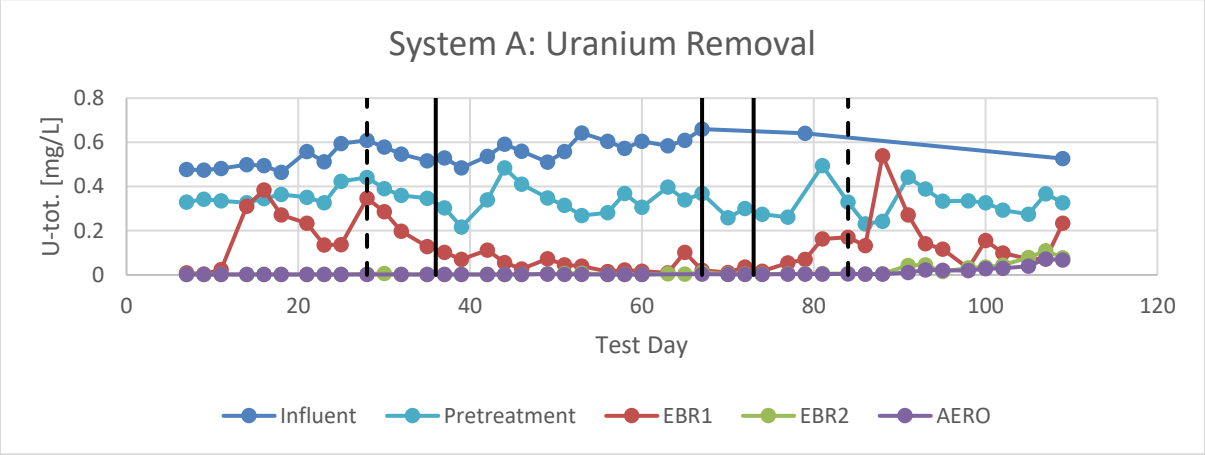


Figure 27. Phase II bench-scale uranium results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Ferric arsenic co-precipitation pretreatment was optimized after the first four weeks of operation (Figure 28). **On average, the initial 79% removal efficiency was improved to 98.4%, removing total arsenic to 0.035 mg/L.** The factors affecting the pretreatment efficiency were the ferric chloride dose, as well as the type of barium pretreatment used for sulfate precipitation since barium sulfate sludge acted as coagulant/flocculant for arsenic co-precipitation. Increasing ferric chloride dose from 20 mg/L to 30 mg/L on test day 30 improved the system efficiency; the resulting total arsenic concentrations in the pretreatment effluent decreased from 0.43 mg/L to 0.077 mg/L. When barium hydroxide was used for sulfate precipitation instead of barium chloride, starting on test day 50, total arsenic concentrations dropped further to 0.029 mg/L. A short-lived evaluation of barium carbonate between test days 77 and 82 showed to be detrimental to both arsenic and uranium removal in the pretreatment; total arsenic concentrations peaked at 0.411 mg/L during that test.

Whenever arsenic concentrations spiked in the pretreatment effluent, a similar spike was observed later in the first-stage EBR effluent. Once the pretreatment was optimized, the EBR configuration and operating conditions were to specifically not target any arsenic reduction.

Arsenic speciation was performed three times throughout the bench trial – at the end of validation testing (day 28), early on during stress-testing when arsenic removal was still in steady-state operation (day 70), and at the end of stress-testing (day 113). The predominant arsenic species in the influent water was arsenate, as expected due to the use of hydrogen peroxide for cyanide destruction (Table 10). After arsenic precipitation pretreatment, arsenate remained the predominant species. The EBR system generated progressively more reduced arsenic species but never produced any methylated arsenic by-products. Depending on the operating conditions, the aerobic post-treatment re-oxidized most of the arsenic remaining in the system into the least bioavailable and less toxic As(V).

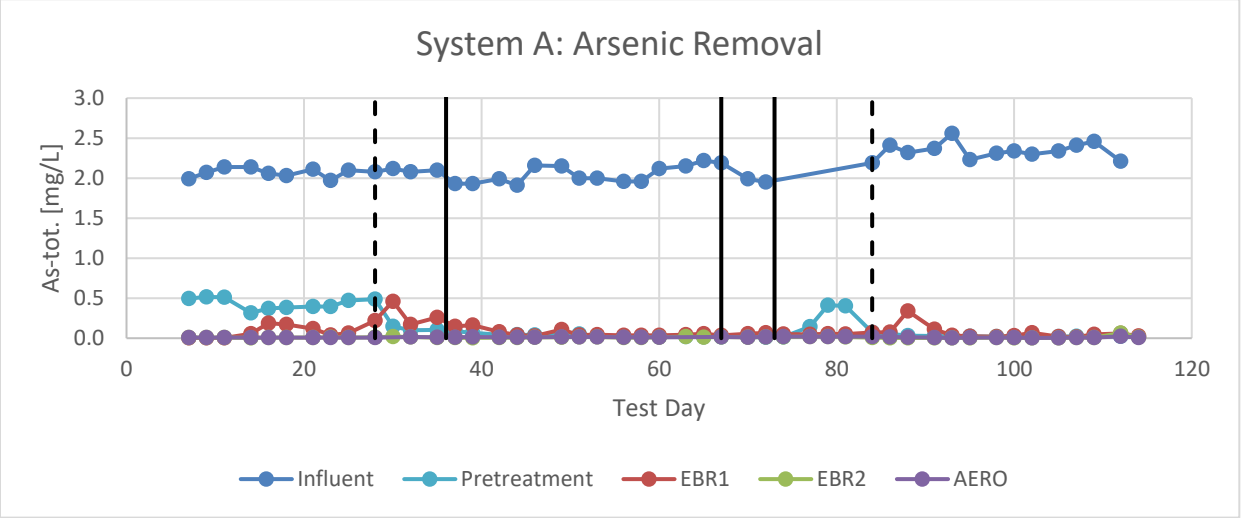


Figure 28. Phase II bench-scale arsenic results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Table 10. Arsenic speciation results, including the following arsenic species: As(V) – arsenate, As(III) – arsenite, MM-As – monomethylarsonic acid, DM-As – dimethylarsonic acid, and a sum of unknown species.

Test Day	As Species	Influent	Pretreatment	EBR1	EBR2	Aerobic
28	**As(V)**	2170 µg/L	119 µg/L	2.34 µg/L	3.16 µg/L	6.44 µg/L
	As(III)	<2.0 µg/L	<0.80 µg/L	200 µg/L	4.88 µg/L	1.77 µg/L
	MM-As	<4.5 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L
	DM-As	<2.5 µg/L	<1.0 µg/L	<1.0 µg/L	<1.0 µg/L	1.06 µg/L
	Unknown	7.8 µg/L	7.5 µg/L	12.9 µg/L	1.48 µg/L	<1.0 µg/L
70	**As(V)**	2,000 µg/L	12.4 µg/L	1.55 µg/L	<0.80 µg/L	6.25 µg/L
	As(III)	<0.80 µg/L	<0.80 µg/L	31 µg/L	2.31 µg/L	<0.80 µg/L
	MM-As	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L
	DM-As	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L
	Unknown	13.2 µg/L	<1.00 µg/L	19.2 µg/L	12.5 µg/L	1.17 µg/L
113	**As(V)**	1730 µg/L	11.2 µg/L	0.821 µg/L	2.03 µg/L	17.8 µg/L
	As(III)	<0.80 µg/L	<0.80 µg/L	25.3 µg/L	5.29 µg/L	<0.80 µg/L
	MM-As	1.21 µg/L	1.21 µg/L	<0.80 µg/L	<0.80 µg/L	<0.80 µg/L
	DM-As	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L
	Unknown	6.47µg/L	<1.00 µg/L	1.05 µg/L	11.4 µg/L	<1.00 µg/L

Arsenic species concentrations varied between testing stages and operating conditions. To illustrate the speciation transformations, Figure 29 shows average arsenic species concentrations across the treatment system.

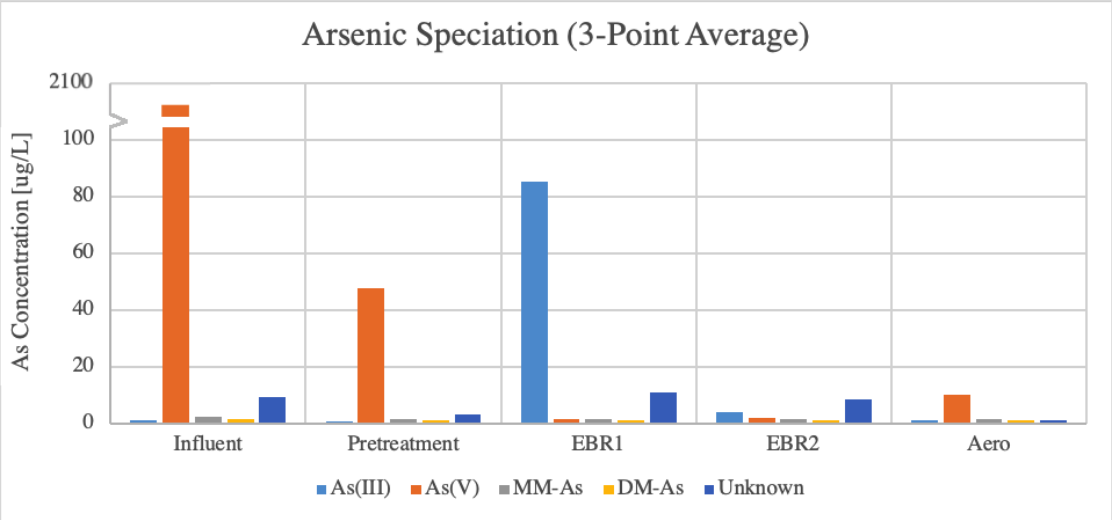


Figure 29. Phase II bench-scale arsenic speciation results: System A. Values averaged over three data points.

System A: Anions

Analytical suite chemistry scans were performed three times throughout the test – at the end of validation testing (day 28), early on during stress-testing when arsenic removal was still in steady-state operation (day 70), and at the end of stress-testing (day 113). **Because of the different testing-stage goals and changing operating conditions across all the treatment units, many of the evaluated parameters were never in a true steady-state. Drawing conclusions based on a limited set of three data points collected during various operating conditions has a number of limitations.**

Table 11 summarizes the results of major ions analysis. Nitrate-N, nitrate-N, and sulfate concentrations obtained from the analytical laboratory support the routine in-house analysis performed at WesTech's labs.

Table 11. The average concentration of anions throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Nitrate-N [mg/L]	335	303	0.034	<0.01	<0.01	3.0
Nitrite-N [mg/L]	1.04	1.57	<0.04	<0.02	<0.02	0.09
Sulfate [mg/L]	2,703	1,530	1,397	902	1,237	1,500
Sulfide [mg/L]	<0.016	<0.01	0.38	0.24	<0.01	N/A
Chloride [mg/L]	138	577	665	648	695	290

The average sulfide concentrations remained nondetectable in the influent and chemical pretreatment effluent, increased to 0.38 mg/L and 0.24 mg/L in the EBR stages, and were oxidized to below the detection limit of 0.01 mg/L in the aerobic post-treatment. While higher than the odor threshold of 0.5 μg/L, the average sulfide concentrations generated within the EBR reactors were orders of magnitude lower than the US OSHA health and safety standards. US OSHA defines sulfide exposure ranges as 100 mg/L (immediately dangerous to life or health), 50 mg/L (maximum peak for 10 minutes), 30 mg/L (maximum concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or serious health effects).

Because of the reagents used in the chemical precipitation steps, chloride levels spiked in the pretreatment effluent and remained elevated throughout the system. The highest chloride concentration in the pretreatment (836 mg/L) was detected when barium chloride was used as a sulfate precipitation reagent. Due to that high concentration, an adjustment was made to use barium hydroxide as a sulfate precipitant instead. However, since hydrochloric acid was used twice in the treatment train following this change (once to adjust the pH after cyanide destruction and the second time to neutralize the pH after barium hydroxide addition), chloride levels remained elevated at 307 mg/L. **We recommend performing additional sulfate precipitation jar tests with different barium salts that would not cause chloride increases (such as barium carbonate) once the mine is operational and actual site waters are available.**

System A: Metals

The average concentrations of metals collected throughout the individual treatment units are summarized in Table 12. For ease of interpretation, these results can be divided into five categories:

1. **Metals present in the influent waters within the forecasted ranges that were already below the discharge targets.**
    - Lead: present below the detection limit of 0.002 mg/L in the influent and throughout the treatment stages.
2. **Metals present in the influent waters within the forecasted ranged but exceeding the discharge targets.**

    2.1. Metals treated to below their respective discharge targets.
    - Molybdenum: present at 0.048 mg/L in the influent, removed to 0.04 mg/L in the pretreatment. The discharge goal of 0.033 mg/L was met within the first-stage EBR.
    - Nickel: present at 0.0053 mg/L in the influent, removed to less than 0.003 mg/L in the chemical pretreatment. The discharge goal of 0.002 mg/L was met within the first-stage EBR.
    - Calcium: present at 261 mg/L in the influent, removed to less than 90 mg/L in the final effluent. Calcium treatment target is 180 mg/L.

    2.2. Metals not treated to below their respective discharge targets.
    - Manganese: present at 0.029 mg/L in the influent. The initial spike of manganese concentrations observed throughout the EBR system was attributed to the addition of molasses as a nutrient source. Stress-testing with ethanol as the sole nutrient demonstrated that manganese could be maintained at or below the influent concentrations throughout the EBR treatment. Since no nutrients or reagents were added to the aerobic post-treatment column, a further spike discovered in the aerobic system effluent can only be

attributed to the microbial support media – in this case, pumice was used as a cost-effective alternative to activated carbon. Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of manganese occurs.

Table 12. The average concentration of metals throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Aluminum-tot. [mg/L]	<0.1	<0.1	<0.1	<0.1	<0.1	0.06
Antimony-tot. [mg/L]	0.61	0.38	0.06	0.02	<0.008	0.07
Arsenic-dis. [mg/L]	2.05	0.16	0.15	0.02	0.01	N/A
Barium-tot. [mg/L]	0.17	0.10	0.04	0.06	0.09	N/A
Cadmium-tot. [mg/L]	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00004
Calcium-tot. [mg/L]	261	259	98	58	87	180
Chromium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.001
Copper-tot. [mg/L]	0.018	0.006	<0.003	<0.003	<0.004	0.004
Iron-tot. [mg/L]	0.105	<0.1	0.23	0.12	<0.16	0.05
Lead-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0032
Magnesium-tot. [mg/L]	195	121	124	114	112	50
Manganese-tot. [mg/L]	0.029	0.024	0.062	0.064	0.271	0.016
Mercury-tot. [mg/L]	0.0034	0.00013	<0.0001	<0.00009	<0.00009	0.0001
Molybdenum-tot. [mg/L]	0.048	0.040	0.02	<0.005	<0.002	0.033
Nickel-tot. [mg/L]	0.0053	<0.003	<0.002	<0.002	<0.002	0.002
Potassium-tot. [mg/L]	16.2	12.1	14.7	14	13.7	8
Selenium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0015
Silver-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.00009
Sodium-tot. [mg/L]	1500	1433	1460	1443	1430	890
Thallium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0015
Uranium-dis. [mg/L]	0.61	0.35	0.22	0.004	<0.002	N/A
Zinc-tot. [mg/L]	<0.008	<0.006	<0.01	<0.006	<0.006	0.02

3. Metals present in the influent waters outside of the forecasted ranges.

3.1. Metals present in the influent waters at higher concentrations than forecasted and removed by the treatment to below their respective discharge targets.

- Antimony: influent concentrations of 0.61 mg/L reduced to 0.38 mg/L in the chemical pretreatment and reduced further by the biological treatment to 0.06 mg/L and 0.02 mg/L in the consecutive EBR stages. The discharge target of 0.07 mg/L was met in EBR1.
- Copper: present at 0.018 mg/L in the system influent, reduced by 66.7% in the pretreatment, and removed further biologically to below the detection limit of 0.003 mg/L. The discharge goal of 0.004 mg/L was met in the first EBR stage.

- Mercury: present at 0.0034 mg/L in the influent, reduced to 0.00013 mg/L in the chemical pretreatment. The discharge limit of 0.0001 mg/L was met within the first-stage EBR.

3.2. Metals present in the influent waters at higher concentrations than forecasted and not removed by the treatment to below their respective discharge targets.

- Magnesium: present at 195 mg/L in the influent, removed in the chemical pretreatment to 121 mg/L. It remained at a similar level throughout the biological treatment, exceeding the discharge limit of 50 mg/L. Water softening pretreatment step should be added to remove excess hardness minerals during pilot-scale testing.
- Potassium: present at 16.2 mg/L in the influent, removed to 12.1 mg/L in the pretreatment, and varied between 13.7-14.7 mg/L in the biological treatment. The upper-level prediction for potassium in Coffee waters is 11 mg/L. The discharge target is 8 mg/L.
- Sodium: present at 1,500 mg/L in the influent and not removed by any treatment stages. The upper-level prediction for sodium in Coffee waters is 1,168 mg/L.

3.3. Metals present in the influent waters at lower concentrations than forecasted.

- Iron: present in the influent at 0.105 mg/L. The initial spike of iron concentrations observed throughout the EBR system was attributed to the addition of molasses as a nutrient source. Stress-testing with ethanol as the sole nutrient demonstrated that iron remained at or below the influent concentrations.
- Zinc: present in the influent below the detection limit of 0.008 mg/L. Remained nondetectable throughout the treatment.

4. Metals with analytical detection limits higher than the discharge target.

- Aluminum: present below the detection limit of 0.1 mg/L.
- Cadmium: present below the detection limit of 0.0005 mg/L.
- Chromium: present below the detection limit of 0.002 mg/L.
- Selenium: present below the detection limit of 0.002 mg/L. Selenium speciation results are shown in Table 13, indicating that the influent concentrations averaged about 1 μg/L, with a somewhat even distribution between selenate and selenite. The EBR system removed both selenate and selenite below the detections limits. No other (often more bioavailable and/or more toxic) species of selenium were detected throughout the treatment.
- Silver: present below the detection limit of 0.002 mg/L.
- Thallium: present below the detection limit of 0.002 mg/L.

5. Metals with no specified discharge targets.

- Dissolved arsenic: present at 2.05 mg/L in the influent, reduced to 0.16 mg/L in the pretreatment, and further reduced biologically to 0.02 mg/L in the EBR treatment.
- Barium: present at 0.17 mg/L in the influent, reduced to 0.10 mg/L in the pretreatment, remained at similar levels throughout the rest of the treatment.
- Dissolved uranium: present at 0.61 mg/L in the influent, removed to 0.35 mg/L in the pretreatment. Reduced biologically to 0.004 mg/L.

Table 13. Selenium speciation results, including the following arsenic species: Se(VI) – selenate, Se(IV) – selenite, Se-CN – selenocyanate, MeSe(IV) – methylselenic acid, Se-Met – selenomethionine, $SeSO_3$ – selenosulfate, and a sum of unknown species.

Test Day	Se Species	Influent	Pretreatment	EBR1	EBR2	Aerobic
28	**Se(VI)**	0.403 µg/L	0.365 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L
	Se(IV)	0.789 µg/L	0.173 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-CN	<0.25 µg/L	<0.05 µg/L	<0.05 µg/L	<0.05 µg/L	<0.05 µg/L
	Me-Se(IV)	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-Met	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-SO_3	<0.30 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L
	Unknown	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
113	**Se(VI)**	0.507 µg/L	0.395 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L
	Se(IV)	0.252 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-CN	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L
	Me-Se(IV)	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-Met	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-SO_3	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L
	Unknown	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L

System A: Cyanides

The average concentrations of cyanides are summarized in Table 14. The biological treatment removed total cyanide from 0.35 mg/L to 0.16 mg/L. WAD cyanide's elevated levels in the influent (0.04 mg/L), while lower than the predicted levels of 0.09-0.2 mg/L, exceeded the discharge target of 0.025 mg/L; **the EBR system removed WAD cyanide to below the detection limit of 0.006 mg/L. Thiocyanates remained relatively stable throughout the treatment.**

Table 14. The average concentration of cyanides throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Total CN [mg/L]	0.35	0.40	0.22	0.17	0.16	N/A
WAD CN [mg/L]	0.041	0.038	<0.015	<0.006	<0.006	0.025
Thiocyanate [mg/L]	0.40	0.33	0.24	0.40	0.22	N/A

System A: Residual Nutrients

While Table 15 provides a summary of residual nutrients results from the entire duration of bench-scale testing, some of the averaged data might be misleading. The residual nutrient parameters were monitored throughout the testing, and their concentrations changed depending on the operating

conditions and the goals of a given testing stage. All residual nutrient parameters, except for total organic carbon (TOC), were monitored twice a week.

Ammonia-N and organic carbon were present in the Coffee waters at significantly higher concentrations than the modeling had forecasted for the on-site chemistry. This was likely caused by natural cyanide bio-attenuation in Coffee solutions during storage since several biochemical metabolic pathways of cyanide biodegradation produce organic carbon and ammonia. When received at WesTech's Labs in October 2019, WAD cyanide concentration in the leach solution was 0.691 mg/L; by the time the rinse solutions were delivered in February 2020, WAD cyanide concentration in the leach solution dropped to 0.116 mg/L, indicating that natural biodegradation was occurring in the barrels. In the same period, ammonia-N increased in the leach solution from 68 mg/L to 83.4 mg/L.

Such high ammonia and organics concentrations are not expected to be present during normal operation of the mine and only occurred because of the prolonged storage of the generated leach waters. Ammonia-N is expected to be found at 0.025-0.06 mg/L in the heap leach rinse solutions, which is considerably lower than the discharge target of 8 mg/L. Even though the average ammonia-N concentrations in the system effluent were at 27.9 mg/L, the EBR system removed it to less than 20 mg/L through cell assimilation, while the aerobic post-treatment decreased it further to 7 mg/L. Conditions in the aerobic post-treatment had to be closely controlled to limit available oxygen that could lead to nitrate/nitrite production.

Organic carbon indicators, i.e., biological oxygen demand (BOD), chemical oxygen demand (COD), and total organic carbon (TOC), all followed the same trend. Medium concentrations of organics were found in the system influent, then increased in the biological EBR system before being oxidized to CO_2 and removed in the aerobic post-treatment. The average organics concentrations given in Table 15 can be misleading since they disregard a bench-scale project's optimization, adjustments, and stress-testing conditions. Figure 30 and Figure 31 illustrate the organics loading changes throughout the testing stages, using BOD and COD as examples. During the first month of operation, both the anaerobic and aerobic unit processes were in start-up and equilibration modes; the elevated nutrient levels in the EBR system were expected during start-up. The aerobic post-treatment needed time to establish a high-density biofilm on the support media to sustain the needed oxidation kinetics. **When the aerobic biofilm was well-established in the last 45 days of operation, the effluent BOD concentrations were typically below the detection limit of 5 mg/L.**

Table 15. The average concentration of nutrients throughout the Phase II bench-scale testing.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
BOD [mg/L]	21.7	17.3	312	517	582	N/A
COD [mg/L]	104	112	307	704	498	N/A
TOC [mg/L]	5.2	4.0	96	69	116	N/A
Ammonia-N [mg/L]	27.9	22.3	21.2	19.7	7.0	8
Phosphate-P [mg/L]	0.41	0.33	0.54	1.93	5.85	0.14

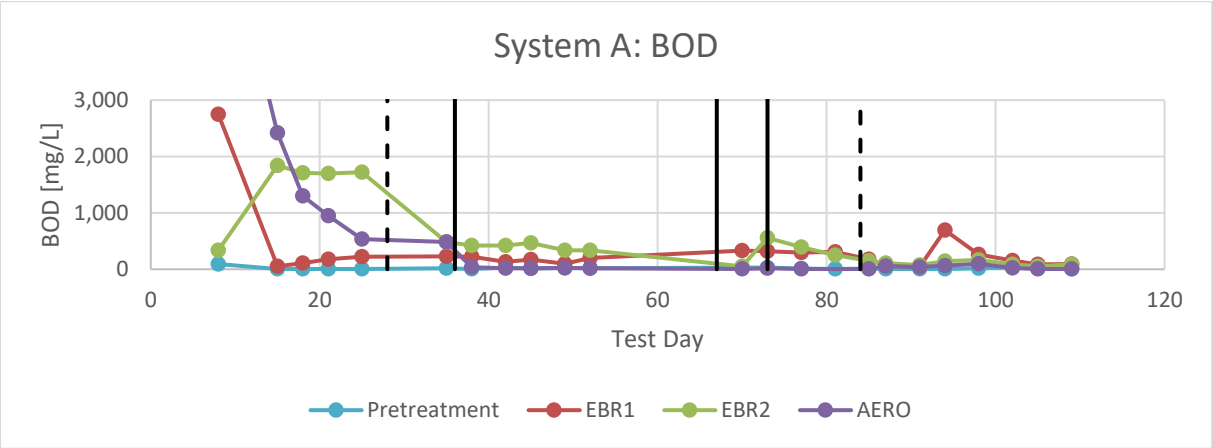


Figure 30. Phase II bench-scale results: System A overall BOD data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

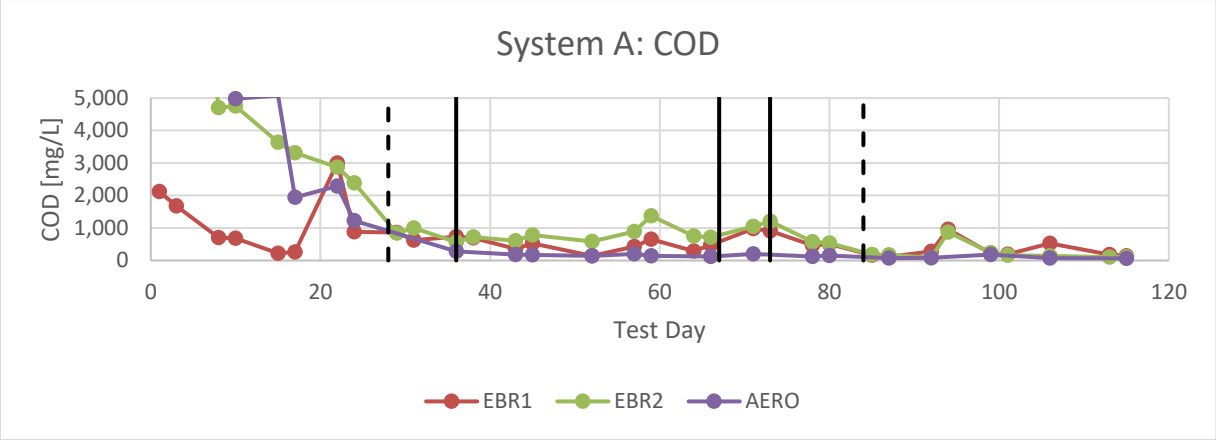


Figure 31. Phase II bench-scale results: System A overall COD data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Total phosphate-P was present in the influent waters at 0.41 mg/L – a level twice as high as the water quality modeling had forecasted. As a residual nutrient, phosphate followed a similar trend throughout the EBR treatment system as the residual organics (Figure 32). Initial elevated concentrations can be attributed to start-up and steady-state operation using molasses/ethanol mixture as a nutrient. During the last two weeks of operation, once the system was stabilized and ethanol was used as a sole carbon source, the average EBR effluent PO_4-P concentrations were 0.18 mg/L for EBR1 and 0.35 mg/L for EBR2, when the average system influent carried 0.25 mg/L PO_4-P. With no external source of phosphorus, the slightly elevated levels detected in the second-stage EBR as compared to the system influent can only be explained by residual concentrations still being rinsed out from the preliminary testing stages. **A pilot- and full-scale installation is expected to not require any external phosphate additions and that the EBR system would remove some of the PO_4-P present in the influent waters through assimilatory pathways.**

Since no nutrients or reagents were added to the aerobic post-treatment column, the continuously elevated phosphate levels discovered in the aerobic system effluent can be attributed to the microbial support media – in this case, pumice was used as a cost-effective alternative to activated carbon. Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of phosphate occurs.

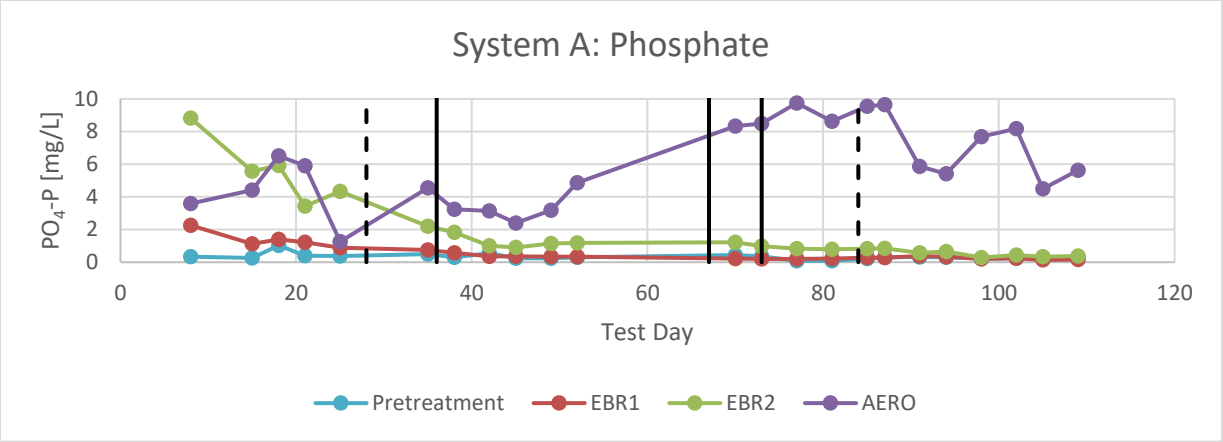


Figure 32. Phase II bench-scale results: System A overall phosphate-P data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

System A: Radiochemistry

Water samples from System A were sent for radiochemistry analysis to Pace Analytical Laboratories. The general trend can be illustrated by the gross radiation graph, shown in Figure 33. Table 16 shows the detailed results of the radiochemical analysis. Most of the analyzed radioisotopes were present at concentrations lower than their respective uncertainty errors. Gross alpha and beta radiation spiked in the pretreatment effluent waters before dropping back down in the biological treatment effluents.

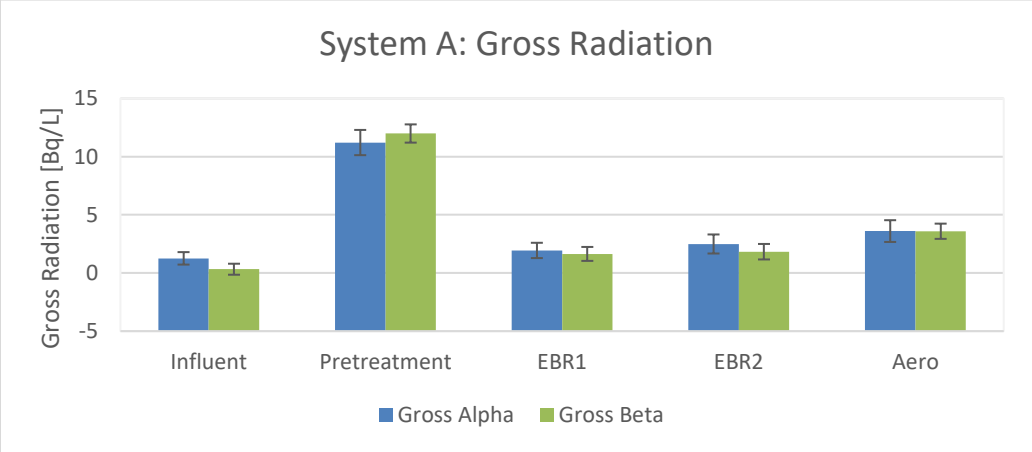


Figure 33. Phase II bench-scale results: System A gross radiation results.

Table 16. Phase II bench-scale results: Radiochemistry analysis of water samples collected from all the treatment stages. One data point.

	Influent	Pretreatment	EBR1	EBR2	Aero
Gross Alpha [pCi/L]	33.9 ±14.5	303 ±29.3	52.3 ±17.8	67.3 ±22.1	97.3 ±25.3
Gross Beta [pCi/L]	8.64 ±12.8	324 ±21.2	44.2 ±16.2	49.4 ±18.0	96.9 ±17.7
Ra-226 [pCi/L]	0.207 ±0.233	1.21 ±0.407	0.212 ±0.188	0.03 ±0.102	-0.0056 ±0.176
Ac-228 [pCi/L]	4.34 ±10.4	-3.90 ±12.6	4.38 ±10.7	6.78 ±9.97	1.43 ±10.1
Am-241 [pCi/L]	-23 ±13.9	-9.36 ±22.1	-13.5 ±13.5	-14.2 ±13.3	-12.9 ±13.2
Sb-124 [pCi/L]	-0.385 ±3.19	-3.29 ±4.19	0.399 ±3.32	1.52 ±3.28	3.86 ±3.34
Be-7 [pCi/L]	33.9 ±45.5	11.1 ±35.9	24.3 ±47.1	-11.7 ±49.6	13.7 ±51.6
Bi-212 [pCi/L]	-19.7 ±43.5	-29.6 ±57.1	23.7 ±45.2	-11.6 ±44.8	43.4 ±43.9
Bi-214 [pCi/L]	12.1 ±7.16	16.3 ±9.14	48.8 ±9.59	8.7 ±6.69	8.79 ±6.65
Ce-137 [pCi/L]	2.09 ±3.66	-1.75 ±4.42	1.67 ±3.64	0.352 ±3.49	-1.98 ±3.69
Co-60 [pCi/L]	0.435 ±2.51	0.429 ±3.32	-0.255 ±2.46	1.8 ±2.49	0.211 ±2.51
Ir-192 [pCi/L]	-0.658 ±3.68	-0.0703 ±3.55	0.251 ±4.01	-5.54 ±3.88	-4.38 ±3.97
Pb-212 [pCi/L]	-2.20 ±6.69	6.68 ±6.96	3.69 ±6.97	3.98 ±6.48	7.61 ±6.80
Pb-214 [pCi/L]	6.7 ±8.66	6.22 ±7.87	21.3 ±9.35	2.62 ±8.56	9.59 ±8.75
K-40 [pCi/L]	-12.3 ±45.5	31.3 ±53.9	7.76 ±45.6	-0.959 ±47.8	4.97 ±47.1
Sc-46 [pCi/L]	-0.117 ±3.66	-3.65 ±4.37	-1.03 ±3.75	1.65 ±3.79	2.7 ±3.92
Tl-208 [pCi/L]	-0.723 ±3.33	1.97 ±4.43	3.66 ±3.57	0.429 ±3.37	4.3 ±3.55
U-235 [pCi/L]	4.77 ±23.9	0.975 ±5.11	0.766 ±4.75	-10.8 ±23.4	-4.35 ±23.9
U-238 [pCi/L]	155 ±84.6	-21.7 ±54.1	14.4 ±50.0	29.8 ±51.5	26.1 ±50.9
Ce-134 [pCi/L]	-0.709 ±2.20	0.121 ±2.80	-1.07 ±2.34	0.35 ±2.20	1.53 ±2.14

In terms of compliance with the proposed water discharge standards, Figure 34 shows radium-226 analysis results. Ra-226 has a discharge target of 0.016 Bq/L (corresponding to 0.432 pCi/L), which was met throughout all treatment stages, except for the pretreatment effluent.

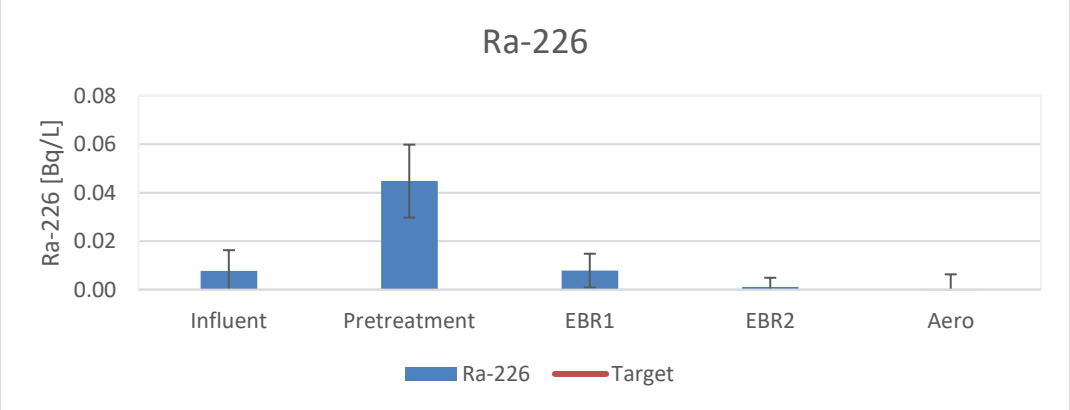


Figure 34. Phase II bench-scale results: System A radium-226 results.

At the conclusion of bench-scale testing, the columns were taken apart, and solids were collected from each treatment stage. This included the dewatered pretreatment sludge, activated carbon support media with any residual precipitates and microbial biofilm from the EBR columns, and the pumice support media with any residual precipitates and microbial biofilm from the aerobic post-treatment. **Except for Pb-214, Tl-208, U-235, and U-238, most of the analyzed radioisotopes were present at concentrations lower than their respective uncertainty errors (Table 17).**

Table 17. Phase II bench-scale results: Radiochemistry analysis of solids samples collected from all the treatment stages. One data point.

	Pretreatment Sludge	EBR1 Solids	EBR2 Solids	Aero Solids
Gross Alpha [pCi/g]	29 ±2.76	8.83 ±1.53	9.57 ±1.63	3.71 ±2.19
Gross Beta [pCi/g]	17.8 ±2.10	11.6 ±1.66	8.01 ±1.87	8.2 ±2.06
Ra-226 [pCi/g]	0.472 ±0.157	0.25 ±0.09	0.204 ±0.0821	0.434 ±0.115
Ra-228 [pCi/g]	0.165 ±0.169	0.112 ±0.106	0.0344 ±0.109	0.354 ±0.158
Bi-212 [pCi/g]	0.0469 ±0.65	0.54 ±0.389	0.0452 ±0.324	0.662 ±0.488
Pb-212 [pCi/g]	0.0146 ±0.101	0.175 ±0.0648	0.12 ±0.0581	0.554 ±0.0974
Pb-214 [pCi/g]	0.445 ±0.128	0.299 ±0.0757	0.222 ±0.0678	0.382 ±0.103
K-40 [pCi/g]	0.649 ±0.692	0.276 ±0.319	0.166 ±0.341	12 ±1.74
Tl-208 [pCi/g]	0.0175 ±0.0605	0.068 ±0.0361	0.0645 ±0.043	0.153 ±0.050
U-235 [pCi/g]	0.389 ±0.364	0.0441 ±0.0347	0.0761 ±0.039	0.13 ±0.232
U-238 [pCi/g]	5.05 ±2.26	3.79 ±1.54	4.27 ±1.62	0.193 ±0.487

As a point of reference, the US EPA does not consider radium as a "source material," and therefore, it would not be considered a by-product if present in the water treatment residuals. Uranium, however, is considered a "source material." The US EPA classifies any waste (solid or liquid) containing more than 0.05% by weight uranium, a low-level radioactive waste. That weight percentage corresponds to approximately 335 pCi/g for uranium.

The low concentration of radioisotopes in the Coffee waters implies a risk that they might be concentrated in one or multiple stages of the treatment, producing a radioactive by-product or waste that will be difficult to dispose of. Utilizing an optimized chemical pretreatment step removes both uranium isotopes (U-235 and U-238) from the influent waters continuously without generating even low-level radioactive sludge. U-238 concentrations in the influent waters were reduced from 155 ±84.6 pCi/L to levels below the uncertainty errors in the pretreatment step (Table 16), while only generating 5.05 ±2.26 pCi/g of U-238 in the sludge (Table 17). This point is also illustrated by the gross radiation detected in solids collected from the treatment stages (Figure 35). **A low-level peak of gross radioactivity in the pretreatment sludge suggests a concentration of the radioisotopes that can be safely disposed.**

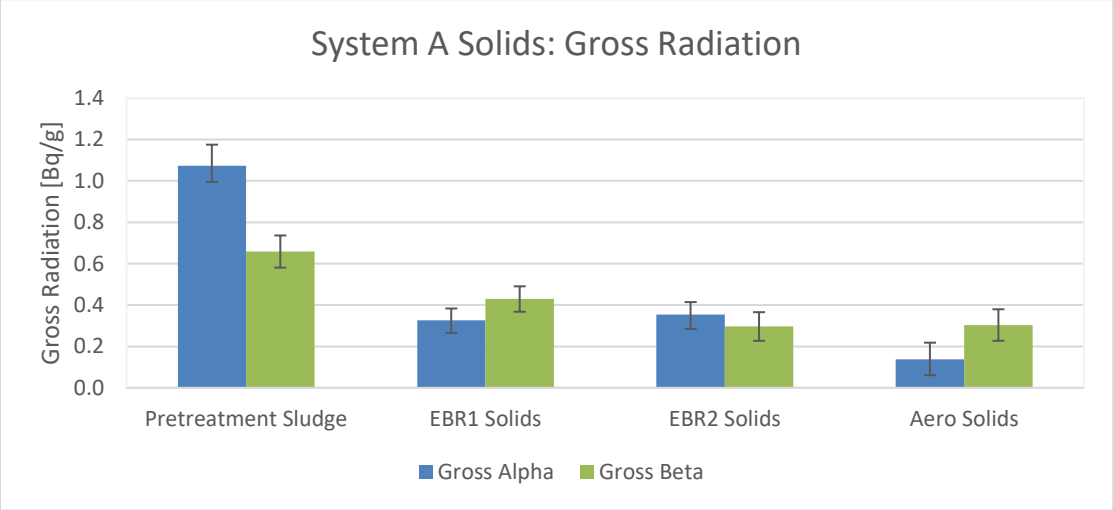


Figure 35. Phase II bench-scale results: System A solids radiation results.

System A: Toxicity Characteristic Leaching Procedure

At the conclusion of bench-scale testing, the columns were taken apart, and solids were collected from each treatment stage. This included the dewatered pretreatment sludge, activated carbon support media with any residual precipitates and microbial biofilm from the EBR columns, and the pumice support media with any residual precipitates and microbial biofilm from the aerobic post-treatment. The solids were submitted to AWAL laboratories for toxicity characteristic leaching procedure (TCLP) analysis.

All the collected solids passed the TCLP analysis (Table 18). Most metals were not leached in detectable quantities from any generated solids. The only exceptions were arsenic (leached out of the pretreatment sludge at 0.128 mg/L – well below the allowable limit of 5 mg/L) and barium (leached out of the EBR1 solids at 0.34 mg/L – well below the allowable limit of 100 mg/L). Since the ferric co-precipitation is a one-pass system, similar TCLP results from the pretreatment sludge can be expected from the pilot-scale test and full-scale installation. The EBR system has the potential of concentrating the contaminants with time. Assuming a linear accumulation and leachability of barium in the first-stage EBR, it would take 33,823 days of continuous operation (or about 93 years) to reach the allowable limit of 100 mg/L in the EBR solids.

Table 18. Toxicity characteristic leaching procedure (TCLP) results.

	Pretreatment Sludge	EBR1 Solids	EBR2 Solids	Aero Solids	Limit
As [mg/L]	0.128	<0.02	<0.02	<0.02	5.0
Ba [mg/L]	<0.3	0.34	<0.3	<0.3	100.0
Cd [mg/L]	<0.0035	<0.0035	<0.0035	<0.0035	1.0
Cr [mg/L]	<0.2	<0.2	<0.2	<0.2	5.0
Pb [mg/L]	<0.01	<0.01	<0.01	<0.01	5.0
Hg [mg/L]	<0.01	<0.01	<0.01	<0.01	0.2
Se [mg/L]	<0.01	<0.01	<0.01	<0.01	1.0
Ag [mg/L]	<0.01	<0.01	<0.01	<0.01	5.0

Quality Control Results

As part of the internal quality control testing, AWAL Labs performed method blanks (MB), laboratory control samples (LCS), matrix spikes (MS), and matrix spike duplicates (MSD) on the submitted samples. Method blanks use an analyte-free matrix, such as deionized water, through the complete procedure; it is used to evaluate contamination potential due to sample preparation and analytical procedure. Laboratory control sample uses the same analyte-free matrix as MB but is spiked with a known concentration of the analyte of interest; it is used to determine if the procedure is working within the established control limits, without the interference from the sample matrix. Finally, matrix spike uses an aliquot of the sample spiked with a known concentration of the analyte of interest; it is used to determine whether the procedure works within the established control limits, including sample matrix interferences. The matrix spike is routinely performed in duplicate as the MSD. The recoveries of the spiked analyte are evaluated to determine the accuracy in a given matrix, while the comparison between the MS and MSD shows how precise the procedure is in a given matrix.

For total metals analysis, the acceptable recovery control limits for the QC samples must be within 75%-125%. The recoveries of both total arsenic (Figure 36) and total uranium (Figure 37) were well within the acceptable recovery limits. Based on the standard deviations obtained from matrix spikes and matrix spike duplicates, the precision of total arsenic measurements was defined as ±0.0028 mg/L, while the accuracy was ±0.0068 mg/L (Table 19). For total uranium, the precision and accuracy were ±0.0061 mg/L and ±0.0111 mg/L, respectively. **The established precisions and accuracies of the total metals analyses were an order of magnitude lower than their respective discharge targets, giving us high confidence in the obtained results.**

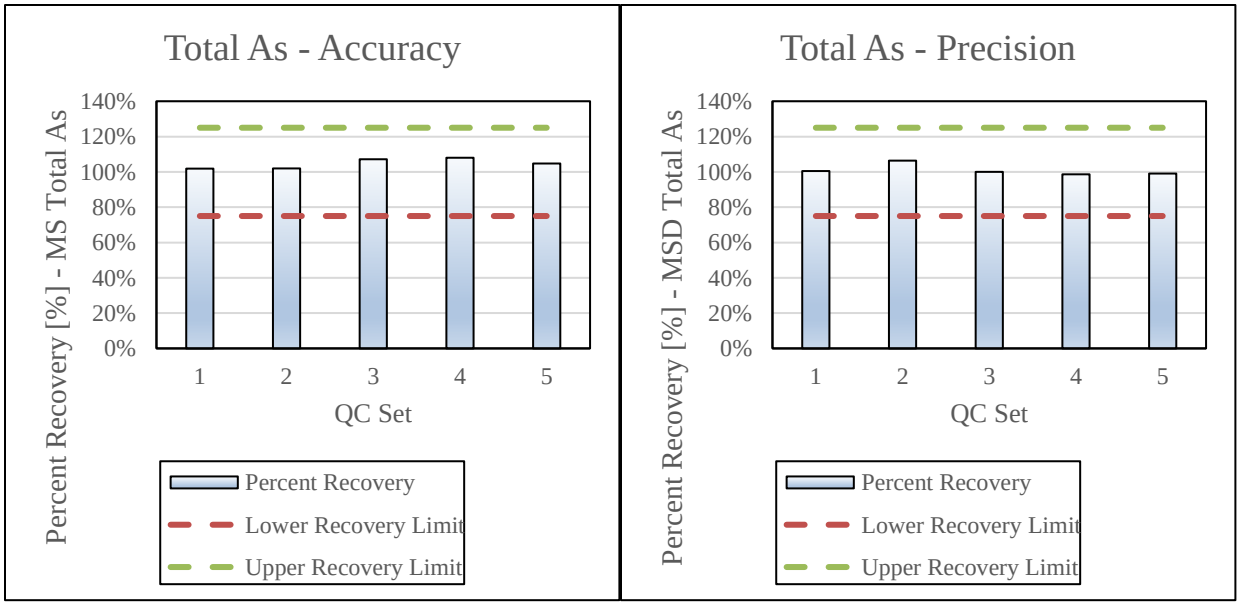


Figure 36. Quality control results for total arsenic analysis.

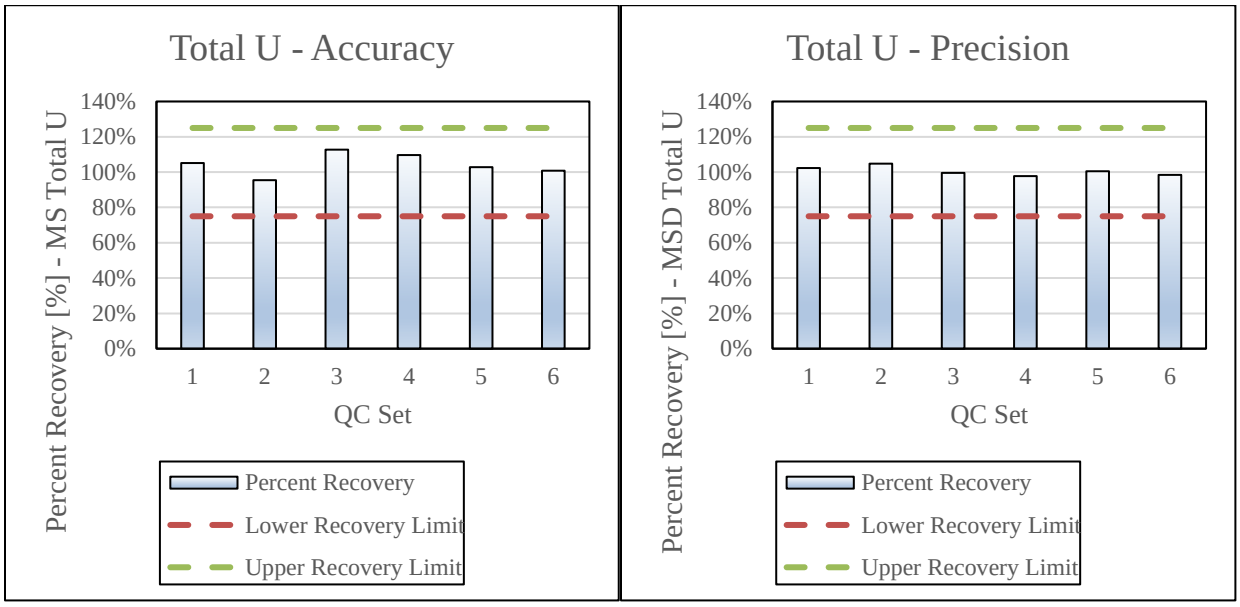


Figure 37. Quality control results for total uranium analysis.

Table 19. Analytical precision and accuracy during bench-scale testing of Coffee waters.

	Average Precision [mg/L]	Average Accuracy [mg/L]
Arsenic-tot.	±0.0028	±0.0068
Uranium-tot.	±0.0061	±0.0111
Nitrate-N	±0.01	±0.04
Sulfate	±11.7	±61.9

For anions, the acceptable recovery control limits must be within 90%-110%. The recoveries of nitrate-N and sulfate were shown to be within these limits (Figure 38 and Figure 39). Very high precision (±0.01 mg/L) and accuracy (±0.04 mg/L) were established for nitrate-N analysis (Table 19). Sulfate analysis carried a ±11.7 mg/L precision and ±61.9 mg/L accuracy, providing very high confidence in the obtained results compared to the 1,500 mg/L discharge target.

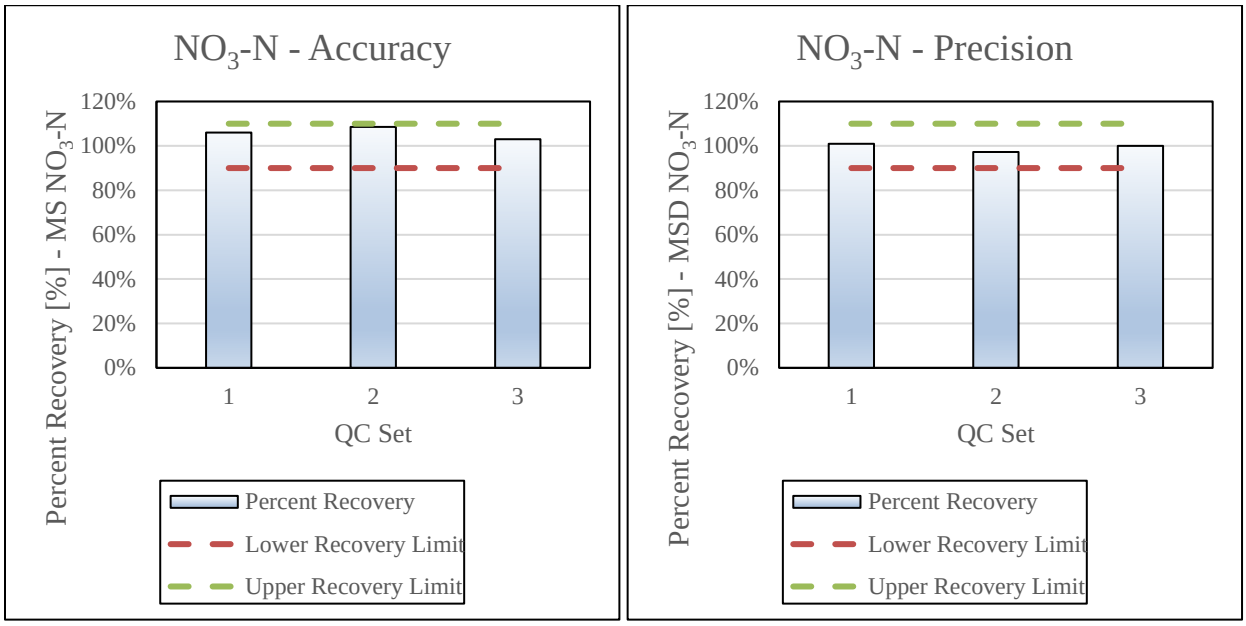


Figure 38. Quality control results for nitrate-N analysis.

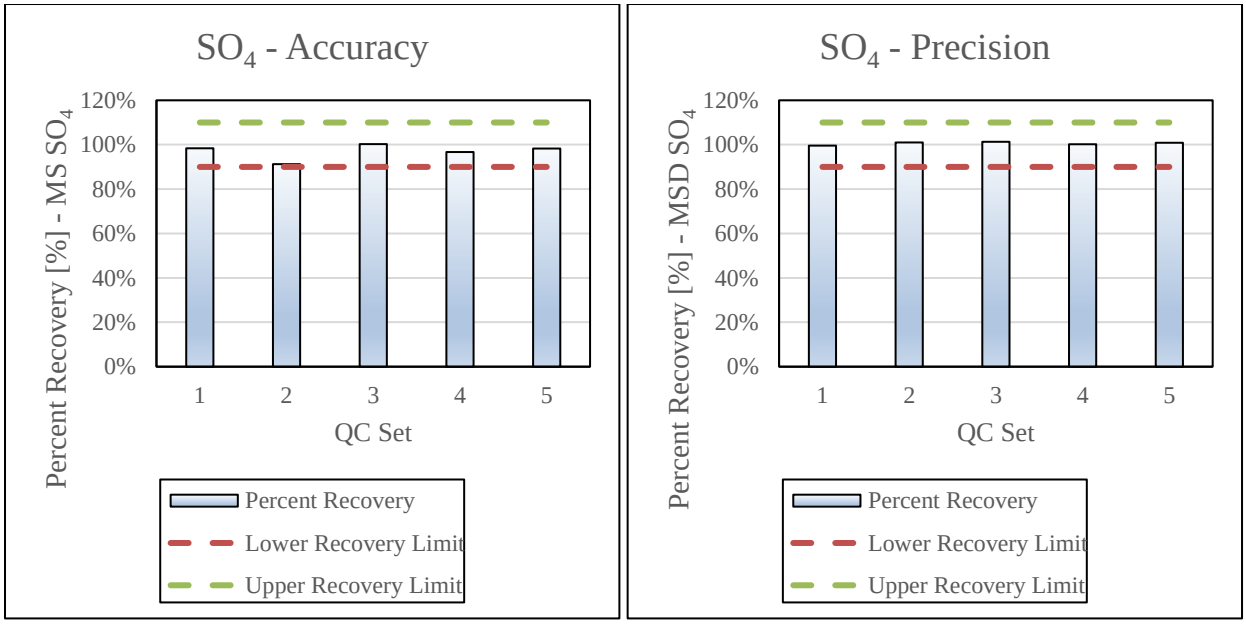


Figure 39. Quality control results for sulfate analysis.

Preliminary Design and Operational Parameters

Based on the results obtained from bench-scale testing, a set of preliminary design and operational parameters was developed for a pilot-scale demonstration trial (Table 20). It is recommended that the pilot be conducted once the Coffee Mine is operating and actual leach waters are generated.

The pilot demonstration is a required last step before preliminary engineering of the water treatment plant can be completed. The on-site demonstration will be conducted over at least a three-month period with a seasonal temperature change. The testwork and analytical plan will be developed prior to the pilot demonstration and will include at the minimum the same level of detail as the Phase II bench-scale program.

Table 20. Summary of the design and operational parameters for pilot-scale testing.

Unit process	Retention time	Reagent dose
Ferric Co-precipitation	~ 1hr	~ 30 mg/L $FeCl_3$
Sulfate Precipitation	~1 hr	~ 2 g/L Ba
EBR Treatment	7-10 hrs	0.6-0.9 mL/L ethanol
Aerobic Post-treatment	< 1hr	Continuous air addition

CONCLUSIONS

The Phase I feasibility testing successfully demonstrated the removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Nitrate-N was removed from an average of 188 mg/L to below the detection limit of 0.19 mg/L. After process adjustments, average removals of 98.8% and 99.1% were achieved for arsenic and uranium, respectively. Furthermore, sixteen other metals, as well as total and WAD cyanides, were removed by the EBR system.

Even though arsenic removal was demonstrated with the biological treatment, the feasibility testing proved that long retention times and high nutrient doses would be required to meet the required discharge levels. The Phase I recommendation was to investigate phys-chem arsenic removal options.

The in-situ feasibility tests demonstrated enhanced denitrification upon inoculation with the EBR effluent and nutrient additions. Natural nitrate reduction occurred in the control column upon nutrient additions due to the presence of a native denitrifying microbial population. However, inoculation with the EBR microbial population enhanced the denitrifying performance. Nitrate-N was reduced in the in-situ test column from approximately 150 mg/L to 13.9 mg/L when the EBR effluent was used to irrigate the columns, and it was reduced to 26.4 mg/L when DI water was used as column influent.

In line with the Phase I findings, the Phase II bench-scale testing demonstrated that the best approach for the Coffee Mine water treatment is a multi-stage treatment train that consists of a phys-chem pretreatment for arsenic and sulfate precipitation, biological EBR treatment for denitrification and metals polishing, and a small aerobic post-treatment for removal of residual nutrients and reintroduction of dissolved oxygen. The list below presents the detailed findings pertaining to each unit process.

1. Chemical pretreatment

- **The pretreatment design took advantage of combining three steps to benefit the overall system performance.** The cyanide destruction step aided the oxidation of more reduced arsenic species and converted them into arsenate, which is the most amenable form of arsenic to ferric co-precipitation. Instead of further reagent additions after ferric dosing, barium salts that were used to precipitate sulfate also acted as coagulants and flocculants for the already formed arsenic precipitates.
- **System optimization demonstrated that arsenic could be removed to below the discharge target of 0.035 mg/L with ferric co-precipitation alone.**
  - Arsenic analysis had an accuracy of ±0.0068 mg/L.
- **Sulfate was shown to be removed from the Coffee waters to below the discharge target of 1,500 mg/L with barium precipitation alone.** Jar tests demonstrated that barium dose is directly proportionate to the amount of sulfate precipitated; greater or lower sulfate removal can be achieved with an adjusted Ba dose.
  - Sulfate analysis had an accuracy of ±61.9 mg/L.
  - The evaluated barium salts (barium chloride and barium hydroxide) resulted in elevated chloride concentrations passing through the treatment system. A jar test examination of

different barium salts alone and in combination is recommended once the mine is operational and actual site waters are available to establish the most suitable reagent dose to avoid generating excess chlorides.

- **The implications of the successfully demonstrated pretreatment of both arsenic and sulfate include the need for a significantly smaller biological EBR system, no requirement for the addition of complex organic nutrients, and a lower organic carbon addition, resulting in lower residual nutrient concentrations.**

- **A 39% removal of total uranium was achieved on average with the chemical precipitation pretreatment.**
  - The pretreatment sludge removed the radioisotopes, rendering the following EBR treatment less likely to accumulate them. The average gross alpha radiation in the pretreatment sludge was 29 ±2.76 pCi/g, while gross beta radiation was 17.8 ±2.10 pCi/g.
- **Sludge generated in the pretreatment passed the TCLP analysis.**

2. EBR treatment

- **A single-stage EBR treatment operated with a 7-hr HRT and a 0.6 mL/L ethanol dose removed nitrate-N to below the detection limit of 0.3 mg/L.**
  - Nitrate-N analysis had an accuracy of ±0.004 mg/L.
  - Average nitrite-N concentration (an intermediary denitrification by-product) in EBR1 was 0.037 mg/L, meeting the discharge target of 0.09 mg/L.
- **Total uranium removal to below the discharge target 0.1 mg/L was achieved with the first-stage EBR treatment using an 11-hour HRT and 0.9 mL/L ethanol dose.**
  - Total uranium analysis had an accuracy of ±0.0111 mg/L
- Once optimized to target only nitrate and uranium, the EBR system was demonstrated to allow residual arsenic and sulfate to pass through without further reducing either one.
  - The speciation results show that the EBR system did not produce any methylated arsenic species, even during the preliminary testing stages, when residual arsenic was removed biologically.
- **In addition to the contaminants of interest, the EBR system removed the following metals from elevated concentrations in the influent waters to below their respective discharge targets: antimony, copper, mercury, molybdenum, and nickel.**
  - The EBR system removed all selenium species to below detection, including organo-selenium species that are more bioavailable in the natural environment.
  - Iron and manganese were present in the influent waters above their discharge targets and passed through the EBR system largely unchanged after the system was provided with ethanol as a sole nutrient source.
  - If present above their respective discharge targets, magnesium and calcium will need to be removed through an additional softening pretreatment step prior to EBR treatment. Although possible, removing hardness minerals in the EBR system is not advised because their elevated concentrations would load the bioreactor bed with solids and blind the activated carbon media in a relatively short amount of time (a few years).

- Monovalent cations, such as potassium and sodium, were present at higher levels than forecasted by the water quality models and exceeded their respective discharge targets. The EBR system cannot be used to target them.

- **The EBR system polished WAD cyanide to below the detection limit of 0.006 mg/L.**
- **Once the pretreatment was optimized, ethanol was used as a sole nutrient source for the EBR treatment, resulting in low residual nutrient generation.**
  - Ammonia-N concentrations of several mg/L were removed through an assimilatory pathway in the EBR treatment. However, since the influent NH_3-N concentrations were 465-times higher than forecasted (27.9 mg/L, instead of 0.06 mg/L), elevated ammonia still passed through the EBR system.
  - Average BOD concentrations stabilized at about 100 mg/L in the EBR system effluent.
  - Phosphate concentrations of 0.18 mg/L and 0.35 mg/L were generated from EBR1 and EBR2, respectively, when the average system influent carried 0.25 mg/L PO_4-P. A pilot- and full-scale installation is expected to not require any external phosphate additions and that the EBR system would remove some of the PO_4-P present in the influent waters through assimilatory pathways.
- **Neither the EBR treated effluents nor the EBR solids, including the activated carbon matrix as well as any precipitated residues and biofilm, accumulated gross radiation.**
- **EBR solids, including the activated carbon matrix as well as any precipitated residues and biofilm, passed the TCLP test.**

3. Aerobic post-treatment

- **Once optimized, the aerobic post-treatment removed BOD to below the detection limit of 5 mg/L.**
- **On average, the aerobic column removed ammonia-N to 7 mg/L, meeting the discharge goal of 8 mg/L while not generating excess nitrate/nitrite species.** The influent ammonia-N concentrations are forecasted to be present at 465-times lower concentrations (up to 0.06 mg/L) in the Coffee waters.
- **A significant spike of phosphate-P (5.85 mg/L on average) detected in the aerobic post-treatment effluent is attributed to phosphorus leaching out of the microbial support media (pumice) since no nutrients or reagents were added to the system.**
  - Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of phosphate occurs.
- The aerobic post-treatment did not negatively affect any parameters removed by the EBR treatment upstream, except for manganese.
  - Manganese concentrations spiked in the post-treatment effluent to an average concentration of 0.271 mg/L – over 4.2x increase from the EBR system effluent. Since no nutrients or reagents were added to the post-treatment, the source of manganese can only be attributed to the pumice used as a support matrix inside the column.

APPENDIX 7-B

Coffee Mine Heap Leach Facility Cover Design Summary Report

Coffee Mine Heap Leach Facility Cover Design Summary Report – Final

July 31, 2023



Newmont™

okane

Integrated Mine Closure and Relinquishment Solutions

Coffee Mine Heap Leach Facility Cover Design Summary Report – Final

1075-220-019

July 31, 2023

Prepared for:

Newmont
3-151 Industrial Road
Whitehorse, Yukon
Y1A 2V3

Prepared by:

Mitchell Barteaux
Project Coordinator
mbarteaux@okc-sk.com

Okane Consultants Inc.

112 - 112 Research Drive
Saskatoon, SK S7N 3R3
Canada

Telephone: (306) 955 0702
Facsimile: (306) 955 1596
Web: www.okc-sk.com

Rev. #	Rev. Date	Author	Reviewer	PM Sign-off
A	April 14, 2022	LT	DC	MB
B	May 11, 2022	LT	DC	MB
0	June 3, 2022	LT	MB	MB
1	May 19, 2023	BW	MB	MB
2	July 31, 2023	MB	DC	MB
3	March 25, 2024	MB	DC	MB

DISCLAIMER

This document has been provided by Okane Consultants Inc. (Okane) subject to the following limitations:

1. This document has been prepared for the client and for the particular purpose outlined in the Okane proposal and no responsibility is accepted for the use of this document, in whole or in part, in any other contexts or for any other purposes.
2. The scope and the period of operation of the Okane services are described in the Okane proposal and are subject to certain restrictions and limitations set out in the Okane proposal.
3. Okane did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referred to in the Okane proposal. If a service is not expressly indicated, the client should not assume it has been provided. If a matter is not addressed, the client should not assume that any determination has been made by Okane in regards to that matter.
4. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation, or information provided by the client or a third party and which have not therefore been taken into account in this document.
5. The passage of time will affect the information and assessment provided in this document. The opinions expressed in this document are based on information that existed at the time of the production of this document.
6. The investigations undertaken and services provided by Okane allowed Okane to form no more than an opinion of the actual conditions of the site at the time the site referred to in the Okane proposal was visited and the proposal developed and those investigations and services cannot be used to assess the effect of any subsequent changes in the conditions at the site, or its surroundings, or any subsequent changes in the relevant laws or regulations.
7. The assessments made in this document are based on the conditions indicated from published sources and the investigation and information provided. No warranty is included, either express or implied that the actual conditions will conform exactly to the assessments contained in this document.
8. Where data supplied by the client or third parties, including previous site investigation data, has been used, it has been assumed that the information is correct. No responsibility is accepted by Okane for the completeness or accuracy of the data supplied by the client or third parties.
9. This document is provided solely for use by the client and must be considered to be confidential information. The client agrees not to use, copy, disclose reproduce or make public this document, its contents, or the Okane proposal without the written consent of Okane.
10. Okane accepts no responsibility whatsoever to any party, other than the client, for the use of this document or the information or assessments contained in this document. Any use which a third party makes of this document or the information or assessments contained therein, or any reliance on or decisions made based on this document or the information or assessments contained therein, is the responsibility of that third party.
11. No section or element of this document may be removed from this document, extracted, reproduced, electronically stored or transmitted in any form without the prior written permission of Okane.

EXECUTIVE SUMMARY

This Heap Leach Facility (HLF) Cover System design report is a primary appendix to the Coffee Mine reclamation and closure plan (RCP). The RCP has been developed by Ensero Solutions Canada Inc. (Ensero) and JDS Energy and Mining (JDS), for Newmont's Coffee Mine located in the Yukon, Canada, and includes input from various technical experts: SRK, JDS, Lorax Environmental (Lorax), Hemmera Inc. (Hemmera), Forte Dynamics (Forte), and Okane Consultants (Okane).

A HLF cover system design was completed by Okane, to satisfy the projects licencing applications, with the objective achieving an approximately 30-50% design level. This corresponds to approximately a Class 3 estimate as per the Association for the Advancement of Cost Engineering (AACE) (AACE International, 2022). A failure modes and effects analysis (FMEA) was completed by the project team of technical experts, to assess and confirm the Base Case closure plan for the HLF cover system (among other mine domains (Okane, 2022)). Okane carried out design support studies to provide additional confidence in the Base Case cover system performance, including conceptual and analytical modelling, 1D and 2D soil plant atmosphere (SPA) numerical modelling, and evaluation of reclamation materials available at site.

The HLF cover system consists of a plateau, and slope segments. The HLF plateau will be covered with a low-permeability barrier layer (e.g., geosynthetic clay liner (GCL), or other suitable barrier layer determined in future design stages), followed by a 0.5 m store and release cover system. The HLF slope will be graded to an angle of 2.5H:1V and covered with a 0.5 m store and release cover system. Surface runoff drainage channels have conceptually been designed by Forte, consisting of rip-rap armoured and geofabric lined channels graded into the HLF surface. Net infiltration, or net percolation (NP), is estimated as <5% of mean annual precipitation on the plateau area and approximately 24% NP on slope segments. This performance is anticipated to satisfy performance criteria for water quality emanating from the toe of the HLF as toe seepage.

The design for the HLF cover system was undertaken to confirm that the Base Case design is technically feasible, and that risks are adequately addressed for the purposes of advancing to Detailed Design and Final Remediation Plan. Further optimizations and remaining uncertainties were viewed from a risk mitigation perspective and will be investigated in the next engineering phase.

TABLE OF CONTENTS

1 INTRODUCTION 1
1.1 Project Objectives and Scope 1
1.2 Report Organization 1
2 PROJECT AND SITE DESCRIPTION 3
2.1 Project Details and Layout 3
2.2 Climate 5
2.2.1 Climate Change 6
2.3 Surface Hydrology 6
2.4 Geochemistry 8
2.5 Geotechnical 8
2.6 Water Management 8
2.6.1 Surface Water Management 8
2.7 Water Quality 9
3 FAILURE MODES AND EFFECTS ANALYSIS 10
4 DESIGN SUPPORT STUDIES 12
4.1 Conceptual Model 12
4.1.1 HLF Base Case Concept Summary 12
4.2 Analytical Water Balance 13
4.3 Numerical Water Balance Modelling 14
4.3.1 1D Modelling 15
4.3.2 1D Sensitivity Modelling 16
4.3.3 2D Modelling 17
4.3.4 Key findings of SPA Modelling 18
4.4 Reclamation Material Assessment 18
4.4.1 Reclamation Material Balance 19
4.4.2 Reclamation Material Priority 19
4.4.3 Material Suitability 22
5 HLF COVER SYSTEM DESIGN OVERVIEW 25
5.1 HLF Cover System Design 25
5.2 Reclamation Material Requirements 27
5.2.1 Material Take-Offs 27
6 RECOMMENDATIONS 28
7 REFERENCES 30

APPENDICE LIST

Appendix A Conceptual Model

Appendix B Analytical Water Balance

Appendix C Reclamation Material Priority Memorandum

Appendix D FMEA Workshop Fact Sheet #8 and #9

Appendix E SPA Numerical Modelling

Appendix F Drawings

LIST OF TABLES

Table 4.1: Summary of analytical water balances for HLF cover system scenarios....14
Table 4.2: Summary of the numerical water balances for the HLF base case cover system scenarios....16
Table 4.3: Summary of the numerical water balances for the HLF sensitivity cover system scenarios. 16
Table 4.4: Reclamation material priority list for discussion....20
Table 5.1: HLF Cover System MTOs 27

LIST OF FIGURES

Figure 2.1: Coffee Mine general arrangement....4
Figure 2.2: Monthly mean air temperature and precipitation from the km 11 climate station. 5
Figure 2.3: Watersheds in and near the project area. 7
Figure 4.1: Conceptual water flow within the store and release with GCL cover system on the plateau. Blue arrows show water flow. 17
Figure 4.2: Conceptual water flow within the store and release cover system on the slopes. Black arrows show water flow....18
Figure 4.3: Texture triangle of reclamation materials sampled during 2018 (Tetratech, 2018) 22
Figure 4.4: Example risk framework....23
Figure 4.5: RUSLE erosion estimates for the HLF cover system. 24
Figure 5.1: Plan view of the HLF and cover system....26
Figure 5.2: Plateau cover system cross section....26
Figure 5.3: Slope cover system cross section....26

LIST OF DRAWINGS

1075-220-01 Heap Leach Landform Sections and Detail

1 INTRODUCTION

A reclamation and closure plan (RCP) for the Newmont Coffee Mine project located in the Yukon, Canada is being developed by Ensero Solutions Canada Inc. (Ensero) and JDS Energy and Mining Inc. (JDS). Okane was retained by Ensero to provide a design for the heap leach facility (HLF) cover system. Design aimed to support construction and operational licensing applications by achieving an approximately 30% to 50% design. Design of this level is "preliminary" in nature and equivalent to approximately the Association for the Advancement of Cost Engineering (AACE) Class 3 estimate (AACE International, 2022). An AACE Class 3 estimate occurs when the level of project definition is approximately 30% to 70% of full project definition with a costing accuracy from -20% to +30%. Class 3 estimates are generally used to form the basis for the project budget and serve as a control estimate. The primary focus of the design is assessing design alternatives, identifying risk and opportunity, and confirm that the design is feasible for advancing to the detailed design in subsequent stages of project development. This HLF Cover System design report is a primary appendix to the Coffee Mine RCP.

1.1 Project Objectives and Scope

The overarching objective of the HLF cover system design is to produce a cover system in support of the project licensing applications for the Coffee Mine HLF. To meet this objective, Okane has provided a design with the objective of being feasible, meeting site-specific objectives, is cost effective, and constructible. The cover system has been designed to where baseline closure costs and material take offs (MTO's) for the HLF can be established.

Specific objectives of the HLF cover system design includes:

- Evaluation and confirmation that the current conceptual cover system (Base Case) is feasible and is likely to meet site specific closure objectives;
- Understand risk and opportunity with regards to the HLF cover system meeting returning land use and closure objectives; and
- Develop a cover system design that provides opportunity to be in alignment with site specific returning land use, and cover system performance objectives in support of the overall project development.

1.2 Report Organization

For convenient reference, this report has been subdivided into the following sections:

- Section 2 – provides pertinent background information to this project and site;

- Section 3 – provides the documentation of the process and results of the failure modes and effects analysis;
- Section 4 – provides summaries of design support studies completed as part of this mandate;
- Section 5 – provides a description of the HLF cover system design;
- Appendix A – provides a detailed site description and conceptual model;
- Appendix B – provides a detailed description of the analytical water balance;
- Appendix C – reclamation material priority list
- Appendix D – provides supporting information from the Failure Modes and Effects Analysis pertinent to the HLF Cover System design;
- Appendix E – provides a detailed description of the water balance modelling; and
- Appendix F - Drawings

2 PROJECT AND SITE DESCRIPTION

The following section provides a summary of the site and project details pertinent to the HLF cover system design.

2.1 Project Details and Layout

The proposed Coffee Gold Mine (the Project) is an open-pit gold mine owned by Goldcorp Kaminak Ltd, a subsidiary of Newmont. The Project is located in the White Gold District of west-central Yukon, approximately 130 km south of the City of Dawson, 140 km west of Pelly Crossing, 95 km south-west of Beaver Creek, and 330 km northwest of Whitehorse. The Project is located wholly within the traditional territory of Tr'ondëk Hwëch'in, partially within the traditional territory of Selkirk First Nation and First Nation of Na-cho Nyäk Dun, and partially within the asserted territory of White River First Nation. The Project consists of four open pits (Latte, Double Double, Supremo, and Kona), an HLF, and permanent and temporary waste rock storage facilities (WRSFs) (Figure 2.1). The HLF and associated surface water management infrastructure are located at the southern limit of the site.

The HLF will be constructed along the ridge to the west of the process plant and pits, in the southwestern corner of the site. It will be double lined with a geosynthetic clay liner (GCL) overlain by a low-density polyethylene (LLDPE) geomembrane. Drainage pipes will be nested in a 500 mm thick layer of permeable gravel at the base of the pad to collect pregnant (i.e., gold bearing) solution from the HLF.

Ore will be stacked at the HLF in 10 m lifts at the angle of repose of the ore material. HLF stages will be physically divided using ditches or berms to provide hydraulic isolation of heap leach solution between stages. There is also hydraulic separation by cell, or approximately every 100 m of pad in the long-axis direction. Benches will be constructed as part of the HLF to produce an overall 2.5H:1V or flatter toe-to-crest slope for the stacked ore.

The HLF will be progressively regraded for closure to maintain an overall slope of 2.5H:1V or flatter. Grading will also be optimized to promote the conveyance of water off and away from the HLF. The flat areas of the HLF will be capped with a low permeability geosynthetic clay layer (GCL) (or similar) underlying a store-and-release cover system. The slopes will be covered with a store-and-release cover system only. The storage layer is a 0.5 m layer of reclamation material, soil, or other suitable material.

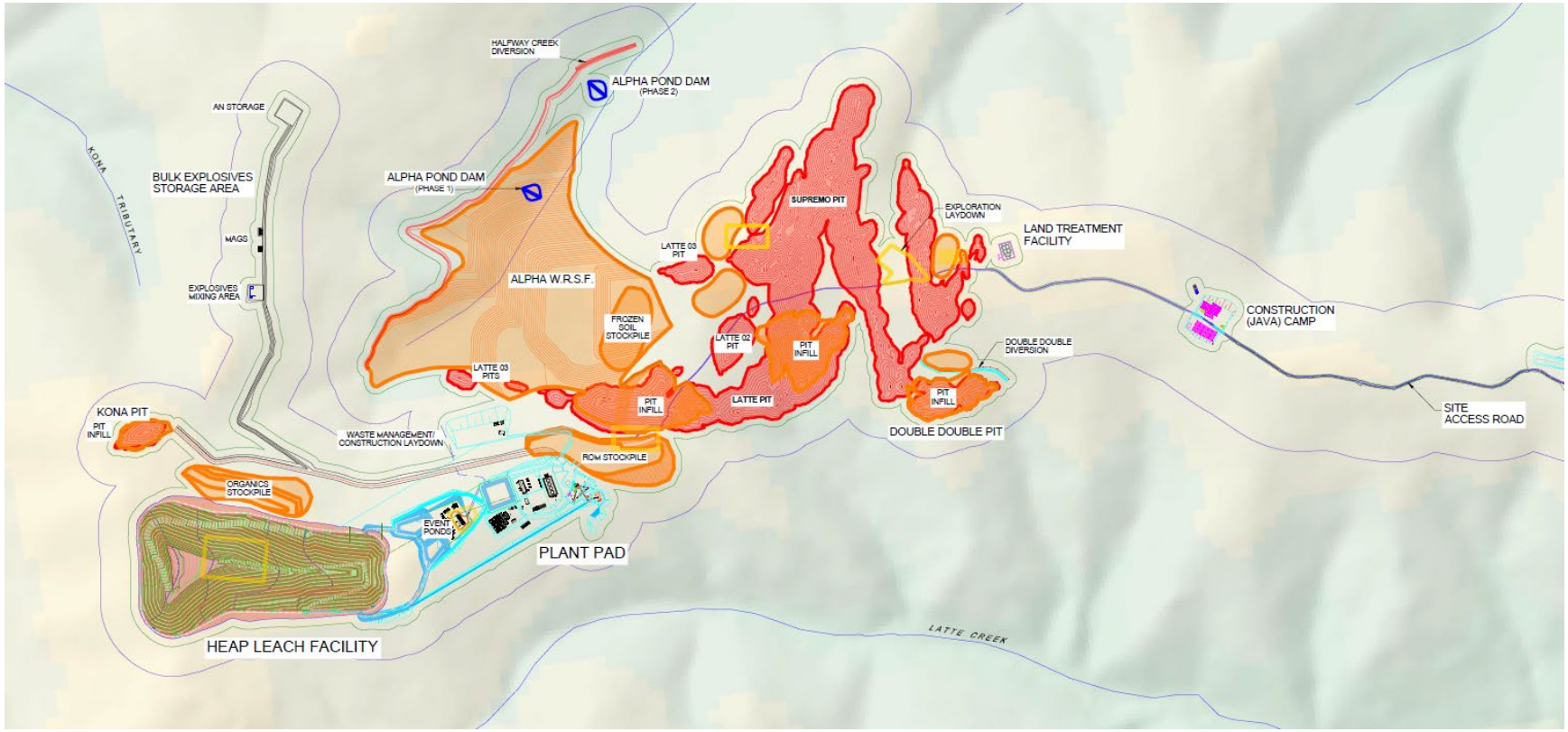


Figure 2.1: Coffee Mine general arrangement.

From Newmont, 2022

2.2 Climate

A baseline meteorology study began in 2012 (Lorax, 2022). Data from 2012 to 2014 was sourced from an automated weather station located adjacent to the mine access road between camp and the proposed HLF, at an elevation of 975 masl (Km 11 station). In 2018, another weather station including a full suite of climate sensors was added to the baseline program, located adjacent to the proposed HLF at an elevation of 1,340 masl (Kona station). In addition to the weather stations there are also two tipping bucket rain gauge stations and a comprehensive network of snow course stations.

The climate at Coffee Mine is characterized as subarctic continental (Dfc) under the Köppen-Geiger climate classification system where:

- D – 'continental' where average temperature of the coolest month is < -3°C, and average temperature of the warmest month is > 10°C;
- f – 'without a dry season' where precipitation is relatively evenly disturbed throughout the year; and
- c – 'cold summer' where one to three months average temperatures reach > 10°C but < 22°C.

Temperatures at the Km 11 climate station range from an average of -17°C in December to 14°C in July (Lorax, 2022). Mean annual precipitation is estimated to be 504 mm at the elevation of the HLF (~1,300 masl) (Lorax, 2022), with 67% falling as rain from April to mid-October (Figure 2.2).

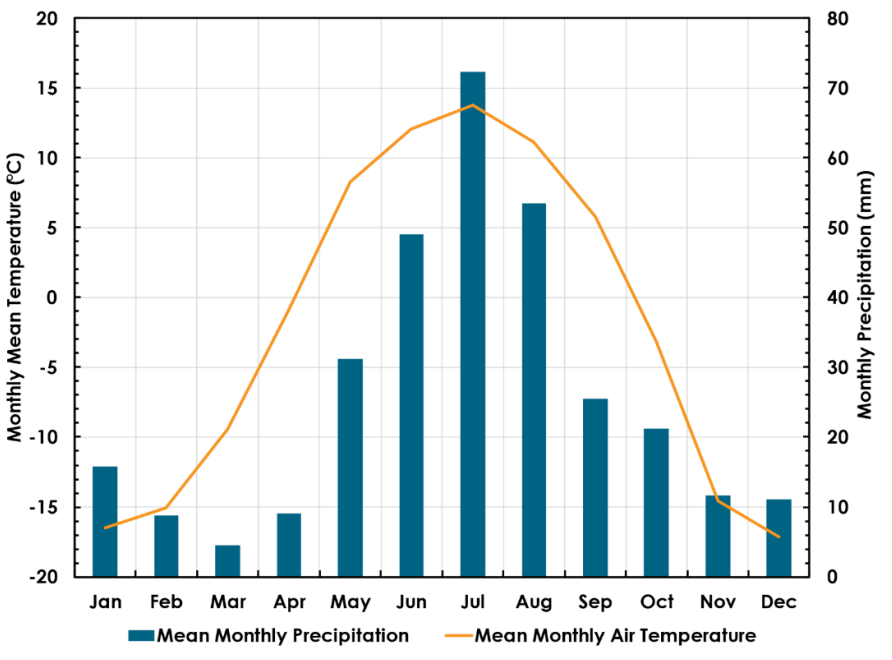


Figure 2.2: Monthly mean air temperature and precipitation from the km 11 climate station.

Lorax (2022) developed a 77-year synthetic climate database consisting of temperature and precipitation based on the Dawson A climate record.

2.2.1 Climate Change

Lorax (2022) developed climate change projections for the Coffee Creek region under the RCP4.5, RCP6.0 and RCP8.5 scenarios of the IPCC's Fifth Assessment Report (AR5) (IPCC, 2013).

Under climate change conditions, the temperature at the Coffee Mine site is expected to rise in the range of 2.5°C to 5.0°C by 2100. Winter temperatures are expected to increase at a greater rate than summer temperatures, increasing by 1°C per decade in the winter against 0.3°C per decade in the summer. Under the RCP4.5 scenario, the average decadal temperature is expected to rise 2.5°C from the 2010-2019 average by 2099. A greater increase is expected under RCP6.0 with an increase in the decadal average of 3.1°C by 2099, while RCP8.5 shows the greatest increase of 5.0°C by 2099 (Lorax, 2022).

Precipitation is also expected to increase at the site, with average annual precipitation projected to increase 20% to 35% by 2100, with slightly wetter summers and winters, but little change in spring and fall precipitation (Lorax, 2022). Under the RCP4.5 scenario, the decadal annual average precipitation is expected to rise to 688 mm by 2099 relative to 2010-2019. A larger increase is expected with RCP6.0 and RCP8.5, with precipitation increasing to 719 mm and 788 mm, respectively (Lorax, 2022).

2.3 Surface Hydrology

Topography is characterized by stream erosion resulting in gently rounded hills with tightly incised valleys. The HLF is located on top of a ridge in the headwaters of the Latte Creek and Halfway Creek watersheds (Figure 2.1 and Figure 2.3). The HLF is located along a ridge in between Halfway and Latte Creek with an average elevation of roughly 1,300 masl. Precipitation is the only significant source of water at the HLF, and surface water is limited to a number of small watercourses that originate on the ridge and flow into the Yukon River. The four catchments near the Mine Site include Latte Creek, Coffee Creek, Halfway Creek and Yukon Tributary 24 (YT-24)

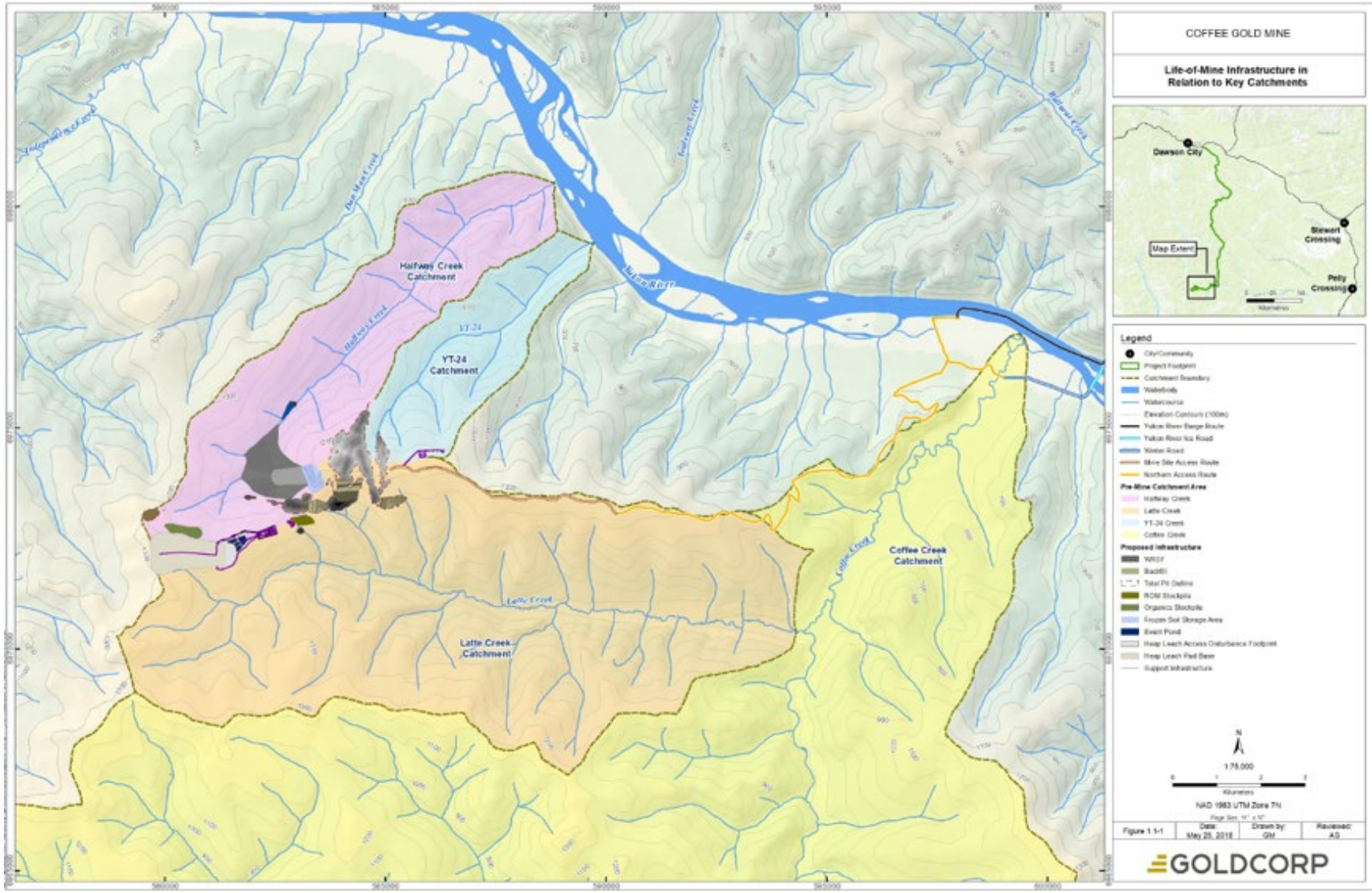


Figure 2.3: Watersheds in and near the project area.

Hemmera, 2018.

2.4 Geochemistry

Geochemical characterization can inform the potential evolution of both leachate and solids used over the LOM. Geochemical characterization includes both static and kinetic analyses to determine the leachability of metals, acid production potential and the evolution of both water quality and solids chemistry over time. Static analyses include tests such as acid base accounting, whole rock analysis and mineralogy. Kinetic analyses can involve humidity cell tests, column experiments, kinetic field bins, or field trials where the temporal evolution of water quality can be evaluated.

Gold mineralization in the host rock is characterized as "invisible gold" and is hosted in disseminated sulfides, primarily pyrite. The deposit has been described as an orogenic gold deposit and exhibits a strong Au-As-Sb metal association. The gold is primarily found in auriferous pyrite, arsenian pyrite and arsenopyrite (MacWilliam 2018). Exposure of sulfides during ore crushing and processing can cause oxidation that may lead to metal release and acid rock drainage (ARD) (MEND, 2009).

Extensive work has been done to characterize the geochemistry of the HLF. The primary potential constituents of concern (COCs) are NO_3, As, and U as well as cyanide (CN), Cd, Cu, Hg and Sb at various stages of the rinsing and reclamation cycle.

2.5 Geotechnical

The heap leach pad will be constructed on moderate sloping natural topography. Surficial soils are relatively shallow, with a topsoil layer of approximately 0.3 m and ice-rich materials extending to a depth of approximately 2.0 m. Underlying weathered granite bedrock transitions to competent bedrock quickly with outcrops on the eastern and western perimeter of the heap leach pad. All surficial topsoil and permafrost material will be removed from the base of the heap leach pad. Stability berms are planned to be constructed in the perimeter toe area to enhance stability of the HLF. Landform design for the HLF was completed by Forte Dynamics.

2.6 Water Management

Water management for the HLF area includes surface water collection ponds, surface water collection channels, solution distribution piping, and collection piping.

2.6.1 Surface Water Management

Four ponds are to be constructed in the HLF area, two event ponds (EP-1N and EP-1S), a rainwater pond for clean water; and a third event pond (EP-2) (Newmont 2019). The ponds will be located on the east end of Stage 1 between the HLF and the processing plant.

The HLF is designed to divide into two separate drainages, which requires the need for north and south solution collection ditches. Water will be conveyed from the HLF to the event ponds via the north and south event and rainwater channels.

2.7 Water Quality

Runoff from the HLF contributes to the overall site wide water quality and may impact loadings of COCs into the receiving environment. The Base Case proposes releasing treated water from the event ponds into Halfway Creek. During operation, processing of the ore will involve effluent laden with CN, As, U, and other metal(loid)s, which will be collected, processed, and recirculated. The gold extraction circuit is considered a closed circuit and all solution will pass through the processing plant (YESAB, 2021).

A baseline water quality investigation by Lorax (2017) shows that background water quality from a monitoring well downstream of the proposed HLF is a Ca-HCO_3 water type pH ranging from 6.6 to 8.0 and low conductivity. Major Ions were typically low, primarily Ca (~50 mg/L) and total alkalinity (~160 mg/L). The water quality at this location was classified as anoxic with mildly reducing conditions.

The planned final water quality in closure is to be of sufficient quality for release to Halfway Creek or the Alpha pond which overflows into the Halfway Creek drainage (YESAB, 2021). For the purposes of estimating long-term seepage water quality, the use of a passive treatment system is assumed (Lorax, 2017-B).

3 FAILURE MODES AND EFFECTS ANALYSIS

The Project team has developed a conceptual Base Case closure design established from outcomes of an alternatives assessment (Newmont, 2021). To refine the Base Case design and identify mitigation strategies for unacceptable risk and for risks to be classified as low as reasonably practical (ALARP), Okane facilitated a failure modes and effects analysis (FMEA) workshop with the Project team (Okane, 2022). Okane's approach to closure planning utilized the FMEA as the primary tool to support risk-based decision making throughout the life of the project. The FMEA workshop was utilized to identify inherent risks and opportunities within the Base Case design and outline strategies / future studies to mitigate Newmont's residual risks within the near- short- and long-term.

The FMEA process utilized Newmont's risk matrix and set of risk definitions to rank potential failure modes. All failure modes or risks identified were addressed by determining the necessary risk mitigation measures (in the form of future studies / work or tactical design optimizations) to reduce the risks' probability of occurrence or the severity of the consequences.

The FMEA was conducted on a site-wide basis; however, the below outlines key FMEA outcomes specific to the HLF Cover System. The complete FMEA report is included in Okane, 2022.

Eleven failure modes were identified with regards to the HLF. The following risk rankings were identified:

- Six failure modes were identified as having a moderate risk ranking
- Three failure modes were identified as having a high risk ranking
- Two failure modes were identified as having a severe risk ranking

Following mitigation, all residual risks were determined to be as low as reasonably practical within the context of the current project definition. Two residual risk rankings were identified as high risk:

- Net percolation through the heap leach facility is in excess of passive treatment system capacity, leading to an inability to sufficiently treat water and meet discharge criteria (Failure Mode ID #11).
- Passive reactive barrier (PRB) system is not effective in passively treating water in the long-term resulting in exceedance of water quality objectives in Halfway Creek (Failure Mode ID #13).

Under Newmont's risk profile no failure modes were identified as a fatal flaw that would require mitigation through altering the Base Case design of the HLF Cover System, and at this time all risks can be sufficiently mitigated through future studies/work. In discussion with Newmont, the residual life of project cost consequences were identified as acceptable given the current project definition.

Failure modes and effect pathways will be carefully monitored and periodically investigated as the project advances to ensure additional mitigations are not required. The FMEA demonstrated confidence within the Base Case HLF Cover System design and can allow Newmont to advance through licencing and advance the closure planning at the Coffee Mine.

4 DESIGN SUPPORT STUDIES

A series of design support studies were conducted in support of advancing the HLF cover system design to the 30-50% design stage. The design support studies were developed with the goal of identifying design constraints and opportunities for the current the HLF cover system for the Coffee Mine. The following sections provide a summary of the individual support studies, while appendix sections contain additional details and results.

4.1 Conceptual Model

Reference: B-1075-220-001 Coffee Mine Heap Leach Facility Conceptual Model, November 2021 (Appendix A)

The purpose of the conceptual model is to identify any existing gaps in the conceptual understanding of the HLF Base Case that may impact the ability to achieve the required level of cover system design for the project (30-50%). The conceptual model also acts as an important communication tool for use within project design to describe current and anticipated conditions for the HLF. A complete conceptual model is included in Appendix A, the HLF Base Case concept is provided below.

4.1.1 HLF Base Case Concept Summary

The HLF is a conventional, multi-lift and free draining heap, constructed directly on bedrock or structural fill (Newmont, 2019). When complete, the HLF will cover an approximate area of 102 ha with a capacity of approximately 67M tonnes (Mt). At its deepest, the HLF will 115 m thick.

The HLF will be regraded for closure to maintain an overall slope of 2.5H:1V or flatter. The plateau area of the HLF will be capped with an infiltration barrier underlying a store-and-release cover system. The slopes will be covered with a store-and-release cover system only. The store-and-release layer is assumed as a 0.5 m layer of finely graded waste rock (i.e., minimal leaching potential), soil, or other suitable material.

Based on the INAP Guidance Document (2017) for a barrier-type cover system, 5 – 15 % of precipitation will report as net percolation (NP) through the heap; however, with a GCL or similar barrier layer, NP in the immediate term is expected to be closer to the lower end 5% range with the relatively low net percolation being driven by tears and imperfections introduced in the construction stage. Longer term performance of the GCL will also be impacted by cation exchange between the GCL and heap/cover material. This can result in altered performance for the GCL such as increased hydraulic conductivity and resulting increases in NP.

Conceptually, the store-and-release cover system on the slopes of the HLF will allow approximately 25 to 50% of precipitation to report as net percolation. The proposed cover for the slopes will be placed at

an angle of 2.5H:1V or flatter. Potential cover materials will be further characterized in operations to determine if the 2.5H:1V slope is sufficiently shallow to mitigate erosion to acceptable levels (see Section 4.4.3).

The HLF is anticipated to be in a fully wetted up condition at closure due to the nature of heap leach processing. Okane anticipates that the HLF will go through a period of drain down following the addition of a cover system following which the HLF will reach a steady state.

4.2 Analytical Water Balance

Reference: B-1075-220-003 Coffee Mine Heap Leach Cover Design – Analytical Water Balance to Support Alternatives Assessment (Appendix B)

The alternatives evaluated in the alternatives assessment (Newmont, 2022) were primarily differentiated by variations in the coverage and application of a geosynthetic clay layer (GCL) cover system. The alternatives included either:

- GCL cover system on plateau section **only,** with store and release cover system on slope sections; or
- GCL cover system on **both** plateau and slope sections.
- Okane completed conceptual water balances for these scenarios to estimate performance with and without a GCL cover on the slopes, and with a GCL on the plateau segments.

Table 4.1 summarizes the water balances developed by Okane, using an analytical tool and average wet and dry years (i.e. not including high return period design storm events), for the potential cover system scenarios of the HLF. The primary focus for this assessment is the amount of net percolation (NP) reaching the underlying heap material through the cover system. The water balance results provided in Table 4.1 are consistent with the conceptual range of cover system performance presented in terms of "very low," "low," "moderate," "high", and "Very High" NP from the International Network for Acid Prevention cover system guidance document (INAP 2017). For the HLF, a very high NP rate is classified as greater than 50% (% of PPT), high NP is between 25% PPT and 50% of PPT, moderate (Mod) is between 15% PPT and 25% PPT, low is between 5% PPT and 15% PPT, and very low (VL) is less than 5% PPT. The cover systems are estimated to perform within the following NP classifications:

- The flat areas of the HLF with an infiltration barrier (GCL) underlying a 0.5 m store-and-release cover system – Very Low
- The slopes covered with a 0.5 m store-and-release cover system – high
- The slope areas of the HLF with an infiltration barrier (GCL) underlying a 0.5 m store-and-release cover system – Very Low

Table 4.1: Summary of analytical water balances for HLF cover system scenarios

Cover System/Terrain	Climate Year	PPT	SUB	AET	S	RO	IF	NP	
		mm	mm	mm	mm	mm	mm	mm	% PPT
Plateau with GCL	Dry	370	31	273	-16	0	74	8	2%
	Average	**499**	**44**	**303**	**0**	**0**	**136**	**16**	**3%**
	Wet	650	62	333	16	27	191	22	3%
Slope with GCL	Dry	370	31	273	-16	0	74	8	2%
	Average	**499**	**44**	**303**	**0**	**0**	**136**	**16**	**3%**
	Wet	650	62	333	16	27	191	22	3%
Slope base case (simple store and release)	Dry	370	31	273	-16	0	0	82	22%
	Average	**499**	**44**	**303**	**0**	**0**	**0**	**152**	**30%**
	Wet	650	62	333	16	27	0	213	33%

PPT = Precipitation; SUB = Sublimation; AET = Actual Evapotranspiration; S = Change in near surface water storage; RO = Runoff; IF = Interflow; NP = Net Percolation

The conceptual water balance parameters provided within this assessment highlights an important consideration for future HLF landform design work; specifically, the amount of water that will need to be managed as interflow. As water moves laterally down gradient above the GCL, the contributing area will increase along with the amount of water to be managed. This is particularly important for the cover system scenario including a GCL on the slope (i,e, there is no interflow anticipated in the base case slope cover system water balance). In this scenario, there will be a critical point along the slope where water will need to be brought to surface and managed through surface water drainage ditches, drop structures, etc. In addition, the lateral drainage capacity of the cover material, or dedicated lateral drainage layer, will need to be designed to accommodate the anticipated flow, and to meet stability requirements (as to manage risks involving the development of positive pore-water pressure).

The Base Case closure cover system design does not include a GCL on the HLF slope segments; therefore, this analysis provides supporting information for future design alternatives or assessments which could include a low flux barrier layer on the slopes.

Additional assessment is required to calculate the required transmissivity (lateral drainage capacity) to manage flows above the GCL on the plateau. This will also inform on the location, and flow capacity requirements, of surface water management features to be included on the HLF.

4.3 Numerical Water Balance Modelling

Reference: B-1075-220-020 Coffee Mine SPA Numerical Modelling (Appendix E).

To enhance the understanding of the various HLF cover system alternatives and the Base Case evaluated in the previous alternatives assessment, Okane completed one-dimensional (1D) and two-

dimensional (2D) soil-plant-atmosphere (SPA) numerical modelling. The objective of the 1D numerical modelling is to provide estimated water balance parameters and associated performance.

Following the 1D numerical modelling and sensitivity analysis, simple 2D modelling was completed to demonstrate the understanding of water movement above the GCL (plateau) and without a GCL (slope) as well as to support the HLF cover system design.

4.3.1 1D Modelling

Okane completed preliminary one-dimensional (1D) conceptual water balances for the following scenarios to estimate performance with and without a GCL cover on the slopes and with a GCL on the plateau segment.

The GCL cover system was modelled as:

- 0.5 m storage layer;
- 0.3 m gravel drainage layer;
    - Included in anticipation that a GCL cover system might be required on the slopes of the HLF.
- 1 cm geosynthetic clay layer; and
- 5.0 m of rinsed ore.

The store-and-release cover system was modelled as:

- 0.5 m storage layer; and
- 5.0 m of rinsed ore.

Table 4.2 summaries the water balance developed by Okane through 1D numerical modelling for the potential cover system scenarios of the HLF. The primary focus for this assessment is the amount of net percolation (NP) reaching the underlying heap material through the cover system.

Table 4.2: Summary of the numerical water balances for the HLF base case cover system scenarios.

Cover Scenario	Mean Annual Precipitation (mm)	Evapotranspiration (% MAP[1])	Runoff (% MAP)	Net Percolation (% MAP)	Sublimation (% MAP)	Interflow (% MAP)
GCL Cover System	499	53%	16%	4%	14%	13%
Store-and-Release Cover System	499	46%	16%	24%	14%	-

[1] – Mean Annual Precipitation

4.3.2 1D Sensitivity Modelling

One-dimensional sensitivities were performed to investigate the effects of heterogeneity of the storage layer, vegetation, and climate change on cover system performance. Two variations on the storage layer were modelled, one with a saturated hydraulic conductivity an order of magnitude higher (Sensitivity A) and one with a saturated hydraulic conductivity an order of magnitude lower (Sensitivity B).

The influence of vegetation was investigated through the addition of vegetation parameters in the calculation of the surface water balance and surface energy balance of the base case models. Vegetation was simulated as sparse vegetation using 30% ground cover and a rooting depth of 0.2 m. This can be considered "medium-term" vegetation development, i.e. more established than immediate term, but not quite a climax vegetation community. Results from the sensitivities are presented in Table 4.3.

Table 4.3: Summary of the numerical water balances for the HLF sensitivity cover system scenarios.

Cover Scenario	Mean Annual Precipitation (mm)	Evapotranspiration (% MAP[1])	Runoff (% MAP)	Net Percolation (% MAP)	Sublimation (% MAP)	Interflow (% MAP)
GCL with Storage Layer Sensitivity A	499	46%	18%	4%	14%	18%
GCL with Storage Layer Sensitivity B	499	46%	25%	4%	14%	11%
GCL with Vegetation	499	49%	24%	4%	14%	9%
GCL under RCP6.0	564	53%	13%	4%	13%	17%

Store and Release with Sensitivity A	499	44%	18%	24%	14%	-
Store and Release with Sensitivity B	499	41%	25%	20%	14%	-
Store and Release with Vegetation	499	42%	24%	20%	14%	-
Store and Release under RCP6.0	564	47%	13%	27%	13%	-

1 – Mean Annual Precipitation

4.3.3 2D Modelling

Conceptual two-dimensional modelling was performed to show the flow paths of infiltrating water. The two-dimensional cross section was split into two model domains; one highlighting the conceptual performance of the slope store and release cover system and the other highlighting the conceptual performance of the plateau store and release with GCL cover system.

The 2D conceptual modelling showed that, on the plateau, where a GCL is part of the cover system, the majority of the infiltrating water was diverted laterally above the GCL (Figure 4.1). On the slopes, with the store and release cover system, most of the infiltrating water flowed vertically through the cover system and into the ore below (Figure 4.2).

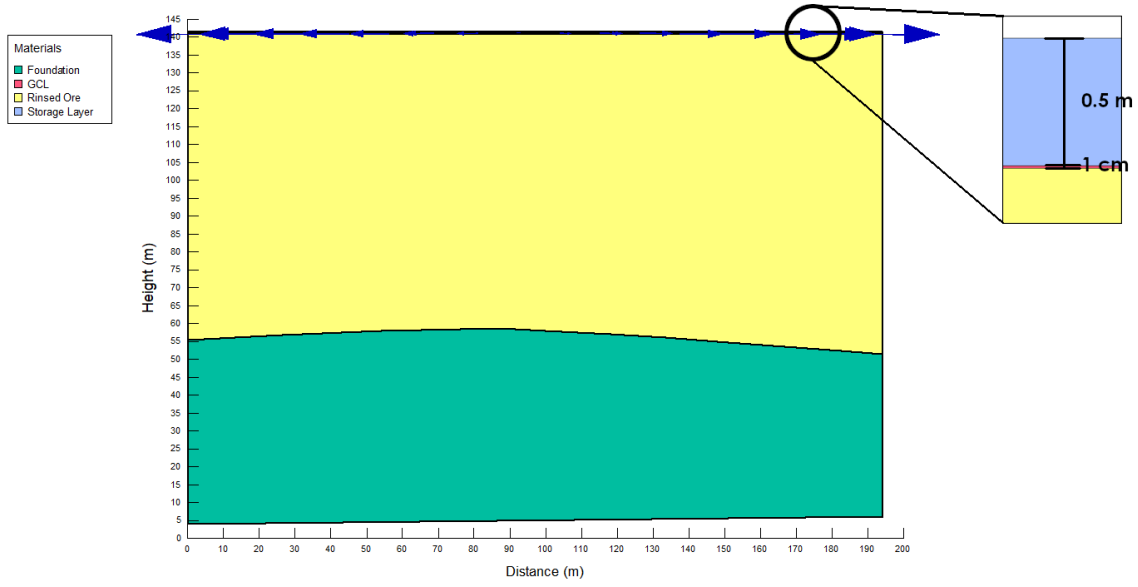


Figure 4.1: Conceptual water flow within the store and release with GCL cover system on the plateau. Blue arrows show water flow.

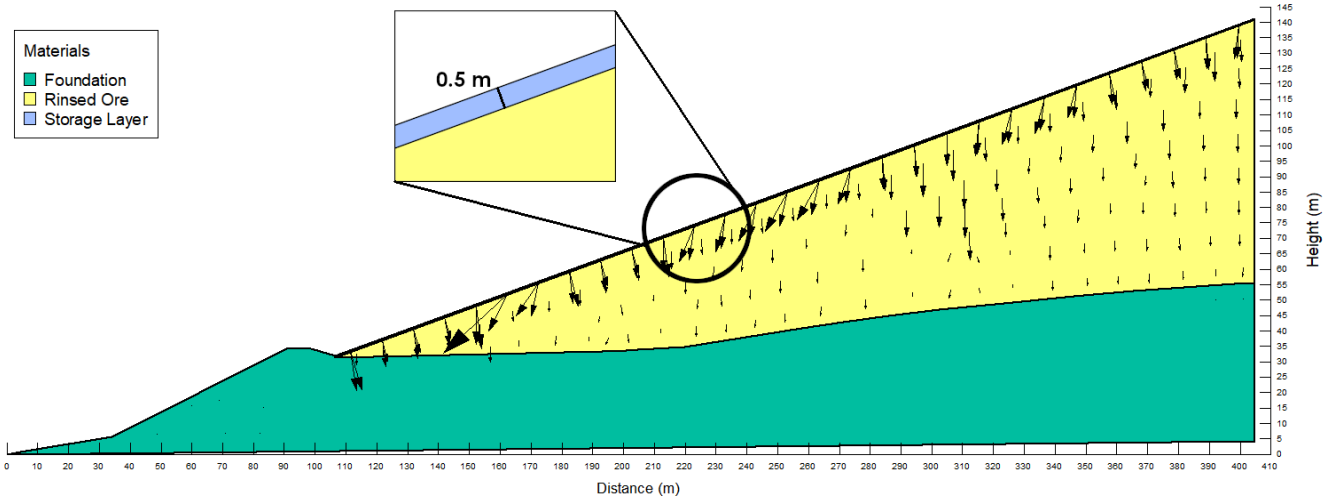


Figure 4.2: Conceptual water flow within the store and release cover system on the slopes. Black arrows show water flow

4.3.4 Key findings of SPA Modelling

The SPA modelling enhances the understanding of water fluxes within the HLF cover system. NP on the plateau is expected to be very low as a result of the GCL, and moderate on the slopes under a range of materials and climatic conditions as demonstrated by sensitivity analysis. The conceptual 2D assessment demonstrates dominant water flow pathways for the slope and plateau.

The SPA model supports the Base Case cover system concept, in that performance is in line with the expected range of NP for the site setting. The anticipated NP can be incorporated into draindown and water quality prediction models to understand long term HLF performance and whether water quality objectives for the HLF are met. This assessment is anticipated to be completed in future design stages.

4.4 Reclamation Material Assessment

Multiple test pitting and geotechnical investigations were carried out to determine volumes and available materials at sites across the Coffee mine including the proposed HLF. A detailed investigation was carried out in 2017 that included eight boreholes on the HLF site (Tetra Tech, 2017). JDS (2018) compiled the results of the 2017 test pitting program and generated available material volumes and expected surface material requirements for reclamation. JDS (2019) provided an updated assessment of pre-production available reclamation material volumes, and was combined with the results of the JDS (2018) report to generate an estimate of total reclamation material volumes, both pre-production, and during operations.

4.4.1 Reclamation Material Balance

Reference: B-1075-220-010 Coffee Mine FMEA Workshop Factsheets – Fact Sheet #8 (Appendix D)

Okane compiled the information provided in JDS 2018 and JDS 2019 to develop an estimate of the overall availability of reclamation material for the Coffee project. Material was classified as organics, upper silt, lower gravel, and weathered bedrock. A variety of cover system requirement scenarios was investigated to assess the impact on total available reclamation material for different cover system volume requirements based on potential cover system thicknesses. The assessment also investigated a variety of options for cover system application across the site assets to look at the material balance based on what site features had a cover system applied.

4.4.2 Reclamation Material Priority

Reference: B-1075-220-017 Coffee Mine Reclamation Material Priority Table (Appendix C)

Okane, Ensero and Newmont developed a first pass prioritization for cover system material application at the site to initiate discussions on where to focus effort on cover system application. Refinement of the prioritized list will be required through collaboration with Stakeholders and First Nations in future design stages.

It is understood that the HLF will be the top priority to receive reclamation material, and that subsequent landforms will receive excess material following HLF reclamation as opportunity develops, or design requires to meet performance criteria. The rankings developed in the priority list considered the following in development:

- HLF is the top priority;
- Visibility from the Yukon River, or other potential high traffic areas;
- Optimizing vegetation success – prioritizing south facing slopes; and
- Reclamation of partially backfilled pits with pit lakes assumes no reclamation material placed below the final pit lake water levels.

Table 4.4 presents the priority list based on a first pass conceptual approach.

Table 4.4: Reclamation material priority list for discussion

Domain	Location	Pros	Cons	Priority	Notes
HLF including event ponds	Upland	• Key stakeholder expectation for cover	• Large area	1	• This has been identified as the #1 priority based on previous discussions with the project team
Alpha WRSF	Upland and Lowland	• Might be visible from Yukon river • Significant asset to reclaim, gaining positive support from stakeholders	• Large surface area to reclaim • Potentially multiple revegetation strategies required along northern and western slopes to account for ecosites	2	• Headwaters of Halfway creek • Slope aspect of North, West, and South • Slopes with benches • 815masl - 1,150 masl • Anticipated to be free draining • Rock drain below WRSF
Alpha Pond and Dam	Lowland	• Potentially valuable habitat in the valley	• Potentially low geochemical risk	3	• Material stripped from dam footprint will be stockpiled and used for dam reclamation
Kona Pit (Complete Backfill)	Upland	• Small area to cover	• Might not be very visible • Pending Geochem work - risk for ML-ARD could be low	4	• Backfilled with waste from Kona Pit and is NAG but metal leaching potential, pit wall could be 20% PAG. • Surface runoff from backfill will report to halfway creek via the Alpha WRSF rock drain
Double Double Pit (Complete Backfill)	South Facing Slope	• High likelihood of successful revegetation given slope aspect • Potentially visible from Latte Creek	• Might not be a significant area of concern for revegetation	5	• Waste rock from Supremo Pit used to backfill • Ore is classified as NAG • Pit walls are NAG, but potential metal leaching. Water quality modelling indicates that water accumulating in pit voids can be directly discharged to

					receiving environment. No additional Geochem stabilization required. • No groundwater inflows • Groundwater discharge to Latte Creek
Access Roads / Haul roads/ airstrips	Multiple	• Areas with high visual impact	• Low geochemical risk	6	• Some roads have different reclamation requirements
Plant Site / Camp Site/Crusher	Upland	• Areas with high visual impact • Small area to reclaim	• Low geochemical risk	7	• Simple organics layer and grading/contouring
Latte Pit (Partial Backfill - above final pit lake)	South Facing Slope	• Reduce potential loads to pit • Reclaiming roads (causeway area) could be a high priority area in terms of visibility	• Risk of ML-ARD low? • Reclaimed Slopes into the pit (above final pit lake) provide lower value?	8	• Partial backfill acts as an access road for ore haulage • Pit will be receptor for HLF seepage water • Ultimately will overflow into the Alpha Rock drain and Halfway creek • Some seepage to groundwater is expected • No Groundwater inflows
Supremo Pit (partial backfill - above final pit lake)	Ridge top extending down southern slope	• Reclaiming roads (causeway area) could be a high priority area in terms of visibility	• Less visual impact considering a partially backfilled pit	9	• Multiple pit lakes • Receptors include Latte creek, YT-24 and Halfway creeks • Analysis underway to see if more backfill can happen in Supremo.

4.4.3 Material Suitability

Reference: B-1075-220-011 Coffee Mine FMEA Workshop Fact Sheets – Fact Sheet #9 (Appendix D)

Material quality in addition to quantity is a critical piece of reclamation planning. Reclamation material will be stockpiled, with organics managed separately to the gravels and silts. It is anticipated that the materials available for reclamation will have a texture that is roughly 40% sand, 40% cobble and gravel, and 20% clay and silt. This estimate is based on the texture triangle developed from the TetraTech 2018 test pitting program (Figure 4.3).

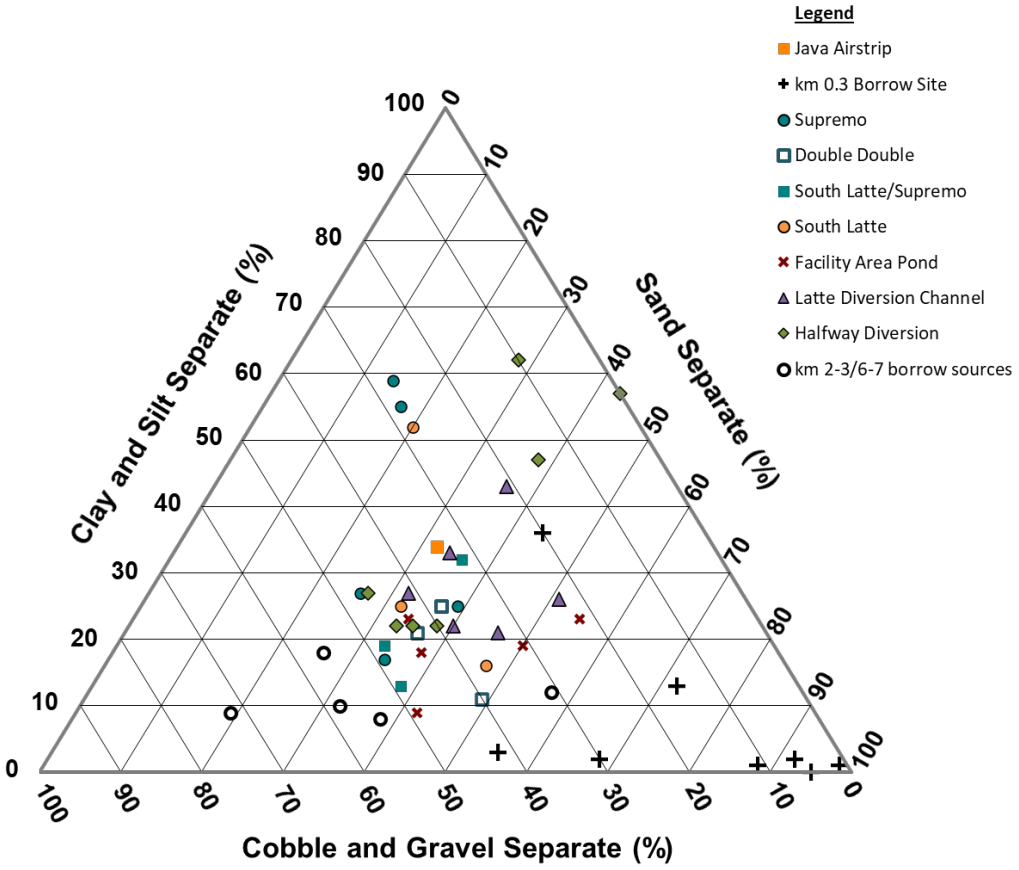


Figure 4.3: Texture triangle of reclamation materials sampled during 2018 (Tetratech, 2018)

The FMEA workshop (Okane, 2022) highlighted erosion on the 2.5:1 HLF slope as a moderate risk, resulting in excessive erosion or physical instability. Mitigation of this risk involves short-term monitoring and maintenance of rills and gullies. Additional assessments to identify suitability of material to resist erosion to an acceptable level will be required. This will involve the establishment of a site-specific erosion risk framework to qualitatively understand the level of acceptable erosion, and identification of a material texture that meets established erosion performance criteria. Given that water holding capacity and in

general, vegetation establishment success, are linked to the amount of finer fraction material within reclamation material, it is likely that a balance between establishing vegetation and resisting erosion will be required.

In addition to suitable material texture, nutrients and minerals within reclamation material will need to be adequate for support of the desired plant communities. A complete soils assessment with a focus on meeting the requirements of desired vegetation will be required within future design iterations.

4.4.3.1 Preliminary Erosion Assessment

A preliminary assessment of erosion risk was completed to understand, at a high level, the potential for erosion to occur on the HLF slope based on estimated reclamation material properties, and anticipated slope lengths and grades for the HLF. The objective of the assessment is to highlight potential risk, and guide future study. The assessment utilized the revised universal soil loss equation (RUSLE) from the United States Department of Agriculture (USDA) and a conceptualized erosion risk framework.

Erosion Risk Classification	Erosion Rate (t/ha/yr.)	Denudation Rate* (mm/y)	General Description
Very Low	< 1	<0.07	Negligible impact on surfaces. Landform erosionally stable.
Low	1 to 10	0.07 – 0.7	Minor impact to landform surfaces / cover system performance. Landform conducive to vegetation establishment and trending towards an inherently erosionally-stable surface.
Moderate	10 to 25	0.7– 1.8	Landform generally stable with limited adverse effect on overall cover system / landform surface performance. Some rilling and gully development. Certain areas potentially requiring minor remedial earthworks repairs to prevent worsening.
High	25 to 50	1.8 – 3.7	Material losses from the cover system are substantial, resulting in adverse performance and surfaces trending towards instability. Likely to require revegetation strategies and active management strategies to mitigate erosion issues.
Very High	> 50	> 3.7	Substantial material loss from the cover system. Substantial earthworks and revegetation strategies required for remediation.

* Dependent on bulk density.

Figure 4.4: Example risk framework

The assessment found that at slope lengths of 80m (longest anticipated uninterrupted slope) at a 2.5H:1V slope, and with estimates of long-term vegetation establishment, an erosion rate of approximately 26 t/ha/yr could be expected. This can be interpreted as a "high" erosion rate based on the example erosion risk framework.

Figure 4.4 is a tornado plot which shows how erosion rates change relative to the Base Case when various parameters are manipulated. For example, following cover system application and vegetation has not had an opportunity to establish, erosion rates are expected to be very high (~60t/ha/yr). As expected, erosion rates decrease as vegetation is able to develop, and as slope gradients become more shallow.

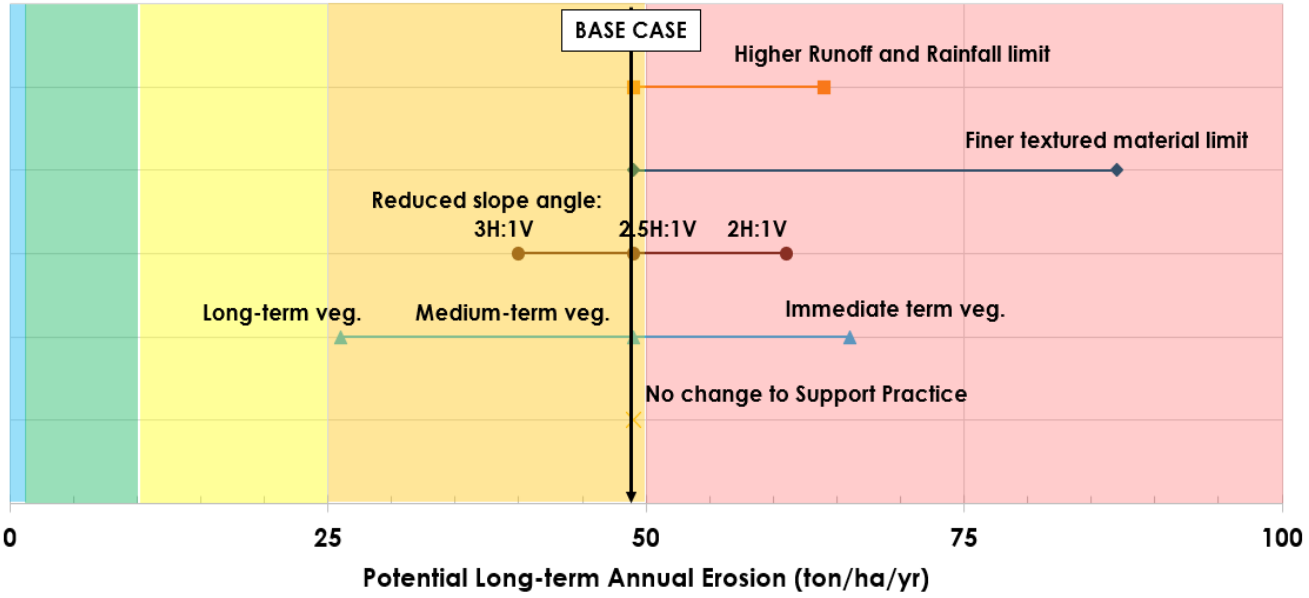


Figure 4.5: RUSLE erosion estimates for the HLF cover system.

The preliminary RUSLE results demonstrate the importance of additional assessment to better understand erosion risk at the HLF, and develop cover system material specifications to meet project specific erosion criteria. The Very High erosion rate expected for the 2H:1V slope as shown in Figure 4.5 provides insight into potential erosion risk for the conceptual surface water management areas, which are to be cut into the HLF resulting in steeper gradients compared to the rest of the slope.

5 HLF COVER SYSTEM DESIGN OVERVIEW

The HLF cover system design is aimed to support project licensing by achieving an approximately 30% to 50% design. Design of this level is preliminary in nature and equivalent to approximately the Association for the Advancement of Cost Engineering (AACE) Class 3 estimate (AACE International, 2022). The primary focus of the design is assessing design alternatives, identifying risk and opportunity, and confirm that the design is feasible for advancing to the detailed design in subsequent stages of project development.

The FMEA was used, in part, to develop and confirm the Base Case design for the HLF, and also identify future studies required to reduce risk and uncertainty. Design support studies provided additional information and enhanced the understanding of Base Case cover system performance on a site-specific basis. This provides additional confidence that the Base Case will meet environmental performance requirements.

5.1 HLF Cover System Design

The HLF plateau will be covered with a low-permeability barrier layer (e.g., geosynthetic clay liner (GCL), or other suitable barrier layer determined in future design stages), followed by a 0.5 m store and release cover system. The HLF slope will be graded to an angle of 2.5H:1V and covered with a 0.5 m store and release cover system. Surface runoff drainage channels have conceptually been designed by Forte Dynamics, as illustrated in drawing No.1075-220-001 and Figure 5.1. Figure 5.2 and Figure 5.3 show the cross section of the plateau and slope cover systems, respectively.

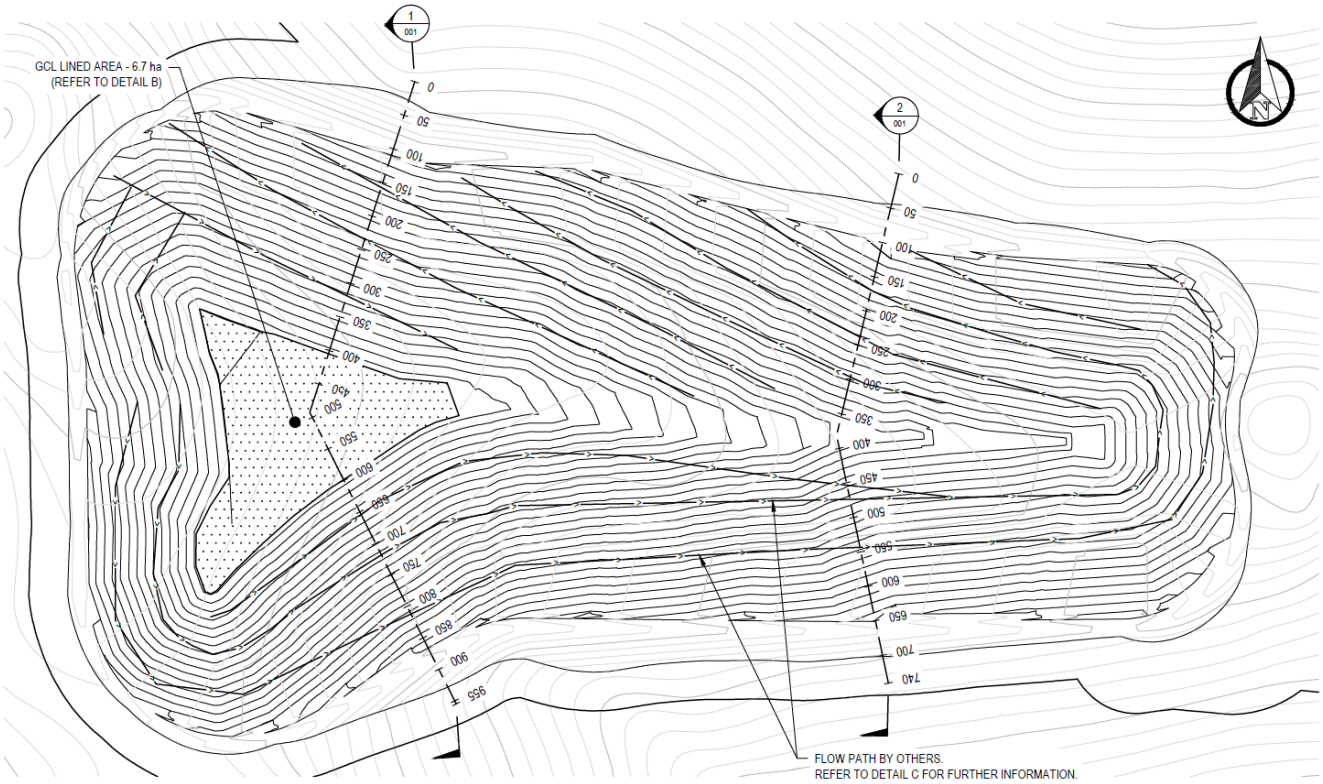


Figure 5.1: Plan view of the HLF and cover system.

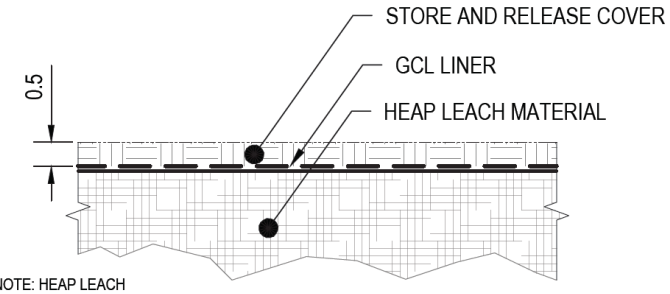


Figure 5.2: Plateau cover system cross section.

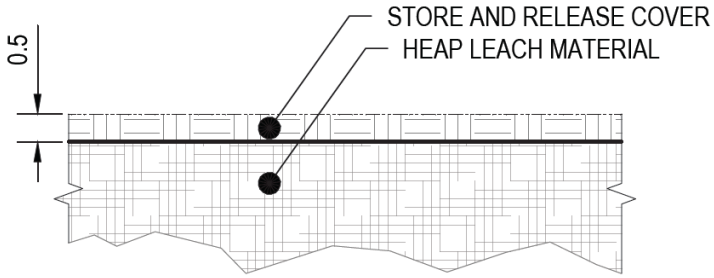


Figure 5.3: Slope cover system cross section

5.2 Reclamation Material Requirements

5.2.1 Material Take-Offs

The following material take-offs (MTOs) have been developed based on the cover system design presented in Section 5. Volumes have been developed based on offsets from the final HLF ore surface provided by Forte in Dwg EXH-001.

Table 5.1: HLF Cover System MTOs

Component	Area (m^2)	Depth (m)	Material	Volume (m^3)	Comment
Store and Release Cover System	1,083,185	0.5	Reclamation Material	541,593	Development of cover system specifications (e.g. PSD) to occur in detailed design
GCL	75,080	-	GCL	-	Includes additional 1.0 m to complete key-in, and additional 1.0 m to drape down slope. Overlap estimate of 10%. Drainage layer requirement to be determined in detailed design

6 RECOMMENDATIONS

Design support studies were conducted to advance the Coffee Mine Heap Leach Facility cover system to the next phase of engineering and design. Support studies included conceptualization, numerical modelling, and assessment of risk through completion of an FMEA workshop.

The following recommendations have been developed for consideration in future design stages:

- Develop confidence in the base case design though circulation with regulators and stakeholders for comment.
- Develop a conceptual erosion risk framework to assess against anticipated erosion. Additional assessment including material testing, erosion flumes or field trials to refine assumptions made in predictive erosion models will increase the confidence in analytical results.
- Surface water management features to be designed and evaluated to incorporate an understanding of applicability and operation in northern climates.
- Development of a monitoring system for the HLF cover system to capture key mechanisms impacting performance, and establishing a performance trajectory early in closure.
- Additional material characterization to assist in the development of an appropriate material specification for reclamation material, and increase confidence in borrow areas, volumes, and availability.
- Evaluate alternatives and suitability of the GCL as a low flux layer on the plateau cover system.
- Incorporate HLF cover system water balance into log-term seepage and water quality assessment.

7 CLOSURE

We trust information provided is satisfactory for your requirements. Please do not hesitate to contact the undersigned for further information or questions.

Prepared by:



Mitchell Barteaux
Project Coordinator

Reviewed by:

David Christensen, P.Eng.
Senior Engineer

8 REFERENCES

Association for the Advancement of Cost Engineering (AACE) International. 2022. AACE International Recommended Practice No. 10S-90 Cost Engineering Terminology. Rev. February 18, 2022

Hemmera Envirochem Inc., 2018. Draft Reclamation and Closure Plan, Coffee Gold Project. File No. 1658-003.01. Prepared for Goldcorp Inc. November 2018.

International Network for Acid Prevention. 2017. Global Cover System Design Technical Guidance Document.

IPCC. 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.) Cambridge University Press. Cambridge, United Kingdom and New York, NY, USA.

JDS 2018. Surface Material for Reclamation. Memorandum prepared for Jennie Gjertsen, James Scott. October 25.

JDS 2019. Material Balance Report Coffee Project. July 5.

Lorax Environmental Services. 2017. Appendix 12-A Coffee Gold Project Baseline Water Quality Report. March 3.

Lorax Environmental Services. 2017-B. Appendix 12-D Coffee Gold Project Geochemical Characterization Report. March 22.

Lorax Environmental Services. 2022. Coffee Gold Project: 2021 Hydro-meteorology Baseline Report. Prepared for Newmont Goldcorp. January 28, 2022.

MacWilliam, Kathryn R. G. 2018. The Geology and Genesis of the Coffee Gold Deposit in West-Central Yukon, Canada: Implications for the Structural, Magmatic, and Metallogenic Evolution of the Dawson Range and Gold Exploration Models. Thesis. University of British Columbia.

MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials, MEND Report 1.20.1. Prepared by William A. Price for MEND Program.

Newmont 2019. Goldcorp Kamanik, a subsidiary of Newmont Corporation (Newmont). 2019 Coffee Gold Mine YESAB Project Proposal Appendix A – Project Description Overview. December 2019.

Okane, 2022. Coffee Mine FMEA Summary Report. Report No. 1075-220-018. March 16

Tetra Tech. 2017. Fall 2017 Testpitting Program, Coffee Mine Site Phase 1: Proposed Infrastructure Footprings, Phase 2: Proposed Open Pit Areas. Prepared for JDS Energy & Mining.

Yukon Environmental and Socioeconomic Assessment Board (YESAB). 2021. Screening Report and Recommendation – Coffee Gold Mine 2017-0211. October 2021.

Appendix A

Conceptual Model

Calgary

Suite 1900, 736 6th Avenue SW
Calgary, AB T2P 3T7
Canada
www.okc-sk.com

Our ref: B-1075-220-001

November 4, 2021

Ryan Herbert, P.Ag.
Practice Lead, Environmental Permitting
Ensero Solutions
410 - 885 Dunsmuir Street
Vancouver, British Columbia
V6C 1N5

By email rherbert@ensero.com

Re: Coffee Mine Heap Leach Facility Conceptual Model

Okane Consultants (Okane) was engaged by Ensero Solutions (Ensero) to prepare a conceptual model for the Newmont Gold (Newmont) Coffee Mine (the Project) Heap Leach Facility (HLF) as part of the development of a cover system design. The purpose of the conceptual model is to identify any existing gaps in the conceptual understanding of the HLF that may impact the ability to achieve the required level of cover system design for the project (30-50%). The conceptual model also acts as an important communication tool for use within project design to describe current and anticipated conditions for the HLF.

The first portion of this memorandum provides the current understanding of the base case design for the HLF. Following the current understanding is the conceptual model of performance, based on the base case design. The remainder of the document provides a detailed physical conceptual model for the Coffee Mine HLF.

This report is considered a "living document" and will be constantly updated throughout the project as additional information and new data is compared with the existing concept.

Current Understanding of HLF Design

It is understood that the HLF design is currently being updated; however, the following summarizes the most recent design submitted in the Reclamation and Closure Plan (RCP) (Hemmera, 2018). The HLF is a conventional, multi-lift, free-draining ridge-top leach pad with ponds, a solution distribution network, and collection piping (JDS Energy & Mining Inc.; JDS, 2016). When complete, the HLF will cover an area of 102 ha (Hemmera, 2018) with an ultimate design height of 80 m (JDS, 2016) and nominal capacity of 47M tonnes (Mt), with the potential to expand to 61 Mt. Construction of the HLF will begin between Year -2 and Year -1 of the life of mine (LOM) plan with the construction of Stage 1, with a capacity of 7.2 Mt (JDS, 2016). Subsequent Stages will have capacity between 8 Mt and 20 Mt, or 1.5 to 4 years of operating capacity (Table 1).

Table 1: HLF Operation Timing, Cumulative Area and Heap Volume, and Heap Crest Elevation by Stage

Heap Leach Pad Stage	Operation Timing	Cumulative Pad Area (ha)	Cumulative Heap Volume (Mt)	Heap Crest Elevation (m)
Stage 1	Year -2 (Apr) to Year -1 (Oct)	27.1	7.2	1,270
Stage 2	Year 1 (Nov) to Year 3 (Mar)	49.8	19.2	1,300
Stage 3	Year 3 (Apr) to Year 7 (May)	75.4	39.4	1,340
Stage 4	Year 7 (Jun) to Year 9 (Nov)	81.9	47.3	1,350

JDS, 2016

The HLF will be constructed along the ridge to the west of the process plant and pits, in the southwestern corner of the site. It will be double lined with a geosynthetic clay liner (GCL) overlain by a low-density polyethylene (LLDPE) geomembrane. Drainage pipes will be nested in a 500 mm thick layer of permeable gravel at the base of the pad to collect pregnant (i.e., gold bearing) solution from the HLF.

Ore will be stacked at the HLF in 10 m lifts at the angle of repose of the ore material. HLF stages will be physically divided using ditches or berms to provide hydraulic isolation of heap leach solution between stages. There is also hydraulic separation by cell, or approximately every 100 m of pad in the long-axis direction. Benches will be constructed as part of the HLF to produce an overall 2.5H:1V or flatter toe-to-crest slope for the stacked ore.

The HLF will use dilute cyanide solutions with pH ranging from 10.5 to 11.0 (Hemmera, 2018). The leaching process will be closed circuit, except for the provision of make-up water. Barren leach solution will be irrigated onto the HLF using drip irrigation for approximately 40 days prior to the addition of a new lift of material. Pregnant solution will be conveyed to the processing plant through the collection piping network underlying the HLF and above the liner.

The HLF is equipped with an automatic overflow system to prevent release of leach solution during upset conditions. Heap leach operators can also direct overflow to event ponds, where heap leach solution can be recirculated to the heap.

Beginning in Year 5, the HLF will be regraded to maintain an overall slope of 2.5H:1V or flatter (Hemmera, 2018). Grading will also be optimized to promote the conveyance of water off and away from the HLF. The flat areas of the HLF will be capped with an infiltration barrier underlying a store-and-release cover system (Figure 1). The slopes will be covered with a store-and-release cover system only. The storage layer has been scoped as a 500 mm layer of finely graded waste rock (i.e., minimal leaching potential), soil, or other suitable material.

The cover system goals are as follows (Hemmera, 2018):

- Provide physical stability of the heap, including stable slopes and erosion resistance.
- Provide for positive drainage to prevent the creation of saturated zones.
- Route runoff away from the HLF and into natural drainage channels to minimize erosion or other ill effects.
- Reduce infiltration by 20 – 25%, and up to 30% of mean annual precipitation.

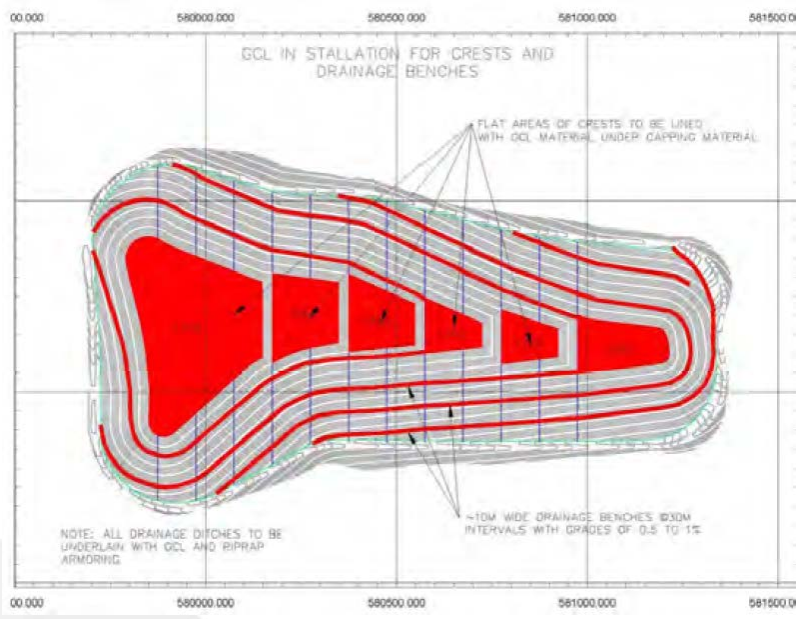


Figure 1: HLF at closure showing areas to receive GCL in capping system (red).

Hemmera, 2018

Conceptual Model of Performance

Based on the Köppen-Geiger climate classification system, the climate at Coffee Mine is characterized as subarctic continental (Dfc), which is indicative of a cold climate with no dry season. The International Network for Acid Prevention (INAP) Global Cover System Design Technical Guidance Document (2017) provides cover system performance criteria for various cover system types for a given climate prescription.

The flat areas of the HLF are anticipated to be covered with a low permeability barrier, as well as a store-and-release cover system as a protective layer. Based on the INAP Guidance Document (2017) for a barrier-type cover system, 5 – 15 % of precipitation will report as net percolation (NP) through the heap; however, with a GCL or similar barrier layer, NP in the immediate term is expected to be closer to the lower end 5% range and driven by tears and imperfections introduced in the construction stage. Longer term performance of the GCL will also be impacted by cation exchange between the GCL and heap/cover material. This can result in altered performance for the GCL such as increased hydraulic conductivity and resulting increases in NP.

The store-and-release cover system on the slopes of the HLF will allow approximately 25 to 50 % of precipitation to report as net percolation. The proposed cover for the slopes will be placed at an angle of 2.5H:1V or flatter (Hemmera, 2018) and will act as a conduit for the interflow of infiltrating water downslope, therefore potentially being subjected to surface erosive forces. Potential cover materials have not been sufficiently characterized at this stage of mine development to determine if the 2.5H:1V slope is sufficiently shallow to mitigate erosion or whether a 500 mm store-and-release cover system is an appropriate conduit for interflow.

The HLF is anticipated to be in a fully wetted up condition at closure due to the nature of heap leach processing, as well as the proposed double rinse of the HLF. Okane anticipates that the HLF will go through a period of drain down following the addition of a cover system on the flat and sloped portions of the structure, following which the HLF will reach a steady state. The quality of water released from the HLF during this drain down process is unknown; furthermore, the quality of water from drain down is unlikely to vary with different cover system prescriptions. The selection of a cover system for the HLF will be dependent on the desired performance of the HLF following drain down. Conceptualization of the load following steady state is important for selection of an appropriate cover system.

There is uncertainty regarding the impact of lateral oxygen ingress through the store-and-release cover system on the slopes of the HLF, and the potential for generation of stored acidity as a result of oxidation. Any oxidation from oxygen ingress is also anticipated to change with time and as near-surface material oxidizes.

The HLF pad is lined; however, based on the conceptual flow model and Okanes understanding of downstream receptors, if there is persistent seepage from drain down, seepage may daylight at the toe

of the HLF and be transported to either the Halfway Creek or Latte Creek watershed, and ultimately to Coffee Creek. The long-term seepage water quality is not well understood at this time; however, it is understood that this is currently part of ongoing studies.

Physical Conceptual Model

The following provides a conceptual model of the physical environment of the Coffee Mine HLF developed through a review of relevant documentation provided by Ensero and Newmont, as well as publicly available documentation related to the site. Relevant documents reviewed include:

- Hemmera, 2018. Draft Reclamation and Closure Plan, Coffee Gold Project. File No. 1658-003.01
- JDS Energy & Mining Inc. 2016. NI 43-101 Feasibility Study Technical Report for the Coffee Gold Project, Yukon Territory, Canada.
- Lorax Environmental Services. 2015. Climate Change Projections for Coffee Creek Region, Yukon
- Lorax Environmental Services. 2017a. Coffee Gold Baseline Hydrogeological Assessment.
- Lorax Environmental Services. 2017b. APPENDIX 12-D Geochemical Characterization Report.
- Lorax Environmental Services. 2019a. Coffee Mine Update Study, Water Balance and Water Quality Model.
- Lorax Environmental Services, 2019b. Coffee Gold Project: 2019 Hydro-meteorology Baseline Report.
- MacWilliam, Kathryn R. G, 2018. The Geology and Genesis of the Coffee Gold Deposit in West-Central Yukon, Canada: Implications for the Structural, Magmatic, and Metallogenic Evolution of the Dawson Range and Gold Exploration Models.
- The Mines Group Inc. (MINES). 2016. Feasibility Design Report for Coffee Gold Heap Leach Facility, Yukon Territory, Canada.
- Mines Group , 2019. YESAB Scenario Heap Leach Facility Configuration.
- SRK (Steffen Robertson & Kirsten). 2016. 2015 Geotechnical Field Investigation for Kaminak Coffee Gold Project.
- Tetra Tech. 2017. Fall 2017 Testpitting Program, Coffee Mine Site Phase 1: Proposed Infrastructure Footprings, Phase 2: Proposed Open Pit Areas.
- Tetra Tech. 2017. Thermal Evaluation of Duration of Thaw of Permafrost Soils at Coffee Mine Site Study Area Under Long-term Climate Conditions, Yukon, Canada.

Project Description

The Coffee Mine is a proposed project located in the White Gold district of west-central Yukon, approximately 130 km south of Dawson (Hemmera Envirochem Inc.; Hemmera, 2018) in Tr'ondëk Hwëch'in Traditional Territory. The Project consists of four open pits (Latte, Double Double, Supremo, and Kona), an HLF, and permanent and temporary waste rock storage facilities (See Figure 2). The HLF and

associated surface water management infrastructure are located at the southern limit of the site. The scope of the gap assessment and conceptual model (CM) is limited to the HLF at this time.

The mine is planned to be a truck-and-shovel, open pit operation with an anticipated Life of Mine (LOM) of approximately 12 years (Hemmera, 2018). This is anticipated to produce 5 million tonnes (Mt) of heap leach feed per year. The HLF will operate nine months a year, with run-of-mine material stockpiled during the winter months.

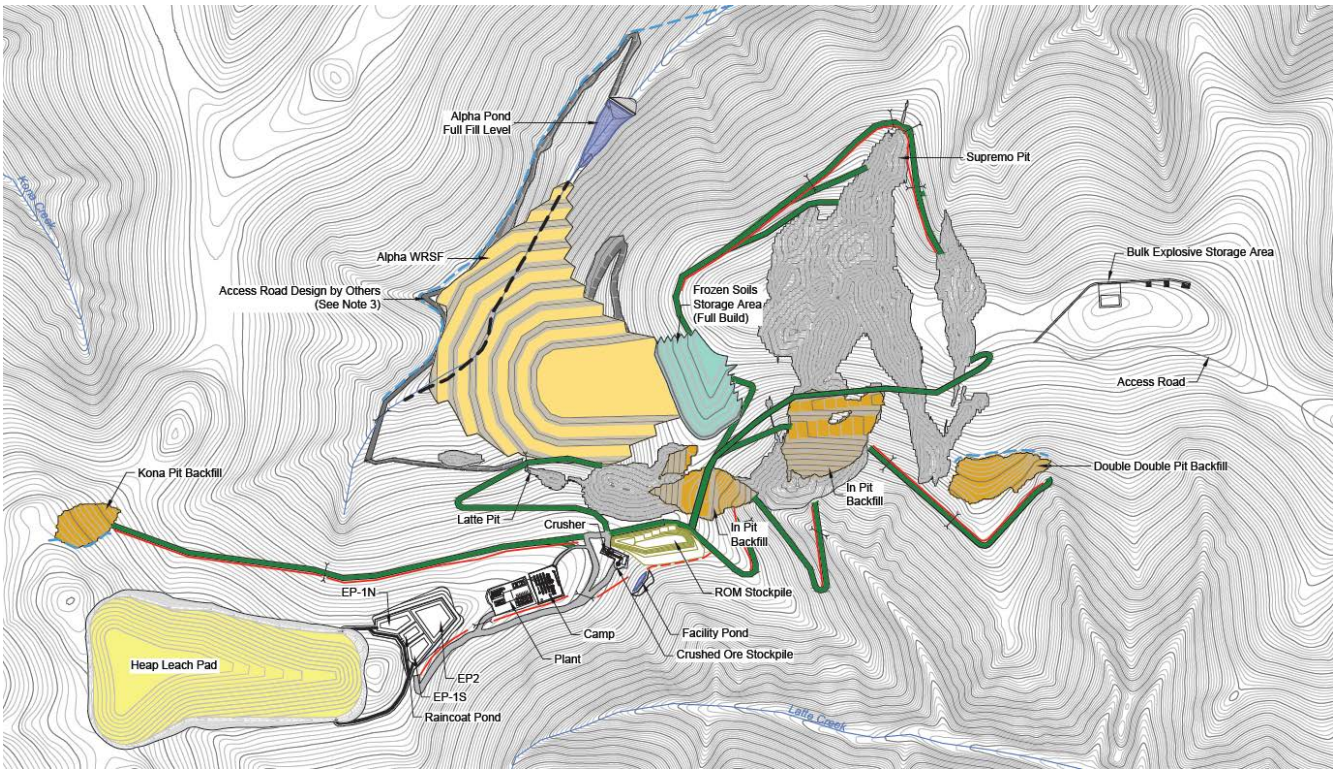


Figure 2: Mine site layout at the commencement of closure and reclamation activities in Year 13

Hemmera, 2018

Climate

A baseline meteorology study began in 2012 (Lorax, 2019b). Data from 2012 to 2014 was sourced from an automated weather station located adjacent to the mine access road between camp and the proposed HLF, at an elevation of 975 masl (Km 11 station). In 2018, another weather station including a full suite of climate sensors was added to the baseline program, located adjacent to the proposed HLF at an elevation of 1,340 masl (Kona station). In addition to the weather stations there are also two tipping bucket rain gauge stations and a comprehensive network of snow course stations.

The climate at Coffee Mine is characterized as subarctic continental (Dfc) under the Köppen-Geiger climate classification system where:

- D – 'continental' where average temperature of the coolest month is < -3°C, and average temperature of the warmest month is > 10°C;
- f – 'without a dry season' where precipitation is relatively evenly disturbed throughout the year; and
- c – 'cold summer' where one to three months average temperatures reach > 10°C but < 22°C.

Temperatures at the Km 11 climate station range from an average of -17°C in December to 14°C in July (Table 2) (Lorax, 2019b). Mean annual precipitation is estimated to be 499 mm at the elevation of the HLF (~1,300 masl) (Lorax, 2019b), with 56% falling as rain from May to September. Table 2 provides a summary of the average monthly conditions at the Km 11 climate station from the period July 2012 to September 2020. Figure 3 illustrates the relationship between monthly mean precipitation and air temperature at the Km 11 station.

Lorax (2019b) developed a 74-year synthetic climate database consisting of temperature and precipitation based on the Dawson A climate record. Monthly summaries of this dataset are provided in Table 3. The synthetic climate database was scaled to the elevation of the HLF (Lorax, 2019b). Elevations across the Coffee Mine property range from 400 to 1,500 masl (Hemmera, 2018).

Due to the elevation range, temperature inversion occurs locally during the winter months. Ridgetop temperatures can be up to 10°C warmer than valley bottom. The average inversion lapse rate (i.e., change in temperature with elevation) in the winter months (October to April) is 5.8°C/1,000 m. During the summer months (June through August), the temperature lapse rate is -3.3°C/1,000 m, i.e. cooler with increased elevation (Lorax, 2019b), consistent with expected changes in temperature due to elevation gain.

Table 2: Summary of the average climate parameters at the Km 11 climate station for the period July 2012 to September 2020.

Month	Mean Temperature (°C)	Mean Relative Humidity (%)	Daily Solar Radiation (W/m²)	Mean Wind Speed (m/s)	Mean Precipitation[1] (mm)	Mean Days with Precipitation	Mean Potential Evapotranspiration (mm)
January	-16.5	79	8	1.2	15.8	11.1	-
February	-15.0	76	34	2.1	8.9	7.8	-
March	-9.5	62	108	2.5	4.5	6.9	-
April	0.9	55	191	2.7	9.0	7.0	52
May	8.3	50	230	2.9	31.3	10.2	102
June	12.0	60	240	2.6	49.0	15.6	108
July	13.7	67	208	2.4	72.3	16.3	95
August	11.1	70	156	2.4	53.4	14.9	71
September	5.7	68	106	2.5	25.5	12.6	38
October	-3.2	80	42	2.1	21.3	10.1	11
November	-14.6	83	8	0.9	11.6	10.3	-
December	-17.2	80	3	1.0	11.1	12.3	-
Annual	-2.1	69	114	2.1	313.7	135.1	477

1 – Data gaps in 2018-2020 were infilled based on Kona climate station gauge data and winter gradient of 8%/100 m and summer gradient of 4%/100 m elevation gain between Kona (1,340 masl) and Km 11 (975 masl) climate stations.

Table 3: Summary of the average climate parameter in the 74-year synthetic climate database.

Month	Average Maximum Air Temperature (°C)	Average Minimum Air Temperature (°C)	Average Air Temperature (°C)	Average Monthly Precipitation (mm)
January	-9.4	-15.2	-12.3	29.1
February	-9.0	-14.4	-11.7	20.6
March	-5.5	-11.5	-8.5	17.0
April	4.4	-2.6	0.9	14.2
May	8.9	1.3	5.1	30.8
June	14.8	6.1	10.4	50.6
July	16.2	8.1	12.1	91.8
August	14.2	6.0	10.1	57.6
September	7.3	0.5	3.9	39.0
October	1.3	-3.4	-1.0	42.0
November	-10.8	-15.1	-12.9	36.6
December	-12.2	-17.7	-15.0	36.7
Annual	1.7	-4.8	-1.6	466.0

(Lorax, 2019b)

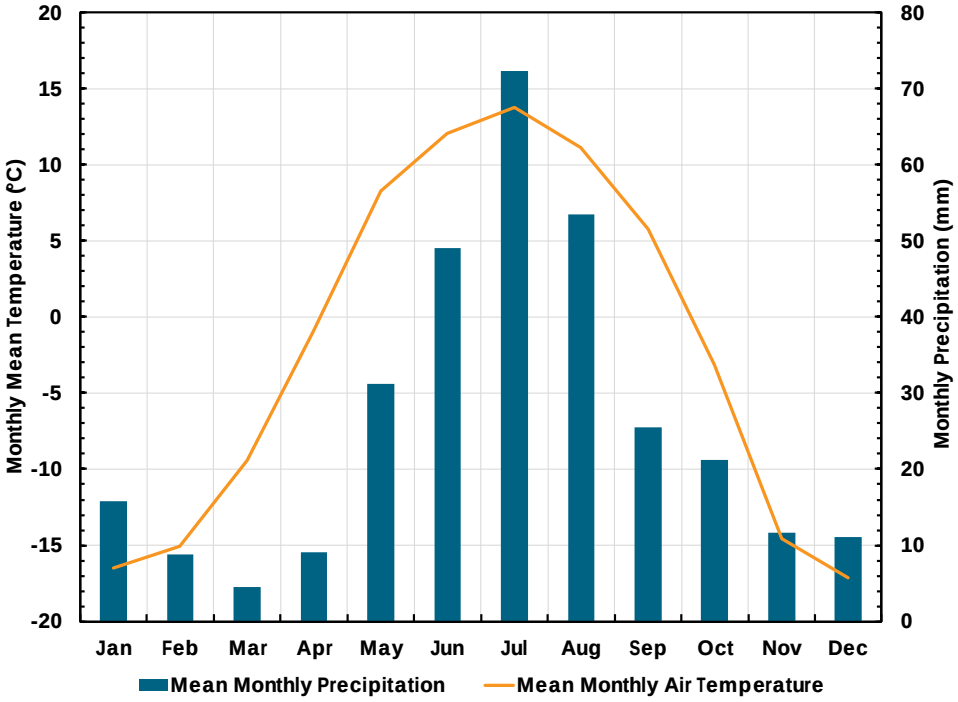


Figure 3: Monthly mean air temperature and precipitation from the km 11 climate station.

Precipitation is also impacted by the elevation change on site. Due to orthographic effects, the precipitation rate increases with elevation. During the summer months (May to September), rainfall increases by 4%/100 m of elevation gain, while during the winter months (October to April) snowfall increases by 8%/100 m of elevation gain (Lorax, 2019b).

The snowpack is estimated to reach a maximum snow-water equivalent (SWE) of 151 mm by April 1 in an average year (Hemmera, 2018). In an extremely dry year (1:200 return period), SWE is expected to be 71 mm, while a wet year (1:200 return period) is predicted to produce a SWE of 292 mm (Lorax, 2019b). Based on regional climate stations, snowmelt in the region has begun by April 15 and is complete by May 15 to June 1, as shown in Figure 4. Melt rate is estimated to be approximately 26 mm per day but may be as high as 40 to 50 mm per day.

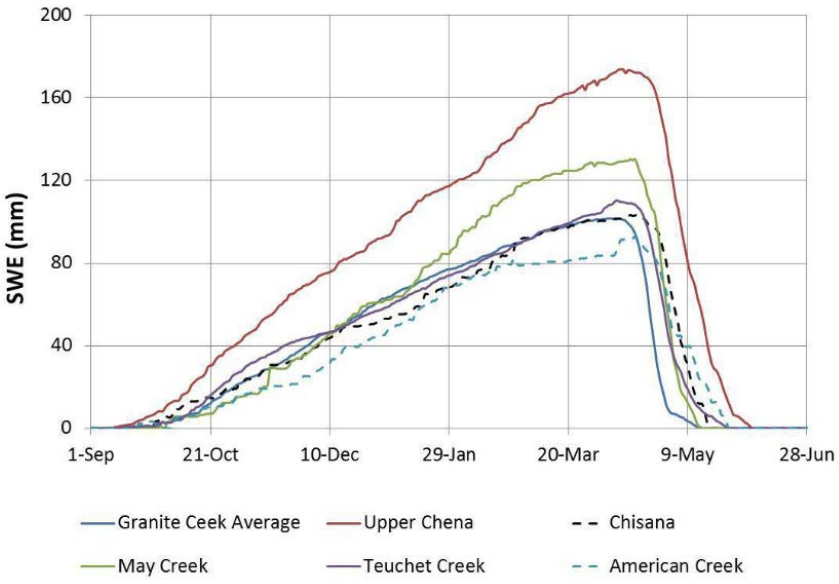


Figure 4: Average SWE data for Snow Pillow Stations nearest Coffee Creek.

(Hemmera, 2018)

Climate Change

Lorax (2015a) developed climate change projections for the Coffee Creek region under the A2 emission scenario of the Special Report on Emission Scenarios (IPCC, 2000) and updated the projections in 2019 (Lorax, 2019b) to include the RCP6.0 and RCP8.5 scenarios from IPCC's Fifth Assessment Report (AR5) (IPCC, 2013). The A2 scenario includes increasing population and regional economic development in independent and self-reliant nations. Lorax (2015b) chose the A2 scenario as the worst-case scenario as it represented the most rapid increase in emissions by 2100. This pathway has greater emissions than RCP6.0 and is similar to RCP8.5 of IPCC's AR5 (IPCC, 2013) and between SSP3-7.0 and SSP5-8.5 of IPCC's Sixth Assessment Report (AR6) (IPCC, 2021).

Under the A2 scenario, the temperature at the Coffee Mine site is expected to rise 3°C to 5°C by 2100. Summer is expected to see the largest in temperature, rising from an average June-July-August temperature of 11.3°C in the historical database to between 14.9°C and 16.5°C by 2100 (Lorax, 2015b). Under the RCP6.0 scenario, the average decadal temperature is expected to rise 3°C from the 2010-2019 average by 2099. A greater increase is expected under RCP8.5 with a decadal increase of 4.7°C by 2099 (Lorax, 2019b).

Precipitation is also expected to increase at the site, with average annual precipitation projected to be in the range of 477-525 mm/year by 2100 under the A2 scenario (Lorax, 2015b). Under the RCP6.0 scenario, the decadal annual average precipitation is expected to rise to 498 mm by 2099 relative to

2010-2019. A larger increase is expected with RCP8.5, with precipitation increasing to 560 mm (Lorax, 2019b). The region around the site is expected to see larger increases, up to a 20% increase, resulting in annual average precipitation in the range of 574-670 mm/year by the end of the century. Current trends in monthly precipitation distribution, with the majority of precipitation in May through September while March and April are dry months (see Figure 3), is expected to remain over the remainder of the century. The expected increase in precipitation will occur as increased summer and winter precipitation, with spring and fall precipitation remaining largely unchanged.

These changes are expected to have an impact of the permafrost underlying the site. Currently, approximately 62% of the site is underlain by discontinuous permafrost (~34% by ice-poor permafrost, ~27% by permafrost with visible excessive ice, and ~1% by ice-rich permafrost). This is consistent with the permafrost fraction expected based on the mean annual air temperature (MAAT), as shown in Figure 5. An increase of 3°C to 5°C by 2100 under the A2 scenario will reduce the permafrost fraction significantly, potentially thawing permafrost completely. Thermal analysis by Tetra Tech (2017) showed that under the A2 scenario, all permafrost soils on site will thaw by 2100. Under the no climate change scenario, Tetra Tech (2017) found that permafrost will not thaw, and the active layer remains at approximately 1.2 m.

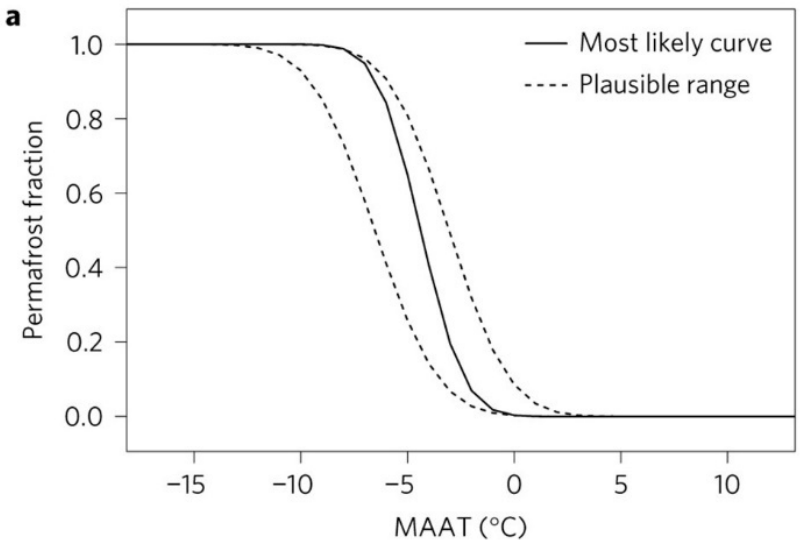


Figure 5: Likely and plausible range of permafrost fraction as a function of the mean annual air temperature (MAAT).

(Chadburn et al., 2017)

Geology and Hydrogeology

The Coffee mine site area lies within the portion of the Northern Dawson Range that did not undergo glaciation during the Pliocene to early Pleistocene epochs (3 million to 1.8 million years ago); however, glaciers were present within the Stewart River valley to the north and west, and to the east of the mine

(Hemmera, 2018). Topography is characterized by stream erosion resulting in gently rounded hills with tightly incised valleys. The HLF is located on top of a ridge in the headwaters of the Latte Creek and Halfway Creek watersheds (See Figure 2 and Figure 7).

The Coffee gold deposit is a mid-Cretaceous partially oxidized deposit of structurally controlled gold in which ore is hosted in second and third order faults and fractures that are genetically related to the Coffee Creek fault (Macwilliam, 2018). It is characterized by elevated As and Sb, +/- Ag, Bi, U,Hg, and Ba (JDS, 2016). Mineralization occurs within a series of steeply dipping brittle fractures that crosscut all lithologies in the project area. Dacite and andesite dykes subsequently intruded these fractures.

The Project is in an area of relatively low seismic activity in the St. Elias region where the Pacific plate is being subducted beneath the North American plate. The St. Elias region includes southwestern Yukon Territory, northwestern British Columbia, and southeastern Alaska. The Project is located between the Denali and Tintina fault systems to the northeast, where the rates of seismic activity decrease dramatically (Hemmera, 2018). Creek traces in the area are interpreted to be representative of permeable fault structures.

Surficial Geology

The surficial geology on-site consists of atypical loess deposits (i.e., aeolian silt) infills and silt mixing with weathered bedrock (Tetra Tech, 2017). The silt unit thickens towards the southwest side of the mountains and has been interpreted to originate from the Donjek, White, and Yukon River terraces.

Weathered bedrock underlying the silt consists of schist (weathering to micaceous sand) in the east and granitoid (weathering to gravel) in the west. Colluvium deposits containing air voids occurs on steeper slopes in the area and is likely to be coarse grained, whereas ice-rich re-sedimented loess and peat form colluvial aprons on lower slopes, and fluvial deposits occur in valleys. These deposits may be subject to gullying, cryoturbation (mixing of materials from various soil horizons due to freezing and thawing), solifluction (gradual mass wasting slope process related to freeze thaw activity), permafrost processes, periglacial processes (geomorphic processes from seasonal thawing in permafrost areas), landslides, and snow avalanches (Hemmera, 2018).

Peat occurs locally and in discontinuous lenses (Tetra Tech, 2017). In the western part of the Project, frost-jacked granitic boulders overlie peat forming a boulder layer that is especially prevalent underneath the HLF (Hemmera, 2018). Peat acts as an insulator, and in locations where peat is present, frozen ground/ice exists approximately 0-50 cm below the peat. Near the HLF, the depth to weathered bedrock ranges from 0.8 to 1.8 m below ground surface.

Soils on-site are predominantly cryosols (i.e., permafrost soils), and unfrozen soils are represented primarily by brunisols. Parent materials within the Project and along the Northern Access Route (NAR) are

predominantly colluvium. The dominance of colluvium may limit the quality of soils available for reclamation (Hemmera, 2018).

Bedrock Geology

The allochthonous, pericratonic Yukon-Tanana terrane (YTT) is one of the largest terranes that comprise the northern Cordillera and underlies much of central and western Yukon and eastern Alaska (Macwilliam, 2018). The Coffee creek granitic pluton intruded the metamorphic rocks of the YTT during the late Cretaceous and underlies the southwestern portion of the mine property (Figure 6).

Rocks of the YTT were metamorphosed during the Klondike Orogeny of the late Permian, and subsequently deformed, folded, and stacked along foliation parallel thrusts during the YTT-Laurentia Collision in the Jurassic period (Lorax, 2017; JDS, 2016). The metamorphosed package is predominantly composed of biotite (+ feldspar + quartz + muscovite ± carbonate) schist overlying an augen orthogneiss (Lorax, 2017). The mafic schist has been further subdivided into felsic-intermediate schist, biotite schist, amphibolite, and ultrafafic rocks which occur as rare lenses of amphibolite overlying amphibolite and metagabrro with arc-derived geochemical signatures within the schist. Slices of 20 m thick serpentinized ultramafic rock are also present (JDS, 2016). Both the Paleozoic metamorphic rocks and the Coffee creek pluton are crosscut by brittle fractures and normal faults associated with an extension event during the Cretaceous, which later became intruded by andesite and dacite dykes. Beneath the HLF, bedrock consists of significantly jointed/faulted weathered granite and can be “extremely weak” with variable rock quality with respect to fracture density.

Gold mineralization in the Coffee deposit is associated with polyphase brecciation and intense sulphidation of mica-rich host rocks by a CO_2-S-As-Sb-Au fluid resulting in gold bearing arsenian pyrite (JDS, 2016). Planar gold mineralized zones are dominated by east-west, north-south, and east northeast–west-southwest strike directions (Lorax, 2017). The Supremo zone is housed in several drill-tested T-structure gold corridors which are 5 to 30 m wide. The Latte zone consists of a stacked set of moderately-to-steeply south-southwest dipping brittle-ductile structures. The Double Double zone consists of several discrete, high-grade strands of mineralization up to several metres wide which trend east-northeast and dip steeply to the north. The Kona zone is hosted in equigranular granite and consists of east-northeast trending stacked structures steeply dipping towards the south. The gold structures are associated with narrow, less than 5 m wide, sparsely feldspar phenocrystic to aphanitic andesite to dacite dykes.

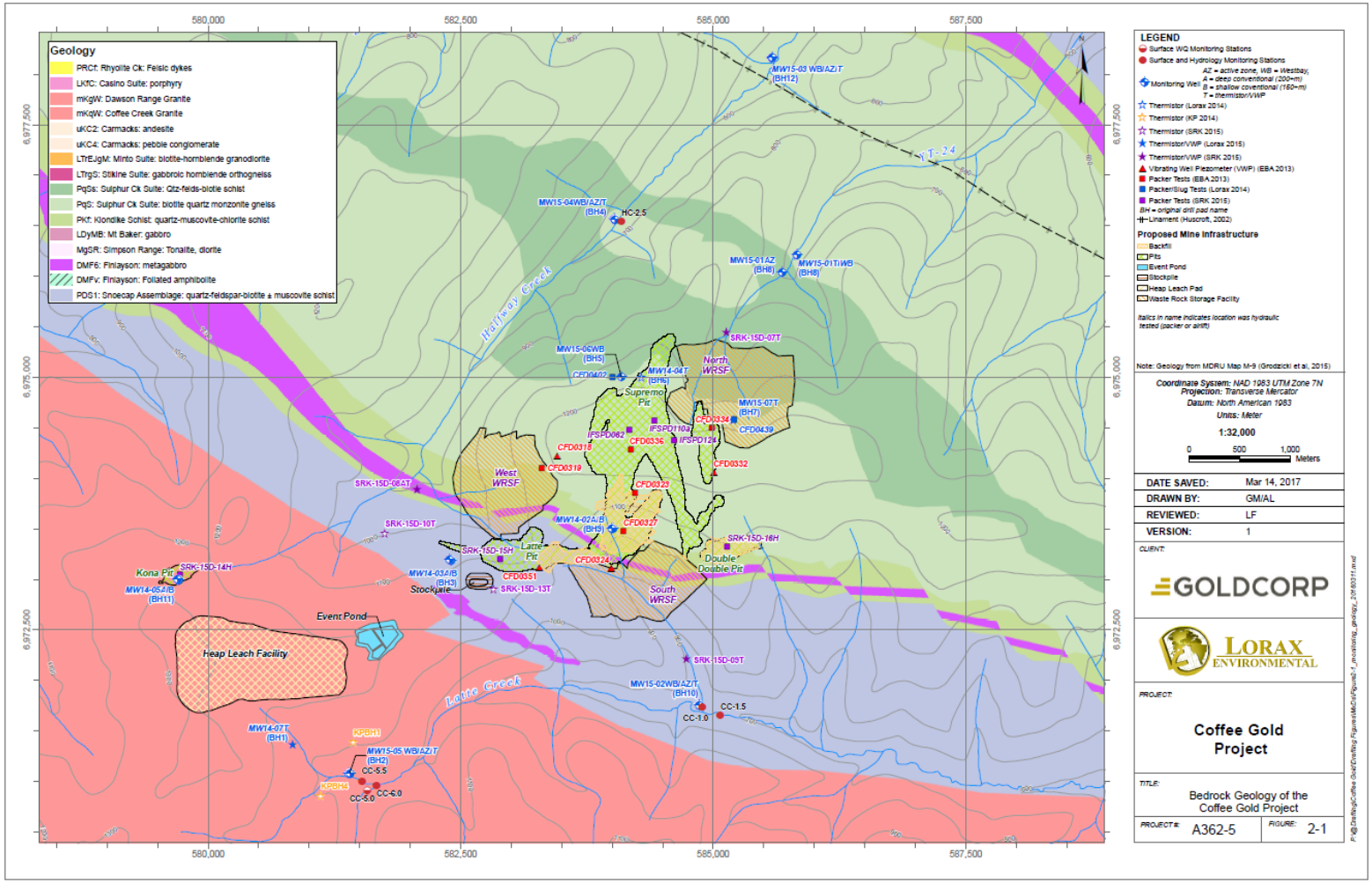


Figure 6: Bedrock Geology underlying the project area

Lorax, 2017

Hydrogeology

Sixteen stations on the property comprise a baseline hydrology network for the project (Lorax, 2019b). Regionally, there are several flow monitoring stations near the mine which have been used to calibrate on-site data. The hydrogeological framework in the project area is controlled by a combination of permafrost, fractures, and large-scale geologic structures, resulting in a complex groundwater system.

Permafrost

The Project area contains lenses of discontinuous permafrost (Hemmera, 2018). Frozen soils are predominately on the north- and west-facing slopes and in valleys; however, isolated areas may be present elsewhere. The discontinuous permafrost occurs along the ridge where the HLF will be constructed and is thickest on higher elevation north-facing slopes. Permafrost thicknesses range from approximately 30 m to 165 m.

Ground ice content (i.e., percent by volume) of the perennially frozen surficial materials is highly variable (Hemmera, 2018). Ice-poor permafrost is common in upland settings along ridges, and on moderately steep valley sides with convex or straight slopes. Ice-rich permafrost is more common in areas with higher organic accumulation and silt-rich sediments in fluvial valley bottoms. Approximately 34% of the Project is underlain by ice-poor permafrost, 27% is underlain by permafrost with visible excessive ice, and approximately 1% is underlain by ice-rich permafrost (Hemmera, 2018).

Permafrost-related processes active on-site include solifluction, active layer detachment, slope creep, frost heave, and thermal erosion. Permafrost temperatures since 2013 indicate the warmest permafrost temperatures (-0.6ºC) occur at the bottom of the Halfway Creek valley and the coldest permafrost temperatures (-2.0ºC) occur at the bottom of YT-24 Creek and on the north-facing slope of the upper Halfway Creek valley. Therefore, the permafrost classification for the site is “warm” and accordingly, the ground is sensitive to disturbance (Hemmera, 2018).

Surface Water

The property includes an area of partially tree-covered hills on the Yukon Plateau, incised by mature drainages that are part of the Yukon River watershed (Hemmera, 2018). Precipitation is the only significant source of water at the HLF since it is situated along a ridge at an elevation of approximately 1,300 masl between the Halfway and Latte Creek watersheds. Surface water is limited to several small watercourses that originate on the ridge and flow into the Yukon River. The four catchments near the Project include Latte Creek, Coffee Creek, Halfway Creek, and Yukon Tributary 24 (YT-24) (Figure 7).

Latte Creek drains the south face of the ridge where the HLF is situated and has a catchment area of approximately 70 km^2. Latte Creek flows eastward to its confluence with Coffee Creek, which has a total catchment area of approximately 487 km^2 and generally flows from south to north towards the Yukon River. The north face of the ridge is drained by YT-24, located on the eastern side of the site. YT-24 has a total catchment area of approximately 12 km^2. Halfway Creek drains the western side and has a total catchment area of approximately 27 km^2. Both YT-24 and Halfway Creek flow northeast to their confluences with the Yukon River.

Local patterns of streamflow are driven by snowmelt freshet that generally occurs late-April to mid-June and is punctuated by multiple rainfall-induced short term (1-2 days) high flow events throughout the summer and fall. Peak flows are driven primarily by rainfall events that are common in the summer months, with secondary peaks occurring in late-May due to melting snowpack.

In general, unit yields across the project site are as follows (Lorax, 2019b):

- Average 8 L/s/km^2 for the open water season (May to October).
    - Ranges from 3 to 13 L/s/km^2 depending on the drainage.
- The highest monthly yields occur in Upper Latte Creek and Halfway Creek during the open water season.
    - Two stations in the Upper Latte Creek drainage yielded the following, averaged over the open water season:
        - 10.8 and 13.3 L/s/km^2
    - One station in the Halfway Creek drainage averaged over the open water season:
        - 9.6 L/s/km^2

Baseflows are enhanced by active layer melt and soil moisture recharge (Lorax, 2019b). Unit yields begin decreasing steadily in October until they reach no-flow conditions in March. Mean annual runoff varies across the property but a correlation with elevation has been found to be an average of 7% increase per 100m gain in elevation. Annual runoff recurrence interval analysis indicated that an extreme wet year would be expected to produce ten times more runoff than an extreme dry year.

Extensive icing of local channels is a significant component of the winter flow regime, known as aufeis, which results from shallow groundwater discharge and/or baseflow freezing. Subsequent flow is forced on top of the existing frozen layer where it also freezes, and this order of events repeats continuously throughout the winter resulting in laminated ice sheets measured up to 1.5 m in thickness and >50 m in width. In sub-arctic watersheds, the aufeis process acts as a storage reservoir for winter baseline flow and can store up to a third of the cumulative annual baseflow

as ice. The presence of aufeis poses significant challenges to obtaining accurate streamflow measurements during the winter months and during the initiation of freshet as well as impacts the distribution of annual streamflow due to the storage of winter baseflow which is released during freshet.

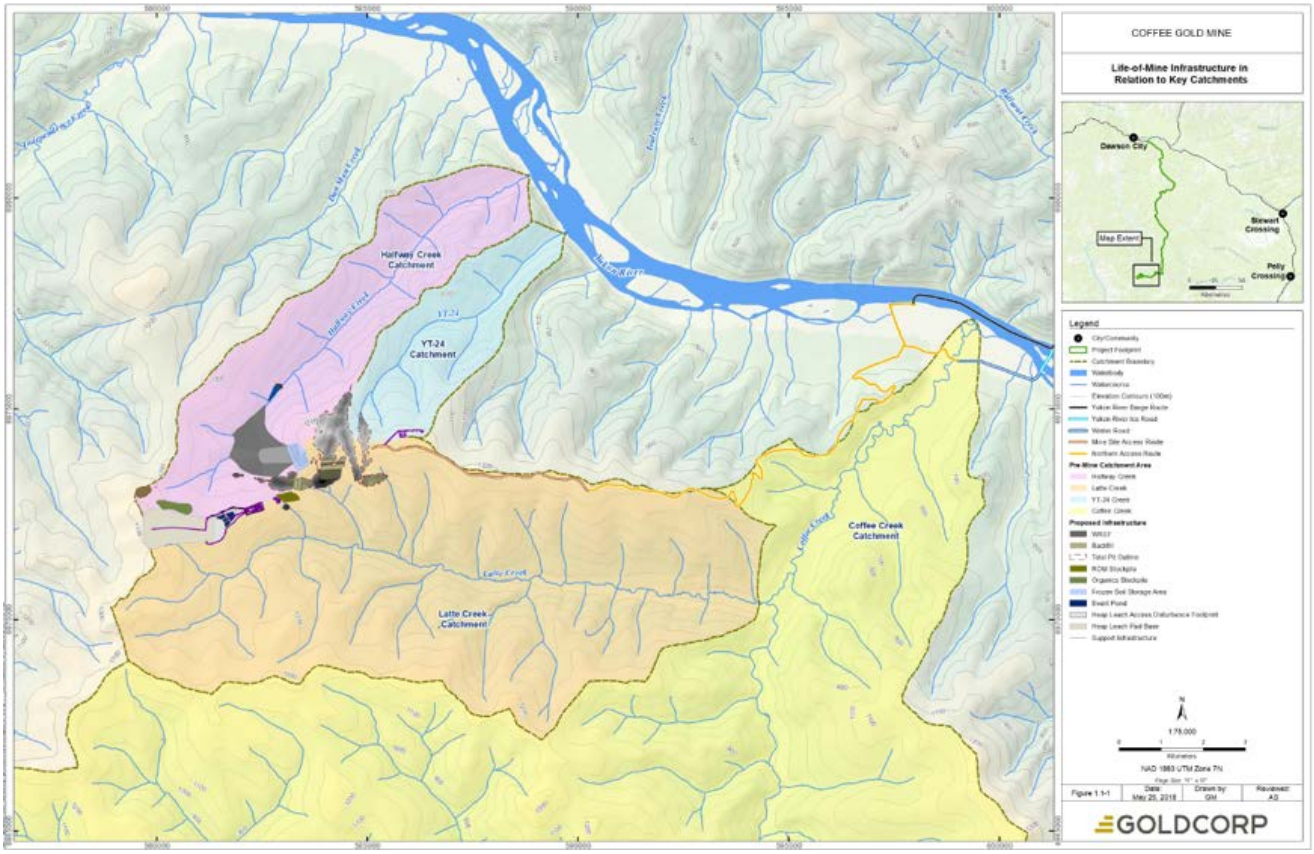


Figure 7: Watersheds in and near the project area

Hemmera, 2018

Groundwater

Physical hydrogeology systems at the site are influenced by discontinuous permafrost acting as an aquitard or aquiclude, a well-developed fracture system in bedrock, and large-scale cross-cutting geologic structures (Hemmera, 2018).

The groundwater monitoring network on-site includes 7 Westbays, 11 conventional monitoring wells, 4 stand-alone vibrating wire piezometers (VWPs) and 17 deep (>20 m) thermistor strings, mostly combined with VWPs (Figure 8). The installations span elevations of ~560 masl to ~1,250 masl on multiple slope aspects (Hemmera, 2018).

Hydraulic testing of bedrock yielded hydraulic conductivity (K) estimates that are typical of a fractured bedrock system (Hemmera, 2018). Values ranged over several orders of magnitude (<1E-10 m/s to >1E-06 m/s), independent of lithology, indicating that structural features that

crosscut all lithologies control groundwater flow. The average K value from tests located near creek traces (along permeable fault structures) is 1E-06m/s. The arithmetic mean of all valley and pit structure K tests is 9E-07 m/s (Lorax, 2017).

In general, groundwater levels in ridge areas range from 130 to > 220 m below the ground surface, with artesian conditions encountered along the drainages. Groundwater levels in the project area are insensitive to individual rainfall events and instead respond to more regional scale seasonal fluctuations that peak anywhere between late summer and winter. The timing of peak groundwater levels is highly variable across the site.

Vertical hydraulic gradients are also variable across the site, influenced by the presence/absence of permafrost, and fractures. In areas where permafrost is present and depth is accurately known, confining conditions have been encountered, except for the slope draining the SU3W pit where the water table occurs at least 50 meters below the base of permafrost, and the slope draining the Kona Pit where the water table occurs approximately 20 m below the base of permafrost.

Groundwater flow generally follows topography, discharging along permeable fault structures (creek traces) as evidenced by seepage at surface and artesian conditions in piezometers located along the drainages. In the reaches of Halfway Creek, discharge of deeper sub-permafrost groundwater to surface has been observed and could occur in other areas where a talik is present.

Baseflow is often overwhelmed by surface runoff and active layer flow during the open water season. Minimum baseflow measured in late winter is considered equivalent to groundwater discharge and ranges from 0.0 to 0.7 L/s/km^2 (Lorax, 2019b). As the baseflow component of streamflow increases, concentrations of some parameters including uranium, calcium, magnesium, and strontium are observed to increase in surface water.

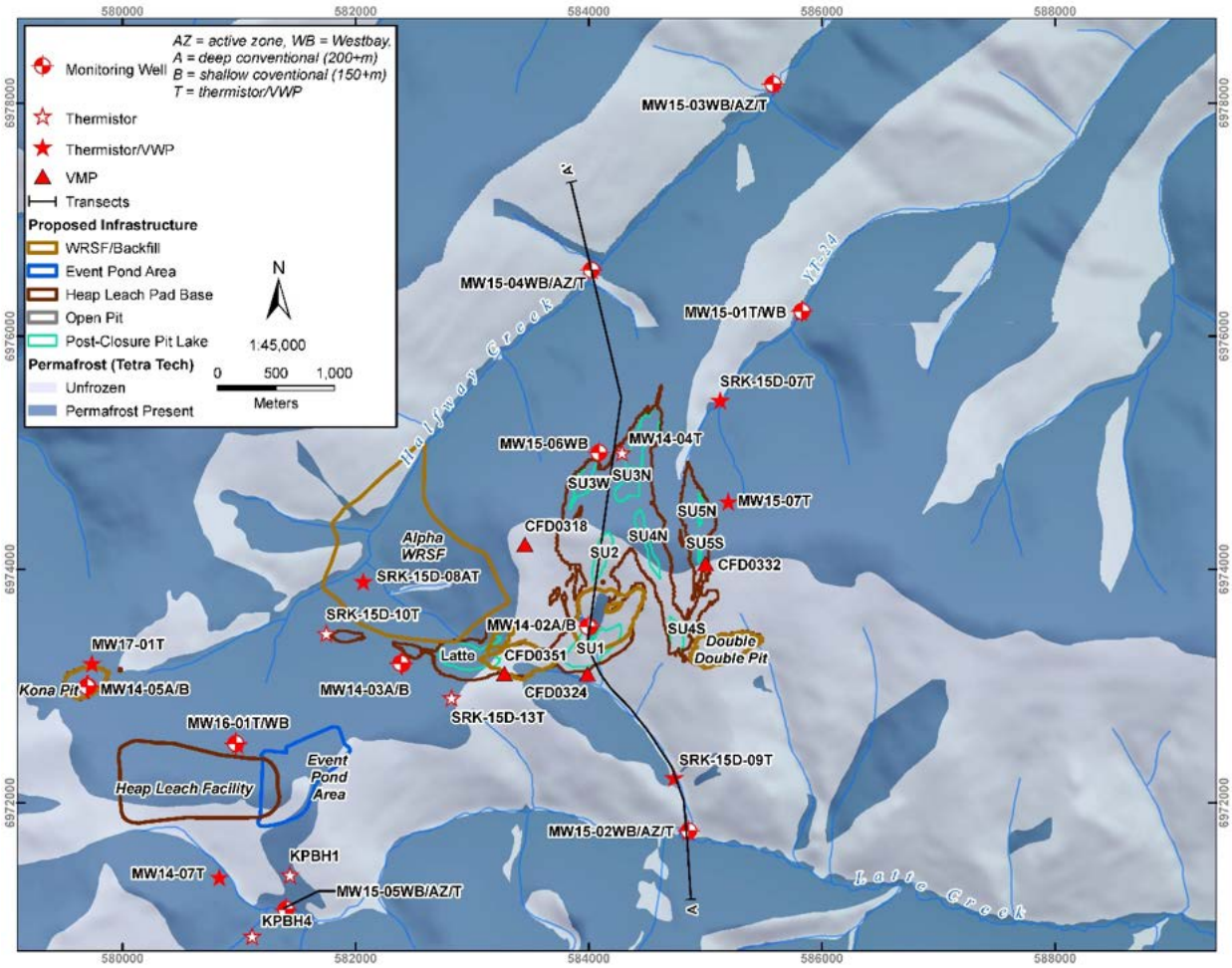


Figure 8: Locations of monitoring wells and permafrost conditions

Hemmera, 2018

Geochemistry

Assessment of the closure plan for the HLF requires geochemical and mineralogical characterization of the materials involved in the HLF. Geochemical characterization can inform the potential evolution of both leachate and solids used over the LOM. Geochemical characterization includes both static and kinetic analyses to determine the leachability of metals, acid production potential and the evolution of both water quality and solids chemistry over time. Static analyses include tests such as acid base accounting, whole rock analysis and mineralogy. Kinetic analyses can involve humidity cell tests, column experiments, kinetic field bins, or field trials where the temporal evolution of water quality can be evaluated.

Gold mineralization in the host rock is characterized as “invisible gold” and is hosted in disseminated sulfides, primarily pyrite. The deposit has been described as an orogenic gold deposit and exhibits a strong Au-As-Sb metal association. The gold is primarily found in auriferous

pyrite, arsenian pyrite and arsenopyrite (MacWilliam 2018). Exposure of sulfides during ore crushing and processing can cause oxidation that may lead to metal release and acid rock drainage (ARD) (MEND, 2009).

A review of the provided documentation for the HLF indicates that extensive work has been done to characterize the geochemistry of the HLF. The RCP (Hemmera, 2018) identified the primary potential constituents of concern (COCs) as NO_3, As, and U as well as cyanide (CN), Cd, Cu, Hg and Sb at various stages of the rinsing and reclamation cycle.

Kinetic Analyses

Starting in 2014 and 2015, Lorax initiated 17 unsaturated column tests, and 10 saturated column tests in 2017. Four of the unsaturated column tests were terminated in 2017 while all the saturated were terminated in 2019 (Lorax 2019a; Lorax 2017b). Eight humidity cells tests were run for 18 months on different types of waste rock. There are eleven ongoing kinetic field bins set up in 2014 and 2015 for both leach tailings and different waste rock lithologies (Lorax 2019a). As of 2019 only the results for the saturated have been made available. A column study of ore with cyanide leach solution was carried out to determine solution chemistry prior to rinsing (Hemmera, 2018).

Results from the first two years of the column tests indicate that pH for waste rock and ore was typically circumneutral with slightly decreasing alkalinity over the same period (Lorax 2017b). Metal leaching results indicate that As loading rates from granite columns were particularly high, while gneiss samples contributed consistently higher U loads than other samples.

The key results from the saturated column study were that metal leaching declined with time, with saturated columns producing generally lower concentrations than unsaturated columns (Lorax 2019a). An exception to this is As which produced higher loads in saturated columns and increased in the initial phases of the experiment. Arsenic mobilization is associated with PO_4 concentrations, and it was found that As concentrations could be decreased by lowering apatite solubility.

Field kinetic analyses results had one or more sample with Al, Sb, Cr, Cu, Fe, Hg, Ni, U, NH_3-N, NO_2-N, and the radioisotope ^{226}Ra all exceed MMER (Metal Mining Effluent Regulations) or 10x CCME (Canadian Council of Ministers of the Environment) guidelines. These results are considered preliminary as less than five pore volumes had passed through the bins at the time of the report (Lorax 2017b).

Geotechnical

Heap Leach Pad Foundation Material

Geotechnical laboratory testing was completed on samples collected during site investigations, including sonic drilling and test pit programs, completed for the HLF by SRK (2016). Laboratory testing results include specific gravity, moisture content, particle size distribution (PSD), Atterberg limits, compaction testing, and direct shear. Sampling depths ranged from approximate 1 to 10 m for the sonic drilling and test pits were excavated to a maximum depth of 2.2 m.

The specific gravity of the leach pad material (SRK-15S-20) was 2.63, which characterized it as silt and sand. PSDs were completed on the sonic drilling and test pit samples, which are presented in Figure 9. Fines content (silt and clays) ranged from 10 to 50% for the samples while the sand content predominantly ranged from 30 to 50%. Soil plasticity of the heap leach pad material ranged from non-plastic to low plastic, with plasticity indexes ranging from 0 to 6.

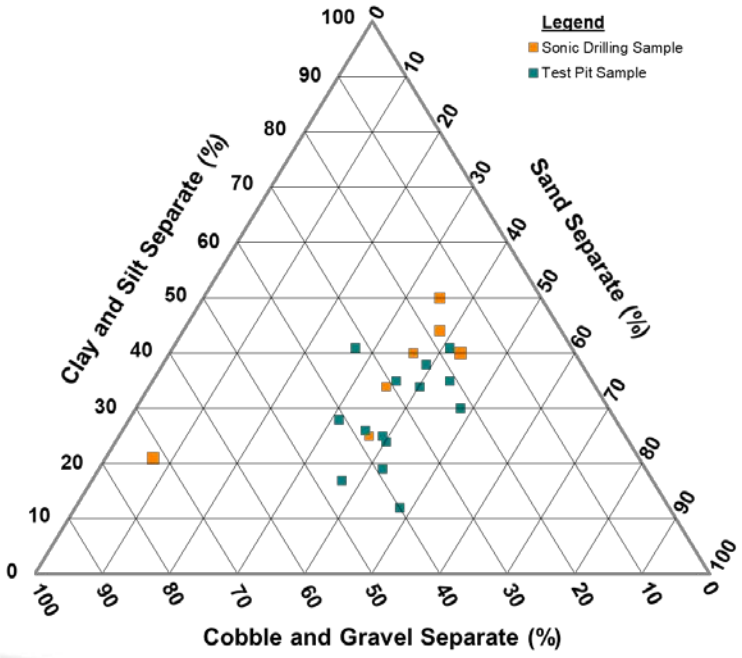


Figure 9: Texture triangle for heap leach pad samples

Data from Table 4-2 in MINES (2016)

Compaction testing (standard proctor) was completed on three material samples (SRK-15TP-04, SRK-15TP-09, and SRK-15TP-34). Optimum moisture contents and maximum dry density for these materials are summarized in Table 4.

Table 4: Heap leach pad sample compaction testing

Sample ID	Sample Depth (m)	Corrected Maximum Dry Density (kg/m³)	Corrected Optimum Moisture Content (%)
SRK-15TP-04	1	2,007	10
SRK-15TP-09	1	2,094	10
SRK-15TP-34	1	1,885	11

Modification of Table 4-4 in MINES (2016)

Direct shear testing was completed on two samples; an intact sample (SRK-15S-13A) and a remolded sample (SRK-15TP-17) (Table 5).

Table 5: Heap leach pad sample direct shear testing

Sample ID	Sample Depth (m)	Moisture Content (%)	Wet Density (kg/m3)	Coh. (kPa)	Friction Angle (deg)
SRK-15S-13A	0.9	16.2	1,686	12	35
SRK-15TP-17	0.4	9.6	2,172	77	42

Modification of Table 4-5 in MINES (2016)

Ore Residue Material

Ore residue material consists of ore material after it has been leached. Testing was completed on leached ore residue materials from column testing completed on different pits and crush sizes by Geo-Logic Associates (GLC) of Grass Valley, California. Geotechnical testing includes specific gravity, moisture content, PSD, Atterberg limits, compaction testing, direct shear, triaxial shear, and hydraulic conductivity.

Specific gravity for the ore residues ranged from 2.69 to 2.75 in which materials were poorly graded gravel with sands, silts, and clay. Ore residues were primarily composed of gravel-sized particles ranging from 60 to 96% (Figure 10). Plasticity indices for these samples ranged from 6 to 16.

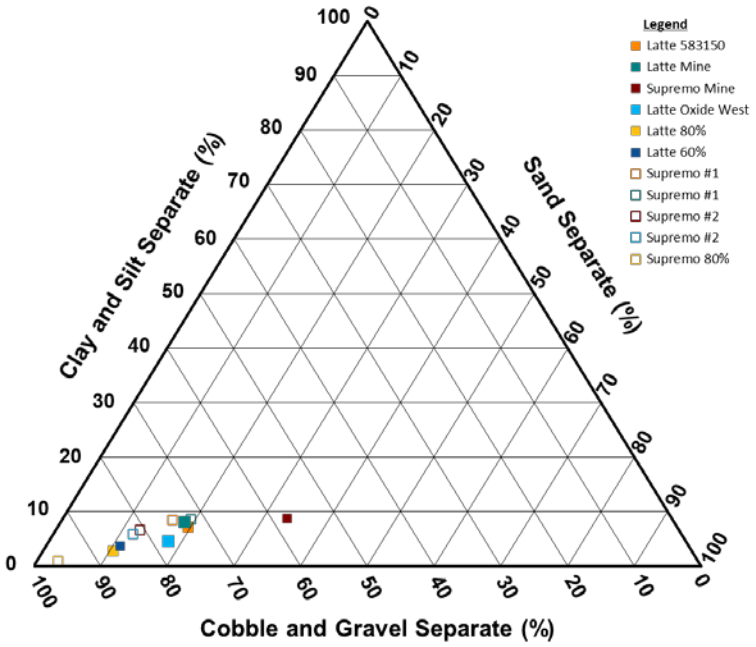


Figure 10: Texture triangle for ore residues

Data from Table 4-2 in MINES (2016)

Compaction testing (standard proctor) was completed on nine ore residue samples. Optimum moisture contents and maximum dry density for these materials are summarized in Table 6.

Table 6: Heap leach pad sample compaction testing

Sample ID	Corrected Maximum Dry Density (kg/m³)	Corrected Optimum Moisture Content (%)
Latte 583150	2,318	6
Latte 583350	2,372	5
Latte Mine	1,887	8
Supremo Mine	1,988	11
Latte Oxide West	2,283	4
Latte 80%	2,497	3
Latte 60%	2,332	3
Supremo #1	2,347	4
Supremo #1	2,400	4

Modification of Table 4-4 in MINES (2016)

Triaxial shear testing was completed on three ore residue samples (Table 7) and hydraulic conductivity testing was completed on four ore residue samples (Table 8).

Table 7: Ore residue sample triaxial shear testing

Sample ID	Confining Stress (kPa)	Dev. Stress (kPa)	Pore Pressure (kPa)	Effective Stress (kPa)	Total Stress (kPa)	Final Moisture Content (%)
Latte 583150	95.8	200.6	55.2	C = 6.89 Ø = 40.2°	C = 27.6 Ø = 22.3°	11.9
	239.2	390.2	135.1			
	487.5	672.2	311.6			
Latte Oxide West	95.8	121.3	57.2	C = 0 Ø = 40.6°	C = 6.9 Ø = 20°	12.5
	239.2	273.7	158.6			
	487.5	513.7	350.3			
Supremo #1	95.8	124.1	68.9	C = 0 Ø = 40.9°	C = 13.8 Ø = 18.9°	13.7
	239.2	254.4	160.6			
	487.5	490.2	360.6			

Modification of Table 4-6 in MINES (2016)

Table 8: Ore residue sample hydraulic conductivity testing

Sample ID	Normal Stress (kPa)	Moisture Content (%)	Dry density (tonnes/m3)	Hydraulic Conductivity (cm/s)
Latte 583150	Initial	2.1	1.56	
	241		1.58	4.8E-01
	248		1.65	4.10E-01
	965		1.53	3.6E-01
	(Drained)	7.6	1.59	
Latte Oxide West	Initial	1.9	1.52	
	241		1.52	4.9E-01
	248		1.53	4.8E-01
	965		1.53	4.5E-01
	(Drained)	6.9	1.53	
Supremo #1	Initial	0.8	1.65	
	241		1.86	7.0E-02
	248		1.94	6.2E-02
	965		2.04	3.5E-02
	(Drained)	11.9		
Supremo #2	Initial	1.9	1.53	
	241		1.69	6.5E-01
	248		1.76	6.7E-01
	965		1.82	6.9E-01
	(Drained)	9	1.82	

Modification of Table 4-7 in MINES (2016)

Heap Leach Pad Liner

The heap leach pad area will be lined with two layers of geosynthetics in a composite manner, consisting of a 2 mm single side textured linear low-density polyethylene (LLDPE) geomembrane overlying a 6 mm heavily reinforced GCL. Material overlying the liner will be 500 mm thick and consist of crushed ore screeded to a P_{100} of 38 mm.

Leakage through the geomembrane is expected to occur through damage of the geomembrane rather than inherent permeability. The GCL permeability is expected to be less than 5×10^{-9} cm/s without loading and decrease to less than 1×10^{-10} cm/s under the ultimate load of the heap (MINES, 2016).

Stability

The heap leach pad will be constructed on moderate sloping natural topography. Surficial soils are relatively shallow, with a topsoil layer of approximately 0.3 m and ice-rich materials extending to a depth of approximately 2 m. Underlying weathered granite bedrock transitions to competent bedrock quickly with outcrops on the eastern and western perimeter of the heap leach pad. All surficial topsoil and permafrost material will be removed from the base of the heap leach pad. Stability berms are planned to be constructed in the perimeter toe area to enhance stability of the HLF.

Minimum factors of safety (FOS) where developed based on the design criteria of the feasibility design based on industry standard practice. The static FOS for short-term or temporary slopes are 1.3 and for long-term or permanent slopes are 1.5. Seismic pseudo-static FOS are 1.1.

A slope stability analysis for the heap leach pad was completed by MINES (2016). Limit equilibrium method of slices for block and circular failure modes was used to determine FOS for four slope sections of the HLF. Both Spencer and Morgenstern Price methodology were used however the Morgenstern Price method indicated lower FOS in almost all cases analyzed. The block failure mode was found to be the most critical mode of failure for both static and pseudo-static analyses for the heap leach pad and ore heap. Acceptable FOSs were indicated for both circular and block failure modes for all other sections analyzed.

It should be noted that no formal settlement analyses have been completed for the HLF; however, it is assumed that the settlement on bedrock areas will be minimal and should pose no risk for damaging the liner system (MINES, 2016).

Water Management

Water management for the HLF area includes surface water collection ponds, surface water collection channels, solution distribution piping, and collection piping.

Surface Water Management

Four ponds are to be constructed in the HLF area, two event ponds (EP-1N and EP-1S) are to be constructed as part of the initial, pre-production construction; a rainwater pond for clean water to be constructed in Year 3 of operation; and a third event pond (EP-2) to be constructed in Year 8 (MINES, 2016). The ponds will be located on the east end of Stage 1 between the HLF and the processing plant.

Pond sizes were determined by modelling the seasonal and multi-year water balance of the HLF (MINES, 2016), which are summarized in Table 9. Ponds are all sized to contain the flood resulting from the probable maximum precipitation which is an event larger than a 1 in 1,000-yr flood. Event and rainwater ponds will have a disturbance area of 8.3 ha at End of Mine Life (Hemmera, 2018).

Table 9: HLF Pond Capacities

Pond	Pond Capacity at Freeboard (m^3)	Pond Capacity at Crest (m^3)
EP-1N	112,300	122,200
EP-1S	89,800	97,800
EP-2	222,900	240,500
Rainwater	47,000	51,900

Modification of Table 2.7 in Goldcorp Kamanik (2019)

The HLF is designed to divide into two separate drainages, which requires the need for north and south solution collection ditches. Water will be conveyed from the HLF to the event ponds via the north and south event and rainwater channels. These channels are designed to convey a 1 in 200-year storm event.

The north and south runoff channels were designed based on anticipated flow rates for contact water. Runoff for the HLF was estimated to be 79 mm for a 100-yr, 24-hour event at an elevation of 1,300 m. Contact runoff volumes were estimated using the worst-case scenario of the entire HLF area (819,050 m^2 or 409,525 m^2 for the north and south sides). The ore material was assigned a runoff coefficient, CN = 75. Results indicated a peak flow rate of 1.764 m^3/s to be used for the contact runoff channel designs.

The rainwater runoff channel was designed in a similar manner as the north and south runoff channels; however, this channel conveys non-contact water to the rainwater pond. Approximately 90% of the HLF will be covered by raincoats by the End of Mine Life, which is approximately 37.9 ha for both the north and south sides. A runoff coefficient CN=99 was used for the area with 10% cover material (4.1 ha) and CN=95 was used for the area with 80% reclaimed. Results indicated a peak flow rate of 6.437 m^3/s to be used for the non-contact runoff channel design.

Surface Water Balance

Lorax completed a site-wide surface water balance update (Lorax, 2019a), which integrated the MINES (2019) models specifically for the HLF. The updated surface water balance includes a higher solution application rate for the HLF, owing to a higher ore stacking rate relative to the previously completed water balance. Makeup water for the increased solution application rate will reportedly be drawn from extraction wells with a capacity of 3,500 m^3/day (Lorax, 2019a). This update moves the timeline for active water treatment from Year 9 to Year 6.

The volume of water requiring treatment and release from the HLF is one of the main parameters of interest in the site-wide surface water balance (Lorax, 2019a). As a result of the increased solution application rates, not only was the timeline for water treatment accelerated, but the maximum required treatment rate increased to 10 L/s in Years 6 – 8 and 20 L/s thereafter, relative to the 7 L/s constant rate identified in the MINES (2019) model.

Water Quality

Runoff from the HLF contributes to the overall site wide water quality and may impact loadings of COCs into the receiving environment. The current base case proposes releasing treated water from the event ponds into the Halfway Creek. During operation, processing of the ore will involve effluent laden with CN, As, U, and other metal(loid)s, which will be collected, processed, and recirculated. The gold extraction circuit is considered a closed circuit and all solution will pass through the processing plant (YESAB, 2021).

A baseline water quality investigation by Lorax (2017) shows that background water quality from a monitoring well downstream of the proposed HLF is a Ca-HCO_3 water type pH ranging from 6.6 to 7.96 and low conductivity. Major Ions were typically low, primarily Ca (~50 mg/L) and total alkalinity (~160 mg/L). The water quality at this location was classified as anoxic with mildly reducing conditions.

After the gold extraction in a heap leach cell is completed, the heap will be rinsed with circumneutral barren solution to volatilize the cyanide and lower the pH, continuing until leach effluent matches rinse solution pH. This solution is expected to have total suspended solids (TSS), CN, As, Cu, and Zn at or exceeding the MMER limits. Other elevated constituents include U, Cd, Hg, and Sb (Hemmera, 2018). The second step (Phase II) of rinsing is to reduce heap leach contaminants to levels acceptable for discharge. This is to be achieved by using treated process water from the electro-biochemical reactor (EBR) and rainwater collected to rinse the heap of contaminants. The treated water is expected to inoculate the heap with microbes and nutrients from the EBR to promote in-situ contaminant reduction (Hemmera, 2018; Lorax, 2016). The effluent from this rinsing is to be used in the Phase I rinsing of younger heap cells (Hemmera, 2018).

The RCP indicates that the planned final water quality is to be of sufficient quality for release to Halfway Creek or the Alpha pond which overflows into the Halfway Creek drainage (RCP, 2017). However, a permeable reactive barrier (PRB) may be used for final polishing of effluent if this isn't achieved through *in-situ* stabilization and the EBR water treatment facility (Hemmera, 2018). The PRB will be set up in either one or two of the former catchment ponds and loaded with materials suitable to filter out remaining contaminants. As progressive reclamation occurs, it is unclear what impact to water quality the decreased percolation will have and what impact the cover system will have.

Water Quality Model

As part of the site wide water balance model, Lorax completed a water quality model (WQM) for the Coffee Mine site (Lorax 2019a). This most recent model was updated to include the LOM plan from preconstruction through to post closure phase. As the model is site wide, results for the model were calculated at the three model nodes near the final discharge sites from the mine. This model treats the HLF as a source term for the development of the WQM.

The source terms for major ions and constituents of concern at the HLF are calculated based on timing during the LOM. This includes processes such as ore placement, leaching and progressive reclamation during operations and placement of the GCL and 0.5m of waste rock cover during closure. The source terms for major ions and COCs were scaled up from kinetic experiments conducted by Lorax of the ore material for leaching and weathering tests and on waste rock for weathering. Closure water quality was scaled up from results of pilot scale water treatment tests, such as EBR tests carried out by Lorax (2016), and from back-calculations of target water quality at the Halfway Creek to get the maximum allowable concentrations in the treated effluent.

Conceptual Closure Plan

Progressive closure of the HLF is anticipated to begin in Year 4 when cells that have been stacked to the ultimate design elevations can begin to be rinsed (See Water Quality). Two phases of rinsing are proposed to volatilize remnant cyanide and reduce contaminant levels, respectively.

The revegetation strategy is planned to be developed based on site-specific testing completed during the Operational Phase as part of progressive reclamation.

HLF Event Pond Closure

Two to three of the HLF event ponds will be incorporated into the PRB if deemed feasible and necessary. The remaining pond(s) will be used for the duration of the water treatment period

(i.e., Year 15 to Year 20), at which point the liner will be folded over any remaining sludge and the sludge will be encapsulated with suitable material.

Monitoring

Geotechnical monitoring is to be completed annually until the completion of closure, at which point the monitoring program will end (JDS, 2016).

Water quality monitoring will occur at designated control points at the frequency specified in the water license. Following closure, water quality monitoring will be systematically scaled back, ending when there are five years of data confirming the final closure objectives have been met (JDS, 2016). It is not clear from the available documentation what the closure objectives are.

PRBs & EBRs

The use of the EBR as a water treatment plant identifies the EBR as removing NO_3 and fixing soluble metals in bench scale tests (Lorax, 2016; Hemmera, 2018). It is anticipated that the EBR will continue in operation up to year 20 of the LOM and will treat Phase II solution to remove contaminants through reduction and precipitation as well as inoculate the heap itself until water quality of effluent has improved enough to discharge. The treated water from the EBR is expected to carry microbes and nutrients into the heap that will further assist in reducing contaminant load (Hemmera, 2018; Lorax, 2016). The current closure plan for the water treatment plant involves sealing the sludge containing precipitated metals in the liner of the former heap leach pond and burying it. The current assumption from the RCP is that there will be “small volumes of sludge” from the water treatment plant (Hemmera, 2018).

If the EBR water treatment plant is unable to achieve discharge water quality, a final polishing water treatment is proposed to occur in a PRB set up in up to two of the former event ponds in the HLF with flow directed through it. Pilot scale test of different PRBs materials and designs have not yet been carried out (Hemmera, 2018).

Reclamation Materials

Multiple test pitting and geotechnical investigations were carried out to determine volumes and available materials (JDS Energy & Mining; JDS, 2018; SRK 2016; Tetratech, 2015; 2017a; 2017b; 2017c; 2018; 2019) at sites across the Coffee mine including the proposed HLF. A more detailed investigation was carried out in 2017 that included eight boreholes on the HLF site (Tetratech, 2017). JDS (2018) compiled the results of the 2017 test pitting programs and generated available material volumes and expected surface material requirements for reclamation (Table 10).

Material Balances

JDS (2018) compiled the results of the 2017 test pitting programs and generated available material volumes and expected surface material requirements for reclamation (Table 10). Overburden was defined as four layers: organics, upper silt, lower gravel, and weathered bedrock. Topsoil in the report was defined as the top two layers of material: organics and upper silt, and the upper 200 mm of the lower gravel that will be removed for use in reclamation. It was assumed that the remaining overburden not classified as topsoil is unsuitable as reclamation material and would be placed in the Alpha WRSF (JDS, 2018). It was assumed that cover placement is 300mm thick during reclamation for assessing required volumes. It is noted that organics will be stored separately and used only as a final cover on closed structures, including the HLF (JDS, 2018).

Table 10: Summary of volumes required and available for both HLF and the total Site

Location	Average Overburden Thickness (m)	Total Overburden volume by Area (m^3)	Average Topsoil Thickness (m)	Total Topsoil Volume by Area (m^3)	Reclamation volume required by area (m^3)
HLF	2.15	2,470,000	1.05	1,206,000	345,000
Plant Area / Infrastructure Pads	2.53	976,000	1.03	397,000	182,000
Kona Pit	2.70	170,000	1.80	113,000	-
Latte Pit	1.45	522,000	0.60	216,000	-
Supremo Pit PH 1-4	1.95	2,504,000	0.95	1,220,000	-
Supremo Pit PH 5	1.90	258,000	1.10	149,000	-
Double Double Pit	1.30	157,000	0.4	48,000	-
Alpha WRSF	-	-	-	-	501,000
Access Roads	-	-	-	-	228,000
Total	**-**	**7,057,000**	**-**	**3,349,000**	**1,256,000**

The calculated volumes do not include the permafrost material, which is to be removed during construction of the pad, or the required volumes for the cover system beyond the assumed 300 mm reclamation cover (i.e., gravel drain layer; Hemmera 2018).

Geotechnical Properties

Extensive detailed geotechnical investigations were carried out between 2015 and 2018 by Tetratech and SRK (SRK 2016; Tetratech, 2015; 2017a; 2017b; 2017c; 2018; 2019). Geotechnical properties of the materials at the HLF site have been discussed in detail already in this report. These investigations variably included PSD analyses (Figure 12, moisture content, excess ice content, specific, frozen and bulk density, porewater salinity, Atterberg limits, compaction tests,

shear tests and organics content. Investigations were carried out at all sites that may see disturbance during mining activities.

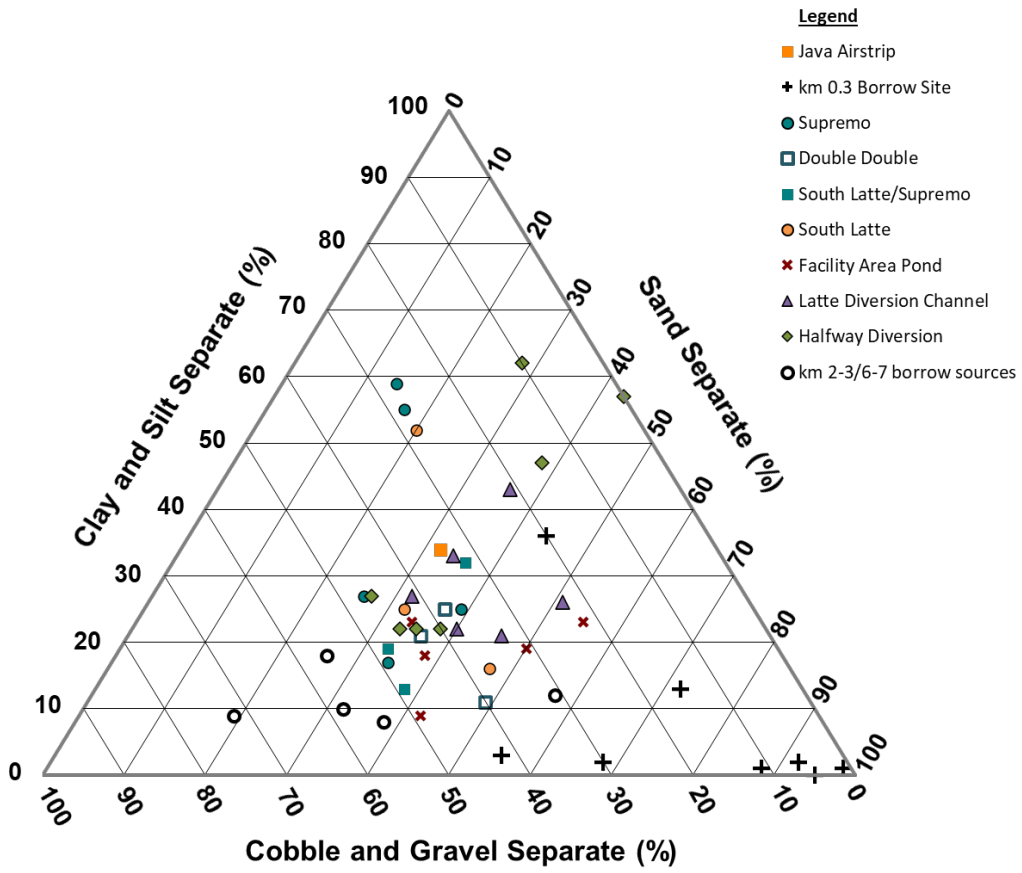


Figure 11: Texture triangle of reclamation materials sampled during 2018 (Tetratech, 2018)

A summary of the 2015 test pitting investigation (Table 11) indicates variability in the material properties between locations. Each of the overburden sites investigated can be generally summarized as poorly to well graded rock fragments with varying amounts of silts and sands. Locations with a greater proportion of rock fragments and lower fines by volume included the km 2-3/km 6-7 borrow sources, the facility pond area, Double Double pit, South Latte and South Latte/Supremo. Generally, the suitability of overburden for reclamation material is limited by excess fines content in some locations (i.e. Java Airstrip) and highly weathered nature of the rock fragments. Tetratech (2018) indicates that processing of the overburden to sort the rock fragments may increase the usability of overburden for various material fill applications. Screened cobbles and boulders may be used in dam applications.

The km 0.3 borrow source is dominated by sand and sub-round gravel that is suitable for road and airstrip construction, though the lack of angularity may require blending with other materials to increase compaction. Localized permafrost zones may require further processing before use in construction. The km 2-3/km 6-7 borrow sources are predominantly well sorted

sand and gravels. The presence of cobbles and boulders indicates that if processed the material can be used for applications with more stringent PSDs (Tetratech 2018).

Table 11: Summary of Atterberg test results from the 2015 investigation (SRK, 2016)

Original Facility Location	Hole/Test Pit ID	Sample Number	Sample Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Plasticity *	Mod. USCS Class	Natural Moisture Content (%)
North Waste Rock Dump	SRK-15S-03	17728	0.6	99	62	37	High	OH	139.9
	SRK-15S-03	17729	6.7-7	0	0	0	NP	-	12.9
	SRK-15S-04	17725	1.1	129	85	44	High	OH	317.8
	SRK-15S-04	17726	3.7	0	19	0	NP	-	16.7
West Waste Rock Dump	SRK-15S-05	17702	2.7	33	27	6	Low	ML	50.3
	SRK-15S-06	17704	0.2	0	0	0	NP	-	6.8
	SRK-15S-07	17708	3.4	0	0	0	NP	-	12.4
	SRK-15S-08	17706	0.9	0	0	0	NP	-	28.3
	SRK-15S-08	17707	3.4	20	17	3	Low	ML	13.8
	SRK-15TP-50	17592	0.4	0	0	0	NP	-	63.0
	SRK-15TP-55	17628	0.3	0	0	0	NP	-	76.5
	SRK-15TP-56	17629	0.35	0	0	0	NP	-	68.4
South Waste Rock Dump	SRK-15S-09	17709	1.8	37	30	7	Low	ML	57.2
	SRK-15S-11	17711	2.3	0	0	0	NP	-	8.8
	SRK-15S-12	17712	2.4	0	0	0	NP	-	19.5
Heap Leach Pad (HLP)	SRK-15S-13A	17718	0.9	25	19	6	Low	CL-ML	16.2
	SRK-15S-20	17722	0.9	23	17	6	Low	CL-ML	73.1
	SRK-15S-25	17723	0.6	25	22	3	Low	ML	12.6
	SRK-15TP-03	17565	0.5-1	29	23	6	Low	ML	10.5
	SRK-15TP-20	17564	0.6	0	29	0	NP	-	20.7
	SRK-15TP-43	17560	0.6	0	21	0	NP	-	12.6
ROM Stockpile & Infrastructure Sites	SRK-15S-29	17732	0.9	0	0	0	NP	-	2.9
	SRK-15S-34	17739	1.1	20	16	4	Low	ML	14.9
	SRK-15S-35	17741	1.2	0	0	0	NP	-	44.9

Table 12: Summary of geotechnical properties from 2018 joint (JDS and Tetratech) test pitting program investigation (Tetratech, 2018)

Site Infrastructure	Sample Number	Depth		Moisture Content (%)	Fines (%)		Sand (%)	Gravel (%)	Cobble (%)	Atterberg Limits			Excess Ice Content (% by volume)	Bulk Density (kg/m³)	Proctor Result	
		From (m)	To (m)		Clay (%)	Silt (%)				LL	PL	PI			Maximum Dry Density (kg/m³)	Optimum Moisture Content (%)
Java Airstrip Alignment	TP01-01	0.30	0.50	11.9	34		32	34	0	17	14	3	-	-	2,040	10.9
	TP02-01	0.20	0.40	13.9									-	-		
	TP03-01	0.20	0.30	29.2									-	-		
	TP03A-01	0.70	1.30	9.5									-	-		
	TP04-01	0.35	0.80	-									-	-		
	TP04A-01	0.10	0.40	16.4									-	-		
km 0.3 Borrow Site	TP05-02	0.70	1.40	2.1	2		68	30	0	-	-	-	-	-	-	-
	TP06-01	0.15	1.00	8.4	36		44	20	0	-	-	-	-	-	-	-
	TP06-02	1.00	1.50	1.4	-		95	5	0	-	-	-	-	-	-	-
	TP06-03	4.00	4.00	6.1	13		72	15	0	-	-	-	-	-	-	-
	TP07-02	1.40	1.60	3.4	2		92	6	0	-	-	-	-	-	-	-
	TP08-02	0.65	1.10	1.7	3		55	42	0	-	-	-	-	-	-	-
	TP08-03	1.10	1.60	2.1	1		98	1	0	-	-	-	-	-	-	-
	TP09-02	1.20	1.50	1.6	1		88	11	0	-	-	-	-	-	-	-
Supremo	TP12-01	0.40	1.20	22.8	55		17	28	0	-	-	-	-	-	-	-
	TP14-01	0.30	0.70	24.1	59		14	27	0	-	-	-	-	-	-	-
	TP17-01	0.00	1.80	11.8	27		26	47	0	-	-	-	-	-	-	-
	TP21-01	0.30	3.50	9.7	17		34	49	0	-	-	-	-	-	-	-
	TP24-01	0.40	1.00	11.5	25		39	36	0	-	-	-	-	-	-	-
Double Double	TP25-01	0.20	1.40	11.0	21		36	43	0	-	-	-	-	-	-	-
	TP27-01	0.30	4.00	10.1	11		49	40	0	-	-	-	-	-	-	-
	TP28-01	0.20	2.20	10.7	25		37	38	0	-	-	-	-	-	-	-
	TP30-01	0.30	1.70	12.2	25		37	38	0	-	-	-	-	-	-	-
South Latte/ Supremo	TP32-01	0.15	0.70	11.1	13		38	49	0	-	-	-	-	-	-	-
	TP32-02	0.70	1.20	17.0	13	19	36	32	-	-	-	-	-	-	-	-
	TP33-01	0.20	0.90	26.4	19		33	48	0	-	-	-	-	-	-	-
South Latte	TP36-01	0.50	1.00	40.4	25		32	43	0	-	-	-	-	-	-	-
	TP36-02	1.00	1.70	17.4	7	9	47	37	-	32	0	0	-	-	-	-
	TP38-01	0.40	1.00	-	52		20	28	0	-	-	-	-	-	-	-

Table 12 (Con't): Summary of geotechnical properties from 2018 joint (JDS and Tetratech) test pitting program investigation (Tetratech, 2018)

Site Infrastructure	Sample Number	Depth		Moisture Content (%)	Fines (%)		Sand (%)	Gravel (%)	Cobble (%)	Atterberg Limits			Excess Ice Content (% by volume)	Bulk Density (kg/m³)	Proctor Result	
		From (m)	To (m)		Clay (%)	Silt (%)				LL	PL	PI			Maximum Dry Density (kg/m³)	Optimum Moisture Content (%)
Facility Pond Area	TP40-01	0.30	1.00	8.9	9		42	49	0	-	-	-	-	-	-	-
	TP42-01	0.40	1.00	19.3	19		50	31	0	-	-	-	-	-	-	-
	TP43-01	0.20	0.80	12.5	23		34	43	0	-	-	-	-	-	-	-
	TP48-01	0.30	1.00	15.1	18		38	44	0	-	-	-	-	-	-	-
	TP49-01	0.40	1.00	11.6	8	15	55	22	-	27	0	0	-	-	-	-
Latte Diversion Channel	TP51-01	0.50	1.00	17.8	26		51	23	0	-	-	-	-	-	-	-
	TP52-01	0.45	1.00	14.4	21		46	33	0	-	-	-	-	-	-	-
	TP58-01	0.60	1.30	25.2	43		36	21	0	-	-	-	-	-	-	-
	TP59-01	0.35	1.30	11.4	8	25	34	33	-	25	0	0	-	-	-	-
	TP59-02	1.30	2.30	8.1	22		40	38	0	-	-	-	-	-	-	-
	TP62-01	0.45	1.30	11.7	27		32	41	0	-	-	-	-	-	-	-
Halfway Diversion	TP64-01	0.25	0.50	194.7	57		43	0	0	-	-	-	-	-	-	-
	TP65-01	0.20	0.50	35.1	22		35	43	0	-	-	-	-	-	-	-
	TP66-01	0.50	0.70	19.0	11	36	38	15	-	0	0	0	0.0	2,116	-	-
	TP66-02	0.70	1.10	41.9	27		27	46	0	-	-	-	29.9	-	-	-
	TP67-02	0.50	0.80	28.6	62		28	10	0	-	-	-	-	-	-	-
	TP68-02	0.45	0.90	9.5	22		33	38	7	-	-	-	-	-	-	-
	TP68-03	0.90	1.20	10.3	7	15	38	40	-	0	0	0	-	-	-	-
	TP69-01	0.90	0.95	529.0	-		-	-	-	-	-	-	41.7	1,001	-	-
	TP69-02	0.40	0.70	277.2	-		-	-	-	-	-	-	34.9	-	-	-
	TP69-03	0.80	1.20	313.7	-		-	-	-	-	-	-	34.4	-	-	-
km 2-3/km 6-7 Borrow Sources	TP70-01	1.50	1.50	5.0	8		38	41	13	-	-	-	-	-	2,150	7.0
	TP71-01	1.50	1.50	7.1	12		57	31	0	-	-	-	-	-	2,170	7.5
	TP72-01	1.50	1.50	12.6	18		26	49	7	-	-	-	-	-	2,060	8.0
	TP73-01	1.50	1.50	4.8	9		19	65	7	-	-	-	-	-	2,140	7.0
	TP74-01	1.50	1.50	9.9	10		32	54	4	-	-	-	-	-	2,160	7.5

HLF Closure Alternatives Assessment

An alternatives assessment was completed following the initial RCP as part of the planning stage for the Coffee project to refine and optimize the closure configuration of the HLF (JDS Energy & Mining Inc.; JDS, 2019). The evaluation of alternatives was a result of a Failure Modes and Effects Analysis (FMEA), which identified risks related to long-term stability of the slopes and functioning of the diversion ditches in closure (JDS, 2018).

Eight potential HLF closure alternatives were identified (JDS, 2019) in addition to the Base Case (see Conceptual Closure Plan), as defined in the Project proposal. The options are summarized in Table 13; a detailed description of each option is available in the Alternatives Assessment report (JDS, 2019).

Pre-screening questions were posed to determine which closure options were viable. All questions were posed relative to the Base Case alternative. Answering “yes” to any of the questions removed the alternative from further consideration in the evaluation. The main questions posed were:

1) Will the alternative result in substantial Project delays?

2) Will the alternative result in an unacceptable NPV?

3) Will the alternative render the Project technically unfeasible?

Only five options moved forward to the Multiple Accounts Analysis (MAA) following pre-screening: Alternative 1, Alternative 5a, Alternative 5b, Alternative 7, and Alternative 8. The remaining options were removed based on NPV (Alternative 3a), technical challenges (Base Case, Alternative 2, and Alternative 4), and unacceptable delays associated with permitting and additional investigations (Alternative 3b and Alternative 6).

The MAA concluded the Alternative 5A was the preferred alternative based on the overall score; however, all alternatives were within 15% and could therefore all be considerations with further refinement (JDS, 2019). Alternative 5A scored highest from technical, environmental, and permitting perspectives. Alternative 1 was the preferred alternative when Project economics were valued more highly.

Table 1: Summary of HLF Alternatives

Alternative	Description	Capacity (Mt)	Closed Slopes	Footprint (ha)	Cover	Discharge	$NPV_{6\%}$ ($M)
Base Case		60	2.5:1	97	GCL + Store and Release (flat only)	Halfway Creek	81.9
Alternative 1	Ditch optimization relative to Base Case	60	2.5:1	97	GCL + Store and Release (flat only)	Halfway Creek & Latte Creek	81.9
Alternative 2	Increased stability and decreased erosion relative to Base Case. Includes optimized ditches (Alt 1). Increased time (geotechnical investigations) and permitting delays.	60	3:1	105	GCL + Store and Release (flat only)	Halfway Creek & Latte Creek	89.5
Alternative 3a	Increased stability and decreased erosion relative to base case. Includes optimized ditches (Alt 1). Smaller capacity associated with flattened slopes within the Base Case footprint.	41	3:1	97	GCL + Store and Release	Halfway Creek & Latte Creek	83.7
Alternative 3b	Alternative 3a as the primary HLF with a second HLF in Valley C (upper Latte Creek). Capacity reflective of both the primary and secondary HLF. Delays associated with geotechnical investigations and permitting for second facility.	160	-	-	-	Halfway Creek & Latte Creek	< 81.9
Alternative 4	Increased stability and decreased erosion relative to Base Case. Includes optimized ditches (Alt 1). Increased time (geotechnical investigations) and permitting delays. Increased cover system application (entire landform).	60	3:1	105	GCL + Store and Release	Halfway Creek & Latte Creek	103.8
Alternative 5a	Constructed as per Base Case, but with slopes regraded to 3:1 as part of closure to increase long term stability. Includes optimized ditches (Alt 1).	60	3:1	97	GCL + Store and Release	Halfway Creek & Latte Creek	98.0
Alternative 5b	Constructed as per Base Case, but with slopes regraded to 3:1 as part of closure to increase long term stability. Includes optimized ditches (Alt 1). Only flat areas and spent ore pushed off the HLF would be covered.	60	3:1	97	GCL + Store and Release (flat & spent ore only)	Halfway Creek & Latte Creek	84.6
Alternative 6	Single facility in Valley C (upper Latte Creek). Delays associated with geotechnical investigations and permitting for second facility.	-	-	-	-	Latte Creek	-
Alternative 7	Similar to Alternative 2, with GCL keyed into slopes, covering the entire landform. Includes optimized ditches (Alt 1).	60	2.5:1	97	GCL + Store and Release (GCL keyed into slopes)	Halfway Creek & Latte Creek	95.3
Alternative 8	Constructed as per Base Case, but with slopes regraded to 3:1 as part of closure using imported waste rock from reclaimed haul roads or the Alpha waste rock storage facility. Includes optimized ditches (Alt 1).	60	2.5:1	97	GCL + Store and Release (flat only)	Halfway Creek	87.9

JDS, 2019

Corporate and Regulatory Commitments / Framework

The Coffee Mine project is governed by the Reclamation and Closure Planning for Quartz Mining Projects Guidelines (the Guidelines) (Yukon Water Board [YWB] and Yukon Government Energy, Mines and Resources [EMR]; YWB & EMR, 2013) document. The document specifies the need for an RCP specifying the return of the mine to an environmentally stable condition suitable for future land use.

Mining projects in the Yukon require a Quartz Mining License (QML) and a Water License (WL) (YWB & EMR, 2013), both of which require an RCP as part of reclamation and closure considerations. The QML is issued by the EMR under the Quartz Mining Act, and the WL is issued by the YWB under the Water Act. RCP updates must be submitted every 2 years (YWB & EMR, 2013).

The Guidelines (YMB & EMR, 2013) outline fundamental mine reclamation and closure objectives for all projects (Table 14). Each RCP submitted for a project must demonstrate how the objectives in Table 14 will be achieved throughout reclamation and closure.

Table 1: Yukon Fundamental Mine Reclamation and Closure Objectives

Value	Reclamation and Closure Objectives
Physical Stability	All mine-related structures and facilities are physically stable and performing in accordance with designs. All mine-related structure, facilities, and processes can withstand severe climactic and seismic events.
Chemical Stability	Release of contaminants from mine-related waste materials occurs at rates that do not cause unacceptable exposure in the receiving environment.
Health and Safety	Reclamation eliminates or minimizes existing hazards to the health and safety of the public, workers, and area wildlife by achieving conditions similar to local area features. Reclamation and closure implementation avoids or minimizes adverse health and safety effects on the public, workers, and area wildlife.
Ecological Conditions and Sustainability	Reclamation and closure activities protect the aquatic, terrestrial, and atmospheric environments from mine-related degradation and restore environments that have been degraded by mine-related activities. The mine supports a self-sustaining biological community that achieves land use objectives.
Land Use	Lands affected by mine-related activities (e.g., building sites, chemical and fuel storage sites, roads, sediment ponds, tailings storage facilities, waste rock storage areas, underground workings, etc.) are restored to conditions that enable and optimize productive long-term use of land. Conditions are typical of surrounding areas or provide for other land uses that meet community expectations. Site access is consistent with community land use expectations.
Aesthetics	Restoration outcomes are visually acceptable.

Value	Reclamation and Closure Objectives
Socio-economic Expectations	Reclamation and closure implementation avoids or minimizes adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits. Reclamation and closure activities achieve outcomes that meet community and regulatory expectations.
Long-term Certainty	Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete.
Financial Considerations	Minimize outstanding liability and risks after reclamation activities are complete.

YWB & EMR, 2013

Project-specific closure objectives for the Coffee Mine were developed in collaboration with Tr'ondëk Hwëch'in and Selkirk First Nation (Hemmera, 2018) (Table 15).

Table 2: Coffee Gold Mine Closure Objectives

Closure Value	Closure Objectives*
Physical and Chemical Stability	All mine-related infrastructure is physically and chemically stable and performing in accordance with designs, which take into consideration longer-term risks such as for severe climatic and seismic events. Protect and maintain the land, air, and water in a condition that provides for sustainable use. Ensure water remains substantially unaltered from pre-mining conditions to the extent practicable with respect to quantity, quality, and rate of flow, including seasonal rate of flow
Health and Safety	Protect the health and safety of people and area wildlife using and accessing the site by emulating pre-mining conditions to the extent practicable.
Ecological Processes and Functions	Protect or enhance ecological processes and functions to maintain ecosystem condition and support diverse, productive, and self-sustaining biological communities with assemblages and abundances of species that are typical for the geographic area and are consistent with site capabilities that emulate pre-mining conditions.
Land Use	Protect and maintain environmental quality (a combination of physical and chemical stability as well as ecological processes and functions) consistent with the principle of Sustainable Development. Restore lands affected by mining-related activities to allow for future land use similar to surrounding areas to the extent practicable. Ensure the site and specific assets are available for post-closure.
Country Food and Traditional Economy	To protect the long-term optimal productivity, quality, and diversity of the traditional economy, including the health and viability of country foods and other harvestable resources.

Closure Value	Closure Objectives*
Participation and Positive Relationship	Maintain ongoing positive relationships or partnerships between Goldcorp (now Newmont) and Yukon First Nations through closure. Ensure participation of Yukon First Nations in project planning, and incorporate First Nations knowledge and experience in closure planning and implementation.
Culture and Heritage	Recognize, protect, and foster the culture, and tangible and intangible heritage of Yukon First Nations for the benefit of future generations.
Community Health and Well-Being	Protect and promote the well-being of affected First Nations, their communities, governments, and internal capacities and structures. Protect and promote the well-being of other Yukon residents and the interests of the public.
Economics	Avoid or minimize adverse economic effects on the potentially-affected community and First Nations, while supporting economic stability during and beyond the life of mine.
Aesthetics	Restore views at the site to pre-mining conditions to the extent practicable to facilitate learning and teaching on the land.
Long-term Certainty	Increase certainty and decrease risk regarding post-closure conditions and outcomes (e.g., through contingency planning, revised closure planning based on improved understanding from operations and reclamation research, and adaptive management). Minimize the need for long-term operations, maintenance, and monitoring after reclamation activities are complete by reducing outstanding liabilities and risks.

Hemmera, 2018

Community and Regulatory Engagement

As mining is considered a temporary land use (YWB & EMR, 2013), the Guidelines promote engagement with local governments, communities, first nations, and regulatory authorities as a part of closure planning. The Guidelines encourage ongoing engagement throughout the planning process, as part of continued refinement and improvement of project objectives and as advancements are made as part of reclamation research and modelling results.

Closure

Please do not hesitate to contact me at 403-880-7366 or tkuzyk@okc-sk.com should you have any questions or comments.

Kind regards,

Terryn Kuzyk, M.Sc., P.Eng.,
Geoenvironmental Engineer
tkuzyk@okc-sk.com

Mitchell Barteaux, P.Geo.,
Environmental Geoscientist
mbarteaux@okc-sk.com

Cc: Dave Christensen, Okane Consultants

References

Chadburn, S.E., Burke, E.J., Cox, P.M., Friedlingstein, P., Hugelius, G., and Westermann, S. 2017. An observation-based constraint on permafrost loss as a function of global warming. Nature Climate Change. 7, 340-345. doi: 10.1038/nclimate3262.

GOC. 2002. Fisheries Act SOR/2002-222. Metal and Diamond Mining Effluent Regulations (MMEW).

Goldcorp Kamanik, a subsidiary of Newmont Corporation (Newmont). 2019/ Coffee Gold Mine YESAB Project Proposal Appendix A – Project Description Overview. December 2019.

Hemmera Envirochem Inc. 2017. Coffee Gold Mine YESAB Project Proposal Volume II – Physical Environment. Prepared for Kaminak Gold Corp., a subsidiary of Goldcorp Inc. March 2017.

Hemmera Envirochem Inc., 2018. Draft Reclamation and Closure Plan, Coffee Gold Project. File No. 1658-003.01. Prepared for Goldcorp Inc. November 2018.

International Network for Acid Prevention. 2017. Global Cover System Design Technical Guidance Document.

IPCC. 2021. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.). Cambridge University Press. In Press.

IPCC. 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.). Cambridge University Press. Cambridge, United Kingdom and New York, NY, USA.

IPCC. 2000. Nakićenović, N., and Swart, R., ed., Special Report on Emissions Scenarios: A special report of Working Group III of the Intergovernmental Panel on Climate Change, Cambridge University Press, ISBN 0-521-80081-1, 978-052180081-5 (pb: 0-521-80493-0, 978-052180493-6).

JDS Energy & Mining Inc. 2016. NI 43-101 Feasibility Study Technical Report for the Coffee Gold Project, Yukon Territory, Canada. Prepared for Kaminak Gold Corp. February 2016.

JDS Energy & Mining Inc. 2018. Preliminary Project Failure Modes and Effects Analysis, Coffee Gold Mine Project. Prepared for Goldcorp Inc. March 2018.

JDS Energy & Mining Inc. 2019. Heap Leach Facility Alternatives Assessment, Coffee Gold Mine Project. Prepared for Goldcorp Inc. May 2019. Lorax Environmental Services. 2015a. Climate Change Projections for Coffee Creek Region, Yukon. Lorax memo to Kaminak Gold Corp. September 2015.

Lorax Environmental Services. 2015b. Synthetic Daily Climate Records for the Coffee Gold Project. Lorax memo to Kaminak Gold Corp. April 2, 2015.

Lorax Environmental Services. 2017a. Coffee Gold Baseline Hydrogeological Assessment. Prepared for Goldcorp Inc. March 2017.

Lorax Environmental Services. 2017b. APPENDIX 12-D Geochemical Characterization Report. Prepared for Goldcorp Inc. March 2017

Lorax Environmental Services. 2019a. Coffee Mine Update Study, Water Balance and Water Quality Model. Prepared for Newmont Goldcorp. August 2, 2019.

Lorax Environmental Services. 2019b. Coffee Gold Project: 2019 Hydro-meteorology Baseline Report. Prepared for Newmont Goldcorp. September 23, 2019.

MacWilliam, Kathryn R. G. 2018. The Geology and Genesis of the Coffee Gold Deposit in West-Central Yukon, Canada: Implications for the Structural, Magmatic, and Metallogenic Evolution of the Dawson Range and Gold Exploration Models. Thesis. University of British Columbia.

MEND. 2004. Review of the Water Quality Issues in Neutral pH Drainage: Examples and Emerging Priorities for the Mining Industry in Canada, MEND Report 10.1. Prepared by Stantec Consulting Ltd. for MEND Initiative.

MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials, MEND Report 1.20.1. Prepared by William A. Price for MEND Program.

Mines Group (2019). YESAB Scenario Heap Leach Facility Configuration. Prepared for Newmont Goldcorp. May 9, 2019.

SRK (Steffen Robertson & Kirsten). 2016. 2015 Geotechnical Field Investigation for Kaminak Coffee Gold Project,. Denver USA.

Tetra Tech. 2017. Thermal Evaluation of Duration of Thaw of Permafrost Soils at Coffee Mine Site Study Area Under Long-term Climate Conditions, Yukon, Canada. Tetra Tech memo to Goldcorp Inc. January 19, 2017.

Tetra Tech. 2017. Fall 2017 Testpitting Program, Coffee Mine Site Phase 1: Proposed Infrastructure Footprings, Phase 2: Proposed Open Pit Areas. Prepared for JDS Energy & Mining.

The Mines Group Inc. (MINES). 2016. Feasibility Design Report for Coffee Gold Heap Leach Facility, Yukon Territory, Canada. Prepared for Kaminak Gold Corporation. Report No. 15-78-01- Rev A. January 30, 2016.

Yukon Water Board and Yukon Government Energy, Mines and Resources. 2013. Reclamation and Closure Planning for Quartz Mining Projects. August 2013.

Yukon Environmental and Socioeconomic Assessment Board (YESAB). 2021. Screening Report and Recommendation – Coffee Gold Mine 2017-0211. October 2021.

Appendix B

Analytical Water Balance

Calgary

Suite 1900, 736 6th Avenue SW
Calgary, AB T2P T7
Canada
www.okc-sk.com

Our ref: B-1075-220-003

November 15, 2021

Ryan Herbert
Practice Lead, Environmental Permitting
Ensero Solutions
410-885 Dunsmuir Street
Vancouver, BC
V6C 1N5

Re: Coffee Mine Heap Leach Cover Design – Analytical Water Balance to Support Alternatives Assessment

The Coffee Mine project team is currently in the process of developing an updated reclamation and closure plan (RCP) for the Coffee Mine project, including development of closure strategies for the proposed heap leach facility (HLF). Previous closure planning work for the project included an alternatives assessment, which identified a preferred cover system alternative for the HLF in closure comprised of a geosynthetic clay liner (GCL) low permeability store and release cover system on plateau segments, and a simple store and release cover system on 2.5:1 slope sections.

To enhance the understanding of the various HLF cover system alternatives evaluated in the previous alternatives assessment, Okane Consultants (Okane) completed an analytical water balance assessment. The objective of the analytical water balance is to provide estimated water balance parameters and associated performance of the alternatives that will be incorporated into an updated ranking exercise to be completed by the project team.

Analytical water balance results are provided within the body of this document, followed by supporting information located in Appendix A.

Cover System Alternatives Evaluated

The alternatives evaluated in the previous alternatives assessment were primarily differentiated by variations in the coverage and application of a geosynthetic clay layer (GCL) cover system. The alternatives included either:

- GCL cover system on plateau section **only,** with store and release cover system on slope sections; or
- GCL cover system on **both** plateau and slope sections.

Okane completed conceptual water balances for these scenarios to estimate performance with and without a GCL cover on the slopes, and with a GCL on the plateau segments (see Table 1.

Analytical Water Balance Summary

Figure 1 shows the various components of a typical cover system water balance for a cold region. Table 1 summarizes the water balances developed by Okane, using an analytical tool and average wet and dry years (i.e. not including high return period design storm events), for the potential cover system scenarios of the HLF. The primary focus for this assessment is the amount of net percolation (NP) reaching the underlying heap material through the cover system. The water balance results provided in Table 1 are consistent with the conceptual range of cover system performance presented in terms of "very low," "low," "moderate," and "high" NP from the International Network for Acid Prevention cover system guidance document[1]. For the HLF, a high NP is classified as greater than 40% of PPT (% PPT), moderate (Mod) is between 20% PPT and 40% PPT, low is between 5% PPT and 20% PPT, and very low (VL) is less than 5% PPT. The cover systems are estimated to perform within the following NP classifications:

- The flat areas of the HLF with an infiltration barrier (GCL) underlying a 0.5 m store-and-release cover system – Very Low
- The slopes covered with a 0.5 m store-and-release cover system – Moderate
- The slope areas of the HLF with an infiltration barrier (GCL) underlying a 0.5 m store-and-release cover system – Very Low

[1] International Network for Acid Prevention. 2017. Global Cover System Design Technical Guidance Document.

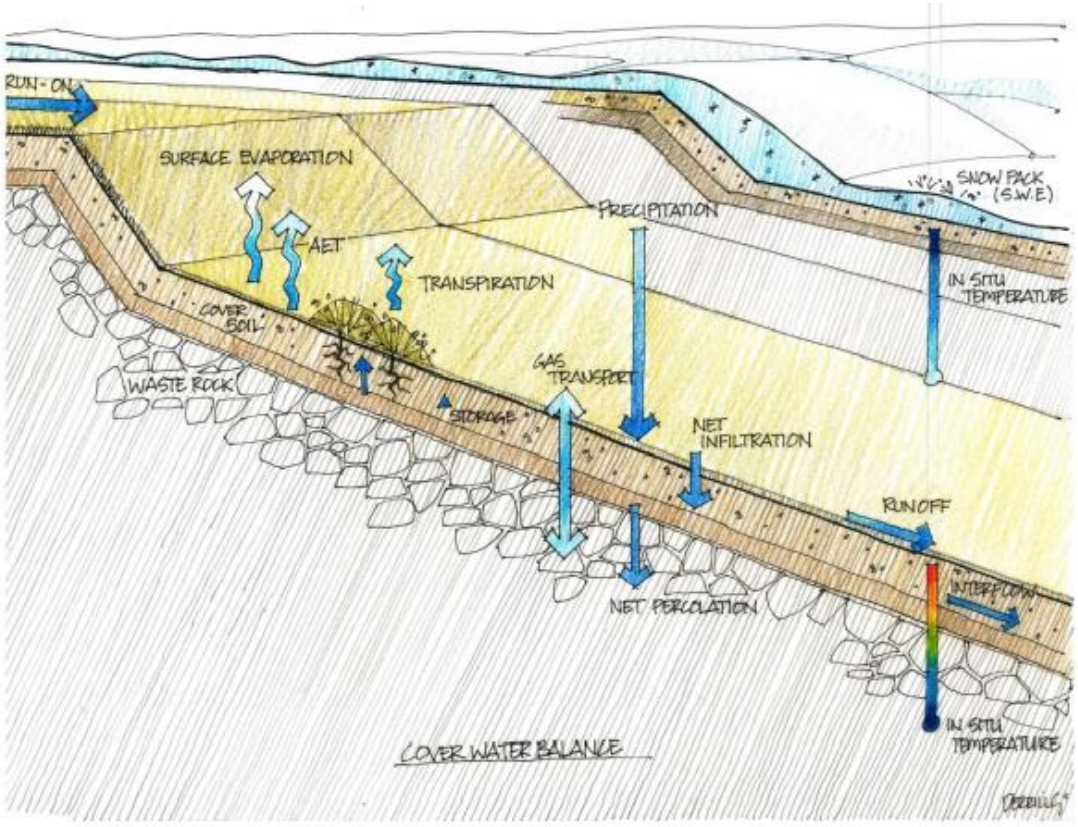


Figure 1: Typical cold regions cover system water balance components

Table 1: Summary of analytical water balances for HLF cover system scenarios

Cover System/terrain	Climate Year	PPT	SUB	AET	S	RO	IF	NP	
		mm	mm	mm	mm	mm	mm	mm	% PPT
Plateau with GCL	Dry	370	31	273	-16	0	74	8	2%
	Average	**499**	**44**	**303**	**0**	**0**	**136**	**16**	**3%**
	Wet	650	62	333	16	27	191	22	3%
Slope with GCL	Dry	370	31	273	-16	0	74	8	2%
	Average	**499**	**44**	**303**	**0**	**0**	**136**	**16**	**3%**
	Wet	650	62	333	16	27	191	22	3%
Slope base case (simple store and release)	Dry	370	31	273	-16	0	0	82	22%
	Average	**499**	**44**	**303**	**0**	**0**	**0**	**152**	**30%**
	Wet	650	62	333	16	27	0	213	33%

PPT = Precipitation; SUB = Sublimation; AET = Actual Evapotranspiration; S = Change in near surface water storage; RO = Runoff; IF = Interflow; NP = Net Percolation

Based on the conceptual water balance presented in Table 1, and the surface area extracted from the HLF map in Figure 2[2], annual drainage volumes collected by a drainage perimeter ditch and NP volume (i.e. basal seepage) were calculated and listed in Table 2. Interflow represents water which moves laterally downgradient on top of the GCL layer at the base of the cover system. This water will express at the surface where engineered drainage ditches allow, or when saturated conditions / areas of low hydraulic conductivity force water to the surface. Runoff is surface water flow, and with regards to the Coffee Mine site, is anticipated to be limited to when snowmelt surpasses the hydraulic conductivity at the surface, (i.e. when frozen soil conditions occur). In general, rainfall events are not anticipated to contribute significantly to runoff given that the hydraulic conductivity of non-frozen cover material is greater than typical rainfall rates. Net percolation (NP) in the assessment represents steady state conditions following HLF draindown; therefore, NP and basal seepage are considered equal. The assessment also assumes that the liner at the base of the HLF is 100% effective at capturing basal seepage and directing to the perimeter ditch or treatment facility as required.

It is understood that the HLF design shown is currently being updated; however, the new HLF footprint area is expected to be reasonably similar. The exercise provides an indicative estimate of the volume and timing of surface water that will require collection in different areas of the HLF. Surface water sources include surface runoff, interflow expressed to the cover surface at the base of GCL cover system areas, and basal seepage from the lined base of the HLF. Monthly drainage volumes collected at three levels of the HLF landscape are shown in Table 3, and Table 4 for the average and wet climate years, respectively. Given the climate conditions at site, conceptual water balance components are presented for frost free months only (April – September). This is because, conceptually, water balance components remain relatively unchanged during the winter months due to freezing. In these tables, the volume collected at the lower level includes water drained from all the upper levels (e.g., volume of drainage collected at level 3 is the total volume from the HLF). The map of levels is presented in Figure 3, and includes conceptual Surface Water Ditches to transmit RO and IF from Level 1 and Level 2 to the base of the HLF (Level 3).

[2] Coffee Gold Mine - YESAB Project Proposal, Appendix 31-C – Conceptual Reclamation and Closure Plan

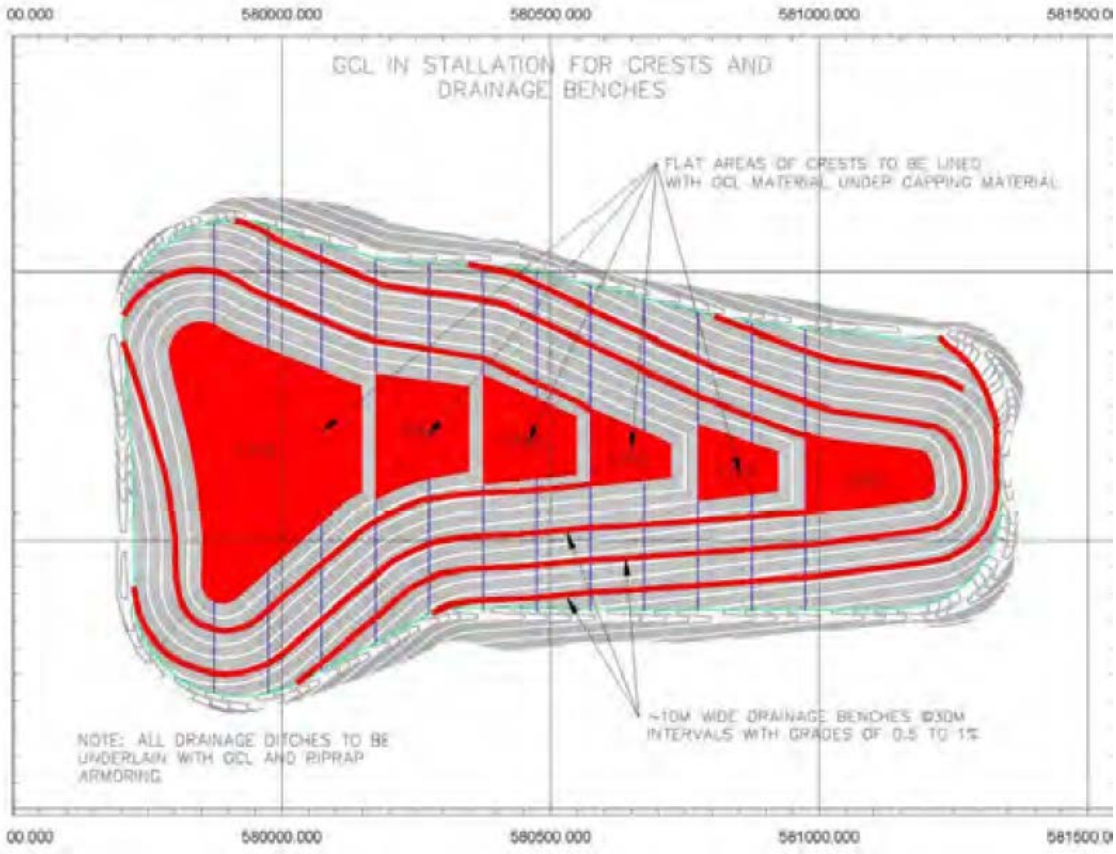


Figure 2: HLF at closure showing relatively flat areas (red) to potentially receive GCL in the cover system (red).

Table 2: Volume of potential surface water collected at the base of the HLF cover system and lined area. (m^3/year)

Climate scenario	Base Case			Slope with GCL		
	RO	IF	NP/ Basal Seepage	RO	IF	NP/Basal Seepage
Dry	0	25,400	59,000	0	76,100	8,300
Average	0	46,700	109,200	0	139,900	16,100
Wet	27,600	65,600	153,500	27,600	196,400	22,700

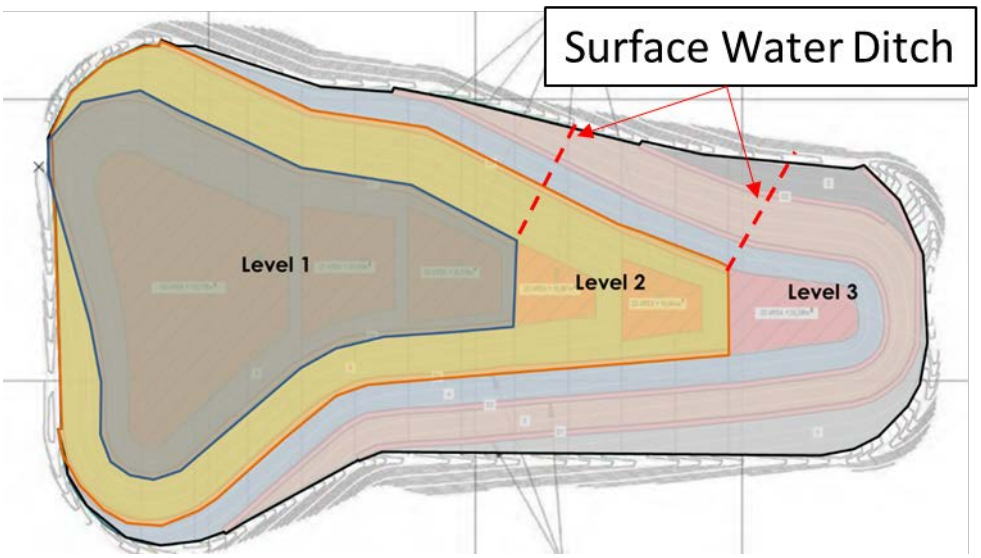


Figure 3: HLF at closure showing three levels of landscape and conceptual surface water ditches.

Table 3: Monthly drainage volume collected at three levels of the HLF – Average Year (m³)

Cover Scenario	Month	Level 1			Level 2			Level 3		
		RO	IF	NP	RO	IF	NP	RO	IF	NP
Base Case	April	0	10,000	7,900	0	12,900	20,300	0	16,300	38,200
	May	0	4,300	3,400	0	5,500	8,700	0	7,000	16,400
	June	0	2,900	2,300	0	3,700	5,800	0	4,700	10,900
	July	0	1,400	1,100	0	1,800	2,900	0	2,300	5,500
	August	0	2,900	2,300	0	3,700	5,800	0	4,700	10,900
	September	0	7,200	5,700	0	9,200	14,500	0	11,700	27,300
	Annual	**0**	**28,700**	**22,700**	**0**	**36,800**	**58,100**	**0**	**46,700**	**109,200**
Slope with GCL	April	0	9,900	7,800	0	12,700	20,000	0	16,100	37,600
	May	0	4,200	3,300	0	5,400	8,600	0	6,900	16,100
	June	0	2,800	2,200	0	3,600	5,700	0	4,600	10,700
	July	0	1,400	1,100	0	1,800	2,900	0	2,300	5,400
	August	0	2,800	2,200	0	3,600	5,700	0	4,600	10,700
	September	0	7,100	5,600	0	9,100	14,300	0	11,500	26,900
	Annual	**0**	**46,100**	**5,300**	**0**	**85,100**	**9,800**	**0**	**139,900**	**16,100**

RO= Runoff; IF= Interflow; NP=Net Percolation; Annual flow was distributed into each month with the estimated following ratios: April – 35%, May – 15%, June – 10%, July – 5%, August – 10%; September – 25%.

Table 4: Monthly drainage volume collected at three levels of the HLF – Wet Year (m³)

Cover Scenario	Month	Level 1			Level 2			Level 3		
		RO	IF	NP	RO	IF	NP	RO	IF	NP
Base Case	April	3,200	14,100	11,200	5,900	18,100	28,600	9,700	23,000	53,700
	May	1,400	6,000	4,800	2,500	7,800	12,200	4,100	9,800	23,000
	June	900	4,000	3,200	1,700	5,200	8,200	2,800	6,600	15,400
	July	500	2,000	1,600	800	2,600	4,100	1,400	3,300	7,700
	August	900	4,000	3,200	1,700	5,200	8,200	2,800	6,600	15,400
	September	2,300	10,100	8,000	4,200	12,900	20,400	6,900	16,400	38,400
	Annual	**9,100**	**40,300**	**31,900**	**16,800**	**51,700**	**81,600**	**27,600**	**65,600**	**153,500**
Slope with GCL	April	3,200	22,700	2,600	5,900	41,800	4,800	9,700	68,700	7,900
	May	1,400	9,700	1,100	2,500	17,900	2,100	4,100	29,500	3,400
	June	900	6,500	800	1,700	12,000	1,400	2,800	19,600	2,300
	July	500	3,200	400	800	6,000	700	1,400	9,800	1,100
	August	900	6,500	800	1,700	12,000	1,400	2,800	19,600	2,300
	September	2,300	16,200	1,900	4,200	29,900	3,500	6,900	49,100	5,700
	Annual	**9,100**	**64,800**	**7,500**	**16,800**	**119,500**	**13,800**	**27,600**	**196,400**	**22,700**

RO= Runoff; IF= Interflow; NP=Net Percolation; Annual flow was distributed into each month with the estimated following ratio: April – 35%, May – 15%, June – 10%, July – 5%, August – 10%; September – 25%.

Surface Water Management Considerations

The conceptual water balance parameters provided within this assessment highlights an important consideration for future HLF landform design work; specifically, the amount of water that will need to be managed as interflow. As water moves laterally down gradient above the GCL, the contributing area will increase along with the amount of water to be managed. This is particularly important for the cover system scenario including a GCL on the slope (i,e, there is no interflow anticipated in the base case slope cover system water balance). There will be a critical point along the slope where water will need to be brought to surface and managed through surface water drainage ditches, drop structures, etc. In addition, the lateral drainage capacity of the cover material, or dedicated lateral drainage layer, will need to be designed to accommodate the anticipated flow, and to meet stability requirements (as to manage risks involving the development of positive pore-water pressure).

Additional assessment is required to calculate the required transmissivity (lateral drainage capacity) to manage flows above the GCL. This will also inform on the location, and flow capacity requirements, of surface water management features to be included on the HLF.

Closure

We trust information provided in this memorandum is satisfactory for your requirements. Please do not hesitate to contact me at (902) 209-7758 or mbarteaux@okc-sk.com should you have any questions or comments.

Mitchell Barteaux,
Environmental Geoscientist
mbarteaux@okc-sk.com

Cc: Dave Christensen, Okane Consultants
Click here to enter the Cc name., Click here to enter the Cc company.

Appendix A
Water Balance Components

Rationales for Water Balance Components

Rationales for the estimates of each water balance component are provided in the following section. Coffee Mine would be classified as a cold site without a dry season and with cold summers (Dfc) using the Köppen-Geiger climate classification system.

Precipitation

Lorax (2019)[3] developed a 74-year synthetic climate database consisting of temperature and precipitation based on the Dawson A climate record. The synthetic climate database was scaled to the elevation of the HLF (Lorax, 2019). The average, 5 percentile, and 95 percentile of precipitation data in 74 years were considered as average, dry, and wet year scenarios in the water balance analysis. Monthly summaries of this dataset are provided in Table A1. Note that for the average and dry years 44% of the precipitation is estimated as snowfall (from October to March) and 56% as rainfall (from April to September), whereas for the wet year 48% of precipitation is snowfall and 55% rainfall.

Table A1: Summary of the precipitation in the 74-year synthetic climate database.

Month	Dry Year Precipitation (mm)	Average Year Precipitation (mm)	Wet Year Precipitation (mm)
January	7	35	78
February	3	25	61
March	2	21	56
April	1	13	30
May	13	34	66
June	18	55	91
July	20	71	137
August	15	63	115
September	11	43	76
October	13	51	106
November	11	44	80
December	18	44	87
Annual	369	499	647

[3]Lorax Environmental Services. 2019b. Coffee Gold Project: 2019 Hydro-meteorology Baseline Report. Prepared for Newmont Goldcorp. September 23, 2019.

Sublimation

Sublimation is a required component of a water balance for any site that develops a snowpack. For this water balance, the sublimation amount also accounts for all snow losses that do not result in liquid water making contact with material surface of the HLF (e.g. wind removal and evaporation directly from the snowpack). Published literature estimates the sublimation range from 10 to 45 percent due to the uncertainty of winter conditions in northern environments[4]. A sublimation rate of 20% of the precipitation from October to March was assumed in this study.

Actual Evapotranspiration

Actual evapotranspiration (AET) was estimated based on the potential Evaporation (PET) 477 mm/year measured at Km 11 weather station. Considering the elevation difference between the mine site and Km 11 weather station, the PET at HLF was assumed to be 382 mm/year. The annual AET of average year was calculated as 303 mm/year with a "Budyko-type" equation:

$$AET = \frac{P}{\left[1 + \left(\frac{P}{PET}\right)^{w}\right]^{\frac{1}{w}}}$$

Where P is the annual precipitation, w is a parameter assumed to be 2 generally[5]. The AET of dry and wet year were assumed to be 0.9 and 1.1 times of average year AET, which equal to 273 and 333 mm/year respectively for all the terrain and cover scenarios. The monthly distribution of AET was calculated with monthly PET data monitored at Km 11 station and are listed in Table A2.

Table A2: Percentage of AET per month for weather scenarios

Month	AET (%)
January	0%
February	0%
March	0%
April	11%
May	21%
June	23%

[4] Scenarios Network for Alaska and Arctic Planning, 2011. Yukon Water Availability Analysis. Prepared for the Northern Climate Exchange, Yukon College. July.

[5] S. Lawrence Dingman. 2015. Physical Hydrology. Third Edition. Waveland Press, Inc.

Month	AET (%)
July	20%
August	15%
September	8%
October	2%
November	0%
December	0%
Annual	100%

Runoff

Runoff was assumed to be zero or very little due to the storage cover layer. Most of the RO was assumed to occur in spring melt season (April). Table A3 provides the percentage of PPT estimated to result in RO for each water year and terrain scenario.

Table A3: Estimated percentages of annual precipitation that runoff slopes during dry, average, and wet years

Scenarios	Dry Year (%)	Average Year (%)	Wet Year (%)
Slope snow melt	0%	0%	10%
Plateau snow melt	0%	0%	10%
Slope rain	0%	0%	5%
Plateau rain	0%	0%	5%

Storage

Water storage within the store-and-release cover system was accounted for by estimating an initial volumetric water content (VWC) for the start of the water balance (September 1) and a VWC representing field capacity (Table A4). These values were assumed based on water retention curves (WRCs; i.e., the relationship between volumetric water content and suction) and data typical of materials in northern areas. The effective thickness of all cover systems were assumed to be 0.5 m.

Table A4: Initial and field capacity volumetric water content (VWC) used to define the storage capabilities of cover system

Cover System	Initial VWC	Field Capacity VWC
0.5 m Store and Release Cover System	0.170	0.200

Initial VWC was set so that there was no change in storage during an average year. This same initial VWC was then also used for the wet and dry years.

Interflow

Interflow is only included as part of the water balance when there is a GCL layer due to its low permeability. Any water that would be percolating below the 0.5 m store-and-release and report as NP is impeded and re-directed laterally (interflow) and directed off site. A small quantity (5%) of the water that reaches the liner is estimated to seep through it and report as NP.

Appendix C

Reclamation Material Priority Memorandum

Calgary

Suite 1900, 736 6th Avenue SW
Calgary, AB T2P 3T7
Canada
www.okc-sk.com

Memorandum

To:	Ryan Herbert – Practice Lead Environmental Permitting, Ensero Solutions
From:	Mitchell Barteaux, Environmental Geoscientist
Our ref:	1075-220-017
Date:	December 15, 2021
Re:	**Coffee Mine Reclamation Material Priority Table**

Table 1 provides a first pass priority list for discussion, for cover system material at the Coffee Mine (Figure 1). It is the understanding of Okane, that the Heap Leach Facility (HLF) will be the top priority to receive reclamation material, and that subsequent landforms will receive excess material following HLF reclamation. The rankings developed in the priority list considered the following in development:

- HLF is the top priority
- Visibility from the Yukon River, or other potential high traffic areas
- Optimizing vegetation success – prioritizing south facing slopes
- Reclamation of partially backfilled pits with pit lakes assumes no reclamation material placed below the final pit lake water levels.

Table 1: Reclamation material priority list for discussion

Domain	Location	Pros	Cons	Priority	Notes
HLF including event ponds	Upland	• Key stakeholder expectation for cover	• Large area	1	• This has been identified as the #1 priority based on previous discussions with the project team
Alpha WRSF	Upland and Lowland	• Might be visible from Yukon river • Significant asset to reclaim, gaining positive support from stakeholders	• Large surface area to reclaim • Potentially multiple revegetation strategies required along northern and western slopes to account for ecosites	2	• Headwaters of Halfway creek • Slope aspect of North, West, and South • Slopes with benches • 815masl - 1,150 masl • Anticipated to be free draining • Rock drain below WRSF
Alpha Pond and Dam	Lowland	• Potentially valuable habitat in the valley	• Potentially low geochemical risk	3	• Material stripped from dam footprint will be stockpiled and used for dam reclamation
Kona Pit (Complete Backfill)	Upland	• Small area to cover	• Might not be very visible • Pending Geochem work - risk for ML-ARD could be low	4	• Backfilled with Beta WRSF waste (from Kona Pit) and is NAG but metal leaching potential, pit wall could be 20% PAG. • Surface runoff from backfill will report to halfway creek via the Alpha WRSF rock drain
Double Double Pit (Complete Backfill)	South Facing Slope	• High likelihood of successful revegetation given slope aspect • Potentially visible from Latte Creek	• Might not be a significant area of concern for revegetation	5	• Waste rock from Supremo Pit used to backfill • Ore is classified as NAG • Pit walls are NAG, but potential metal leaching. Water quality modelling indicates that water accumulating in pit voids can

					be directly discharged to receiving environment. No additional Geochem stabilization required. • No groundwater inflows • Groundwater discharge to Latte Creek
Access Roads / Haul roads/ airstrips	Multiple	• Areas with high visual impact	• Low geochemical risk	6	• Some roads have different reclamation requirements
Plant Site / Camp Site/Crusher	Upland	• Areas with high visual impact • Small area to reclaim	• Low geochemical risk	7	• Simple organics layer and grading/contouring
Latte Pit (Partial Backfill - above final pit lake)	South Facing Slope	• Reduce potential loads to pit • Reclaiming roads (causeway area) could be a high priority area in terms of visibility	• Risk of ML-ARD low? • Reclaimed Slopes into the pit (above final pit lake) provide lower value?	8	• Partial backfill acts as an access road for ore haulage • Pit will be receptor for HLF seepage water • Ultimately will overflow into the Alpha Rock drain and Halfway creek • Some seepage to groundwater is expected • No Groundwater inflows
Supremo Pit (partial backfill - above final pit lake)	Ridge top extending down southern slope	• Reclaiming roads (causeway area) could be a high priority area in terms of visibility	• Less visual impact considering a partially backfilled pit	9	• Multiple pit lakes • Receptors include Latte creek, YT-24 and Halfway creeks • Analysis underway to see if more backfill can happen in Supremo.

Enter table source here.

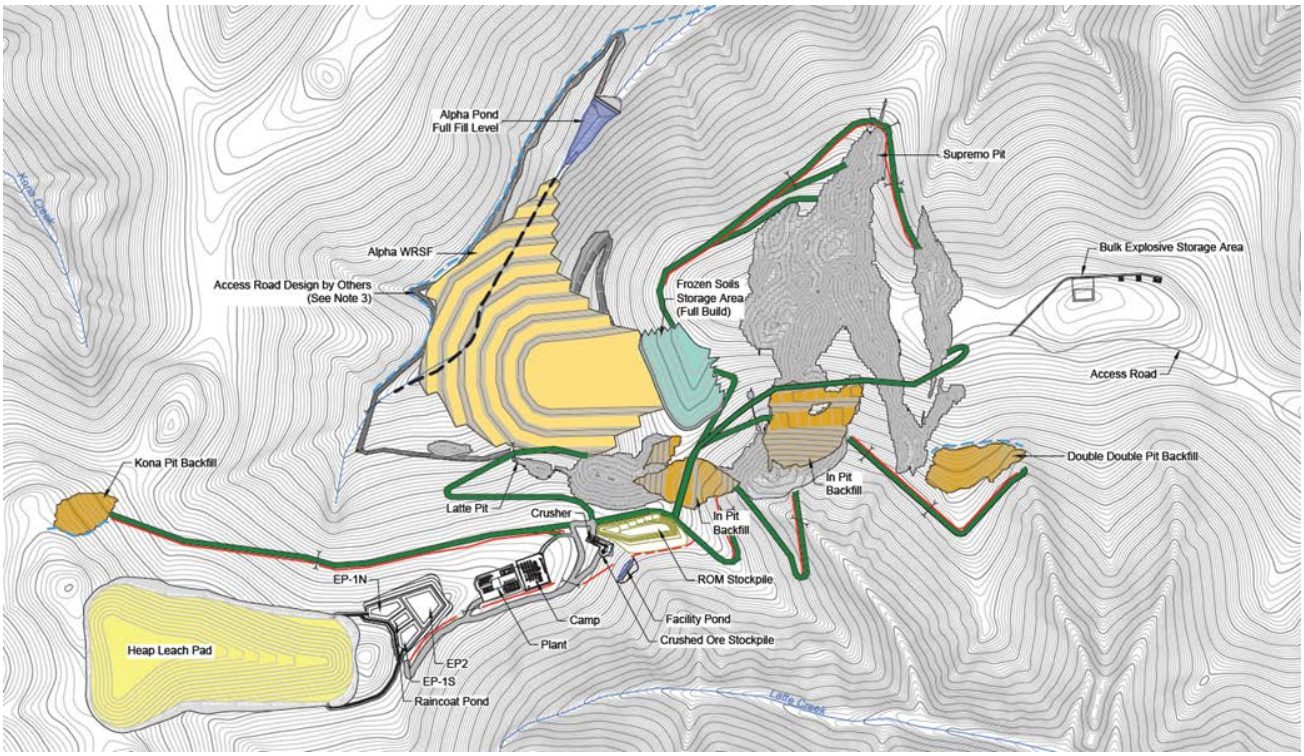


Figure 1: Coffee Mine Layout

We trust information provided in this memorandum is satisfactory for your requirements. Please do not hesitate to contact me at 902-209-7758 or mbarteaux@okc-sk.com should you have any questions or comments.

Appendix D

FMEA Workshop Fact Sheet #8 and #9

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-010
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #8 – Reclamation Material Balance**

Summarizing Reports (References)

- JDS Energy & Mining Ltd. (JDS). 2018. Surface Material for Reclamation.
- JDS. 2019. Material Balance Report Coffee Mine.
- Lorax Environmental (Lorax). 2019. Coffee Mine Update Study Water Balance and Water Quality Model.

Summary of Reclamation Material Volumes

- Overall estimates of available reclamation material ranges from 2.8 Mm^3 to 2.6 Mm^3 depending on the scenario of suitable material below the heap leach facility (HLF).
- Reclamation Material is comprised of 3 stratigraphic units defined by Tetratech test pitting programs – Organics, Upper Silts, and the upper 0.2 m of the Lower Gravel
- JDS (2019) was used to understand pre-production material volumes. JDS (2018) provides estimates for available material from pit development, production, and operations.
- Frozen material defined in the Coffee Mine Update Study (CMUS) was identified as material below the HLF that was not considered organics. The extent of how much of this material is frozen is not known and has been included as upper silt and lower gravel within the materials balance.

- The overall volume (including material outside the HLF foundation), and suitability of frozen material, for use as reclamation material remains an uncertainty for the project given depth of refusal for test pitting programs.
- Surface areas of components required to be reclaimed have been provided in JDS 2018. These will need to be updated as further design of these mine components is advanced in 2022.
- Cover system application scenarios have been presented for 0.3 m, 0.5 m, and 1.0 m to illustrate the impact of cover system alternatives on the overall material balance (Figure 1, and Table 1).
- In consideration of constructability and likely performance requirements, the Base Case cover system for the HLF is assumed to be a 0.5 m store and release overlying a GCL on the plateaued areas, and 0.5 m store and release cover system on sloped segments.
- The Base Case currently assumes no cover system will be placed over the Alpha WRSF.

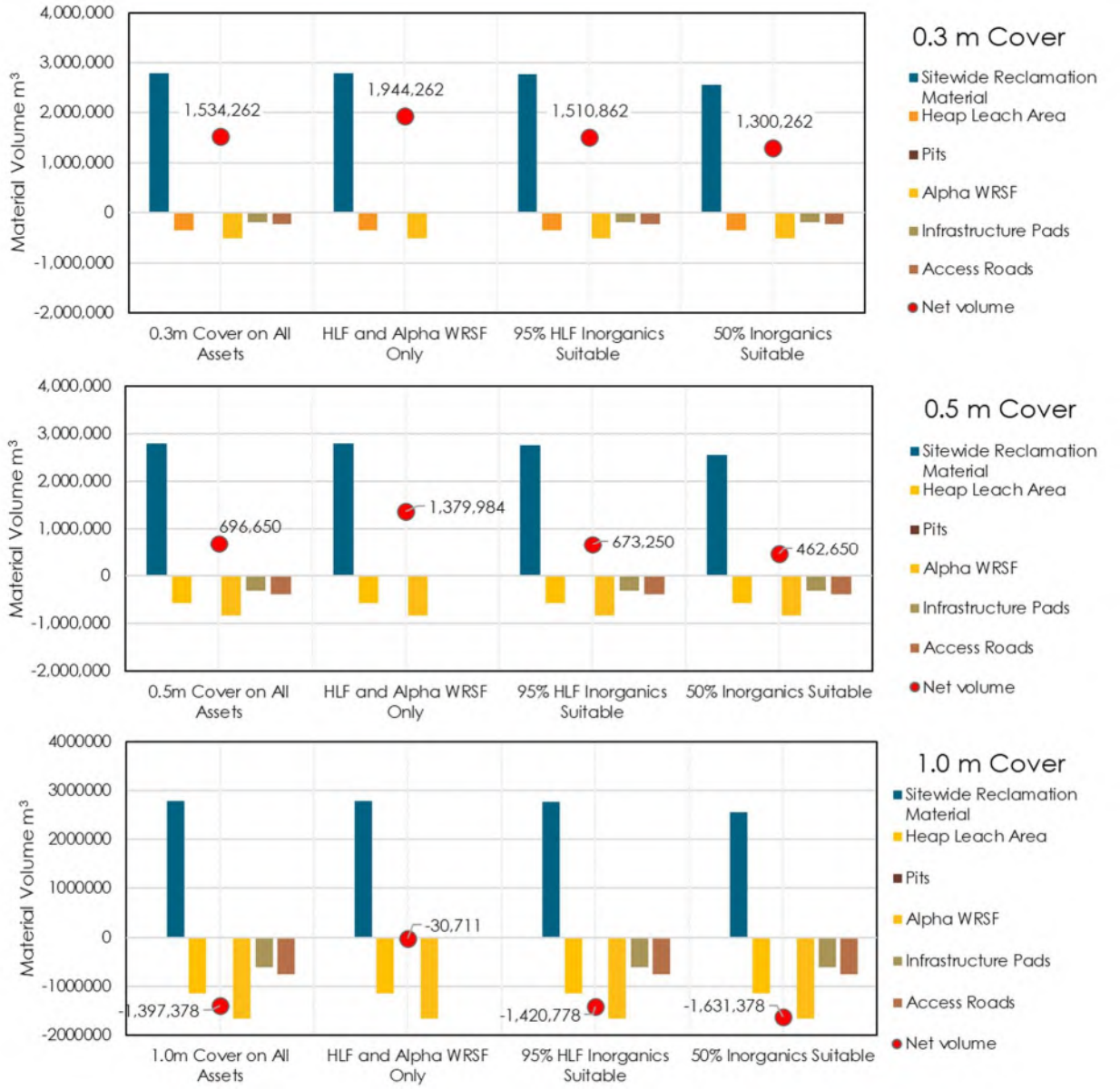


Figure 1: Material balance results for different cover thicknesses and scenarios.

Table 1: Summary of material balances for each scenario.

Average Cover Thickness	Structure	Cover on All Assets	HLF and Alpha WRSF Only	95% HLF Inorganics Suitable	50% HLF Inorganics Suitable
		m^3	m^3	m^3	m^3
0.3 m	Sitewide Reclamation Material	2,790,679	2,790,679	2,767,279	2,556,679
	Heap Leach Area	-345,000	-345,000	-345,000	-345,000
	Pits	0	0	0	0
	Alpha WRSF	-501,417	-501,417	-501,417	-501,417
	Infrastructure Pads	-182,000	0	-182,000	-182,000
	Access Roads	-228,000	0	-228,000	-228,000
	Net volume	1,534,262	1,944,262	1,510,862	1,300,262
0.5 m	Sitewide Reclamation Material	2,790,679	2,790,679	2,767,279	2,556,679
	Heap Leach Area	-575,000	-575,000	-575,000	-575,000
	Pits	0	0	0	0
	Alpha WRSF	-835,695	-835,695	-835,695	-835,695
	Infrastructure Pads	-303,333	0	-303,333	-303,333
	Access Roads	-380,000	0	-380,000	-380,000
	Net volume	696,650	1,379,984	673,250	462,650
1.0 m	Sitewide Reclamation Material	2,790,679	2,790,679	2,767,279	2,556,679
	Heap Leach Area	-1,150,000	-1,150,000	-1,150,000	-1,150,000
	Pits	0	0	0	0
	Alpha WRSF	-1,671,390	-1,671,390	-1,671,390	-1,671,390
	Infrastructure Pads	-606,667	0	-606,667	-606,667
	Access Roads	-760,000	0	-760,000	-760,000
	Net volume	-1,397,378	-30,711	-1,420,778	-1,631,378

Table 2: Reclamation Material Volume by Location and Type (JDS 2018, 2019)

Area	Material Type	Volume Available for Reclamation
Plant Area & Crusher	Organics	82,709
	Upper Silt	-
	Lower Gravel	-
	Weathered Bedrock	-
	Subtotal	**82,709**
Heap Leach Area & Event Ponds	Organics	339,030
	Upper Silt	468,000
	Lower Gravel	
	Weathered Bedrock	-
	Subtotal	**807,030**
Kona Pit	Organics	18,866
	Upper Silt	81,752
	Lower Gravel	12,577
	Weathered Bedrock	-
	Subtotal	**113,195**
Latte Pit	Organics	71,955
	Upper Silt	71,955
	Lower Gravel	71,955
	Weathered Bedrock	-
	Subtotal	**215,864**
Supremo PH 1-4 Pit	Organics	321,019
	Upper Silt	642,038
	Lower Gravel	256,815
	Weathered Bedrock	-
	Subtotal	**1,219,872**
Supremo PH5 Pit	Organics	27,177
	Upper Silt	95,118
	Lower Gravel	27,177

	Weathered Bedrock	-
	Subtotal	149,472
Double Double Pit	Organics	24,129
	Upper Silt	24,129
	Lower Gravel	-
	Weathered Bedrock	-
	Subtotal	48,258
On-Site Development	Organics	154,278
	Upper Silt	-
	Lower Gravel	-
	Weathered Bedrock	-
	Subtotal	154,278
	Total	**2,790,679**
Material Type Summary	Organics	1,039,162
	Upper Silt	914,993
	Lower Gravel	368,524
	HLF Upper Silt and Lower Gravel	468,000
	Weathered Bedrock	

Memorandum

To:	Coffee Mine FMEA Participants
From:	Terryn Kuzyk, Geoenvironmental Engineer
Our ref:	1075-220-011
Date:	February 9, 2022
Re:	**FMEA Fact Sheet #9 – Material Properties**

Summarizing Reports (References)

- The Mines Group Inc. (MINES). 2016. Feasibility Design Report for Coffee Gold Heap Leach Facility, Yukon Territory, Canada. Prepared for Kaminak Gold Corporation. Report No. 15-78-01- Rev A. January 30, 2016.
- SRK (Steffen Robertson & Kirsten). 2016. 2015 Geotechnical Field Investigation for Kaminak Coffee Gold Project,. Denver USA.
- Tetra Tech. 2017a. Thermal Evaluation of Duration of Thaw of Permafrost Soils at Coffee Mine Site Study Area Under Long-term Climate Conditions, Yukon, Canada. Tetra Tech memo to Goldcorp Inc. January 19, 2017.
- Tetra Tech. 2017b. Fall 2017 Test Pitting Program, Coffee Mine Site Phase 1: Proposed Infrastructure Footprints, Phase 2: Proposed Open Pit Areas. Prepared for JDS Energy & Mining.
- Tetra Tech. 2019. Fall 2018 Testpitting Program Data Report Coffee Gold Project. Prepared for JDS Energy & Mining. January 9, 2019.

Summary

- Ore residue (ore material after it has been leached) is poorly graded and primarily gravel (60 to 96%)
- Corrected max dry density for ore residue ranges from 1,887 to 2,497 kg/m^3 and corrected optimum water contents range from 3 to 11%
- Hydraulic conductivity of the ore residue ranged from 3.5x10^{-4} to 6.9x10^{-3} m/s
- Overburden test pitting sites investigated can be generally summarized as poorly to well graded rock fragments with varying amounts of silts and sands.
- Test pitting results indicated that most materials were low to non-plastic
- Discontinuous lenses of permafrost occur under approximately 60% of the site, which acts as a confining layer to the groundwater below. The permafrost classification for the site is “warm” and accordingly, the ground is sensitive to disturbance.
- Frozen soils are predominately on the north- and west-facing slopes and in valleys and thickest on higher elevation north-facing slopes

Materials

Heap Leach Facility – Ore Residue Material

- Ore residue material consists of ore material after it has been leached.
- Testing was completed on leached ore residue materials from column testing completed on different pits and crush sizes by Geo-Logic Associates (GLC) of Grass Valley, California. Geotechnical testing includes specific gravity, moisture content, particle size distribution (PSD), Atterberg limits, compaction testing, direct shear, triaxial shear, and hydraulic conductivity.
- Specific gravity for the ore residues ranged from 2.69 to 2.75 in which materials were poorly graded gravel with sands, silts, and clay. Ore residues were primarily composed of gravel-sized particles ranging from 60% to 96% (Figure 1).
- Plasticity indices for these samples ranged from 6 to 16.

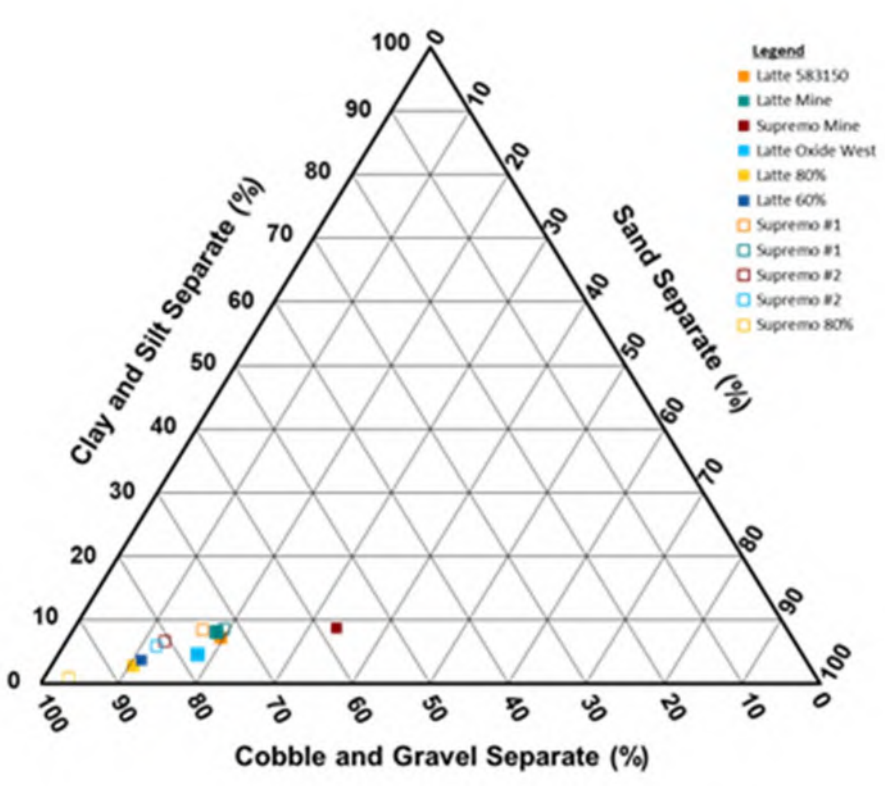


Figure 1: Texture triangle for ore residues

Data from Table 4-2 in MINES (2016)

- Compaction testing (standard proctor) was completed on nine ore residue samples. Optimum moisture contents and maximum dry density for these materials are summarized in Table 1.

Table 1: Heap leach pad sample compaction testing

Sample ID	Corrected Maximum Dry Density (kg/m^3)	Corrected Optimum Moisture Content (%)
Latte 583150	2,318	6
Latte 583350	2,372	5
Latte Mine	1,887	8
Supremo Mine	1,988	11
Latte Oxide West	2,283	4
Latte 80%	2,497	3
Latte 60%	2,332	3
Supremo #1	2,347	4
Supremo #1	2,400	4

Modification of Table 4-4 in MINES (2016)

- Triaxial shear testing was completed on three ore residue samples (Table 2) and hydraulic conductivity testing was completed on four ore residue samples (Table 3).

Table 2: Ore residue sample triaxial shear testing

Sample ID	Confining Stress (kPa)	Dev. Stress (kPa)	Pore Pressure (kPa)	Effective Stress (kPa)	Total Stress (kPa)	Final Moisture Content (%)
Latte 583150	95.8 239.2 487.5	200.6 390.2 672.2	55.2 135.1 311.6	C = 6.89 Ø = 40.2°	C = 27.6 Ø = 22.3°	11.9
Latte Oxide West	95.8 239.2 487.5	121.3 273.7 513.7	57.2 158.6 350.3	C = 0 Ø = 40.6°	C = 6.9 Ø = 20°	12.5
Supremo #1	95.8 239.2 487.5	124.1 254.4 490.2	68.9 160.6 360.6	C = 0 Ø = 40.9°	C = 13.8 Ø = 18.9°	13.7

Modification of Table 4-6 in MINES (2016)

Table 3: Ore residue sample hydraulic conductivity testing

Sample ID	Normal Stress (kPa)	Moisture Content (%)	Dry density (tonnes/m^3)	Hydraulic Conductivity (cm/s)
Latte 583150	Initial	2.1	1.56	
	241		1.58	4.8E-01
	248		1.65	4.10E-01
	965		1.53	3.6E-01
	(Drained)	7.6	1.59	
Latte Oxide West	Initial	1.9	1.52	
	241		1.52	4.9E-01
	248		1.53	4.8E-01
	965		1.53	4.5E-01
	(Drained)	6.9	1.53	
Supremo #1	Initial	0.8	1.65	
	241		1.86	7.0E-02
	248		1.94	6.2E-02
	965		2.04	3.5E-02
	(Drained)	11.9		
Supremo #2	Initial	1.9	1.53	
	241		1.69	6.5E-01
	248		1.76	6.7E-01
	965		1.82	6.9E-01
	(Drained)	9	1.82	

Modification of Table 4-7 in MINES (2016)

Disturbance Materials – Test Pit Investigation Programs

- Extensive detailed geotechnical investigations were carried out between 2015 and 2018 by Tetra Tech and SRK (SRK 2016; Tetra Tech, 2017a; 2017b; 2019).

- These investigations variably included PSD analyses, moisture content, excess ice content, specific, frozen, and bulk density, porewater salinity, Atterberg limits, compaction tests, shear tests and organics content. Investigations were carried out at all sites that may see disturbance during mining activities.

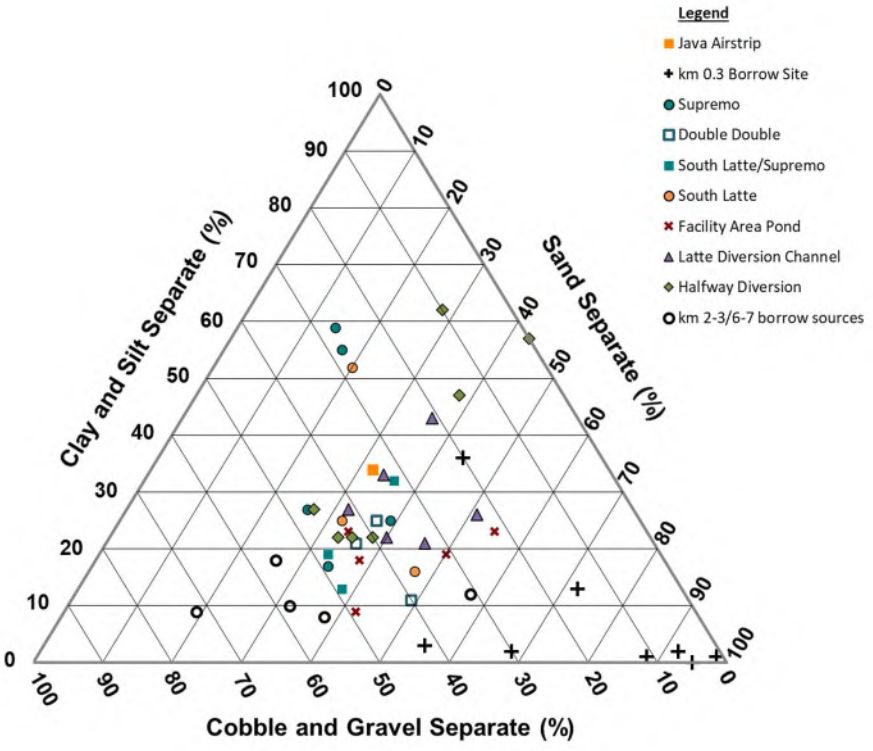


Figure 2: Texture triangle of reclamation materials sampled during 2018

(Tetra Tech, 2019)

- A summary of the 2015 test pitting investigation (Table 4) indicates variability in the material properties between locations. Each of the overburden sites investigated can be generally summarized as poorly to well graded rock fragments with varying amounts of silts and sands. Locations with a greater proportion of rock fragments and lower fines by volume included the km 2-3/km 6-7 borrow sources, the facility pond area, Double Double Pit, South Latte and South Latte/Supremo.
- Generally, the suitability of overburden for reclamation material is limited by excess fines content in some locations (i.e., Java Airstrip) and highly weathered nature of the rock fragments.
- Tetra Tech (2019) indicates that processing of the overburden to sort the rock fragments may increase the usability of overburden for various material fill applications. Screened cobbles and boulders may be used in dam applications.
- The km 0.3 borrow source is dominated by sand and sub-round gravel that is suitable for road and airstrip construction, though the lack of angularity may require blending with other materials to increase compaction.

- Localized permafrost zones may require further processing before use in construction. The km 2-3/km 6-7 borrow sources are predominantly well sorted sand and gravels.
- The presence of cobbles and boulders indicates that if processed the material can be used for applications with more stringent PSDs.

Table 4: Summary of Atterberg test results from the 2015 investigation

Original Facility Location	Hole/Test Pit ID	Sample Number	Sample Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Plasticity *	Mod. USCS Class	Natural Moisture Content (%)
North Waste Rock Dump	SRK-15S-03	17728	0.6	99	62	37	High	OH	139.9
	SRK-15S-03	17729	6.7-7	0	0	0	NP	-	12.9
	SRK-15S-04	17725	1.1	129	85	44	High	OH	317.8
	SRK-15S-04	17726	3.7	0	19	0	NP	-	16.7
West Waste Rock Dump	SRK-15S-05	17702	2.7	33	27	6	Low	ML	50.3
	SRK-15S-06	17704	0.2	0	0	0	NP	-	6.8
	SRK-15S-07	17708	3.4	0	0	0	NP	-	12.4
	SRK-15S-08	17706	0.9	0	0	0	NP	-	28.3
	SRK-15S-08	17707	3.4	20	17	3	Low	ML	13.8
	SRK-15TP-50	17592	0.4	0	0	0	NP	-	63.0
	SRK-15TP-55	17628	0.3	0	0	0	NP	-	76.5
	SRK-15TP-56	17629	0.35	0	0	0	NP	-	68.4
South Waste Rock Dump	SRK-15S-09	17709	1.8	37	30	7	Low	ML	57.2
	SRK-15S-11	17711	2.3	0	0	0	NP	-	8.8
	SRK-15S-12	17712	2.4	0	0	0	NP	-	19.5
Heap Leach Pad (HLP)	SRK-15S-13A	17718	0.9	25	19	6	Low	CL-ML	16.2
	SRK-15S-20	17722	0.9	23	17	6	Low	CL-ML	73.1
	SRK-15S-25	17723	0.6	25	22	3	Low	ML	12.6
	SRK-15TP-03	17565	0.5-1	29	23	6	Low	ML	10.5
	SRK-15TP-20	17564	0.6	0	29	0	NP	-	20.7
	SRK-15TP-43	17560	0.6	0	21	0	NP	-	12.6
ROM Stockpile & Infrastructure Sites	SRK-15S-29	17732	0.9	0	0	0	NP	-	2.9
	SRK-15S-34	17739	1.1	20	16	4	Low	ML	14.9
	SRK-15S-35	17741	1.2	0	0	0	NP	-	44.9

(SRK, 2016)

Table 5: Summary of geotechnical properties from 2018 joint (JDS and Tetra Tech) test pitting program investigation

Site Infrastructure	Sample Number	Depth		Moisture Content (%)	Fines (%)		Sand (%)	Gravel (%)	Cobble (%)	Atterberg Limits			Excess Ice Content (% by volume)	Bulk Density (kg/m³)	Proctor Result	
		From (m)	To (m)		Clay (%)	Silt (%)				LL	PL	PI			Maximum Dry Density (kg/m³)	Optimum Moisture Content (%)
Java Airstrip Alignment	TP01-01	0.30	0.50	11.9	34		32	34	0	17	14	3	-	-	2,040	10.9
	TP02-01	0.20	0.40	13.9									-	-		
	TP03-01	0.20	0.30	29.2									-	-		
	TP03A-01	0.70	1.30	9.5									-	-		
	TP04-01	0.35	0.80	-									-	-		
	TP04A-01	0.10	0.40	16.4									-	-		
km 0.3 Borrow Site	TP05-02	0.70	1.40	2.1	2		68	30	0	-	-	-	-	-	-	-
	TP06-01	0.15	1.00	8.4	36		44	20	0	-	-	-	-	-	-	-
	TP06-02	1.00	1.50	1.4	-		95	5	0	-	-	-	-	-	-	-
	TP06-03	4.00	4.00	6.1	13		72	15	0	-	-	-	-	-	-	-
	TP07-02	1.40	1.60	3.4	2		92	6	0	-	-	-	-	-	-	-
	TP08-02	0.65	1.10	1.7	3		55	42	0	-	-	-	-	-	-	-
	TP08-03	1.10	1.60	2.1	1		98	1	0	-	-	-	-	-	-	-
	TP09-02	1.20	1.50	1.6	1		88	11	0	-	-	-	-	-	-	-
Supremo	TP12-01	0.40	1.20	22.8	55		17	28	0	-	-	-	-	-	-	-
	TP14-01	0.30	0.70	24.1	59		14	27	0	-	-	-	-	-	-	-
	TP17-01	0.00	1.80	11.8	27		26	47	0	-	-	-	-	-	-	-
	TP21-01	0.30	3.50	9.7	17		34	49	0	-	-	-	-	-	-	-
	TP24-01	0.40	1.00	11.5	25		39	36	0	-	-	-	-	-	-	-
Double Double	TP25-01	0.20	1.40	11.0	21		36	43	0	-	-	-	-	-	-	-
	TP27-01	0.30	4.00	10.1	11		49	40	0	-	-	-	-	-	-	-
	TP28-01	0.20	2.20	10.7	25		37	38	0	-	-	-	-	-	-	-
	TP30-01	0.30	1.70	12.2	25		37	38	0	-	-	-	-	-	-	-
South Latte/ Supremo	TP32-01	0.15	0.70	11.1	13		38	49	0	-	-	-	-	-	-	-
	TP32-02	0.70	1.20	17.0	13	19	36	32	-	-	-	-	-	-	-	-
	TP33-01	0.20	0.90	26.4	19		33	48	0	-	-	-	-	-	-	-
South Latte	TP36-01	0.50	1.00	40.4	25		32	43	0	-	-	-	-	-	-	-
	TP36-02	1.00	1.70	17.4	7	9	47	37	-	32	0	0	-	-	-	-
	TP38-01	0.40	1.00	-	52		20	28	0	-	-	-	-	-	-	-

(Tetra Tech, 2019)

Table 5 (Con't): Summary of geotechnical properties from 2018 joint (JDS and Tetra Tech) test pitting program investigation

Site Infrastructure	Sample Number	Depth		Moisture Content (%)	Fines (%)		Sand (%)	Gravel (%)	Cobble (%)	Atterberg Limits			Excess Ice Content (% by volume)	Bulk Density (kg/m³)	Proctor Result	
		From (m)	To (m)		Clay (%)	Silt (%)				LL	PL	PI			Maximum Dry Density (kg/m³)	Optimum Moisture Content (%)
Facility Pond Area	TP40-01	0.30	1.00	8.9	9		42	49	0	-	-	-	-	-	-	-
	TP42-01	0.40	1.00	19.3	19		50	31	0	-	-	-	-	-	-	-
	TP43-01	0.20	0.80	12.5	23		34	43	0	-	-	-	-	-	-	-
	TP48-01	0.30	1.00	15.1	18		38	44	0	-	-	-	-	-	-	-
	TP49-01	0.40	1.00	11.6	8	15	55	22	-	27	0	0	-	-	-	-
Latte Diversion Channel	TP51-01	0.50	1.00	17.8	26		51	23	0	-	-	-	-	-	-	-
	TP52-01	0.45	1.00	14.4	21		46	33	0	-	-	-	-	-	-	-
	TP58-01	0.60	1.30	25.2	43		36	21	0	-	-	-	-	-	-	-
	TP59-01	0.35	1.30	11.4	8	25	34	33	-	25	0	0	-	-	-	-
	TP59-02	1.30	2.30	8.1	22		40	38	0	-	-	-	-	-	-	-
	TP62-01	0.45	1.30	11.7	27		32	41	0	-	-	-	-	-	-	-
Halfway Diversion	TP64-01	0.25	0.50	194.7	57		43	0	0	-	-	-	-	-	-	-
	TP65-01	0.20	0.50	35.1	22		35	43	0	-	-	-	-	-	-	-
	TP66-01	0.50	0.70	19.0	11	36	38	15	-	0	0	0	0.0	2,116	-	-
	TP66-02	0.70	1.10	41.9	27		27	46	0	-	-	-	29.9	-	-	-
	TP67-02	0.50	0.80	28.6	62		28	10	0	-	-	-	-	-	-	-
	TP68-02	0.45	0.90	9.5	22		33	38	7	-	-	-	-	-	-	-
	TP68-03	0.90	1.20	10.3	7	15	38	40	-	0	0	0	-	-	-	-
	TP69-01	0.90	0.95	529.0	-		-	-	-	-	-	-	41.7	1,001	-	-
	TP69-02	0.40	0.70	277.2	-		-	-	-	-	-	-	34.9	-	-	-
	TP69-03	0.80	1.20	313.7	-		-	-	-	-	-	-	34.4	-	-	-
km 2-3/km 6-7 Borrow Sources	TP70-01	1.50	1.50	5.0	8		38	41	13	-	-	-	-	-	2,150	7.0
	TP71-01	1.50	1.50	7.1	12		57	31	0	-	-	-	-	-	2,170	7.5
	TP72-01	1.50	1.50	12.6	18		26	49	7	-	-	-	-	-	2,060	8.0
	TP73-01	1.50	1.50	4.8	9		19	65	7	-	-	-	-	-	2,140	7.0
	TP74-01	1.50	1.50	9.9	10		32	54	4	-	-	-	-	-	2,160	7.5

(Tetra Tech, 2019)

Permafrost

- Lenses of discontinuous permafrost occur under approximately 60% of the site, which acts as a confining layer to the groundwater below.
- Frozen soils are predominately on the north- and west-facing slopes and in valleys and thickest on higher elevation north-facing slopes (30-165 m thick).
    - Ice-poor permafrost is common in upland settings along ridges and on moderately steep valley sides with convex or straight slopes.
    - Ice-rich permafrost is more common in areas with higher organic accumulation and silt-rich sediments in fluvial valley bottoms.
    - Approximately 34% of the project area is underlain by ice-poor permafrost, 27% by permafrost with visible excessive ice, and 1% by ice-rich permafrost.
- Permafrost-related processes active on-site include solifluction, active layer detachment, slope creep, frost heave, and thermal erosion.
- The warmest permafrost temperatures (-0.6ºC) occur at the bottom of the Halfway Creek valley. The coldest permafrost temperatures (-2.0ºC) occur at the bottom of YT-24 Creek and on the north-facing slope of the upper Halfway Creek valley.
- The permafrost classification for the site is “warm” and accordingly, the ground is sensitive to disturbance.

Appendix E

SPA Numerical Modelling

Saskatoon

112 - 112 Research Drive
Saskatoon, SK S7N 3R3
Canada
www.okc-sk.com

Memorandum

To:	Ryan Herbert, P.Ag. – Practice Lead, Environmental Permitting , Ensero Solutions
From:	Joel Steeves, Intermediate Geoscientist
Cc:	Mitchell Barteaux – Okane Consultants
Our ref:	1075-220-020 Rev0
Date:	April 11, 2022
Re:	**Coffee Mine 1D and 2D SPA Numerical Modelling**

The Coffee Mine project team is in the process of developing an updated reclamation and closure plan (RCP) for the Coffee Mine Project (the Project), including the development of closure strategies for the proposed heap leach facility (HLF). Previous closure planning work for the Project included an alternatives assessment, which identified a preferred cover system alternative for the HLF in closure. The closure cover system is comprised of a geosynthetic clay liner (GCL) low permeability store and release cover system on plateau segments, and a simple store and release cover system on 2.5H:1V slope sections.

To enhance the understanding of the various HLF cover system alternatives and the base case evaluated in the previous alternatives assessment, Okane Consultants (Okane) completed one-dimensional (1D) soil-plant-atmosphere (SPA) numerical modelling. The objective of the 1D numerical modelling is to provide estimated water balance parameters and associated performance of the alternatives that was incorporated into an updated ranking exercise completed by the project team.

Following the 1D numerical modelling and sensitivity analysis, simple 2D modelling was completed to demonstrate the understanding of water movement above the GCL (plateau) and without a GCL (slope) as well as to support the HLF cover system design.

Cover System Alternatives Evaluated

The alternatives evaluated in the previous alternatives assessment were primarily differentiated by variations in the coverage and application of a geosynthetic clay layer (GCL) cover system. The alternatives include:

- GCL cover system on plateau sections only, with a store and release cover system on the slope sections; or
- GCL cover system on both the plateau and slope sections.

Okane completed 1D conceptual water balances for these scenarios to estimate performance without a GCL cover on the slopes and with a GCL on the plateau segment.

The GCL cover system was modelled as:

- 0.5 m storage layer;
- 0.3 m gravel drainage layer;
- 1 cm geosynthetic clay layer; and
- 5.0 m of rinsed ore.

The store-and-release cover system was modelled as:

- 0.5 m storage layer; and
- 5.0 m of rinsed ore.

Material Properties

Material properties were estimated for each material based on available lab and field data. The saturated hydraulic conductivity for each material is shown in Table 1, while Figure 1 shows the water retention curve for each material.

Table 1: Saturated hydraulic conductivities of the materials used in the 1D numerical simulations.

Material	Storage Layer	Storage Layer – Sensitivity A	Storage Layer – Sensitivity B	Rinsed Ore	GCL	Gravel Drainage
Saturated Hydraulic Conductivity (m/s)	1×10^{-6}	1×10^{-5}	1×10^{-7}	1×10^{-4}	5×10^{-11}	1×10^{-3}

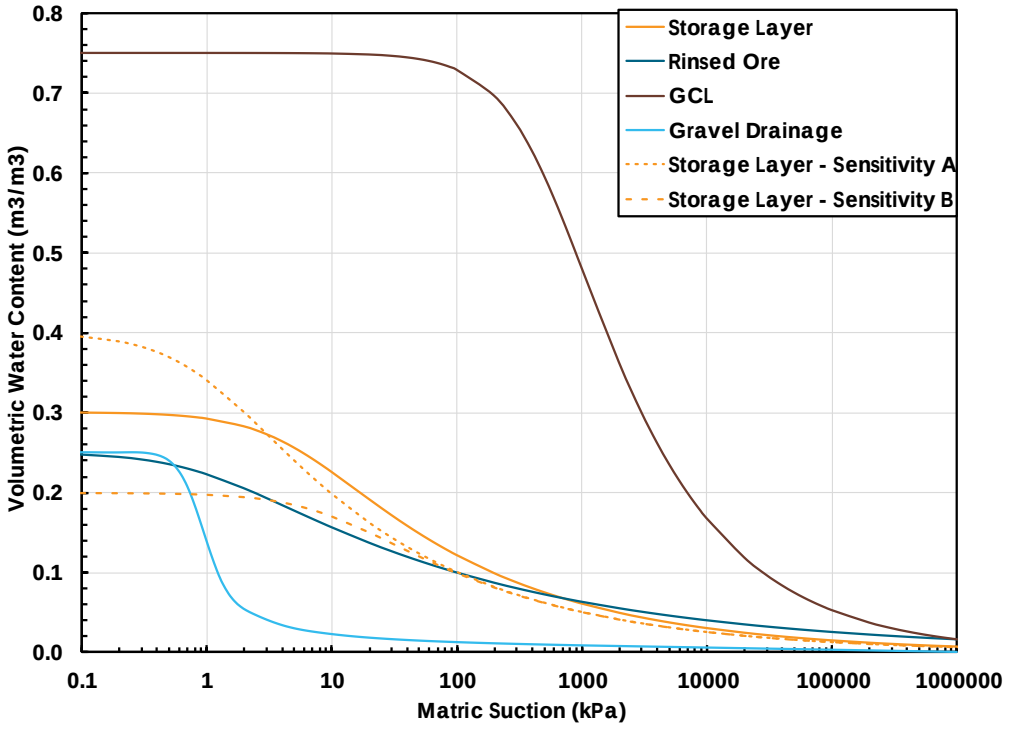


Figure 1: Water retention curves for the materials used in the 1D numerical simulations.

Climate

The upper boundary condition of the numerical model simulates the surface energy balance and surface water balance using daily climatic inputs. The synthetic historical climate database developed by Lorax[1] was used as direct inputs for this numerical modelling. Climate change was incorporated into this modelling as a sensitivity using the representative concentration pathway (RCP) 6.0 database developed by Lorax[1].

Numerical Water Balance Summary

The components of a typical cover system water balance for a cold region are illustrated Figure 2. The International Network for Acid Prevention (INAP) cover system guidance document[2] defines cover system by amount of net percolation (NP) reaching the underlying waste material. The water balance developed by Okane through 1D numerical modelling for the potential cover system scenarios of the HLF is summarized in Table 2. The primary focus for this assessment is the amount of NP reaching the

[1] Lorax Environmental Services Ltd. 2022. Coffee Gold Project: 2021 Hydro-meteorology Baseline Report. January 2022.

[2] The International Network for Acid Prevention (INAP). 2017. Global Cover System Design Technical Guidance Document. November. Online: https://www.inap.com.au/wp-content/uploads/2018/05/global-cover-system-design.pdf

underlying heap material through the cover system. The water balance results provided in Table 2 are consistent with the conceptual range of cover system presented in terms of "very low," "low," "moderate," and "high" NP from the INAP cover system guidance document[3]. For the HLF, a very high NP rate is classified as greater than 50% (% of PPT), high NP is between 25% PPT and 50% of PPT, moderate (Mod) is between 15% PPT and 25% PPT, low is between 5% PPT and 15% PPT, and very low (VL) is less than 5% PPT. The cover systems are estimated to perform within the following NP classifications:

- The plateau areas of the HLF with a GCL underlying a store-and-release cover system – Very Low
- The slopes covered with a store-and-release cover system – Moderate to High

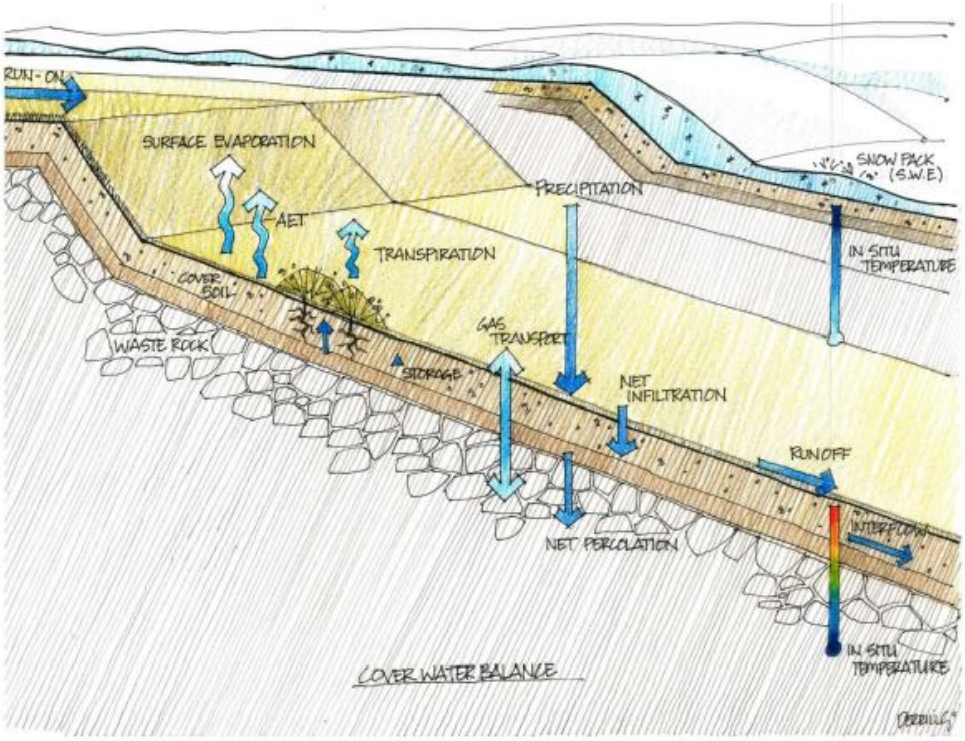


Figure 2: Typical cold regions cover system water balance components.

(INAP, 2017)

Another component of interest in the cover system water balance is interflow. Interflow is a two-dimensional process. In order to account for interflow within the 1D model, water was allowed to exit the model domain at the base of the cover system when the pore-water pressure became positive. This does not account for water flow as a result of hydraulic head differences with elevation changes on the slope but does provide a release for water under saturated conditions and a preliminary estimate of

[3] The International Network for Acid Prevention (INAP). 2017. Global Cover System Design Technical Guidance Document. November. Online: https://www.inap.com.au/wp-content/uploads/2018/05/global-cover-system-design.pdf

interflow. No water was allowed to leave the domain in this way in the slope store-and-release cover system as the absence of a low permeability layer greatly reduces the likelihood of interflow for this cover system scenario.

Table 2: Summary of the numerical water balances for the HLF base case cover system scenarios.

Cover Scenario	Mean Annual Precipitation (mm)	Evapotranspiration (% MAP[1])	Runoff (% MAP)	Net Percolation (% MAP)	Sublimation (% MAP)	Interflow (% MAP)
GCL Cover System	499	53%	16%	4%	14%	13%
Store-and-Release Cover System	499	46%	16%	24%	14%	-

1 – Mean Annual Precipitation

The net percolation varied year-to-year, as shown in Figure 3, but the GCL provided an upper limit on the net percolation into the rinsed ore of 5-6% mean annual precipitation (MAP). The slope store-and-release cover system showed greater net percolation, with most years having between 15% and 30% of MAP percolate into the rinsed ore (Figure 3).

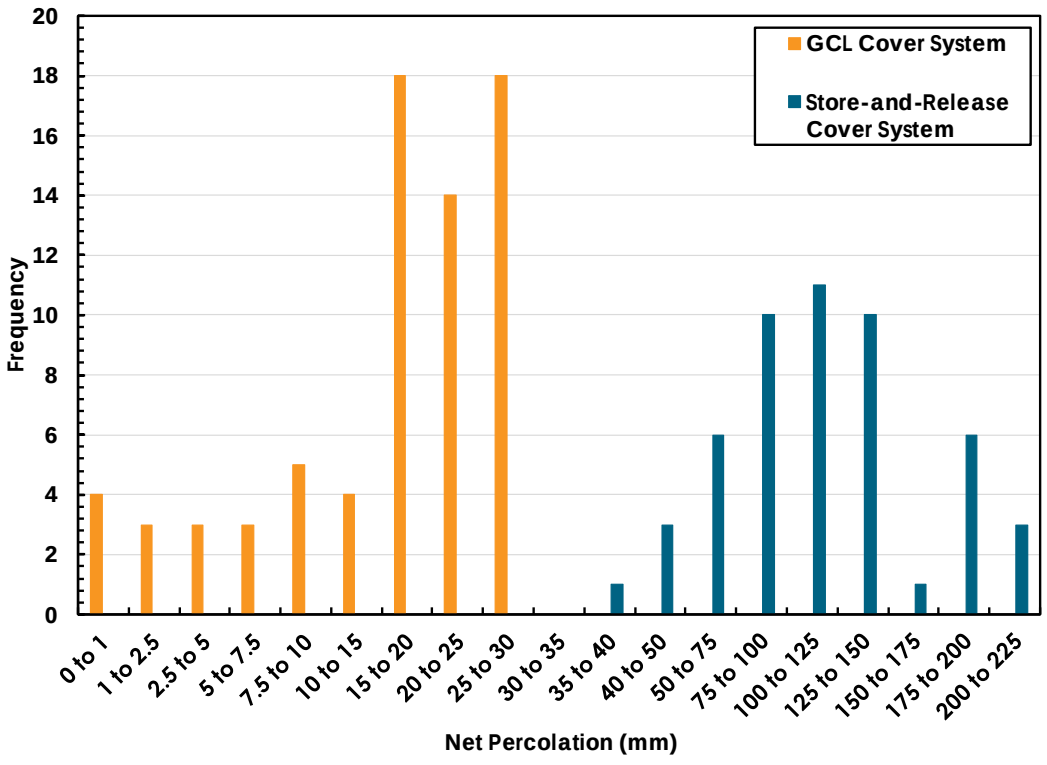


Figure 3: Distribution of net percolation for the base case cover system alternatives simulated.

The distribution of runoff was more equivalent between the different scenarios than the net percolation due to the same surface material being used in the alternatives. Runoff was mostly between 5 and 20% of MAP, as shown in Figure 4. Runoff in these simulations is highly controlled by the presence of frozen soil and its ability to reduce infiltration into the soil. In simulations with the same materials and geometry but no frozen soil, only approximately 1% MAP of runoff was generated.

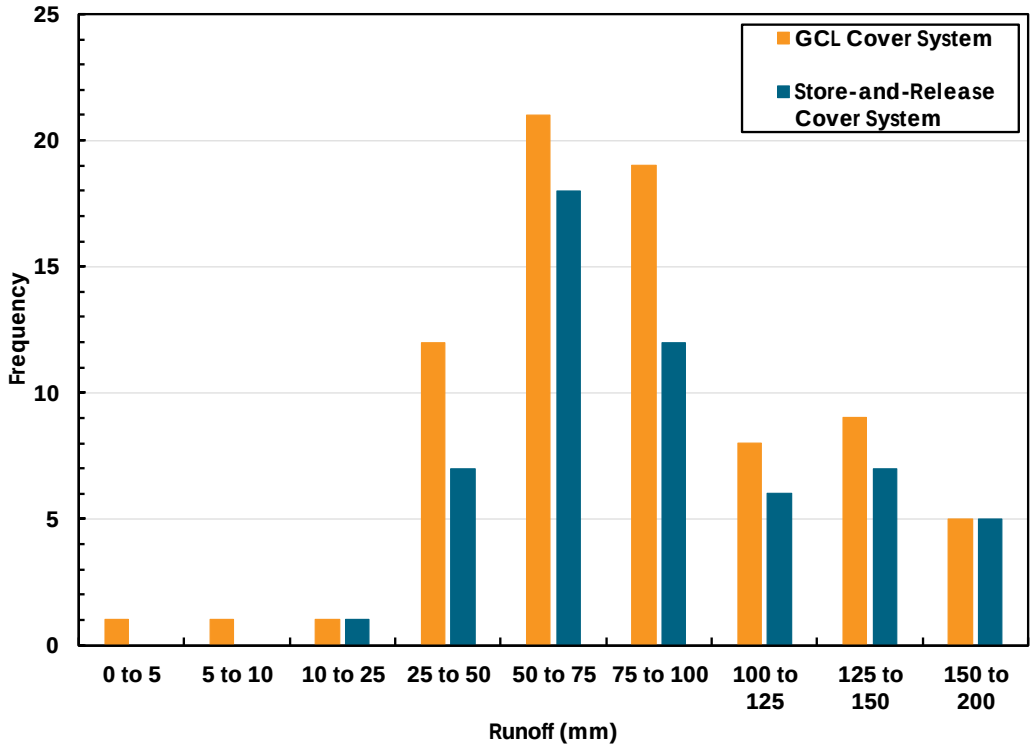


Figure 4: Distribution of runoff for the base case cover system alternatives simulated.

1D Sensitivities

One-dimensional sensitivities were performed to investigate the effects of heterogeneity of the storage layer, vegetation, and climate change on cover system performance. Two variations on the storage layer were modelled, one with a saturated hydraulic conductivity an order of magnitude higher (Sensitivity A) and one with a saturated hydraulic conductivity an order of magnitude lower (Sensitivity B). Figure 1 shows the water retention curves for the sensitivity materials.

The influence of vegetation was investigated through the addition of vegetation parameters in the calculation of the surface water balance and surface water balance of the base case models. Sparse vegetation was simulated using 30% ground cover and a rooting depth of 0.2 m.

Climate change conditions were examined through the application of the RCP6.0 climate database to the base case models.

Results from the sensitivities are presented in Table 3. The GCL cover system on the plateau maintained very low net percolation in all sensitivities. Interflow varied from 9% in the vegetation model up to 18% in the Sensitivity A model. The store and release cover system on the slope maintained moderate net percolation in all sensitivities, with values ranging from 20% MAP in the Sensitivity B and vegetation models up to 27% MAP in the climate change model. Runoff was higher than the base case models in all cases except the climate change sensitivities. Under RCP6.0 conditions, runoff dropped 3%.

Table 3: Summary of the numerical water balances for the HLF sensitivity cover system scenarios.

Cover Scenario	Mean Annual Precipitation (mm)	Evapotranspiration (% MAP[1])	Runoff (% MAP)	Net Percolation (% MAP)	Sublimation (% MAP)	Interflow (% MAP)
GCL with Storage Layer Sensitivity A	499	46%	18%	4%	14%	18%
GCL with Storage Layer Sensitivity B	499	46%	25%	4%	14%	11%
GCL with Vegetation	499	49%	24%	4%	14%	9%
GCL under RCP6.0	564	53%	13%	4%	13%	17%
Store and Release with Sensitivity A	499	44%	18%	24%	14%	-
Store and Release with Sensitivity B	499	41%	25%	20%	14%	-
Store and Release with Vegetation	499	42%	24%	20%	14%	-
Store and Release under RCP6.0	564	47%	13%	27%	13%	-

1 – Mean Annual Precipitation

2D Modelling

Conceptual two-dimensional (2D) modelling was performed to show the flow paths of infiltrating water. The 2D cross section was split into two model domains; one highlighting the conceptual performance of

the slope store and release cover system and the other highlighting the conceptual performance of the plateau store and release with GCL cover system.

The 2D conceptual modelling showed that, on the plateau, where a GCL is part of the cover system, the majority of the infiltrating water was diverted laterally above the GCL, as shown in Figure 5. On the slopes, with the store and release cover system, most of the infiltrating water flowed vertically through the cover system and into the ore below, as shown in Figure 6.

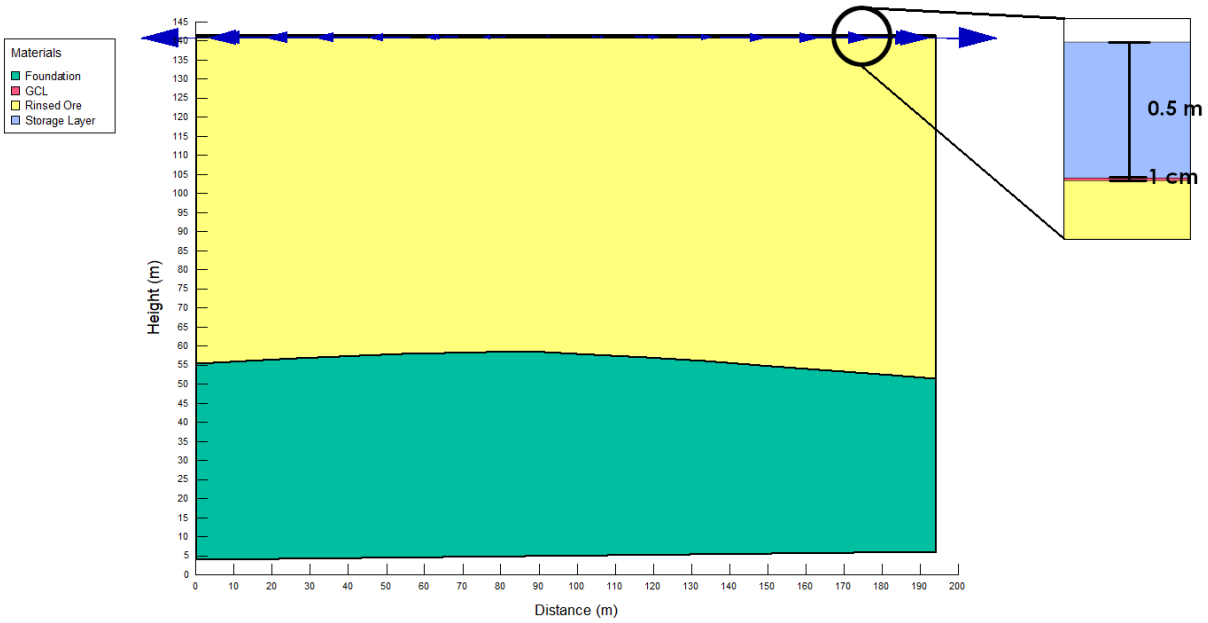


Figure 5: Conceptual water flow within the store and release with GCL cover system on the plateau. Blue arrows show water flow.

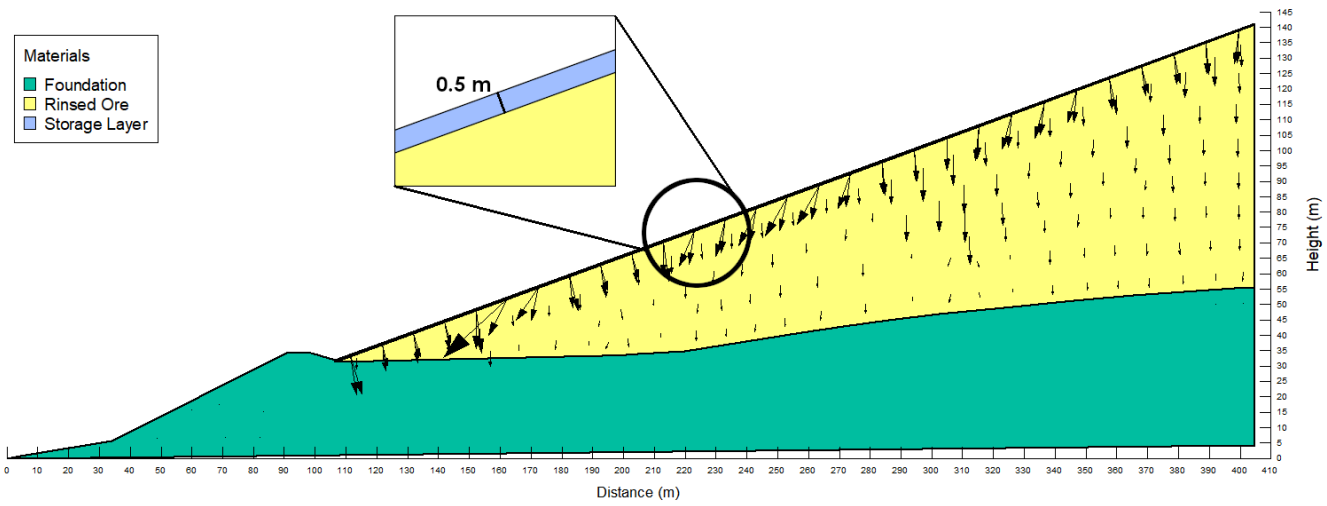


Figure 6: Conceptual water flow within the store and release cover system on the slopes. Black arrows show water flow.

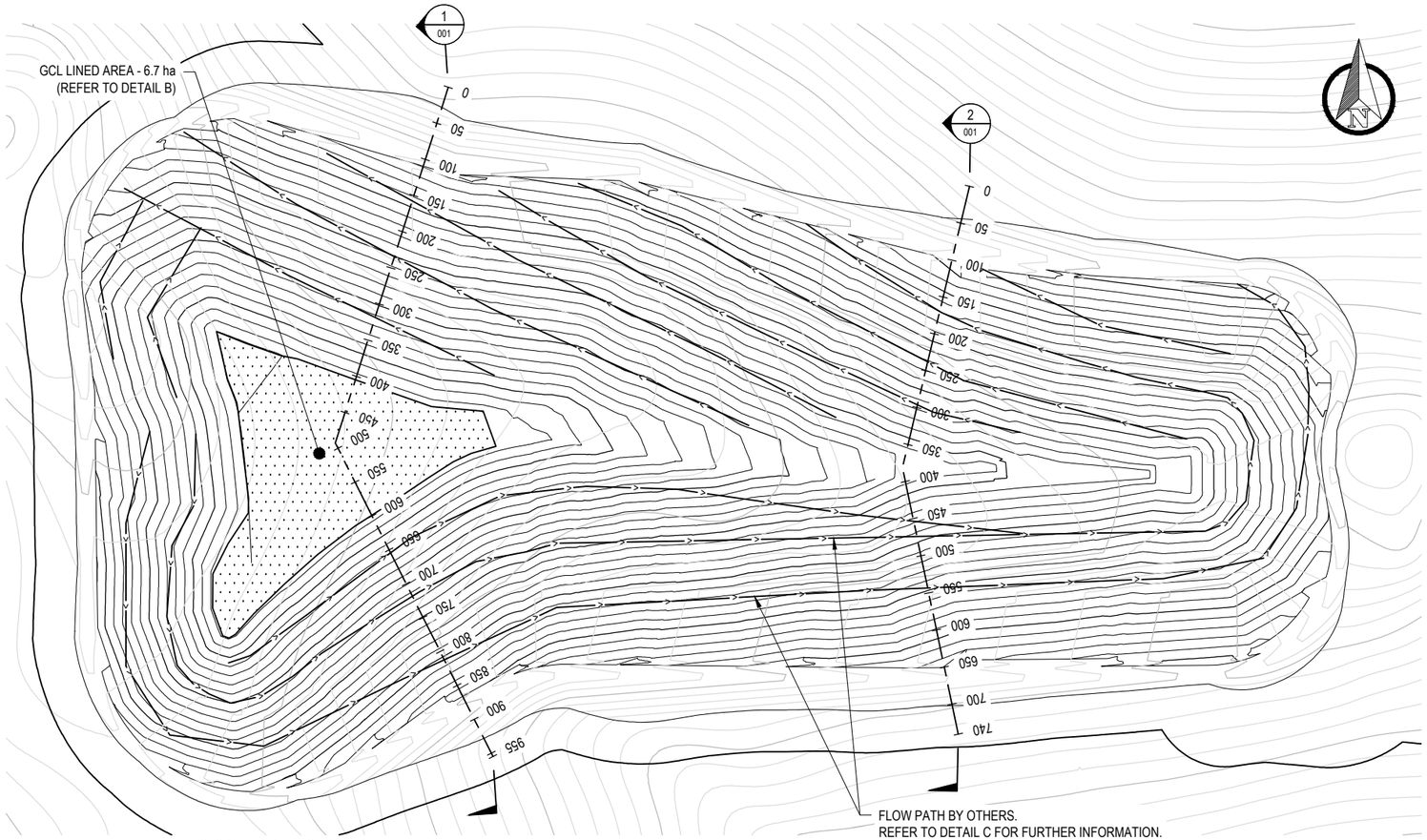
Conclusion

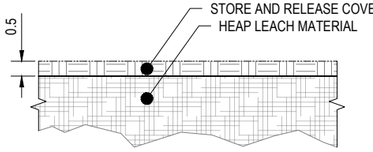
The SPA modelling enhances the understanding of water fluxes within the HLF cover system. NP on the plateau is expected to be very low as a result of the GCL, and Moderate to High on the slopes under a range of materials and climatic conditions as demonstrated by sensitivity analysis. The conceptual 2D assessment demonstrates dominant water flow pathways for the slope and plateau.

We trust information provided in this memorandum is satisfactory for your requirements. Please do not hesitate to contact me at 403-312-9774 or jsteeves@okc-sk.com should you have any questions or comments.

Appendix F

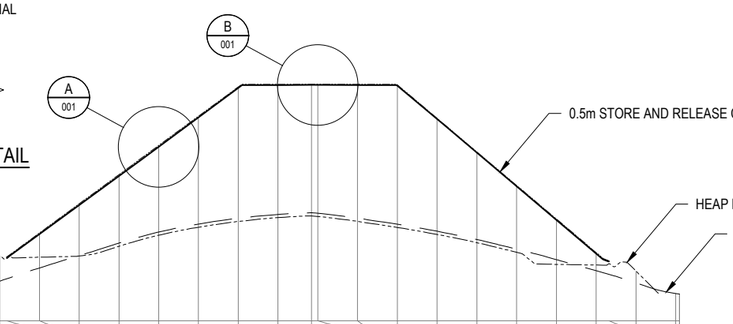
Drawings





TYPICAL LANDFORM COVER SYSTEM DETAIL

DETAIL A 001
1:200



| | | |

For further information contact:

Mitchell Barteaux
Project Coordinator
mbarteaux@okc-sk.com

Okane Consultants Inc.

112 - 112 Research Drive
Saskatoon, SK S7N 3R3
Canada

Telephone: (306) 955 0702
Facsimile: (306) 955 1596
Web: www.okc-sk.com

APPENDIX 7-C

Material Balance Report – Coffee Project



MATERIAL BALANCE REPORT
COFFEE PROJECT
July 2019

JDS Energy & Mining Inc.

Prepared by:
JDS ENERGY & MINING INC.
Suite 900, 999 W Hastings St.
Vancouver, BC V6C 2W2

Prepared for:
Newmont Goldcorp
Suite 3400 – 666 Burrard Street
Vancouver, BC V6C 2X8

Issued: July 5, 2019

Table of Contents

1 Executive Summary 3

2 Geotechnical Characterization 4

2.1 Borrow Sources 4

2.1.1 Fine Aggregate Quarry 4

2.1.2 Coarse Aggregate Quarry 5

2.1.3 Supremo Quarry 5

2.1.4 Latte Pit 6

2.1.5 ROM Stockpile 6

2.2 Stockpiles Dumps 8

2.2.1 Temporary Organics Stockpile 8

2.2.2 Frozen Material Stockpile 8

2.2.3 Run-of-Mine (ROM) Stockpile 8

2.2.4 Alpha Waste Rock Storage Facility (WRSF) 9

3 Construction Infrastructure 9

3.1 Work Breakdown Structure 9

3.2 Earthwork Assumptions 10

4 Construction Roads 11

4.1 Resources 11

4.2 Design 11

4.3 Volumes 13

5 Estimate and Economics 14

6 Material Balance Summary 15

6.1 Cut to Fill 15

6.2 Export to Stockpiles 16

6.3 Import from Stockpiles 17

6.4 Crushed Product 19

7 Geotechnical Recommendations 20

List of Figures

Figure 2-1: Clean Sand Deposit found at KM 0.6 4
Figure 2-2: Test Pit Illustrating Layer of Silt and Sand/Gravel 5
Figure 2-3: Plan View of Supremo Quarry. 6
Figure 2-4: ROM Footprint 7
Figure 4-1: Typical Construction Road Cross-Sections 12
Figure 5-1: Screenshot from Civil 3D Feature Line Elevation Editor 14
Figure 6-1: Local Cut to Fill by WBS 15
Figure 6-2: Organics Stockpile Breakdown 16
Figure 6-3: Total Exported to Stockpiles 17
Figure 6-5: ROM Rehandle 17
Figure 6-6: Supremo Stockpile Breakdown 18
Figure 6-7: Total Imported from Stockpiles 18
Figure 6-8: Crush Analysis 19

List of Tables

Table 2-1: Borrow Sources 4
Table 2-2: Stockpile Locations 8
Table 4-1: Construction Road Sequencing and Borrow Sources 13
Table 5-1: Change in Earthworks Cost 14

1 Executive Summary

JDS Energy & Mining Inc. (JDS) has prepared a Material Mass Balance (MMB) Report for the material movement associated with the construction of the Coffee Project. The intent of the Report is to optimize earthwork activities, improve cost estimates and schedule logic. The MMB aims to correlate earthwork activities to their respective position in the construction schedule culminating in a greater understanding of material requirements and availability.

The current estimate represented in the Coffee Mine Update Study (CMUS) Capital Expenditure (CAPEX) for the 7.4 Million Tonnes per Anum (MTPA) option utilizes estimated haul distances of 0.5, 1 and 3 kilometers. These distances were designated to each work zone based on the activity type (i.e. cut to fill or load haul place (LHP)) and general proximity to potential dumps or borrows assuming a maximum distance of 3 km. Using three-dimensional haul route line work provided by Stantec superimposed on a General Arrangement (GA) Site Layout drawing, a network of haul roads were developed to link work zones with dumps and borrow sources. This data provided realistic three-dimensional haul distances and anticipated cut/fill quantities required to meet construction requirements which were then factored into the truck cycle times, productions and ultimately the unit cost of each activity.

The extent of construction and waste materials investigated in the MMB include:

- **Topsoil** – Tonnage Moved: 1,307,194
- **Overburden / Permafrost** - Tonnage Moved: 1,227,686
- **Rock (rippable/blasted)** - Tonnage Moved: 9,594,245
- **Granular Crushed Products** - Tonnage Moved: 1,341,380
    - 300mm Minus (12")
    - 150mm Minus (6")
    - 50mm Minus (2")
    - 38mm Minus (1.5")
    - 19mm Minus (3/4")
    - 3mm Minus (1/8")

A complete MMB Summary can be found in Appendix A. In addition to this, a detailed Aggregate Production summary is provided in Appendix B.

The final deliverables of this exercise include:

- Map of Key Borrow, Dump and Infrastructure Footprints;
- Material Mass Balance Summary;
- Cost Estimate Summary; and

The Northern Access Road designed by Onsite Engineering Ltd. (OEL) between the Klondike Highway and Java Camp has been excluded from this exercise.

2 Geotechnical Characterization

2.1 Borrow Sources

The borrow sources used in this exercise are identified in Table 2-1 with their respective locations.

Table 2-1: Borrow Sources

Borrow Description	Location
Fine Aggregate Quarry	KM 0.6 on On-site Access Road
Coarse Aggregate Quarry	KM 15 on On-site Access Road
Supremo Pit	Supremo Pit Footprint
Supremo Crusher Stockpile	Supremo Pit Footprint
Latte Pit	Latte Pit Footprint
Run-of-Mine (ROM) Stockpile	Northeast of the Crusher Pad

2.1.1 Fine Aggregate Quarry

At kilometer 0.6 (KM 0.6) along the On-site Access Road from Coffee Camp to the Plant/Mine Site, is an adequate source for fine aggregates required for concrete mixtures.

In 2018, five test pits were excavated in the fine source area. As a result, clean sand (Figure 2-1) with varying amounts of gravel ranging from 1% to 42% was found under silt as shown in Figure 2-2, until refusal on bedrock or permafrost (Tetra Tech Canada Inc. , 2019). This material was classified by Tetra Tech Canada Inc. (Tetra Tech) as suitable to concrete aggregate, road and airstrip surfacing material.

Figure 2-1: Clean Sand Deposit found at KM 0.6



Figure 2-2: Test Pit Illustrating Layer of Silt and Sand/Gravel



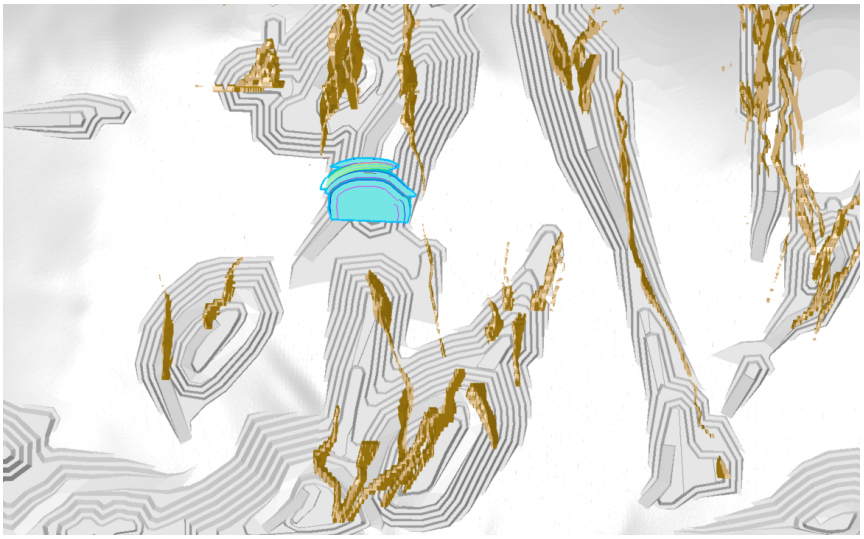
2.1.2 Coarse Aggregate Quarry

During the 2015 Geotechnical Program, Tetra Tech identified that at 15km along the On-site Access Road (KM 15) as a potential coarse aggregate source. The material at KM 15 consists of mica-poor gneiss (Tetra Tech EBA Inc., 2015). This material was tested in a small jaw crusher during the 2015 Geotechnical Program, and deemed potentially suitable following further test work. It's recommended that further test work is completed in the area to confirm characteristics of the rock and understand the extent of the material.

2.1.3 Supremo Quarry

Supremo Mine Pit largely consists of gneiss rock that is assumed to be suitable for fill material. The quarry is required to provide surfacing aggregate for various pieces of infrastructure along with rock, filter, and transition fill materials for the Alpha Dam. The location of the borrow pit has been established between the extents of two veins, to avoid or minimize ore extraction during construction activities. Figure 2-3 below identifies the ore deposit and final pit extents.

Figure 2-3: Plan View of Supremo Quarry.



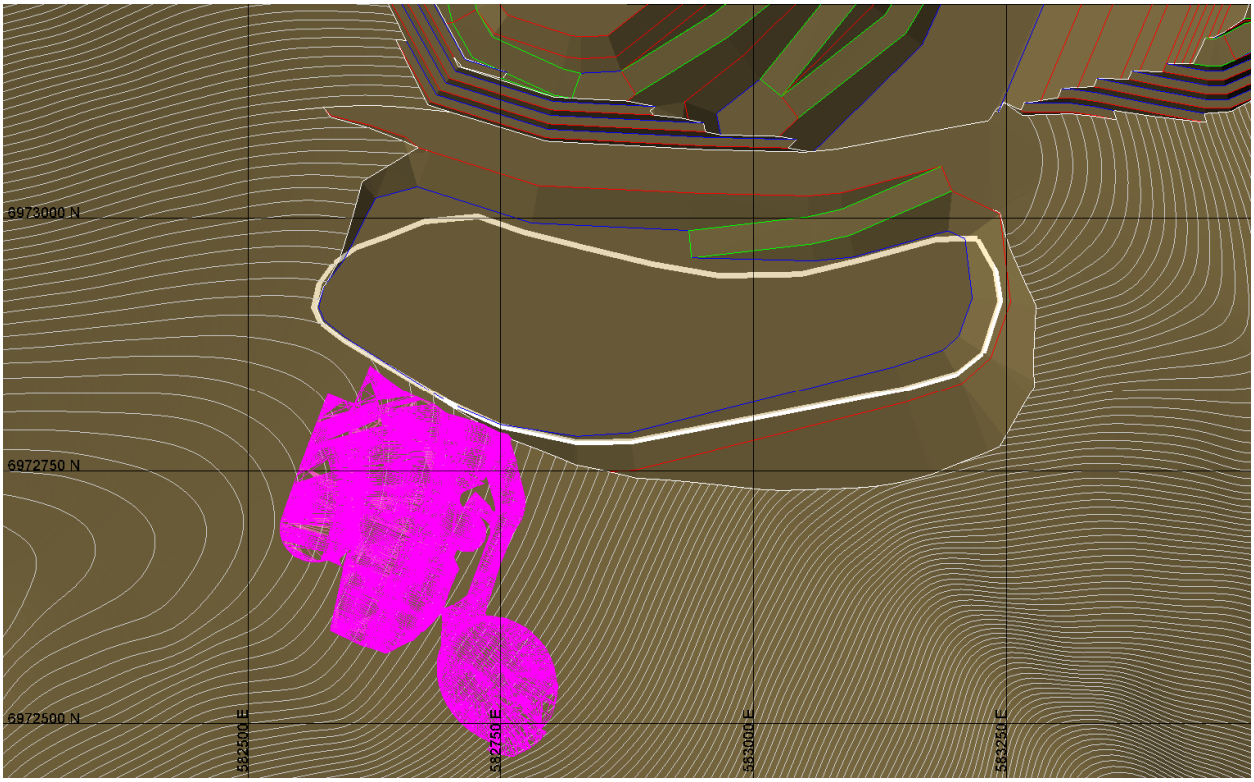
2.1.4 Latte Pit

The Latte Pit is expected to serve as the source for rockfill used in construction roads and bulk fill material for the Alpha Dam due to it being the first pit mined in the mining sequence..

2.1.5 ROM Stockpile

Due to its central location on the General Arrangement drawing provided in Appendix C, the ROM Stockpile was identified as the preferred focal point for the storage of rockfill prior to rehandling and haulage of material to infrastructure as it becomes accessible. See Figure 2-4 for an illustration of the ultimate ROM footprint.

Figure 2-4: ROM Footprint



2.2 Stockpiles Dumps

The stockpile areas utilized in this exercise are identified in Table 2-2 with their respective locations. See Appendix C for detailed illustration.

Table 2-2: Stockpile Locations

Stockpile Description	Location
Temporary Organics Stockpile	North of the Heap Leach Facility
Supremo Temporary Organics Stockpile	Supremo Pit Footprint
Frozen Material Stockpile	North of Latte Pit footprint
Run-of-Mine (ROM) Stockpile	Northeast of the Crusher Pad
Alpha Waste Rock Storage Facility (WRSF)	Northwest of Frozen Material Stockpile

2.2.1 Temporary Organics Stockpile

The Temporary Organics Stockpile is located North of the Heap Leach Facility. This stockpile will accommodate all organics stripped during construction until reclamation, as this material will be used to cover infrastructure upon mine closure (JDS Energy and Mining, 2018). The organics stockpile has been sized to withhold topsoil from all infrastructure pads, roads, and the heap leach facility sparing room for some mining stripping. Topsoil from Mine Pre-stripping is not evaluated in this report. Such stockpiles have not been engineered or established yet.

2.2.2 Frozen Material Stockpile

The Frozen Material Stockpile is located within the footprint of the Alpha Waste Rock Storage Facility (WRSF). The perimeter of the Frozen Material Stockpile will consist of a permeable waste rock berm to allow material to drain. The intent is to store frozen material within the stockpile footprint allowing for the material to drain; once dry, usable material for reclamation can be re-handled and moved to a Temporary Organics Stockpile. Material that is not usable for reclamation will remain in the footprint of the Alpha WRSF and eventually covered by mining waste rock. The Frozen Material Stockpile is sized to hold permafrost material extracted during construction activities, a quantity driven by the amount of permafrost material from the Heap Leach Facility. Note that the Material Balance only extends to the end of the construction phase, and therefore, frozen material from the Heap Leach Facility Stage 1 is reporting to the Frozen Material Stockpile.

2.2.3 Run-of-Mine (ROM) Stockpile

Due to its central location in the General Arrangement, the ROM Stockpile was identified as the preferred focal point for the storage of rockfill prior to rehandling and haulage of material to infrastructure as it becomes accessible.

2.2.4 Alpha Waste Rock Storage Facility (WRSF)

The ultimate size of the Alpha Waste Rock Storage Facility is dictated by the waste rock volumes generated from the Mine Plan. Surplus of any cut materials from infrastructure construction will report to the WRSF.

3 Construction Infrastructure

3.1 Work Breakdown Structure

The MMB considers the movement of topsoil/overburden, rock (rippable/blasted) and construction aggregates required to develop earthwork infrastructure as shown below in the direct cost items of the CAPEX Work Breakdown Structure (WBS).

The following infrastructure is included in the Material Balance[1]:

- **2000 – On-site Development**
  - **2100 – Pad Earthworks**
    - Truckshop Pad
    - Java Camp Pad – *MTO source: JDS*
    - Construction Laydowns – *MTO source: JDS*
      a. Heap Leach Liner & Piping
      b. Plant Materials
      c. Crusher & Conveyor
      d. Batch Plant & Mining Equipment
      e. Miscellaneous
  - **2200 – On-site Roads**
    - On-Site Access Road Upgrade (14km) – MTO source: OEL
    - Construction Roads – *MTO source: JDS*
  - **2300 – Site Water Management**
    - Drainage & Water Management – *MTO source: SRK*
    - Ponds (Alpha, West Side Diversion) – *MTO source: SRK*
  - **2400 – Airstrip Earthworks** – *MTO source: Tetra Tech*
- **3000 – Ore Crushing and Handling**
  - 3100 – Primary & Secondary Crushing Station
  - 3400 – Overland Conveyor
  - 3500 – ROM Ore Stockpile – *MTO source: JDS*
- **4000 – Heap Leach**
  - 4100 – Heap Leach Pad – *MTO source: JDS Feasibility*
  - 4200 – Overland Pipe Trench with Road Option
  - 4300 – Ponds – Stage 1 – *MTO source: JDS Feasibility*
- **5000 – Process Plant**
  - **5100 – ADR Pad**
  - **5800 – Process Utilities**
    - Fresh Water Supply Pad
- **6000 – On-Site Infrastructure**
  - **6400 – Java Camp Pad**
    - Landfarm Pad

[1] Material Take-Off Quantities were provided by HATCH unless otherwise specified

- **6600 – Ancillary Facilities**
  - Long Term / Used Oil Storage
- **6700 – Bulk Fuel Storage & Distribution**
  - Bulk Explosive Facility Pad

- **9999** – Concrete Aggregate Haulage [Indirects]

3.2 Earthwork Assumptions

Though a comprehensive Geotechnical Program applied to the Coffee site, the variability of data between different infrastructure components has led to the integration of a number of assumptions to form the basis of this MMB. These include the following:

1. Concrete Aggregates will be sourced from the fine and coarse gravel stockpiles located at kilometers 0.6 and 15 respectively. Further investigation may be required to validate alternative borrow sources at a closer proximity to the Batch Plant Pad. This material balance assumes there is sufficient suitable material at each location. Further validation is required to determine quantity and suitability of source material.
2. All rock cut from each pad is assumed to be suitable for fill within that same work zone. Excess rock cuts within pad footprints will be transported to the ROM stockpile and rehandled where required.
3. No excess material will be hauled out of construction laydowns. Instead, topsoil, overburden and rock will be dozer pushed to shape each pad.
4. Alpha Dam Scenario 3 (Option 14 – no diversion)[2] was selected for the MMB. Rockfill and Transition material will be sourced from Latte Pit while sand will come from the crusher stockpile located within the Supremo Pit footprint. Rock fill will be used to bridge a connection across Halfway Creek to an access road west of the tributary. This is expected to be a two-fold activity as this bridged entry way will also serve as the North Rock Drain.
5. Construction road grades greater than 10% are limited. Road lengths that exceed a 10% grade are restricted to minimal lengths.
6. The Alpha Pond, Airstrip, Supremo Quarry and Java Camp Pad will have their own stockpiles for Topsoil and Overburden.
7. Material movement is assumed to be unrestricted by environmental limitations. No special allowances have been made for Potentially Acid Generating (PAG) borrow sources.

[2] GOLCOF - Alpha Sediment Pond Update Memo 2019.05.17

4 Construction Roads

4.1 Resources

Initial road design were based on interpretation of the three-dimensional haul route line work produced by Stantec. Where applicable, this line work served as the top grade centerline for road corridors.

CAD files provided by Stantec:

- CMUS_FG_2025_contour_roads
  - Excluded
- CMUS_FG_2025_dump_roads
  - Single alignment optimized as component in North Rock Drain and Alpha Dam access
- CMUS_FG_2025_expit_roads
  - Single switchback used as component in South Rock Drain access
- CMUS_FG_2025_inpit_roads
  - Excluded
- 04-04-2019 ROADS
  - Provided the framework for vast majority of haul road alignments

The compilation of this line work resulted in a fundamental road network comprised of the following sections:

- Supremo to Heap
- Heap Leach Connector
- Kona to ANFO
- Plant to Kona / Topsoil Stockpile
- South Rock Drain Main
- Alpha Waste Rock Storage Facility (WRSF) Switchback

A General Arrangement layout[3] was overlaid onto the CAD drawing to assess the need for additional road designs branching from the core network provided by Stantec. A marked-up drawing of the GA with the designed road network can be found in Appendix D.

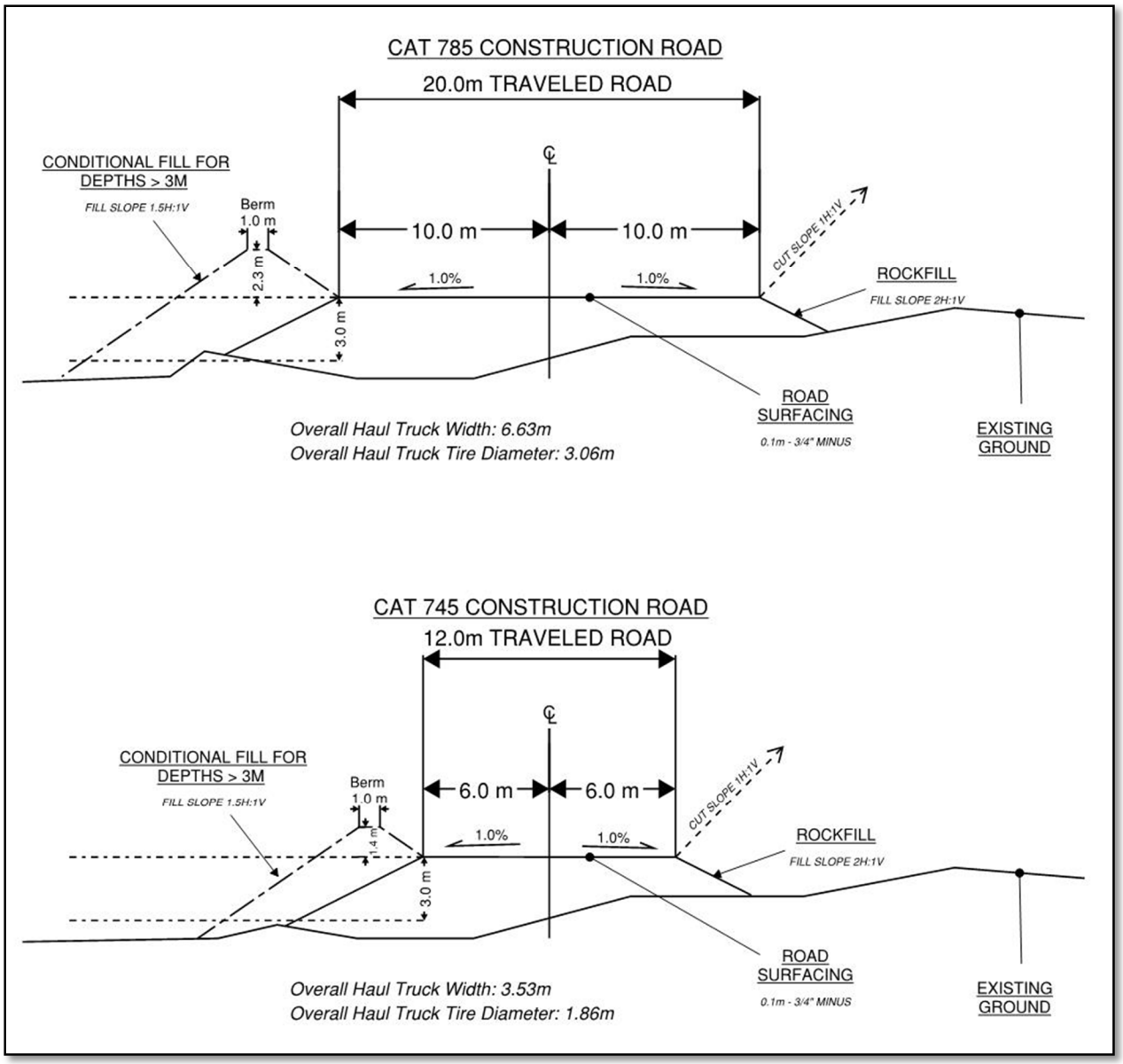
4.2 Design

Road prisms in this exercise are employed to accommodate CAT 745 Articulated Trucks site wide and CAT 785 Off-Highway Trucks in certain sections between the Heap Leach Facility and designated dump locations. Typical cross-sections of construction roads can be found in Figure 4-1. The design subassembly extends cuts at a 1H:1V slope and fills at a 2H:1V slope with a berm for cuts greater than 3 meters in vertical depth. Berms are incorporated when vertical fill depths exceed 3 meters. All road corridors are projected

[3] GOLCOF-010399-GEN-GA-001-RevB_Construction Laydown Plan-004 (2019.04.26)

onto a target 5-m contour original ground (OG) surface to produce the design Triangular Irregular Networks (TIN) surface used in subsequent cut/fill volume calculations.

Figure 4-1: Typical Construction Road Cross-Sections



Additional road extensions were implemented to reach work zones that were not otherwise within the bounds of the Stantec line work. These road extensions include:

- Batch Plant Access Road
- North Rock Drain Extension / Alpha Dam Access
- South Rock Drain Extension

The alignment of the roads listed above can be found illustrated in Appendix D.

The approach adopted in the design of road extensions considered the presence of permafrost in undisturbed ground along the proposed alignments. Due to this, modelled profiles were mainly discriminative to fills rather than cuts in an effort to avoid a breach of the active layer and exposure of permafrost to warmer seasonal temperatures associated with summer months. Should melting of permafrost occur, it would carry substantial structural implications as it has been linked to erosion, landslides and ground subsidence.

4.3 Volumes

All surfacing material would be sourced from a crusher stockpile located near a quarry within the Supremo Pit footprint. However, rockfill would come from the Latte Pit. Total Cut and Fill volumes are summarized in Table 4-1 below.

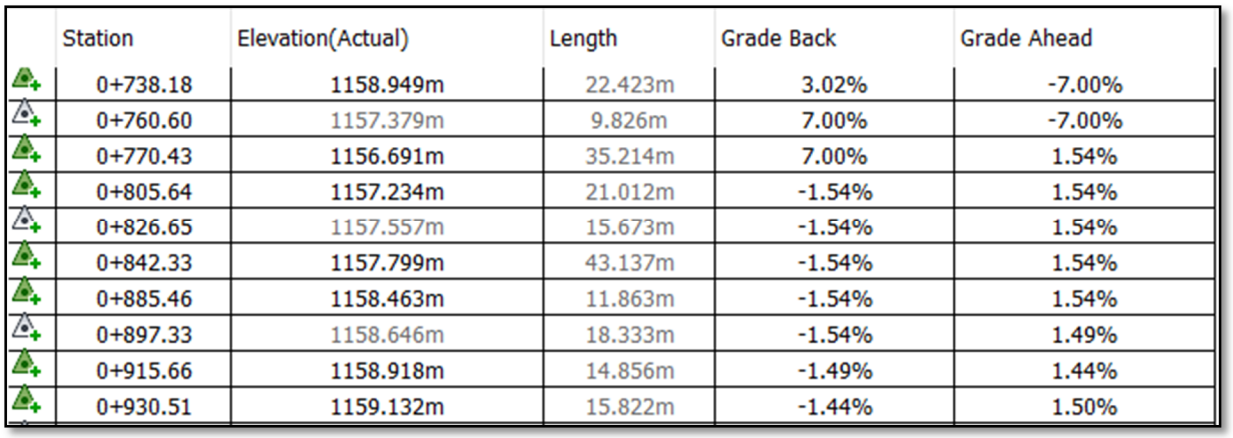
Table 4-1: Construction Road Sequencing and Borrow Sources

No.	Road Section	Design Prism	Cut Volume	Fill Volume
1	Supremo to Heap Leach Facility	745 / 785	8,363	94,501
2	Alpha WRS	745	17,844	78,327
3	South Rock Drain Main / Extension	745	234	354,467
4	North Rock Drain Extension / Alpha Dam Access	745	25,477	462,575
5	Batch Plant Access Road	745	3,702	44,254
6	Heap Leach Connector	745	10,059	57,310
7	Plant to Kona / Topsoil Stockpile	745 / 785	17	319,084
8	Kona to ANFO	745	10,231	37,294

5 Estimate and Economics

A comprehensive pricing evaluation was developed from the Baseline Cost Estimate is a comprehensive pricing evaluation which incorporates measured haul road distances. These three-dimensional distances were extracted from road top CAD feature lines complete with inclination of each haul segment as shown in Figure 5-1.

Figure 5-1: Screenshot from Civil 3D Feature Line Elevation Editor



	Station	Elevation(Actual)	Length	Grade Back	Grade Ahead
	0+738.18	1158.949m	22.423m	3.02%	-7.00%
	0+760.60	1157.379m	9.826m	7.00%	-7.00%
	0+770.43	1156.691m	35.214m	7.00%	1.54%
	0+805.64	1157.234m	21.012m	-1.54%	1.54%
	0+826.65	1157.557m	15.673m	-1.54%	1.54%
	0+842.33	1157.799m	43.137m	-1.54%	1.54%
	0+885.46	1158.463m	11.863m	-1.54%	1.54%
	0+897.33	1158.646m	18.333m	-1.54%	1.49%
	0+915.66	1158.918m	14.856m	-1.49%	1.44%
	0+930.51	1159.132m	15.822m	-1.44%	1.50%

This data was carried over to TALPAC, a Truck Haulage Simulation Software trusted by the mining industry for its accuracy and independence. TALPAC is a simulation tool known for evaluating efficiency, productivity, and economics of truck and loader haulage. After setting route parameters (i.e. rolling resistance, min/max speeds and others), the software was able to calculate a Truck Average Travel time. This duration was integrated into the baseline cost estimate and used to produce revised productivities which resulted in adjusted unit rates that more accurately reflected anticipated construction efforts.

The resulting change in Earthworks Load/Haul/Place costs for the CAPEX component of the Coffee Project is shown in Table 5-1. Based on measured haul distances, we observe an increase in $ 4.9 M for earthworks activities equivalent to a change of 12% from the Baseline Estimate. See Appendix A for a detailed breakdown of changes to Load / Haul Place Costs.

Table 5-1: Change in Earthworks Cost

Description	Cost
Update	$ 47,166,849
Original	$ 42,217,685
Change	$ 4,949,165

6 Material Balance Summary

6.1 Cut to Fill

Cut to Fill material quantities for construction earthworks is predominantly weighted towards On-site Development and the Heap Leach Pad / Event Ponds as illustrated in Figure 6-1.

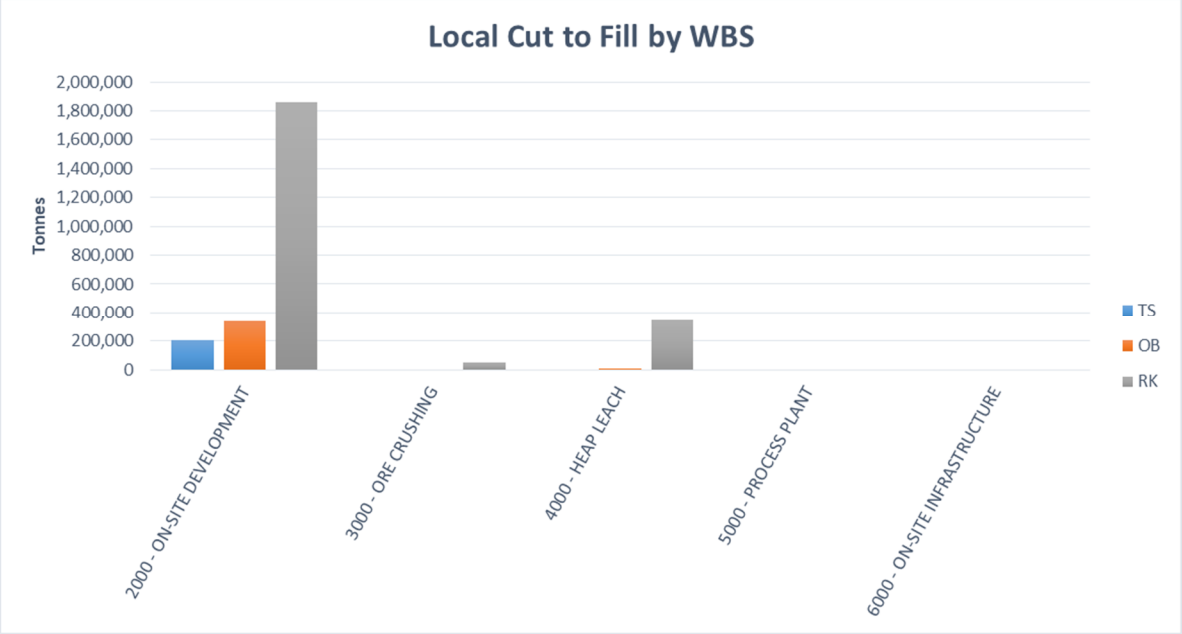
Major activities that contribute to these cut/fill tonnages for On-site Development and the Heap Leach Pad include the following:

- On-site Development
    - Truckshop Pad
    - Java Camp Pad
    - Construction Laydowns
    - Alpha Pond
    - Airstrip
- Heap Leach Pad / Event Ponds
    - Rock Excavation to mass fill, rippable
    - Local cut-to-fill for stability berms within leach pad
    - HLP / Main Solution Cell Trench Separator Berm N&S

Note that topsoil and overburden cut-to-fill tonnages are shown below to illustrate that the Alpha Pond, Java Camp Pad and Airstrip will require excavated quantities to be disposed of in locations near their respective footprints.

See Appendix A for further details on cut-to-fill quantities.

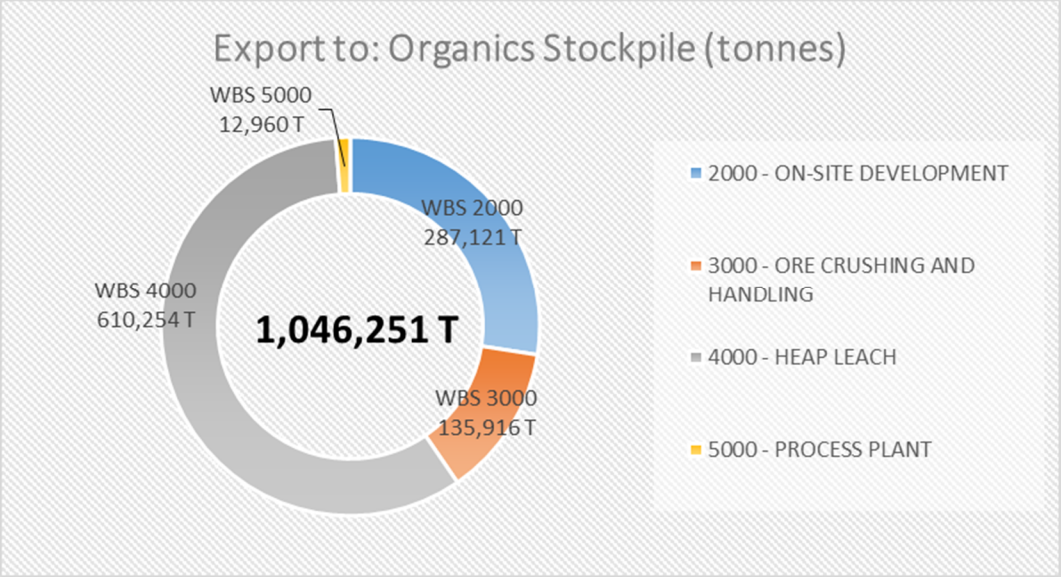
Figure 6-1: Local Cut to Fill by WBS



6.2 Export to Stockpiles

Similar to cut-to-fill volumes identified in the section above, material exported to the Organics Stockpile is weighted towards On-site Development and the Heap Leach Pads / Event Ponds due to their appreciable surface areas. See Figure 6-2 for an illustrated breakdown of stockpile composition.

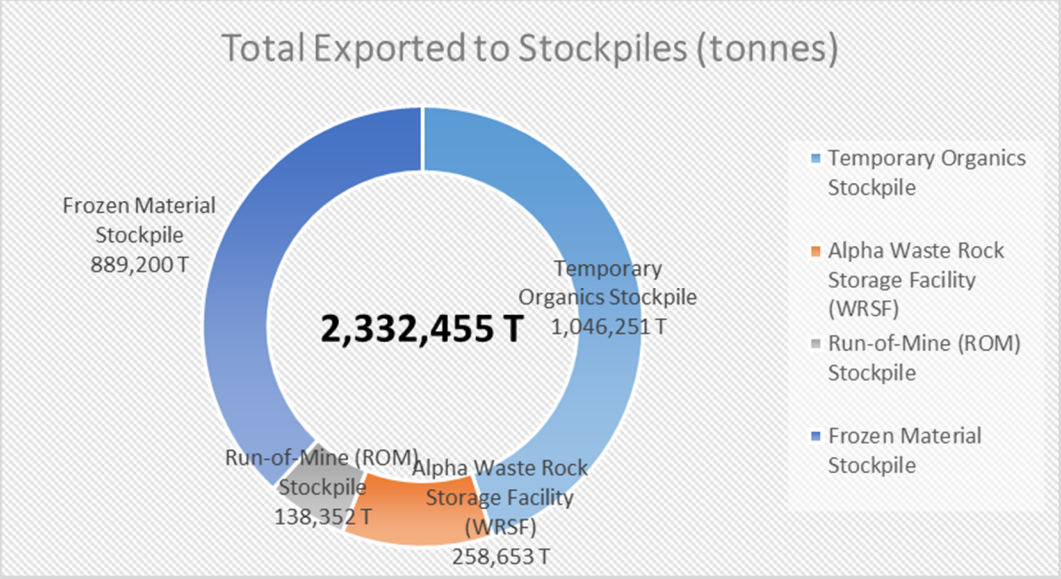
Figure 6-2: Organics Stockpile Breakdown



Alternatively, the ROM Stockpile will serve as an intermittent storage area for rockfill material that is destined for other locations as they become available. A minority of material exported to the ROM stockpile is expected to be rehandled for the construction of subsequent infrastructure. A total excess cut quantity of approximately 2.5 million tonnes from the Heap Leach footprint will be hauled to the ROM stockpile. A shorter haul distance to build construction roads was considered for Heap Leach material in lieu of the ROM; however, transport to the ROM was deemed necessary in order to contribute to its ultimate Pad envelope and available rockfill for rehandling necessary in continued infrastructure development.

The total quantity of earthworks materials allocated to stockpiles is illustrated in Figure 6-3. Aside from the Organics Stockpile and the ROM, major dump locations include the Frozen Material Stockpile and the South Rock Drain which are derived from the Heap Leach and ROM respectively.

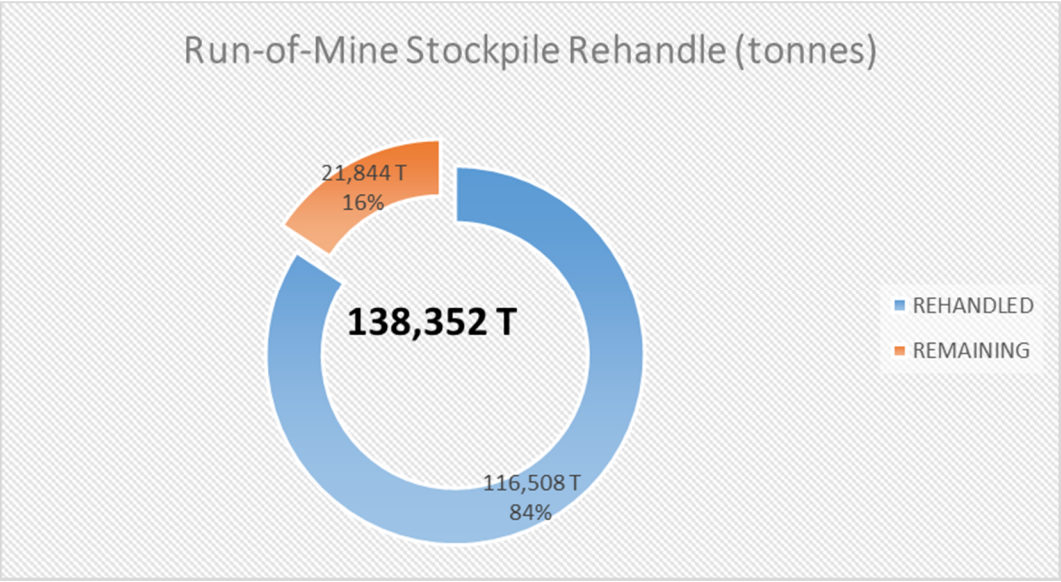
Figure 6-3: Total Exported to Stockpiles



6.3 Import from Stockpiles

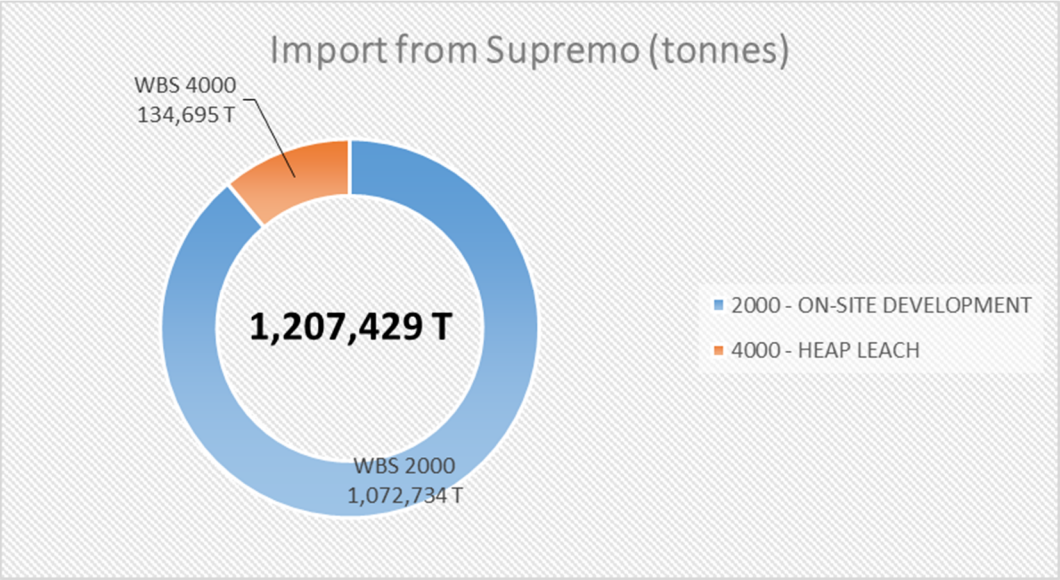
Introduced in the section above, a significant amount of rockfill is expected to be rehandled from the ROM to serve the construction of other site infrastructure. After rehandling of rockfill, about 16% of material originally hauled to the ROM is expected to remain in place resulting in approximately 22,000 tonnes tonnes as shown in Figure 6-4 below.

Figure 6-4: ROM Rehandle



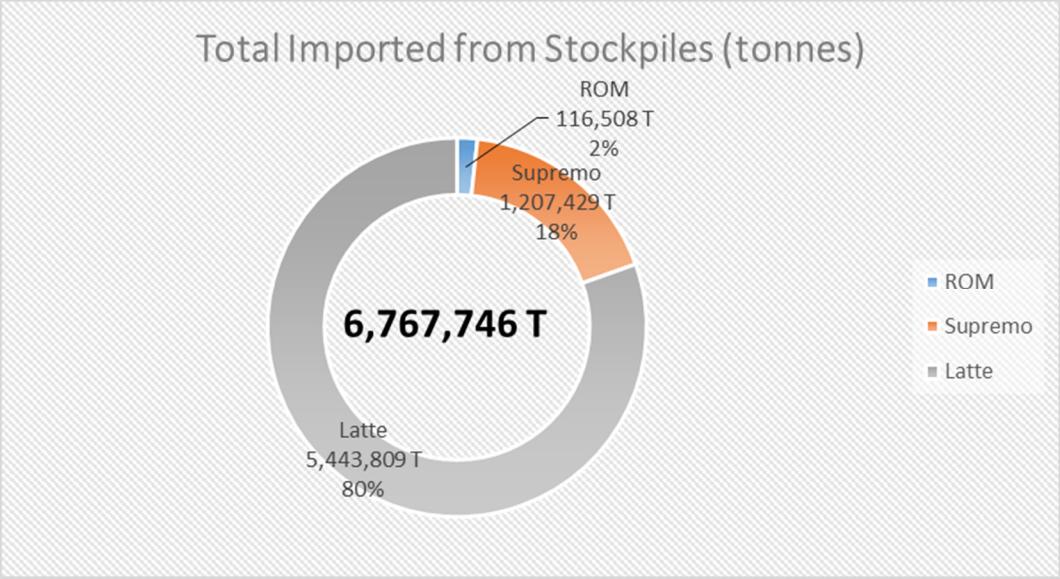
The other primary source of construction material is the Supremo Quarry as it provides surfacing material site wide. See Figure 6-5 below for a breakdown of material sourced from the Supremo Quarry by WBS Description.

Figure 6-5: Supremo Stockpile Breakdown



The value of the Supremo Quarry for sourcing material fills is further highlighted by Figure 6-6 where one can see that it supplies about 18% of rock and granular fill that is not otherwise derived from local cut-to-fills. Alternatively, rockfill for construction roads is supplied by the Latte pit which accounts for 80% of imported quantities from stockpiles.

Figure 6-6: Total Imported from Stockpiles



6.4 Crushed Product

The total sieve analysis of crushed product is outlined in Figure 6-7 below where it is evident that most of the material produced for construction is below 50mm in size. This material is primarily used for granular surfacing of pads, roads and bedding of trenches.

Figure 6-7: Crush Analysis



7 Geotechnical Recommendations

To enhance understanding of the site conditions, JDS recommends that additional Geotechnical investigation be carried out for the coarse and fine aggregate borrow sources in addition to the NAR alignment.

Appendix A

Material Balance Summary

NEWMONT GOLDCORP - COFFEE PROJECT

Material Balance Summary

Printed: 04-Jul-2019

WBS	Desc. Code	Material Type	S.G.	Balanced C/F Tonnes	Cut Dump	Cut Tonnes	Fill Source	Fill Tonnes	Export/Import	Net	Updated Cost L/H/P	Updated Unit Rate ($/tonne)	Original Cost L/H/P	Original Unit Rate ($/tonne)	Change
2100 PAD EARTHWORKS															
2150 TRUCKSHOP PAD				**149,081**		**32,400**		**117,404**		**149,804**	**$ 868,468.16**	**$ 2.91**	**$ 1,014,830.17**	**$ 3.40**	**-14%**
2150	PL	TS	1.8	**0**	Topsoil STKP	**32,400**	Topsoil STKP	**0**	**Export**	**32,400**					
2150	PL	RK	2.3	**149,081**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2150	PL	RK	2.3		ROM STKP	**0**	ROM STKP	**100,903**	**Import**	**100,903**					
2150	PL	GR	1.9	**0**	Supremo	**0**	Supremo	**16,501**	**Import**	**16,501**					
2140 CAMP PAD - PHASE 1				**38,609**		**0**		**0**		**0**	**$ 85,582.93**	**$ 2.22**	**$ 85,582.93**	**$ 2.22**	**0%**
2140	JAVA	RK	2.3	**37,102**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2140	JAVA	GR	1.9	**1,508**	Supremo	**0**	Supremo	**0**	-	**0**					
2230 CONSTRUCTION LAYDOWNS															
2231 HEAP LEACH LINER & PIPING				**0**		**0**		**26,408**		**26,408**	**$ 166,200.45**	**$ 6.29**	**$ 116,272.13**	**$ 4.40**	**43%**
2231	HL	GR	1.9	**0**	Supremo	**0**	Supremo	**26,408**	**Import**	**26,408**					
2232 PLANT MATERIALS				**43,092**		**0**		**4,520**		**4,520**	**$ 93,254.54**	**$ 1.96**	**$ 90,155.05**	**$ 1.89**	**3%**
2232	EP	TS	1.8	**43,092**	Topsoil STKP	**0**	Topsoil STKP	**0**	-	**0**					
2232	EP	GR	1.9	**0**	Supremo	**0**	Supremo	**4,520**	**Import**	**4,520**					
2233 CRUSHER & CONVEYOR				**58,320**		**0**		**10,706**		**10,706**	**$ 128,670.74**	**$ 1.86**	**$ 142,216.07**	**$ 2.06**	**-10%**
2233	ROM	TS	1.8	**58,320**	Topsoil STKP	**0**	Topsoil STKP	**0**	-	**0**					
2233	ROM	GR	1.9	**0**	Supremo	**0**	Supremo	**10,706**	**Import**	**10,706**					
2234 BATCH PLANT & MINING EQUIPMENT				**0**		**0**		**9,517**		**9,517**	**$ 34,091.42**	**$ 3.58**	**$ 41,899.86**	**$ 4.40**	**-19%**
2234	BP	GR	1.9	**0**	Supremo	**0**	Supremo	**9,517**	**Import**	**9,517**					
2235 MISCELLANEOUS				**44,280**		**0**		**4,758**		**4,758**	**$ 86,887.12**	**$ 1.77**	**$ 93,139.33**	**$ 1.90**	**-7%**
2235	LF	TS	1.8	**44,280**	Topsoil STKP	**0**	Topsoil STKP	**0**	-	**0**					
2235	LF	GR	1.9	**0**	Supremo	**0**	Supremo	**4,758**	**Import**	**4,758**					
2200 ON-SITE ROADS															
2220 ONSITE ACCESS ROAD UPGRADE (14KM)				**224,890**		**77,732**		**29,937**		**107,669**	**$ 1,304,439.82**	**$ 3.92**	**$ 1,304,439.82**	**$ 3.92**	**0%**
2220	HR	TS	1.8	**0**	Topsoil STKP	**65,232**	Topsoil STKP	**0**	**Export**	**65,232**					
2220	HR	OB	1.9	**164,491**	Overburden STKP	**0**	Overburden STKP	**0**	-	**0**					
2220	HR	RK	2.3	**60,400**	Alpha Dump	**12,500**	Alpha Dump	**0**	**Export**	**12,500**					
2220	HR	GR	1.9	**0**	Supremo	**0**	Supremo	**29,937**	**Import**	**29,937**					
2221 BATCH PLANT ACCESS ROAD				**8,514**		**0**		**87,769**		**87,769**	**$ 348,869.02**	**$ 3.62**	**$ 339,969.15**	**$ 3.53**	**3%**
2221	2221	RK	2.3	**8,514**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2221	2221	RK	2.3		Latte	**0**	Latte	**85,126**	**Import**	**85,126**					
2221	2221	GR	1.9	**0**	Supremo	**0**	Supremo	**2,642**	**Import**	**2,642**					
2222 NORTH ROCK DRAIN ROAD				**58,596**		**0**		**952,808**		**952,808**	**$ 4,801,834.31**	**$ 4.75**	**$ 3,597,856.98**	**$ 3.56**	**33%**
2222	2222	RK	2.3	**58,596**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2222	2222	RK	2.3		Latte	**0**	Latte	**948,196**	**Import**	**948,196**					
2222	2222	GR	1.9	**0**	Supremo	**0**	Supremo	**4,612**	**Import**	**4,612**					
2223 SOUTH ROCK DRAIN ROAD				**538**		**0**		**778,876**		**778,876**	**$ 2,916,586.33**	**$ 3.74**	**$ 2,837,185.45**	**$ 3.64**	**3%**
2223	2223	RK	2.3	**538**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2223	2223	RK	2.3		Latte	**0**	Latte	**774,803**	**Import**	**774,803**					
2223	2223	GR	1.9	**0**	Supremo	**0**	Supremo	**4,074**	**Import**	**4,074**					
2224 SUPREMO TO HEAP ROAD				**19,236**		**0**		**184,607**		**184,607**	**$ 463,598.57**	**$ 2.27**	**$ 484,397.22**	**$ 2.38**	**-4%**
2224	2224	RK	2.3	**19,236**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2224	2224	RK	2.3		Latte	**0**	Latte	**168,168**	**Import**	**168,168**					
2224	2224	GR	1.9	**0**	Supremo	**0**	Supremo	**16,439**	**Import**	**16,439**					
2225 HEAP LEACH CONNECTOR ROAD				**23,136**		**0**		**100,371**		**100,371**	**$ 491,858.65**	**$ 3.98**	**$ 418,180.69**	**$ 3.39**	**18%**
2225	2225	RK	2.3	**23,136**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2225	2225	RK	2.3		Latte	**0**	Latte	**97,429**	**Import**	**97,429**					
2225	2225	GR	1.9	**0**	Supremo	**0**	Supremo	**2,941**	**Import**	**2,941**					
2226 KONA TO ANFO ROAD				**23,531**		**0**		**55,789**		**55,789**	**$ 331,695.82**	**$ 4.18**	**$ 257,974.75**	**$ 3.25**	**29%**
2226	2226	RK	2.3	**23,531**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2226	2226	RK	2.3		Latte	**0**	Latte	**51,442**	**Import**	**51,442**					
2226	2226	GR	1.9	**0**	Supremo	**0**	Supremo	**4,347**	**Import**	**4,347**					
2227 PLANT TO KONA ROAD				**40**		**0**		**700,968**		**700,968**	**$ 2,297,156.43**	**$ 3.28**	**$ 2,555,442.12**	**$ 3.65**	**-10%**
2227	2227	RK	2.3	**40**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2227	2227	RK	2.3		Latte	**0**	Latte	**693,348**	**Import**	**693,348**					
2227	2227	GR	1.9	**0**	Supremo	**0**	Supremo	**7,620**	**Import**	**7,620**					
2228 ALPHA WRSF SWITCHBACK ROAD				**41,041**		**0**		**126,735**		**126,735**	**$ 420,775.79**	**$ 2.51**	**$ 555,076.96**	**$ 3.31**	**-24%**
2228	2228	RK	2.3	**41,041**	Alpha Dump	**0**	Alpha Dump	**0**	-	**0**					
2228	2228	RK	2.3		Latte	**0**	Latte	**121,654**	**Import**	**121,654**					

WBS	Desc. Code	Material Type	S.G.	Balanced C/F Tonnes	Cut Dump	Cut Tonnes	Fill Source	Fill Tonnes	Export/Import	Net	Updated Cost L/H/P	Updated Unit Rate ($/tonne)	Original Cost L/H/P	Original Unit Rate ($/tonne)	Change
2228	2228	GR	1.9	0	Supremo	0	Supremo	5,082	Import	5,082					
2300	**SITE WATER MANAGEMENT**														
2310	**DRAINAGE & WATER MANAGEMENT**			0		1,324,800		1,934,803		3,259,603	$ 6,861,194.35	$ 2.10	$ 7,504,239.63	$ 2.30	-9%
2310	DRN	RK	2.3		Rock Drain South	1,324,800	Rock Drain South	0	Export	1,324,800					
2310	DRN	RK	2.3		Latte	0	Latte	1,324,800	Import	1,324,800					
2310	DRN	GR	1.9	0	Supremo	0	Supremo	610,003	Import	610,003					
2320	**FACILITY POND**			0		9,420		252,697		262,117	$ 1,336,490.40	$ 5.10	$ 1,614,441.08	$ 6.16	-17%
2320	FP	TS	1.8	0	Topsoil STKP	9,420	Topsoil STKP	0	Export	9,420					
2320	FP	RK	2.3		Latte	0	Latte	240,291	Import	240,291					
2320	FP	GR	1.9	0	Supremo	0	Supremo	12,406	Import	12,406					
2321	**ALPHA POND (Option 14)**			224,919		246,153		450,163		696,316	$ 6,144,166.44	$ 6.67	$ 5,122,714.80	$ 5.56	20%
2321	AP	TS	1.8	22,241	Topsoil STKP	0	Topsoil STKP	0	-	0					
2321	AP	RK	2.3	202,679	Alpha Dump	246,153	Alpha Dump	0	Export	246,153					
2321	AP	RK	2.3		Latte	0	Latte	379,333	Import	379,333					
2321	AP	GR	1.9	0	Supremo	0	Supremo	70,830	Import	70,830					
2400	**AIRSTRIP**														
2410	**AIRSTRIP EARTHWORKS**			640,165		0		66,416		66,416	$ 1,608,017.04	$ 2.28	$ 1,608,017.04	$ 2.28	0%
2410	AS	TS	1.8	38,223	Topsoil STKP	0	Topsoil STKP	0	-	0					
2410	AS	OB	1.9	22,572	Overburden STKP	0	Overburden STKP	0	-	0					
2410	AS	RK	2.3	579,370	Alpha Dump	0	Alpha Dump	0	-	0					
2410	AS	GR	1.9	0	Supremo	0	Supremo	66,416	Import	66,416					
3100	**PRIMARY & SECONDARY CRUSHING STATION**														
2110	**CRUSHING & CONVEYING - OPTION 2**			160,136		30,780		13,885		44,665	$ 591,678.39	$ 2.89	$ 616,097.44	$ 3.01	-4%
2110	CR	TS	1.8	0	Topsoil STKP	30,780	Topsoil STKP	0	Export	30,780					
2110	CR	RK	2.3	160,136	Alpha Dump	0	Alpha Dump	0	-	0					
2110	CR	GR	1.9	0	Supremo	0	Supremo	13,885	Import	13,885					
3300	**LIME ADDITION**														
3300	**LIMESTORAGE**			0		0		0		0	$ -	$ -	$ -	$ -	0%
3400	**OVERLAND CONVEYOR**														
2120	**OVERLAND CONVEYOR**			112,240		22,572		53,121		75,693	$ 729,220.20	$ 3.88	$ 654,351.01	$ 3.48	11%
2120	OC	TS	1.8	0	Topsoil STKP	22,572	Topsoil STKP	0	Export	22,572					
2120	OC	RK	2.3	112,240	Alpha Dump	0	Alpha Dump	0	-	0					
2120	OC	RK	2.3		ROM STKP	0	ROM STKP	6,140	Import	6,140					
2120	OC	GR	1.9	0	Supremo	0	Supremo	46,981	Import	46,981					
3500	**ROM ORE STOCKPILE**														
3500	**ROM ORE STOCKPILE**			52,716		135,916		0		135,916	$ 722,456.07	$ 3.83	$ 747,563.49	$ 3.96	-3%
3500	ROM	TS	1.8	0	Topsoil STKP	135,916	Topsoil STKP	0	Export	135,916					
3500	ROM	RK	2.3	52,716	Alpha Dump	0	Alpha Dump	0	-	0					
4100	**HEAP LEACH PAD - STAGE 1**														
4100	**HEAP LEACH PAD - STAGE 1**			337,007		837,642		2,659		840,301	$ 4,419,037.85	$ 3.75	$ 2,761,578.21	$ 2.35	60%
4100	HL	TS	1.8	0	Topsoil STKP	84,061	Topsoil STKP	0	Export	84,061					
4100	HL	OB	1.9	411	Frozen STKP	711,549	Frozen STKP	0	Export	711,549					
4100	HL	RK	2.3	336,596	Alpha Dump	0	Alpha Dump	0	-	0					
4100	HL	RK	2.3		ROM STKP	42,032	ROM STKP	0	Export	42,032					
4100	HL	GR	1.9	0	Supremo	0	Supremo	2,659	Import	2,659					
4200	**OVERLAND PIPE TRENCH WITH ROAD OPTION**														
4200	**Overland Pipe Trench with road Option - Pre**			0		116,246		105,648		221,894	$ 1,052,434.17	$ 4.74	$ 665,540.07	$ 3.00	58%
4200	HL	TS	1.8	0	Topsoil STKP	19,926	Topsoil STKP	0	Export	19,926					
4200	HL	RK	2.3		ROM STKP	96,320	ROM STKP	0	Export	96,320					
4200	HL	GR	1.9	0	Supremo	0	Supremo	105,648	Import	105,648					
4300	**PONDS (EVENT PONDS & CLEAN WATER POND) - STAGE 1**														
4300	**Ponds (Event Ponds & Clean Water Pond) - I**			11,361		683,918		585,608		1,269,526	$ 5,119,029.04	$ 4.00	$ 3,497,743.64	$ 2.73	46%
4300	EP	TS	1.8	0	Topsoil STKP	506,267	Topsoil STKP	0	Export	506,267					
4300	EP	OB	1.9	0	Frozen STKP	177,651	Frozen STKP	0	Export	177,651					
4300	EP	RK	2.3	9,671	Alpha Dump	0	Alpha Dump	0	-	0					
4300	EP	RK	2.3		Latte	0	Latte	559,220	Import	559,220					
4300	EP	GR	1.9	1,690	Supremo	0	Supremo	26,388	Import	26,388					
5100	**ADR PAD**														
2130	**ADR PAD**			564,226		51,840		44,379		96,219	$ 2,013,467.32	$ 3.05	$ 2,064,593.23	$ 3.13	-2%
2130	PL	TS	1.8	0	Topsoil STKP	51,840	Topsoil STKP	0	Export	51,840					
2130	PL	OB	1.9	151,012	Overburden STKP	0	Overburden STKP	0	-	0					
2130	PL	RK	2.3	282,461	Alpha Dump	0	Alpha Dump	0	-	0					
2130	PL	GR	1.9	130,753	Supremo	0	Supremo	44,379	Import	44,379					

WBS	Desc. Code	Material Type	S.G.	Balanced C/F Tonnes	Cut Dump	Cut Tonnes	Fill Source	Fill Tonnes	Export/Import	Net	Updated Cost L/H/P	Updated Unit Rate ($/tonne)	Original Cost L/H/P	Original Unit Rate ($/tonne)	Change
5700	**REAGENT SYSTEMS**														
5720	**REAGENT STORAGE**			**0**		**0**		**0**		**0**	$ -	$ -	$ -	$ -	0%
5700	**PROCESS UTILITIES**														
5820	**FRESH WATER SUPPLY**			**0**		**12,960**		**0**		**12,960**	$ 48,770.93	$ 3.76	$ 60,231.06	$ 4.65	-19%
5820	PL	TS	1.8	**0**	Topsoil STKP	**12,960**	Topsoil STKP	**0**	Export	12,960					
6400	**JAVA CAMP**														
2180	**LANDFARM (60M X 40M)**			**0**		**0**		**9,120**		**9,120**	$ 78,851.75	$ 8.65	$ 84,843.45	$ 9.30	-7%
2180	LF	GR	1.9	**0**	Supremo	**0**	Supremo	**9,120**	Import	9,120					
6600	**ANCILLARY FACILITIES**														
2152	**LONG TERM / USED OIL STORAGE**			**0**		**0**		**4,020**		**4,020**	$ 36,928.92	$ 9.19	$ 37,401.82	$ 9.30	-1%
2152	PL	GR	1.9	**0**	Supremo	**0**	Supremo	**4,020**	Import	4,020					
2160	**BULK EXPLOSIVE FACILITY PAD**			**67,344**		**40,694**		**15,841**		**56,535**	$ 454,018.98	$ 3.67	$ 406,931.20	$ 3.28	12%
2160	ANFO	TS	1.8	**0**	Topsoil STKP	**40,694**	Topsoil STKP	**0**	Export	40,694					
2160	ANFO	RK	2.3	**67,344**	Alpha Dump	**0**	Alpha Dump	**0**	-	0					
2160	ANFO	GR	1.9	**0**	Supremo	**0**	Supremo	**15,841**	Import	15,841					
6700	**BULK FUEL STORAGE & DISTRIBUTION**														
2170	**FUEL STORAGE PAD**			**36,202**		**48,095**		**52,124**		**72,394**	$ 520,958.25	$ 3.82	$ 578,659.27	$ 4.24	-10%
2170	PL	TS	1.8	**0**	Topsoil STKP	**34,182**	Topsoil STKP	**0**	Export	34,182					
2170	PL	RK	2.3	**36,202**	Alpha Dump	**0**	Alpha Dump	**0**	-	0					
2170	PL	RK	2.3		ROM STKP	**13,913**	ROM STKP	**23,378**	Import	9,465					
2170	PL	GR	1.9	**0**	Supremo	**0**	Supremo	**28,746**	Import	28,746					
9998	**SUPREMO QUARRY CLEARING**			**54,788**		**0**		**0**		**0**	$ 153,915.51	$ 2.81	$ 153,915.51	$ 2.81	0%
9998	GR-STK	TS	1.8	**54,788**	Topsoil STKP	**0**	Topsoil STKP	**0**	-	0					
9999	**CONCRETE AGGREGATE HAULAGE**			**0**		**23,667**		**0**		**23,667**	$ 436,243.63	$ 18.43	$ 104,204.09	$ 4.40	319%
9999	AGG	GR	1.9	**0**	Batch Plant	**23,667**	Batch Plant	**0**	Export	23,667					
TOTAL				**2,994,010**		**3,694,836**		**6,781,659**		**10,215,653**	$ 47,166,849	$ 3.50	$ 42,217,685	$ 3.13	12%
TOTAL		TS	1.8	**260,944**	Topsoil STKP	**1,046,251**	Topsoil STKP	**0**	Export	1,046,251					
TOTAL		OB	2.2	**338,486**	Overburden STKP	**0**	Overburden STKP	**0**	-	0					
TOTAL		OB	2.2		Frozen STKP	**889,200**	Frozen STKP	**0**	Export	889,200					
TOTAL		RK	2.3	**2,260,630**	Alpha Dump	**258,653**	Alpha Dump	**0**	Export	258,653					
TOTAL		RK	2.3		ROM STKP	**152,265**	ROM STKP	**130,421**	Export	21,844					
TOTAL		RK	2.3		Rock Drain South	**1,324,800**	Rock Drain South	**0**	Export	1,324,800					
TOTAL		RK	2.3		Batch Plant	**23,667**	Batch Plant	**0**	Export	23,667					
TOTAL		RK	2.3		Latte	**0**	Latte	**5,443,809**	Import	5,443,809					
TOTAL		GR	1.9	**133,950**	Supremo	**0**	Supremo	**1,207,429**	Import	1,207,429					

MATERIAL SUMMARY

Mat	C/F	CUT	FILL	TOTAL
TS	**260,944**	**1,046,251**	**0**	**1,307,194**
OB	**338,486**	**889,200**	**0**	**1,227,686**
RK	**2,260,630**	**1,759,385**	**5,574,230**	**9,594,245**
GR	**133,950**	**0**	**1,207,429**	**1,341,380**

COST SUMMARY

Description	Cost
Update	$ 47,166,849
Original	$ 42,217,685
Change	$ 4,949,165

NOTES:

1) Rates includes all maintenance, lubes and services
2) Rate includes operator and fuel
3) Rate includes Ground Engaging Tools (GET) and fuel
4) Rates exclude Mobile Equipment Capital Costs, Depreciation and NMTGC Ownership cos

Appendix B

Aggregate Summary

NEWMONT GOLDCORP - COFFEE PROJECT

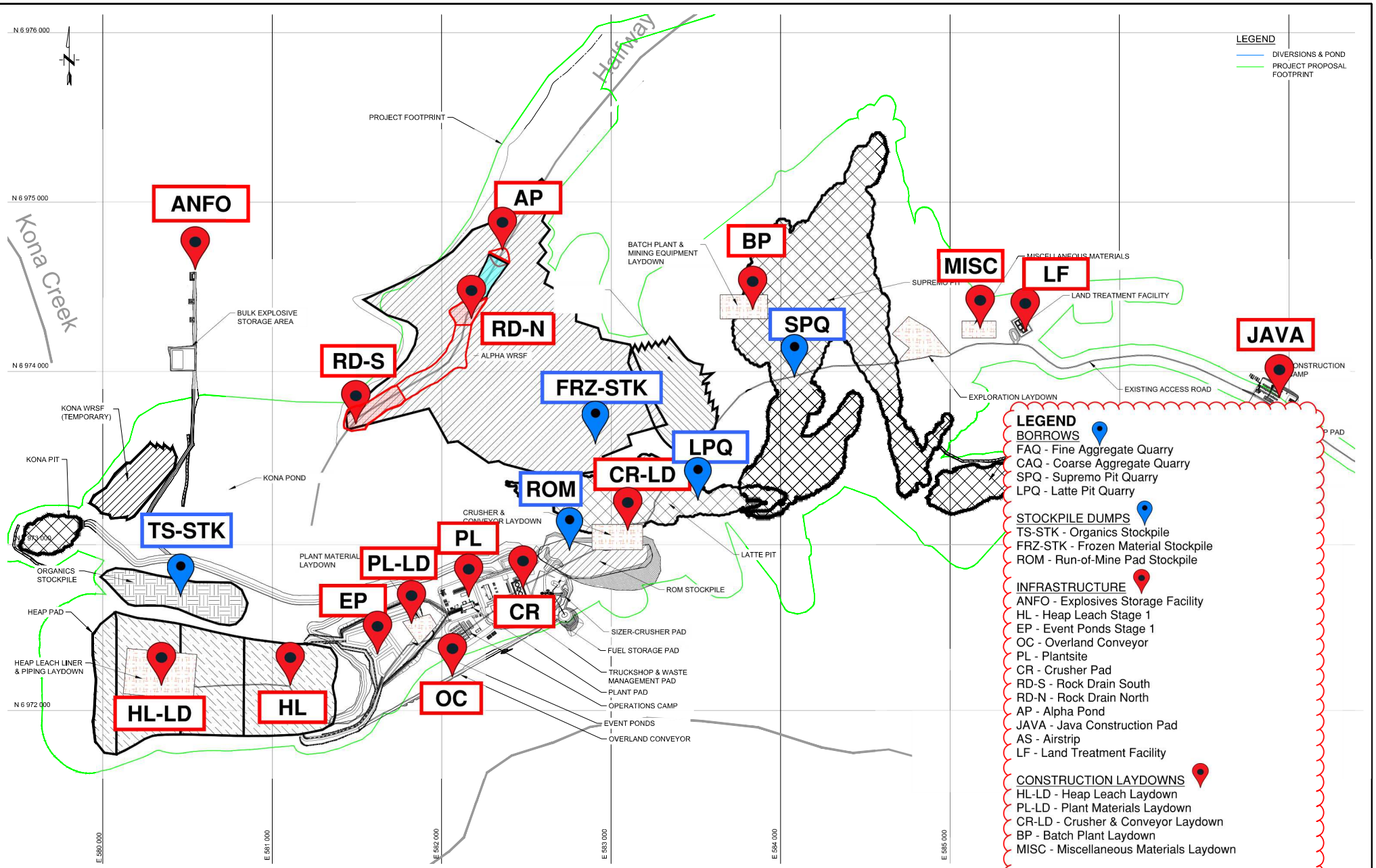
Material Balance - Aggregate Summary

Printed: 04-Jul-2019

WBS	TRUCKSHOP PAD	CAMP PAD - PHASE 1	HEAP LEACH LINER & PIPING	PLANT MATERIALS	CRUSHER & CONVEYOR	BATCH PLANT & MINING EQUIPMENT	MISCELLANEOUS	ONSITE ACCESS ROAD UPGRADE (14KM)	BATCH PLANT ACCESS ROAD	NORTH ROCK DRAIN ROAD	SOUTH ROCK DRAIN ROAD	SUPREMO TO HEAP ROAD	HEAP LEACH CONNECTOR ROAD	KONA TO ANFO ROAD	PLANT TO KONA ROAD	ALPHA WRSF SWITCHBACK ROAD	DRAINAGE & WATER MANAGEMENT	FACILITY POND	ALPHA POND (Option 14)	AIRSTRIP EARTHWORKS	CRUSHING & CONVEYING - OPTION 2	LIMESTORAGE	OVERLAND CONVEYOR	ROM ORE STOCKPILE	HEAP LEACH PAD - STAGE 1	Overland Pipe Trench with road Option - Pre-Production	Ponds (Event Ponds & Clean Water Pond) - Pre-Production	ADR PAD	REAGENT STORAGE	FRESH WATER SUPPLY	LANDFARM (60M X 40M)	LONG TERM / USED OIL STORAGE	BULK EXPLOSIVE FACILITY PAD	FUEL STORAGE PAD	SUPREMO QUARRY CLEARING	CONCRETE AGGREGATE HAULAGE	TOTALS (CCM)
Description	**2150**	**2140**	**2231**	**2232**	**2233**	**2234**	**2235**	**2220**	**2221**	**2222**	**2223**	**2224**	**2225**	**2226**	**2227**	**2228**	**2310**	**2320**	**2321**	**2410**	**2110**	**3300**	**2120**	**3500**	**4100**	**4200**	**4300**	**2130**	**5720**	**5820**	**2180**	**2152**	**2160**	**2170**	**9998**	**9999**	
300mm Minus (12")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150mm Minus (6")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22,527	11,876	21,759	0	0	0	0	0	0	0	0	0	0	828	365	0	3,175	0	0	60,531
50mm Minus (2")	7,088	913	15,984	2,736	6,480	5,760	2,880	18,120	1,368	2,393	2,116	8,865	1,528	2,253	4,101	2,635	0	0	0	0	4,970	0	0	0	0	0	0	8,820	0	0	0	9,000	4,807	0	0	112,816
38mm Minus (1.5")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,117	0	30,894	0	6,012	0	0	0	0	0	0	0	0	0	38,024
19mm Minus (3/4")	476	0	0	0	0	0	0	0	231	399	350	1,085	252	378	511	441	0	0	0	18,412	284	0	8,109	0	0	63,945	0	4,778	0	0	1,932	852	588	1,268	0	0	104,291
9mm Minus (3/8")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6mm Minus (1/4")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	569	0	0	569
3mm Minus (1/8")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,509	3,535	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,044
Screen 38mm Minus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Riprap	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
Shifts	8.3	0.9	16.4	2.8	6.7	5.9	3.0	18.6	1.9	3.3	2.9	11.4	2.1	3.1	5.3	3.6	0.0	60.5	29.7	59.0	5.7	0.0	18.5	0.0	43.6	133.8	8.5	19.1	0.0	0.0	4.8	2.1	10.5	13.6	0.0	0.0	505.4

Appendix C

GA Markup - Infrastructure



REFERENCE DRAWINGS

NO.	DWG NO.	TITLE

NOTES:

DRAWING REVISION

NO.	DESCRIPTION	DATE
B	FOR PERMITTING	2019.04.24
A	FOR INFORMATION	2019.01.21

	NAME	DATE
DRAWN BY:	JG	2019.01.21
DESIGNED BY:	JG	2019.01.21
CHECKED BY:	KS	2019.01.21
APPROVED BY:	TH	2019.01.21

JDS ENERGY & MINING PREPARED THIS DOCUMENT FOR THE EXCLUSIVE USE OF THE CLIENT. ANY USE BY THIRD PARTIES IS AT THEIR OWN RISK.

NEWMONT GOLDCORP. Coffee Mine Project

JDS Energy & Mining Inc.

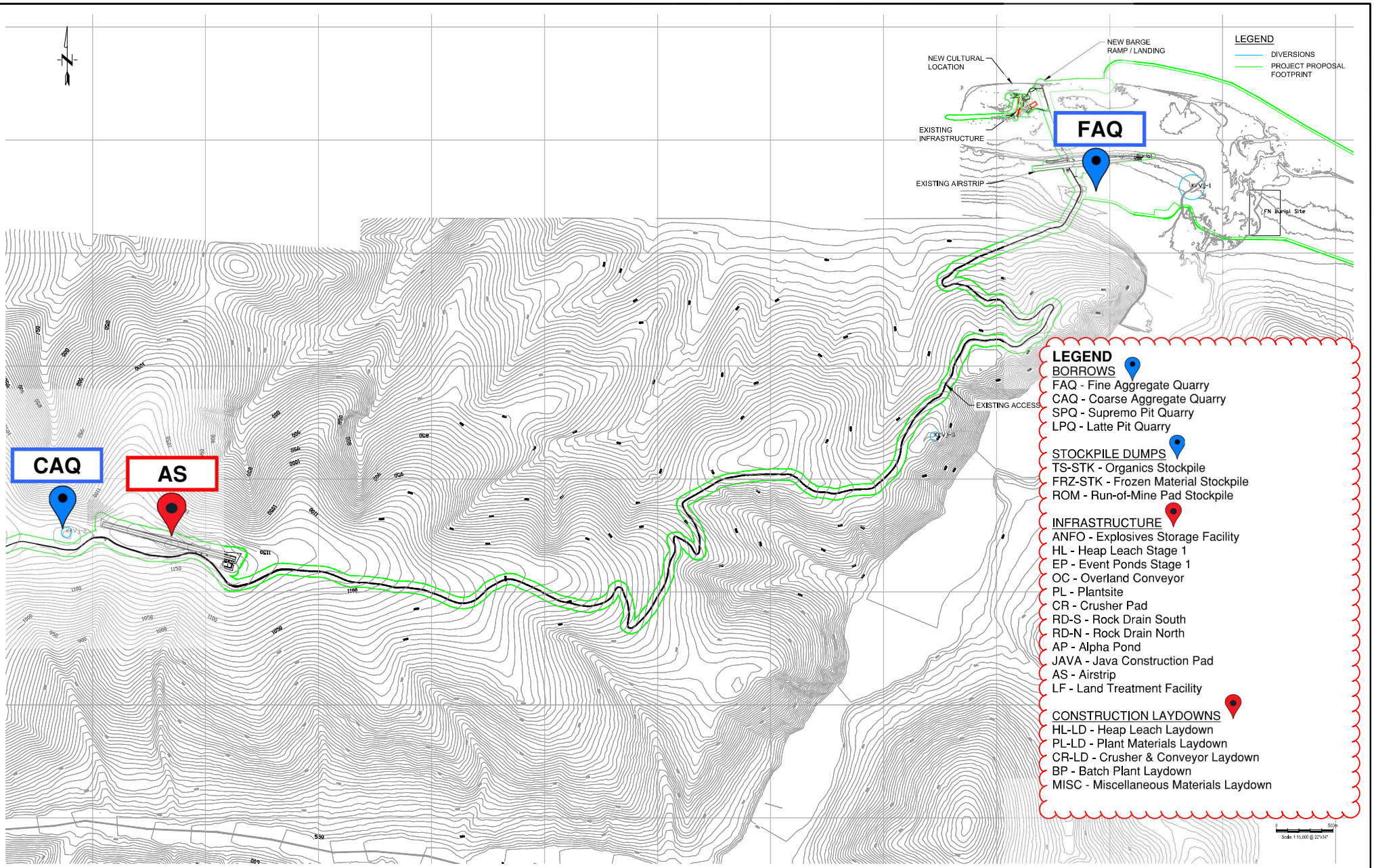
COFFEE GOLD MINE PROJECT

GENERAL ARRANGEMENT
TEMPORARY CONSTRUCTION
INFRASTRUCTURE PLAN

DWG NO. GOLCOF-010399-GEN-GA-001

REV. B

K:\12-..\JDS Drawings\GOLCOF-030000-GEN-GA-000-RevB_Construction Laydown Plan.dwg Apr 26, 2019 - 8:02am



\\jds-fto.jds.local\CoffeeData\12-_JDS Drawings\GOLCOF-000000-GEN-GA-001-RevP_Existing Infrastructure.dwg Jul 05, 2018 - 11:46am

REFERENCE DRAWINGS

NO.	DWG NO.	TITLE

NOTES:

DRAWING REVISION

NO.	DESCRIPTION	DATE
B	FOR INFORMATION	2018.07.05
A	FOR INFORMATION	2018.03.07

	NAME	DATE
DRAWN BY:	JG	2018.03.07
DESIGNED BY:	JG	2018.03.07
CHECKED BY:	TH	2018.03.07
APPROVED BY:	TH	2018.03.07

JDS ENERGY & MINING PREPARED THIS DOCUMENT FOR THE EXCLUSIVE USE OF THE CLIENT. ANY USE BY THIRD PARTIES IS AT THEIR OWN RISK.

GOLDCORP COFFEE GOLD

JDS Energy & Mining Inc.

COFFEE GOLD MINE PROJECT

GENERAL ARRANGEMENT
EXISTING INFRASTRUCTURE
OVERALL SITE PLAN

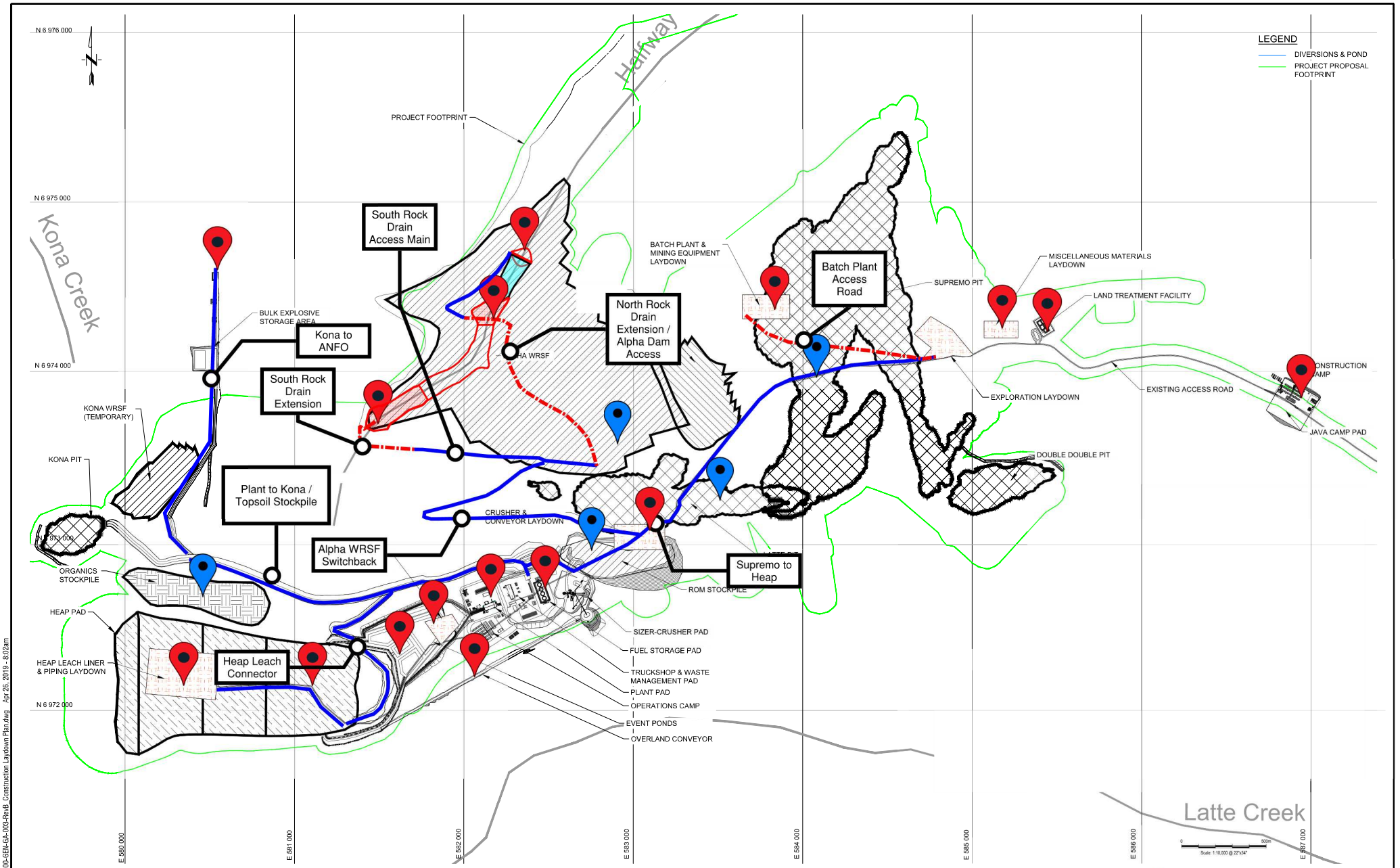
DWG NO. GOLCOF-000000-GEN-GA-001

REV. B

Appendix D

GA Markup - Roads

See Appendix C for Label Descriptions



K:\12-- JDS Drawings\GOLCOF-030000-GEN-GA-000-RevB_Construction Laydown Plan.dwg Apr 26, 2019 - 8:02am

REFERENCE DRAWINGS

NO.	DWG NO.	TITLE

NOTES:

DRAWING REVISION

NO.	DESCRIPTION	DATE
B	FOR PERMITTING	2019.04.24
A	FOR INFORMATION	2019.01.21

	NAME	DATE
DRAWN BY:	JG	2019.01.21
DESIGNED BY:	JG	2019.01.21
CHECKED BY:	KS	2019.01.21
APPROVED BY:	TH	2019.01.21

JDS ENERGY & MINING PREPARED THIS DOCUMENT FOR THE EXCLUSIVE USE OF THE CLIENT. ANY USE BY THIRD PARTIES IS AT THEIR OWN RISK.

NEWMONT GOLDCORP. Coffee Mine Project

JDS Energy & Mining Inc.

COFFEE GOLD MINE PROJECT

GENERAL ARRANGEMENT TEMPORARY CONSTRUCTION INFRASTRUCTURE PLAN

DWG NO. GOLCOF-010399-GEN-GA-001

REV. B

APPENDIX 9-A
Cost Model Summary

Project Name: Coffee Project Peak Liability Closure Cost - Reclamation Plan
Date of Submittal: November 24, 2023
File Name: Coffee_SRCE_2.0 2023 - PEAK LIABILITY v6.xlsm
Model Version: Version 2.0
Cost Data: User Data
Cost Data File: SRCE_Cost_data-USR_v2.0_Metric_Newmont_Master_CDF_2024_R3.xlsm
Cost Estimate Type: LOM Cost Basis: JDS 2024 - Northern Canada

Cost type:	LOM

Budget Year:	2022	
First Year of Operation:	2025	
Closure Year 1:	2027	
Closure Period:	5	years
Post Closure Period:	45	years

ID Code Filter:	
FacilityType Filter:	
Phase Filter:	
Location Filter:	
Property Filter:	

Discount Rate:	1.9%
Discount Period:	MOP
Year of NPV:	2024

Engineering, Design and Construction Plan (%):	5.0%
Contingency (%):	15.0%
Contractor OH and Profit (CP)(%):	13.0%
Contract Administration (%):	2.0%

Show how many years in schedule (10 to 150):	100
Show how many operating years in schedule:	2

Facility/Activity Type	Acct Code	Total Cost	LOM Cost	Scheduled LOM Cost		Plan Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
						Closure Year	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
						Calendar Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076
		CA$		$			CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$	CA$
Total Cost																																																														
0		0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	Waste Rock Dumps	806,257	806,257	806,257			0	0	0	0	806,257	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Tailings	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Heap Leach	541,606	541,606	541,606			0	0	0	0	541,606	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Solution Mgmt	16,577,318	16,577,318	16,577,318			0	0	0	0	16,577,318	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Pits	18,567	18,567	18,567			0	0	0	0	18,567	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Quarries & Borrow Pits	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Underground Openings	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Roads	6,335,651	6,335,651	6,335,651			0	0	581,242	581,242	962,160	581,242	3,629,767	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Process Ponds	1,959,996	1,959,996	1,959,996			0	0	0	0	0	1,959,996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Yards, Etc.	1,801,506	1,801,506	1,801,506			0	0	0	0	0	0	1,801,506	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Landfills	1,015,008	1,015,008	1,015,008			0	0	0	0	0	0	1,015,008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Haul Material	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Foundations & Buildings	12,320,351	12,320,351	12,320,351			0	0	0	0	0	7,304,618	5,015,733	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Other Demo & Equip Removal	168,720	168,720	168,720			0	0	0	0	0	0	168,720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Sediment & Drainage Control	366,634	366,634	366,634			0	0	0	0	0	355,951	10,683	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Well Abandonment	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Waste Disposal	783,718	783,718	783,718			0	0	0	0	0	0	783,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Misc. Costs	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Exploration	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Expl. Roads & Pads	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Monitoring	5,970,000	5,970,000	5,970,000			0	0	890,000	530,000	1,040,000	600,000	930,000	600,000	60,000	210,000	90,000	210,000	60,000	210,000	60,000	210,000	60,000	210,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	Recl. Maint	378,805	378,805	378,805			0	0	0	0	0	0	0	54,115	54,115	54,115	54,115	54,115	0	0	0	0	54,115	0	0	0	0	54,115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	Constr. Mgmt	2,204,766	2,204,766	2,204,766			0	0	440,953	440,953	440,953	440,953	440,953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Closure Planning	678,965	678,965	678,965			0	0	82,540	348,807	82,540	82,540	82,540	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	G & A	10,037,058	10,037,058	10,037,058			0	0	1,978,651	1,978,651	2,050,552	1,978,651	2,050,552	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Other User	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Human Resources	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS		61,964,925	61,964,925	61,964,925			0	0	3,973,386	3,879,653	22,519,952	13,303,951	15,929,179	654,115	114,115	264,115	144,115	264,115	60,000	210,000	60,000	210,000	114,115	210,000	0	0	0	54,115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Engineering, Design and Construction Plan		3,098,246	3,098,246	3,098,246			0	0	193,669	193,983	1,125,998	665,198	796,459	32,706	5,706	13,206	7,206	13,206	3,000	10,500	3,000	10,500	5,706	10,500	0	0	0	2,706	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Contingency		9,294,739	9,294,739	9,294,739			0	0	596,008	581,948	3,377,993	1,995,593	2,389,377	98,117	17,117	39,617	21,617	39,617	9,000	31,500	9,000	31,500	17,117	31,500	0	0	0	8,117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Contractor OH and Profit		8,055,440	8,055,440	8,055,440			0	0	516,540	504,355	2,927,594	1,729,514	2,070,793	85,035	14,835	34,335	18,735	34,335	7,800	27,300	7,800	27,300	14,835	27,300	0	0	0	7,035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Contract Administration		1,239,299	1,239,299	1,239,299			0	0	79,468	77,593	450,399	266,079	318,584	13,082	2,282	5,282	2,882	5,282	1,200	4,200	1,200	4,200	2,282	4,200	0	0	0	1,082	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL COST		83,652,649	83,652,649	83,652,649			0	0	5,364,071	5,237,532	30,401,936	17,960,335	21,504,392	883,055	154,055	356,555	194,555	356,555	81,000	283,500	81,000	283,500	154,055	283,500	0	0	0	73,055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Discounted Cash Flow:		0	0	5,709,154	5,691,538	33,731,057	20,345,524	24,871,808	761,951	130,499	296,518	158,840	285,782	63,736	219,001	61,429	211,072	112,602	203,431	0	0	0	48,695	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPV:	92,902,637																																																											

Discount Rate:	4.0%
Inflation Rate	2.1%
Year of NPV:	2024

Project Name: Coffee Project Life of Mine Closure Cost - Reclamation Plan
Date of Submittal: July 3, 2024
File Name: Coffee_SRCE_2.0 2023 - FINAL CLOSURE v6.xlsm
Model Version: Version 2.0
Cost Data: User Data
Cost Data File: SRCE_Cost_data-USR_v2.0_Metric_Newmont_Master_CDF_2024_R3.xlsm
Cost Estimate Type: LOM Cost Basis: JDS 2024 - Northern Canada

Cost type:	LOM
Budget Year:	2022
First Year of Operation:	2025
Closure Year 1:	2035
Closure Period:	11 years
Post Closure Period:	39 years
ID Code Filter:	
Facility/Type Filter:	
Phase Filter:	
Location Filter:	
Property Filter:	
Discount Rate:	1.9%
Discount Period:	MOP
Year of NPV:	2024
Engineering, Design and Construction Plan (%):	5.0%
Contingency (%):	15.0%
Contractor OH and Profit (CP)(%):	13.0%
Contract Administration (%):	2.0%
Show how many years in schedule (10 to 150):	60
Show how many operating years in schedule:	10

| Facility/Activity Type | Acct Code | Total Cost | LOM Cost | Scheduled LOM Cost | Plan Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
|---|---|---